DO NOT ATTEMPT TO REPAIR AN ATL PROCESSOR WITHOUT READING AND THOROUGHLY UNDERSTANDING THE ATL OPERATING INSTRUCTIONS AND THIS SERVICE MANUAL !!

Table of Contents

CHAPTER 1

Introduction and Cautions

Before proceeding to "troubleshoot" a unit utilizing this service manual, it is important to realize that many "problems" experienced with an ATL are actually the result of misunderstanding how the unit should work. We suggest you familiarize yourself with the instruction manual first to be sure the machine is actually malfunctioning.

This service manual contains data that is applicable to both the ATL-2 and ATL-3 (all versions) except where it has been obviously noted otherwise.

The units ATL-2 and ATL-3 are fully integrated microprocessor controlled film and paper processing machines. Servicing these two units is simplified due to modular construction. The circuit boards can all be removed from the front of the machine with a minimal amount of disassembly. Fuses are centrally located and accessible through a small front panel, and motors and other functional components are mounted with standard hardware eliminating the need for special tools.

Electronic diagnostic tests have been incorporated into the ATL's for easier troubleshooting.

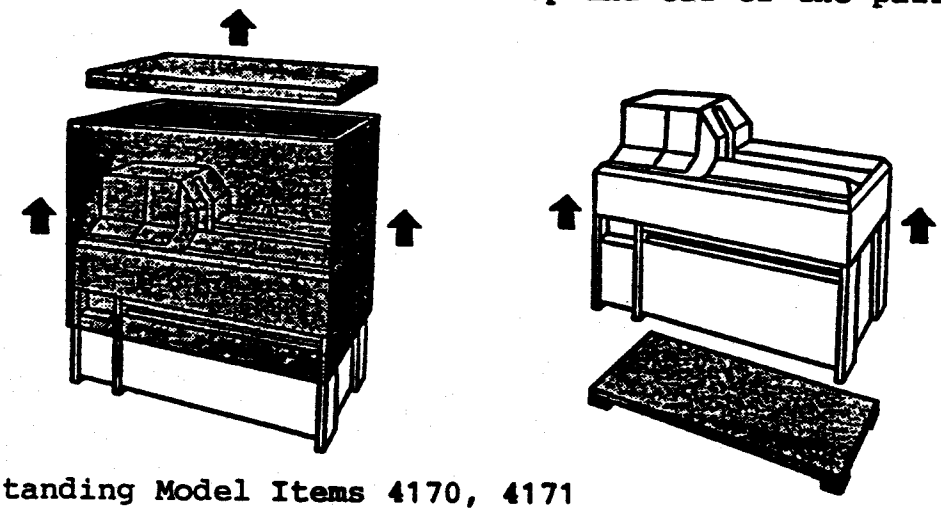
Many other time-saving devices have been incorporated to make servicing simple and efficient.

CHAPTER 2

Packaging and Transport

2.1 ATL-3 Unpacking and Installation

Unpacking:
Remove shipping carton top and pull sleeve up and off of unit. Pull chemical cart out from underneath unit by lifting cart over the spanning board. Lift the unit up and off of the pallet.



Floor Standing Model Items 4170, 4171

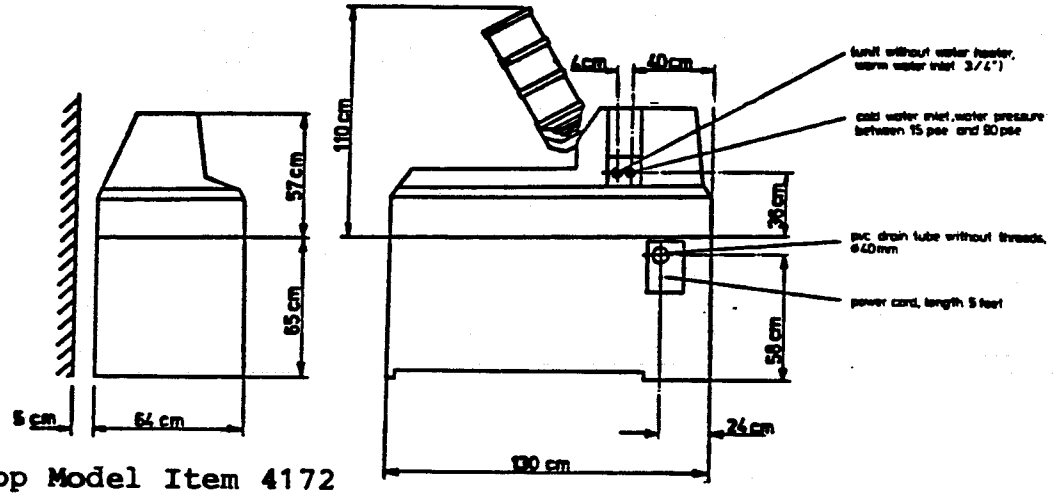
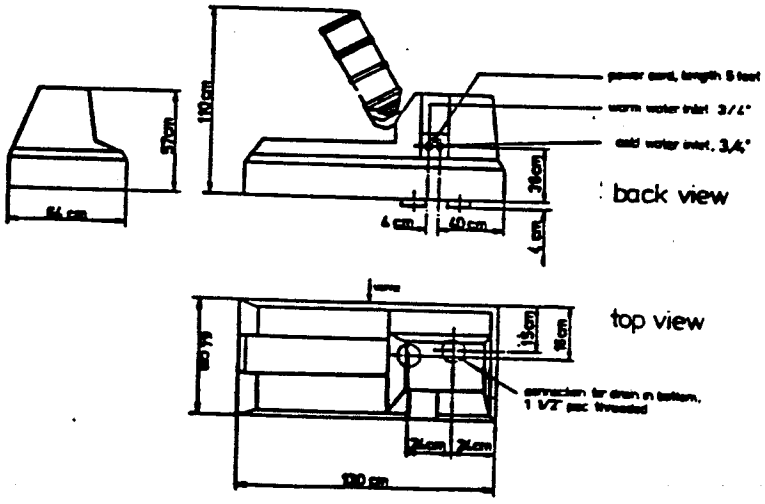
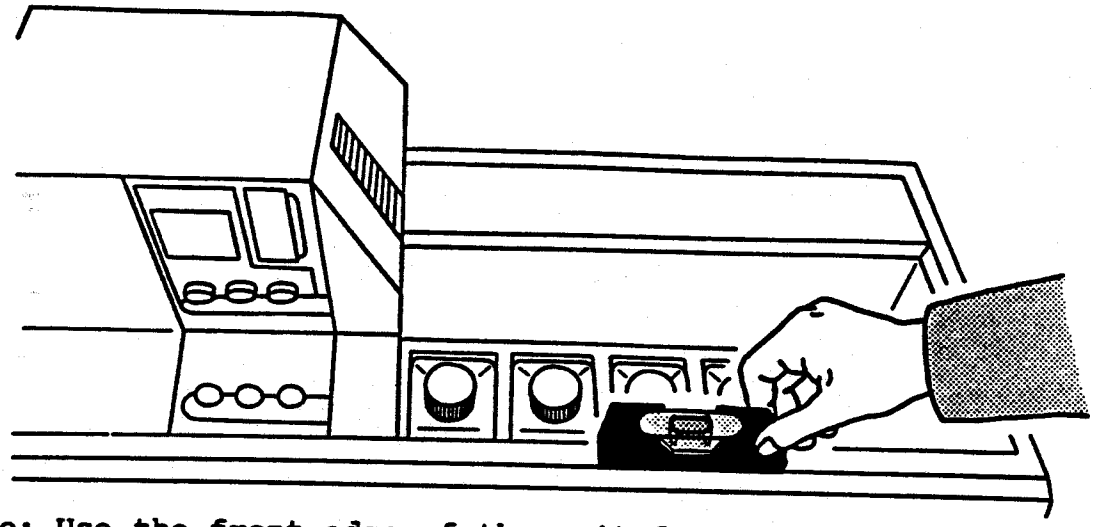


Table Top Model Item 4172



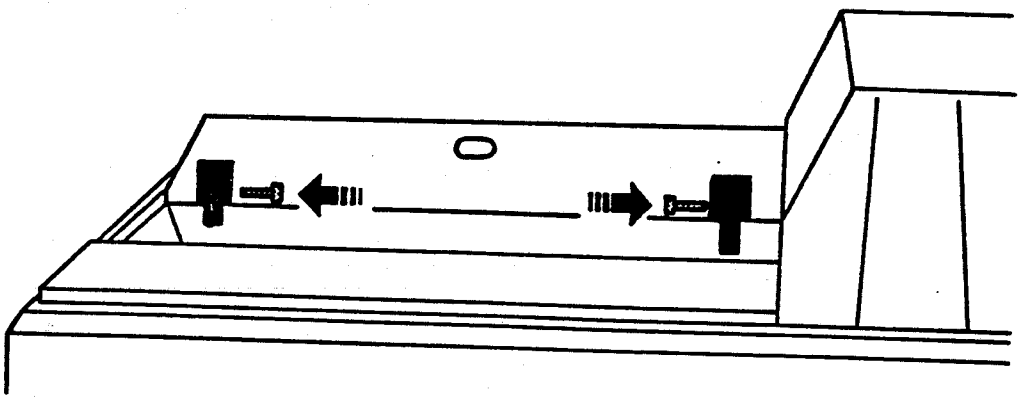
Place the unit in the desired location to begin installation.

Level the unit using Spirit Level provided.



Note: Use the front edge of the unit for proper levelling.

Bottle cover assembly



Place cover over bottle bank, insert guide pins into pin-holes.

Installation:

There are only three items that need to be connected, the power cord, water supply and the drain.

Power Cord

CAUTION!

IF YOU HAVE ANY QUESTIONS ON THIS SECTION COSULT A LICENSED ELECTRICIAN BEFORE PROCEEDING

All three versions of the ATL-3 have a power cord permanantly built-in. The cord should be plugged into a grounded, dedicated socket. The socket should match the pin configuration of the cord for the unit you are installing, see list below.

ATL-3 with boiler #4170 uses a 20 amp. 220 volt receptacle.
ATL-3 without boiler #4171 uses standard 20 amp. 115 volt receptacle.
ATL-3 Table Top #4172 uses standard 20 amp. 115 volt receptacle.

CAUTION!

BE SURE TO TURN OFF THE POWER SWITCH TO THE BOILER BEFORE PLUGGING UNIT IN. BOILER IS EMPTY.

Water supply

CAUTION!
IF YOU HAVE ANY QUESTIONS ON THE FOLLOWING SECTION CONSULT WITH A LICENSED PLUMBER BEFORE PROCEEDING.

All water supply fittings on the ATL-3 use standard 3/4 inch hose The pressure at the hose should be between 15-90 psi. (1-6 bar). If the pressure is higher than 90 psi. (6 bar) a pressure reducer will be necessary, otherwise the pressure relief valve for the boiler will open discharging water into the reclamation area.

TURN WATER ON WHEN HOOKED UP PROPERLY TO FILL BOILER.

Drain

4170/4171
On the back of the machine is a standard PVC 1 1/2 inch drain pipe. Connect this pipe to a waste line, the waste line must already have a trap as there is no trap on the ATL-3.
Check with all local codes before hooking drain line up. Some areas have specific restrictions for Photo Chemical waste.

4172
The drain for this unit comes as a sub-assembly which must be assembled before hooking drain line up.

The ATL-3 water jacket will fill up automatically when the power is turned on
Remove the tape from the Thermostat on the boiler and set it to the capitol letter "E".

Draining the boiler
The boiler holds ten liters of water (2 1/2 gal.) which can be siphoned out using a small, self-priming pump and an electric hand drill.

1. Loosen and disconnect the cold water inlet line to the boiler at the 90 degree elbow which is easiest to reach from the Chemical Cart area.
2. Connect a 3-4 foot flexible tube to the inlet side of the drill and stick it into the boiler inlet until it reaches the bottom of the inside of the boiler. (you may reach a "false bottom" when the tube reaches the various fittings it needs to go beyond. Be sure the tube goes all the way down.)
3. Use the drill to siphon the water out of the boiler.
4. Reassemble elbow fitting and tighten securely.

NOTE: You will not be able to pressure test the water system until the unit is installed in its permanent location.

Sec. 2.2 ATL-3 REPACKING AND SHIPPING

NOTE: THE ATL-3 BOILER MUST BE DRAINED BEFORE TRANSPORTING THE UNIT BY TRUCK. (see sec. 2.1)

Repacking is the reverse of unpacking.
You should have:

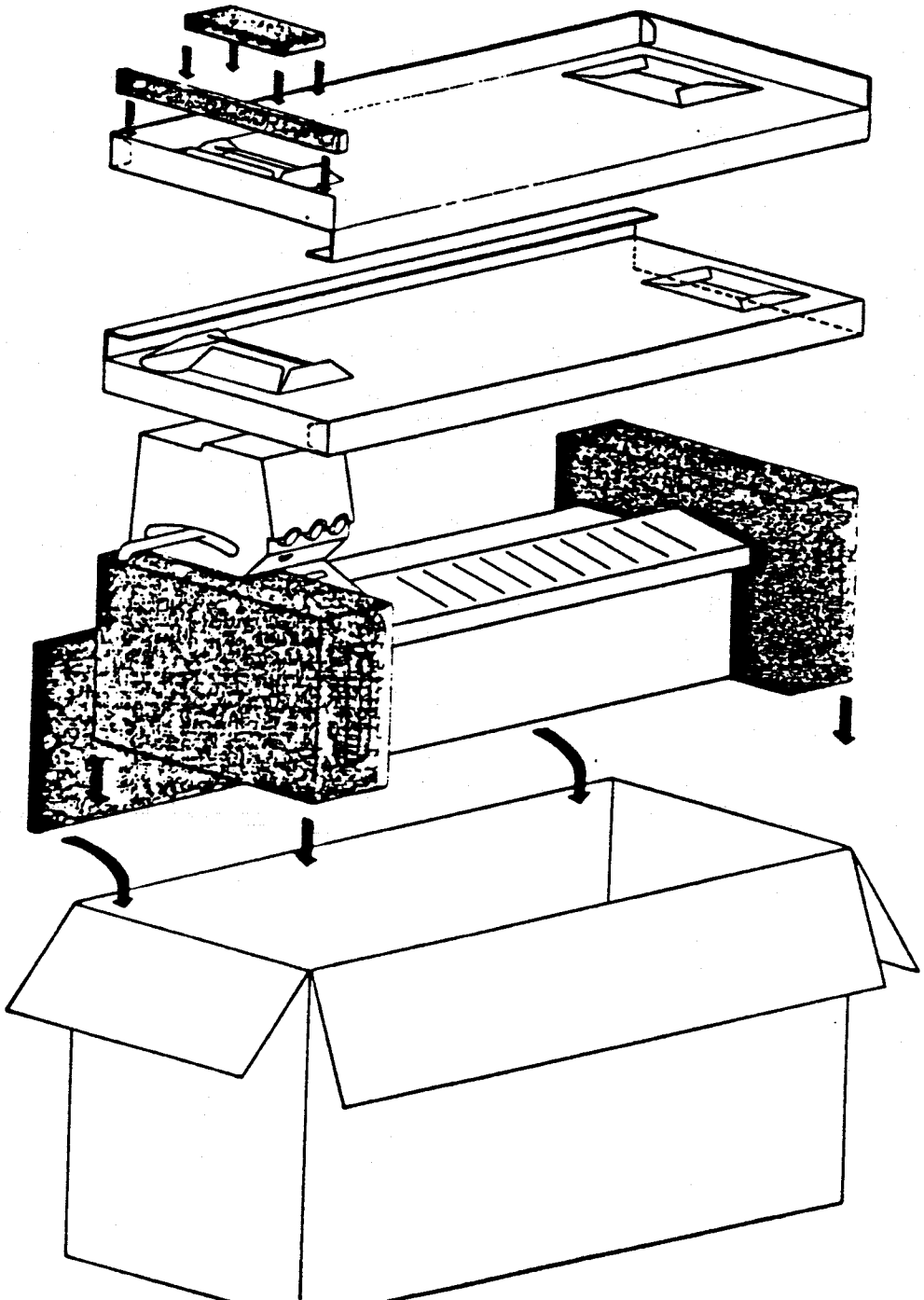
- 1 pallet
- 1 spanning board in front of cart
- 1 cardboard base cap
- 1 cardboard sleeve for entire unit
- 1 cardboard top cap
- 4 styrofoam corner pieces inside sleeve

You must strap the entire unit down to the pallet to avoid damage to the unit.

Caution: Use extreme care when transporting an ATL Processor. Only use lift truck on the side where the control head is, otherwise the unit may fall.

2.3 ATL-2 Unpacking and Installation

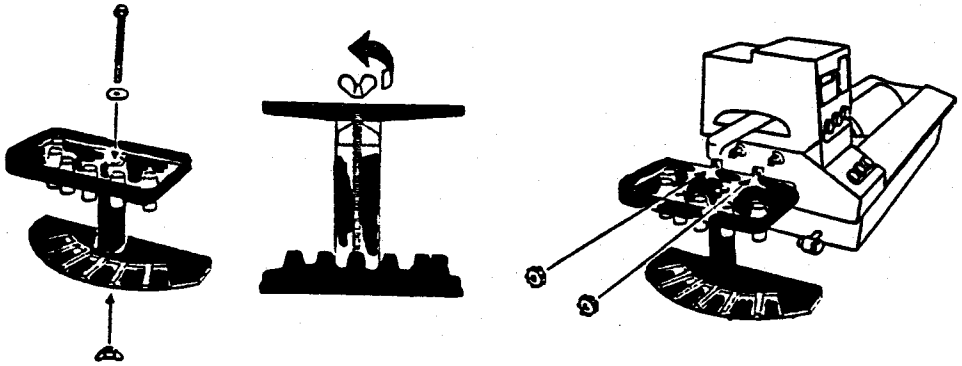
Unpacking



Reclamation unit

A reclamation unit is provided to aid in replenishment of chemistry, allow re-use of chemistry or reclaim chemistry for silver recovery. The unit must be assembled and attached to utilize these options, otherwise it need not be used at all.

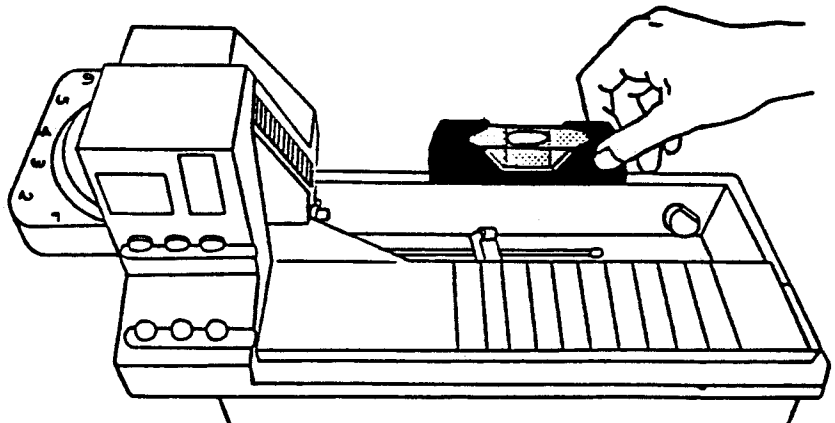
If the assembly is not to be used move the reclamation drain arm toward the back of the machine and latch it on the lip provided. A rubber band may be used if the lip were to get damaged.



Installation

The ATL-2 has three items needing to be hooked up, the power cord, water supply and drain.

The ATL-2 should be on a level surface. Use the Spirit Level provided with the machine.



Power Cord

CAUTION!

CONSULT WITH A LICENSED ELECTRICIAN BEFORE PLUGGING THIS UNIT IN TO BE SURE THE POWER SUPPLY HAS THE PROPER RATING.

The ATL-2 has a standard 115 volt power cord. It should be plugged into a grounded, dedicated, 20 amp. 115 volt power supply.

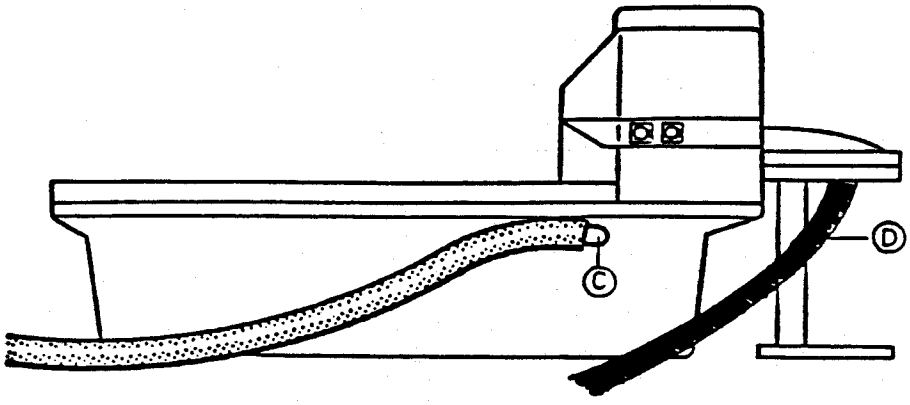
Water Supply

The ATL-2 has a standard 3/4 inch hose-type hook up.
The pressure at the hoses should be between 15-90 psi.(1-6 bar).
As shown in the drawing cold water only should be hooked up to the fixture marked "B" and tempered water within +/-5 degrees C. of the process temperature needed hooked up to "A".

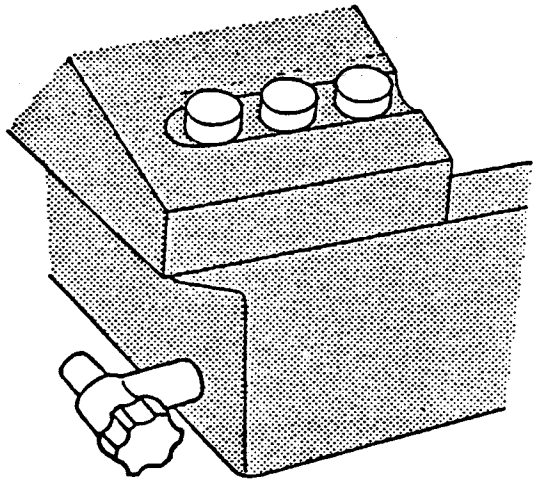
The ATL-2 fills itself up automatically when the cold water is turned on and the power is switched on.

DRAIN

The ATL-2 has three water outlets. The reclamation unit (D) and the trough drain spigot are on the left side of the unit and overflow elbow (C) is on the back.



The reclamation unit drain purges rinse water used in processing. Excess tempering water runs out the overflow elbow. The trough drain spigot releases the water in the main bath. All three drains can be connected together and routed for disposal using kit #4161.
If the ATL-2 is in a sink, a short piece of hose should be attached to the overflow.



CHAPTER 3

Block Diagram and Explanation

Block Circuit Diagram Explanation

3.1 P.C. Board Identification

The following item numbers correspond to the following printed circuit boards.

94015	Interface board, upper electronic head
94016	Transformer board
94017	Interface board, lower control unit
94018	Display board
94022	Control board ATL 2
94023	Control board ATL 3
29002	Foil Keyboard

3.2 Abbreviations (see chap. 15 for other abbreviations)

a) Assemblies:

FP	Filling pump
HM	Lift Motor
SMT	Stepping Motor (air distributor & drain arm)
MVK	Solenoid valve - cold
MVW	Solenoid valve - warm
TMT	Rotation motor
H 1	Heating element 1
H 2	Heating element 2
P	Water jacket recirculation pump
L	Cooling Fan
V & E	Voltage
I	Current
R	Resistance

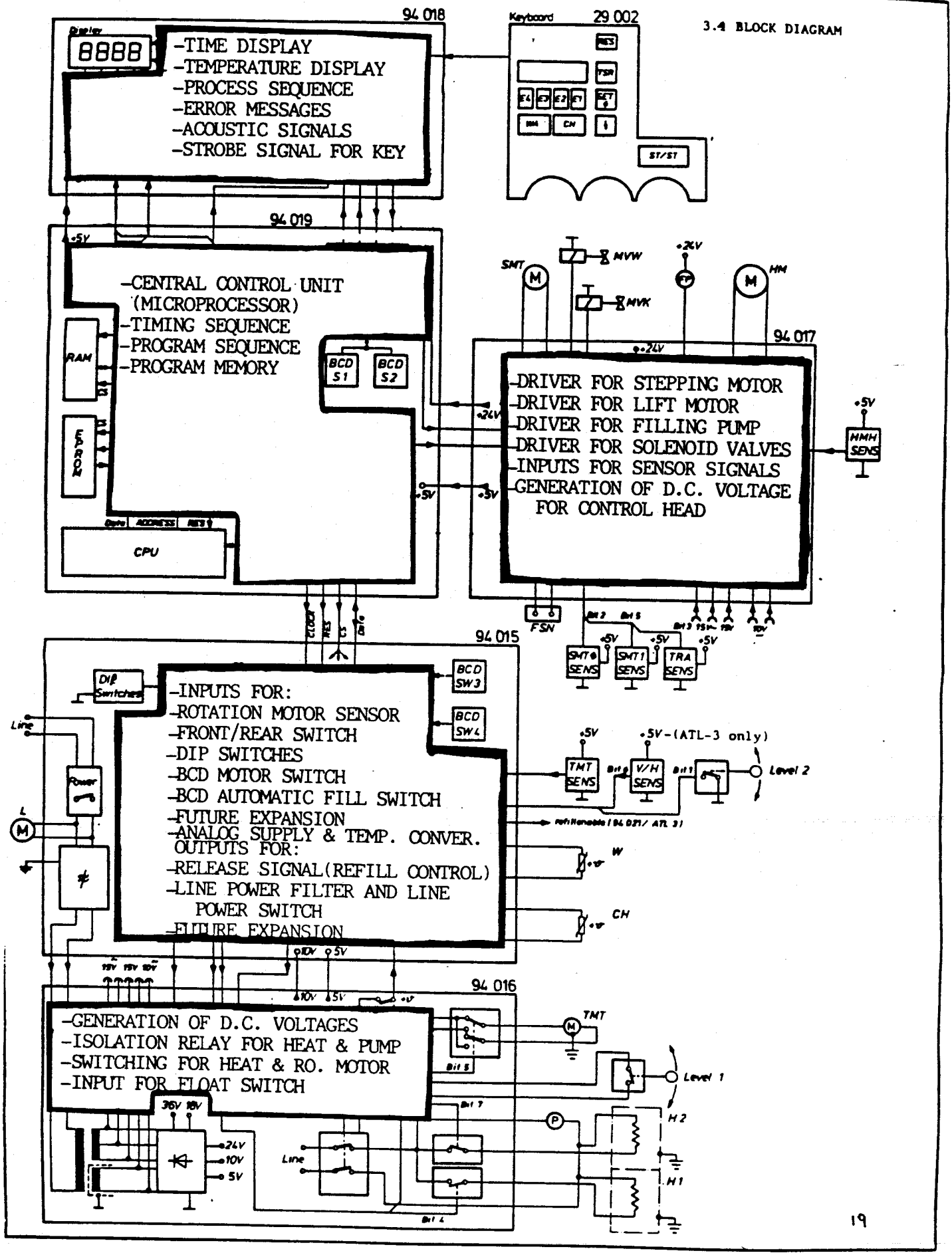
b) Sensors:

FSN	Filling Sensor (chemical /water)
W	Temperature sensor - water jacket
CH	Temperature sensor - chemical bottle
SMT 0 sens.	Hall sensor stepping motor zero position
SMT 1 sens.	Hall sensor stepping motor single step
TRA sens.	Hall sensor drum lifted (swing sensor/ bottom sensor)
HMH-sens.	Hall sensor lifting arm up (upper sensor)
TMT Sens.	Rotation motor sensor
Level 1	Lower float switch
Level 2	Upper float switch

3.3 DC Voltage Distribution

Transformer board: (supply voltages)	36 V 24 V 18 V 5 V
Name of board;	Voltages used:
Transformer board, lower control unit:	10 V 5 V (power supply from trans-former board)
Display board:	24 V 5 V (power supply from inter-face control board)
Control boards ATL 2/3:	5 V (power supply from interface control board)
Interface board, upper electronic head:	36 V 24 V 18 V 5 V

3.4 BLOCK DIAGRAM



CHAPTER 4

Functional Description of Electronic Circuitry

Functional Description - Electronic Circuitry

4.1 Overview

The ATL 2/3 electronic circuitry consists of 5/6 circuit boards (without automatic refilling-5, 4170-6).

Located in Control Head:	Control board Display board Interface board, control head
Located in Motor Unit:	Transformer board Interface board, motor unit

The following summary indicates the functions associated with the individual circuit boards.

Control board (94014/019)	- central control unit (microprocessor) - timing sequence - program sequence - program memory
Display board (94018)	- time display - temperature display - process sequence display - displays for operator guidance - error messages - acoustic signals - strobe signal generation for key entries
Interface board, control head (94017)	- driver for stepping motor - driver for lift motor - driver for filling pump - driver for solenoid valves - inputs for sensor signals - generation of DC voltages for control head
Transformer board (94016)	- line power transformer - generation of DC voltages for motor head - line power isolation relay for heating elements and water bath pump

	- switching stages for heating elements, rotation motor control - input for float switch (minimum level)
Interface board, motor unit (94015)	- generation of + 5 V power supply for analog stage - generation of control voltages for rotation motor - A/D conversion for temperature values
	- inputs for: rotation motor sensor front/rear switch DIP switches BCD motor switch BCD automatic fill switch future expansion - Outputs for: release signal, refill control - future expansion - Line power filter and line power switch

4.2 Control Board ATL 2 (94022)
Control Board ATL 3 (94023)

The control board contains the microprocessor system which controls the timing and program sequence. It processes measured values and sensor signals and calculates and transmits the required control signals.

Processor System Components:

a.	CPU	central processing unit; controls entire program sequence
b.	E-PROM	Erasable programmable read-only memory; can be erased with ultraviolet light; contains machine program codes and data for CPU sequence control
c.	RAM	Random access memory; stores the user program data and auxiliary data for the machine program
d.	Output register	Output signal memory; stores control signals
e.	Input register	Input signal memory; reads input signals on the data bus
f.	VIA	Multi-function interface adapter; input/output module; parallel/serial converter; timer for time control
g.	PROM	Mask programmable read-only memory; address decoder; allocates a chip select signal to each address block used (CS, CE OE).

Data bus:

A 6502 8 bit CPU is used as the central processor. The CPU (IC 1) is connected to all memory and input/output modules via an 8 bit data bus and can therefore read or write data. In addition to the control board, modules which are addressed via the data bus are also located on the motor unit interface board. For this reason the data bus is also connected to ST 4 (plug connector for motor unit interface board).

The data bus is buffered by the bi-directional driver IC 2 to assure perfect data signals. The driver direction can be switched by inverting the R/W signal.

When the CPU writes data to the data bus, a high level is present on pin 1 of IC 2 and IC 2 drives the data in the direction of the data bus. For read operations IC 2 drives the data in the direction of the CPU and a low level is present on IC 2/Pin 1.

To decrease interference sensitivity, pull-down resistor networks are used, which terminate the data bus and therefore suppress reflections and make the data bus less sensitive to external interference.

Address bus/address decoder:

One or more addresses are assigned to each module connected to the data bus. Whether one or more addresses are assigned to a module depends on the number of memory cells present in the module. A chip select signal must be generated from the address signals for each module in order to allow the CPU to address all modules with the proper address. This is accomplished by the address decoder, consisting of the decoder PROM IC 7 and the two de-multiplexers IC 5 and IC 6.

The address areas allocated to the PROM outputs are entered in the circuit diagram in hexadecimal form.

With the exception of the chip select signal 01 all PROM outputs in the active state are switched to low level.

The chip select signal 01 must be at high level in the active state, because this signal is not connected directly to the RAM; it is first ANDed with the reset signal. In the event of a power failure reset, this logic operation protects the RAM from uncontrolled access and therefore data loss.

There is a further subdivision of the chip select signals at the PROM outputs 02 and 03 for the input registers in the address area 0400-04FF and the output registers in the address area 0500-05FF in order to allow all registers to be adressed individually. This additional subdivision is accomplished by IC 5 and IC 6.

Connection to several address lines is required for the modules containing a number of addresses in order to be able to select each address within the allocated address block.

Control bus:
In addition to the data bus for data transfer and the address bus in combination with the chip select signals a number of various control signals are required for address and module selection, which are explained in this section:

a. 1 MHz clock: OSC (oscillator)
The 1 MHz clock OSC is generated by the integrated quartz oscillator QOS and supplies the time base for all operations in the processor system. This clock is inverted and buffered by IC 13 and connected to the A/D converter on the motor head interface board via plug ST 4.

b. System clock: PHI 2
The system clock PHI 2 (IC 1/Pin 39) is derived from the 1 MHz clock OSC by the CPU. The frequency of the system clock is also 1 MHz. However the pulse/space timing is directly connected with internal CPU operations. For example PHI 2 - high level indicates that the signals on the address lines are stable and therefore read and write operations can be performed.

c. R/W signal:
High level on the read/write line indicates a read operation, low level a write operation.

d. RAM R/W signal:
The RAM R/W signal corresponds to the function of the R/W signal, however, it is also synchronized with PHI 2 in order to assure stable data signals for write operations to the RAM.

e. RES signal:
The reset signal initializes the CPU and VIA and thereby assures that a program starts at a defined point in the machine program with defined CPU and VIA register contents.

f. IRQ signal: The IRQ signal requests a main program interrupt for execution of an IRQ subroutine. This signal is generated by IC 16 (VIA) under the control of the internal VIA timer. The signal appears every 50 ms in the form of low level for the duration of the IRQ subroutine and serves as the time control. The IRQ subroutine reads all sensor signals and measured values and sends control signals.

g. SYNC signal: The SYNC signal indicates that an instruction code is being read into the CPU by output of a high voltage level for the duration of approx. 1 us.
This signal is not sent to the control bus, however, it can be measured during trouble-shooting to determine whether the CPU is operating.

VIA (IC 16):

The multi-function interface module IC 16 (VIA) contains in addition to the two I/O ports PA and PB, a shift register for parallel/serial conversion and two 16 bit counters. Port PB is used as an input port for the BCD switches S 1 and S 2. Port PA is programmed as an input port for the keyboard byte and stores the keyboard byte present at the strobe input (IC 16/Pin 40) via plug ST 1 with a negative pulse.

Timer 1, one of the two 16 bit counters, is used for time sequence control of the entire program. This counter is loaded with the hex. vlue C 350, which corresponds to a decimal value of 50000. The counter therefore generates an IRQ signal on IC 16/Pin 21 every 50 ms.

Output Registers:

74HC374 8 bit D-registers are used as output registers. The data byte present at the D-outputs is stored in the D-register by a positive edge at clock input Pin 11 and is then available at the Q-outputs. The clock input of an addressed output register is set to low level by the demultiplexer IC 5 (address coding). The clock input is reset to high level (positive edge) with the trailing edge of PHI 2 and the data stored.

Use of Registers:

IC 8 - LED and buzzer control
IC 9 - LED control and inhibit for manual lifting arm control
IC 10 - Control of the unit lift motor, filling pump, stepping motor and solenoid valves.

Input registers:

An 74HC241 8 bit bus driver is used as the input register (IC 11). This circuit is organized into 2 groups of 4 drivers each. Each group is activated via its own control input (1 G/Pin 1 and 2 G/Pin 19), each of which requires a different level (active: 1 G=low; 2 G=high).

For this reason the associated chip select signal Y O (IC 6) is sub-divided into an inverted and non-inverted signal. When the module is activated inputs A are switched through to the corresponding outputs Y.

Use of Register:

IC 11 - Examination of sensor signals, chemical keys, water temperature and SET/RUN switch.

Reset Circuit:

We differentiate between 4 types of reset:

a. Power on reset: The reset signal generated as the supply voltage is built up by IC 15 switches off all I/O devices, initializes the CPU and VIA, protects the RAM from data loss and assures that the program is restarted at the point is was interrupted following a power failure.

b. Power fail reset: This reset signal is generated by IC 15 in the event of a power supply failure. and protects the RAM from data loss. In addition it switches off all I/O devices.

c. Key reset: The key reset interrupts the program, initializes the CPU and VIA and starts the air distributor on a zero point search (stepping motor).

d. Watchdog reset: A watchdog reset is generated by the watchdog circuit if the program "crashes" and corresponds to the power-on reset in terms of function (see also section on watchdog circuit).

Function of Reset Circuit:

a. Power-on/power-fail reset

The reset circuit consists of IC 15 and the two NAND gates IC 13 a and b.

If the 5 V power supply exceeds the 4.75 V threshold at the sensing input of the voltage monitoring module TL 7705 (IC 15/Pin 7) the output (IC 15/Pin 5) goes to a low level. If this threshold is exceeded only for a short time, e.g. during build-up of the supply voltage, the output remains at low for approx. 90 ms after the voltage on the sensing input (IC 15/Pin 7) has exceeded the 4.75 V threshold.

The reset signal travels to the CPU (IC 1), VA (IC 16) and the output register IC 10 over the two NAND gates IC 13 a and b.

The CPU and VIA are thereby initialized and the outputs of register IC 10 are set to the high resistance state. Since the outputs are connected to ground via resistor network NW 5, all units are switched off.
The reset signal is available on plug ST 4 for deactivation of the output registers on the motor unit interface board.

b. Key reset

When the reset key is pressed C 14 is connected to ground via plug ST 1/Pin 19 generating a short low pulse at IC 13 a/Pin 2 This travels over IC 13 b to the CPU, VIA and registers.

Pressing the reset key causes a strobe signal to be released on the display board, whose negative edge is present at the strobe input of the VIA (IC 16/Pin 40), a short time after termination of the reset pulse to the CPU.

The strobe signal is buffered in the VIA and read out by the CPU. This allows a differentiation between key reset and power on/power-fail reset and the CPU can terminate the program and start the air distributor zero point search.

c. Watchdog Reset

The watchdog reset corresponds to the power-on/power-fail reset in terms of function with the difference that triggering of IC 15 is accomplished via reset input Pin 2 instead of via the voltage level at input Pin 7.

Watchdog Circuit:

The actual watchdog circuit consists of the re-triggered monoflop IC 17 a. The retention time of the monoflop is set to approximately 225 ms with R 12 and C 13. Pulses must be fed continuously to the trigger input Pin 4 in order to keep the output Pin 6 at high level. The IRQ signal, which supplies a pulse every 30 ms is used for triggering. If the pulses are not received for longer than 25 ms, the output Pin 6 goes to low. A low pulse is then generated to IC 15/Pin 2 via C 15, which results in a reset pulse with a duration of approx. 90 ms. The remaining sequence corresponds to that for power-on/power-fail reset.

In addition the monoflop IC 17b, wired as a bi-stable monoflop is triggered, switching on the green and red section of the power failure display. Reset: The warning triangle illuminates yellow.

Battery Backup Circuit:

The battery backup circuit supplies the C-mos-RAM IC 4 with power when the unit is switched off or during a power failure.
Since the RAM is in the standby mode when the line power is not present and the power consumption is extremely low in this mode, the lithium battery has a life of approx. 10 years. However, this asumes that the control board is handled properly. A control board with battery soldered in should never be laid on a conductive surface, e.g. antistatic mat.

Function: When the + 5 V voltage is present the RAM is supplied with power via D 1 and the lithium battery is coupled via D 2. When the + 5 V voltage is not present the battery takes over the power supply via R 8 and"D 2.

General Information on Machine Program Sequence:

Following the positive edge of the reset signal the CPU takes the program standard address from the E-PROM via the reset vector. The CPU then starts running the program at this point.

During this operation the following functions are performed continuously.

a. Fetch instruction code from E-PROM (and SYNC signal generating).
b. Fetch any associated data from E-PROM.
c. Execute instruction.

The entire program is a sequence of many diffgrent instructions. Execution of the instructions is accomplished taking into consideration the user data in the RAM.

A low level at the IRQ input of the CPU can interrupt the main program if the interrupt has been permitted by a corresponding instruction. This instruction sets the indent. bit in the CPU and thereby allows the main program to be interrupted for the purpose of executing an IRQ subroutine. After running the IRQ subroutine the CPU returns to the point of exit in the main program.

The IRQ program is called every 50 ms in the ATL program by the timer 1 IRQ signal of the VIA. This allows various instruction sequences in the main program, special subroutines and the IRQ routine to be run once, or a number of times, thereby forming the entire program sequence.

4.3 Functional Description - Display Board

The display board contains all optical displays,the buzzer and the interface with the foil keyboard. The display board is connected to the control board via the plug connectors ST 1 and SV 2.

Display Board Components:

a.	4 bit binary decoder (IC 2):	Control of the process step LED's
b.	Drivers (IC 1, IC 5, IC 10):	LED and buzzer control

c. Darlington Array (IC 3):	Switching stages for 7 segment display multiplexer and LED's
d. 7 segment decoder/ driver (IC 6):	Serial/parallel conversion of the display data, multiplexing of the 7 segment display and generation of the display characters
e. NAND gate and mono-flop (IC 8, IC 9, IC 10):	Generation of the strobe signal for the key byte
f. Schmitt Trigger (IC 4/Pin 8,9,10):	Switching of the display brightness

Control of 7 Segment Display:

The display data is processed by the control board in serial and transferred every 15 ms in two groups of 8 bits each. In order to display the data it is first necessary for it to be converted to parallel data and then decoded. Serial/parallel conversion is accomplished by IC 6. For this purpose IC 6 receives the serial data signal at Pin 5 and the processed shift file at Pin 13 via the monoflop IC 7

Low level is applied to the enable input IC 7/Pin 12 for the duration of data transfer by the second monoflop in IC 7.

In addition, the serial/parallel converter IC 6 also contains the BCD to 7 segment decoder with segment drivers a-g and the multiplexer which allocates the segment data to the displays via switch outputs Pin 7, 8, 10 and 11. The switch outputs Pin 7, 8, 30 and 11 of IC 6 control the displays LD 1 through LD 4 via Darlington drivers.

Display Brightness Switching:

The brightness of the display and the LED's is adjusted by a photo-resistor R 34 and the OR gate IC 4 (Pins 8,9 and 10+ wired as a Schmitt-Trigger.

If the room is very bright the output of the Schmitt-Trigger (IC 4/Pin 10) is high causing the two transistors T 2 and T 1 to be connected through by IC 4/Pin 11 or IC 4/Pin 11 and IC 1/Pin 2, and activates the decoder IC 2 via the enable inputs pin 18 and 19. The transistor T 1 serves as a power supply for a portion of the LED's, while T 2 switches the common ground for all Darlington drivers in IC 3.

Since the two transistors are continuously switched on in a bright room, the controlled LED's are also continuously supplied with power and are therefore bright. If the light intensity in the room is low the output of the Schmitt-Trigger (IC 4/Pin 10) is at low level and transistors T 1 and T 2 as well as the enable inputs of decoder IC 2 are activated only by short pulses to IC 4/Pin 13. This causes all activated LED's and the 7 segment display to illuminate only at low intensity.

Since the control pulses to IC 4/Pin 13 must be synchronous with the multiplex signal for the 7 segment display, the pulses are generated directly from the multiplex signal via diodes D 38 through D 41 and shaped to a defined length by one of the two monoflops in IC 9.

Generation of the Strobe Signal:

A strobe signal is generated on the display board, which triggers acceptance of the key byte in the VIA (IC 16/control board) to avoid "bouncing" of the membrane keys. The strobe signal is generated by the second monoflop in IC 9 and is available in the form of a positive pulse with a duration of approximately 20 ms at output Q 1 (IC 9/Pin 13).

The monoflop is triggered by the NAND gate IC 10/Pin 3 and the low path filter consisting of R 29 and C 9 when a key is pressed.

During the program sequence only, the start key should be operable and in the set mode all keys except for the start key, the keys are subdivided into 2 groups:

Group 1: start key ST/ST
Group 2: keys E 1, E 2, E 3, E 4, TSR, SET0 and step key

In each case only one of the two groups is enabled for strobe signal generation under the control of the set/run switch on the control board via IC 8, IC 10 (Pins 8, 9, 10) and IC 10 (Pins 4, 5, 6). The reset key is always enabled. Since the negative edge of the strobe signal is the active edge, a chatter period of less than 20 ms is bridged.

Manual Lifting on Control Disable:

Short term errors can occur when the lift motor driver receives control signals to lift and lower simultaneously. For this reason manual control is disabled during processor control access to the lift motor driver.

Function: During process control access to the lifting motor driver the HM disable (ST 2/Pin 12) is set to high level. This high level disables the manual control signals E 3 and E 4 via the OR gate IC 4/Pin 2 and 5.

4.4 Control Head Interface Board (94017)

This board contains the interface for contol and monitoring of all units and sensors for the assembly stage.

Control Head Interface Board Components:

a.	Driver:	Control of solenoid valves, filling pump and stepping motor
b.	Motor bridge:	Control of lift motor
c.	Comparator:	Examination of fill sensor
d.	Inputs:	Receiving sensor signals and sending to control board
e.	Voltage regulator:	Generation of the supply voltages

Rectifier/Voltage Regulator:

The rectifier circuits G1 1 AND G1 2 supply the unstabilized voltages 10 V, 18 V and 36 V for power supply to the control head and assemblies. The stabilized voltages +5 V and + 24 V are obtained via IC 5 and IC 6.

Filling Pump Driver:

The filling pump is connected to the + 24 V power supply via plug ST 4/Pin 5. If Pin 4 of plug ST 4 is connected through to ground via T 12, the filling pump is active.

Since the air distributor must be in the position corresponding to the process step when the filling pump is active, control can only be accomplished by the processor control.

Manual operation is accomplished under control of the processor systems just as manual control for the lift motor, and not directly via hardware control.

Control - Lift Arm:

The bridge circuit consisting of T 1 through T 9 is used for control of the lift arm.

Control is accomplished either by the processor control or directly, via manual operation (see also display board description/section: "Manual Lift Arm Control Disable").

"Lift" Mode:

If the lift mode is activated, IC 4/Pin 11 is at high level and IC 4/Pin 8 at low level.

The following situation results in the bridge circuit:

- T 6 is conductive blocking T 1
- T 2 becomes conductive; the circuit with C 6, D 6, R 11 and R 12 assures that it slowly becomes conductive rather than suddenly ("soft start")
- T 3 and T 9 are non-conductive
- T 4 is conductive
- T 5 is non-conductive

In this manner the lift motor is connected through to ground via T 2 and R 1 and to + 36 V via T 4.
When the sensor magnet then passes by the Hall switch IC 90, the output of the Hall switch (plug ST2/Pin 8) switches off the signal to the lifting arm control. This puts the bridge circuit back into the quiescent and transistors T 4, T 5 and T 1 are conductive.

Since the lift motor is now short-circuited by T 4 and T 5 it is stopped while T 1 is decoupled by D 2.

"Lowering" Mode:

In this mode IC 4/Pin 8 is at high level and IC 4/Pin 11 at low level.

This results in the following situation in the bridge circuit:

- T 9 is conductive blocking T 4
- T 3 is conductive
- T 2 and T 6 are non-conductive
- T 1 is conductive
- T 5 is non-conductive

The lift motor is connected to ground via T 3 and R 1 while the + 18 V supply reaches the lift motor via T 1 and D 2.

Current Limitation:

The voltage drop resulting from the lifting motor current flowing through R 1 controls the two current limitation transistors T 7 and V 8. If the current is too high T 7 or T 8 causes the active ground transistor for the bridge circuit to become less conductive.

The current value for lifting is approximately 3.4-3.8 A, the value for lowering 1.2 - 1.4 A.

Stepping Motor Control:

Two push/pull drivers in IC 1 are used for control of the stepping motor. The outputs Out 1 and Out 2 are connected to + 24 V or to ground depending on inputs IN 1 and IN 2 and in this manner control the direction of rotation of the stepping motor. Both outputs are at low level when the stepping motor is stopped.

The Hall switches IC 92 and IC 93 associated with the step motor serve for position control of the air distributor and generate a low level in the active state, which is fed to the input register of the control board (SMT 0, SMT 1).

Solenoid Valve Control:

The other two drivers in IC 1 are used for control of the solenoid valves MVK and MVW.

Fill Sensor:

The fill sensor consists of the two needle chains in the filling fitting of the lift arm and the comparator IC 2. During the filling operation a resistance of 1 M ohm is present between the needle chain, which results in an increase in the input voltage to the comparator (Pin 3). This results in a high level at the output (Pin 6), which is fed to the input register of the control board (signal FSN).

4.5 Transformer Board (94016)

The transformer board provides the AC voltage for the control head and the DC voltages for the motor unit. The switching circuits for heater 1, heater 2 and the circulation pump as well as the electronic control circuitry for the rotation motor are located on this board.

All control signals are provided by the motor unit interface board.

Components:

a. Line transformer, rectifier, voltage regulator:	Power supply for control head and motor unit
b. Relay:	Switching circuits for heater 2,"pump, line isolation, switching supply voltage for electronic control circuitry
c. OP amplifier:	Control of rotation motor speed
d. Zero voltage switch (IC 3), optocoupler:	Switching circuit for heater 2

Switching Circuits for Heaters 1 and 2:

The switching circuit for heater 1 consists of the optocoupler OK 1, the zero voltage switch IC 3 and Triac IC 1.

Heater 2 is switched by relay rel. 2.

Line Isolation Relay:

The line power for the heating elements and circulation pump can be switched off as required with relay rel. 1. Switching is accomplished by the processor control when the water bath overheats or by the float switch connected via plug ST 1 when the water level in the bath is too low. Also switching off by transistors T 2 and T 3 is possible; these transistors are controlled directly by the overheating protection monoflop IC 16 on the motor unit interface board.

Speed Control - Rotation Motor:

The control circuit consisting of T 7 and IC 2 is an E/I control.

This circuit is supplemented only by the pre-amplifier stage IC 1 for adaptation of the control voltage V soll (ST 2/Pin 3) to the input sensitivity of the control stage.

A switching circuit for the control voltage of the control stage is used, which limits the power loss of transistor P 7 at low speeds or in the event of a malfunction.

Switching is accomplished by relay rel. 4 controlled by the microprocessor.

The thermoswitch S 1 monitors the temperature of transistor T 7. If T 7 overheats the switch generates a low level at the monitor input TEMP.EX (ST 2/Pin 1).

4.6 Functional Description - Motor Unit Interface Board (94015)

In addition to further I/O registers, the motor unit interface board also contains the analog interface for collection of the analog readings (temperature) and output of the control voltage for the rotation motor.

Motor Unit Interface Board Components:

a. Input register - Examination of:
- BCD switch for rotation motor speed (IC 13)
- -BCD switch for automatic filling quantity (IC 13)
- -transistor temperature monitor for rotation motor IC 13
- -Rotation motor stand still indicator IC 16 a (IC 13)

IC 1
- -DIP switches SW 1/1 through 5 (IC 1)
- -Front/rear switch on plug ST 3 (IC 1)
- -Top float switch on plug ST 2 (IC 1)
- -Floating input to EXTERN plug ST 4 (IC 1)
- -A/D converter data (IC 10)

b. Output registers Output of:
- -Control signal, nominal rotation motor speed (IC 8)
- -15 V/30 V switching (IC 8)
- -Control voltage TEMP/ON (IC 8)
- -Test signals TS 1 - TS 3 (IC 2)
- -Expansion, EXTERN plug ST 4, (IC 2)
- -Floating outputs to plug ST 8 (IC 2)
- -Refill control enable (IC 2)
- -Control bit, heater 1 (IC 14)

		-Control bit, heater 2 (IC 14) -Control signals for A/D converter (IC 14)
c.	D/A converter	Generation of control voltage for rotation motor
d.	A/D converter	Conversion of temperature readings chemical/water sensors
e.	Comparator and monoflop	Overheating protection, switches heating elements off
f.	Operation Amplifier	Preamplifier for temperature readings (IC 5/IC 6) Impedance converter for control voltage (IC 3)
g.	Optocoupler	Isolation of chemical refill control from processor system
h.	Line filter and power switch	

Input registers:

The input registers IC 1, IC 10, and IC 13 correspond to the input registers on the control board in terms of function. The required chip select signals are provided by the control board.

Output registers:

The output registers IC 2, IC 8 and IC 14 correspond to the output registers on the control board in terms of function. The required chip select signals are provided by the control board.

Temperature Measurment:

Since the two preamplifiers for the chemical and water temperature are identical in terms of design, only the amplifier for the water temperature value is described here.
The bridge circuit consisting of resistors R 18, R 19, P 4, R 20 and the temperature sensor is supplied with power by the reference element IC 12 and delivers the differential input voltage for the op-amp IC 6. Adjustment of the zero point is accomplished with P 4. The amplifier circuit has two alignment points; P 3 for adjustment of the gain and P 7 for offset adjustment.

The amplifier output is connected to the A/D converter input via R 25 and BR 1.

The two preamplifiers differ only in the gain adjustment.

Overheating Protector:

Only a portion of the overheating protection circuit is located on the interface board. A total of three independent measures protect the unit from overheating.

a. Temperature sensor check for short circuit or discontinuity, via software.

b. When the water level drops below the minimum required level the heating elements and the line isolation relay are switched off via the bottom float switch.

c. In the event of a processor control failure or output register IC 14 failure the line isolation relay is switched off by the protection circuit consisting of comparator IC 15, monoflop IC 16 b and transistor T 1.

If the temperature in the water bath exceeds the 55 degree limit a positive edge is generated by comparator IC 15 at vhe trigger input of monoflop IC16 b.

This results in low level at the output (Pin 9) of the monoflop, which provides for an interruption to the line isolation relay power supply.

However, if the water bath is already overheated when the line power is switched on (e.g. overheated following a short power failure), the edge required to set the monoflop can no longer be generated. Transistor T 1 is also used to assure that the circuit still operates properly. This transistor pulls the overheating protection output to lower level.

A/D Converter:

A 4 channel converter with a resolution of 10 bits is used as the A/D converter (IC 11).

Of the 4 possible channels only channels CH 0 and CH 1 are used. Both channels are the same and can be selected via software.

An input register (IC 10) and an output register (IC 14) are assigned to the A/D converter for operations without address lines and R/W signal.

The output register assumes control of the converter, while the input register serves as a converter layout.

The precision reference diode ZN 458 (IC 12) with an output voltage of 2.45V +/- 1.5 % serves to provide the reference voltage.

D/A Converter:

The D/A converter (IC 7) generates an analog control signal for control of the rotation motor speed from the binary input signal. The maximum possible resolution of the converter is 6 bits, however only 5 bits are used. A parallel regulator with an output voltage of 2.5 V - 3 V is used for reference. An op-amp wired as a voltage follower is connected to relieve the load on the D/A converter output. Initial adjustment of the speed can be accomplished with P 5.

Rotation Motor Standstill Indicator:

A stand-still indicator was implemented for monitoring the rotation motor. This consists of the retriggerable monoflop IC 15 a, which is triggered by the rotation motor sensor on plug ST 9. The drum sensor is a hall switch, which is triggered at intervals by ring magnets located on the motor shaft.

If the pulses generated in this manner are not present the output of the monoflop(IC 16 a/Pin6) goes to low level after a short time and after a delay of 1.6 seconds the processor control starts reversing the drum motor direction of rotation continuously in order to eliminate any contact problems on the pole switching relay.

Simultaneously the supply voltage is switched over to 15 V to reduce the power loss of the drum motor control transistor. Also, the error message 2 is displayed.

The pole reversal function and output of error message 2 continue until the output of monoflop IC 16a is switched back to high level, i.e. pulses are again present from the rotation motor sensor.

4.7 Chemical Refill Circuit Board (94021)

(Models 4170 & 4171 only)

The chemical refill control board controls and monitors the six refilling pumps.

Chemical Refilling Circuit Board Components:

a.	Switching circuits:	Relays RL 1 - RL 6; switch pumps 1 - 6.
b.	Enable circuit:	T 2, IC 1, T 1; disables the refilling pumps when the filling pump in the control head is active.
c.	Timer:	IC 1; switches off pumps when the maximum pumping time is exceeded (e.g. supply reservoir empty or filter clogged).
d.	Buzzer:	Bz; gives warning when the maximum pumping time is exceeded (e.g. supply reservoir empty or filter clogged).

If at least one of the float switches SW 1-SW 6 is active (float down), the associated relay is connected to the + 12 V supply. Simultaneously + 12 V is fed to the enable transistor T 2 via the corresponding diode of diode network"DN 1. However since T 1 does not become conductive without an enable signal via plug ST 10, the relay cannot pull in. If an enable signal is then given by the processor control via the optocoupler to the motor unit interface board, Pin 2 of plug 10 is then connected to ground.

T 2 is therefore conductive and IC 1 receives power. High level is then present at the output IC 1/Pin 3, which activates T 1, after a delay of approximately 30 seconds (R 11, R 13, C 12). The relay pulls in.

IC 1 contains a timer, which keeps the output IC 1/Pin 3 at high level for approximately 6.5 minutes. If the refilling operation is not completed within this time (float switch closed for longer than 6.5 min.), pin 3 of IC 4 goes to low level switching off all relays.

Simultaneously high level is switched to IC 1/Pin 2 of the buzzer and the enable is maintained via T 3 in order to prevent resetting of the error message by switching off the enable signal (self-retaining circuit)." Before expiration of the 6.5 min. the timer can be reset at any time by interrupting the enable signal. This is always accomplished when the filling pump in the control head is activated.

To prevent resetting the timer when the reset key is pressed, C 9 is installed, which maintains the enable for a short time.

CHAPTER 5

Troubleshooting

5.1 Troubleshooting - Introduction

The circuitry used in the ATL-2,3 is capable of an assortment of self-diagnostic tests. These tests are simply programs which are written into the operting memory. The operating memory is stored on a small electronic device called an EPROM which stands for "Erasable Programmable Read-Only Memory". In order to perform these diagnostic tests it is essential for the unit to have a lighted numerical display which you are able to change using standard program entry functions. The fact that the display changes at all indicates that the program is running.

Troubleshooting - Program Running

Two versions of an eprom were used when the ATL-2,3 were first introduced. You can determine which version you have by pressing the lateral agitation button and the program step button simultaneously. In the display will appear a 4 digit code, if the first two numbers are 86 or 87 you have the first version, if the first two numbers are in the twenties or thirties then you have the second version.

Note: Eproms can easily be changed and are completely compatible. All improvements or updates will be made available to ATL owners.

Troubleshooting - First Version

With the first version of eprom there is a limited amount of troubleshooting capability. While the machine is switched on the program in memory is constantly running and "looking" for any irregularities in several of the main components. If an irregularity is "spotted" the machine will display a flashing number in the left digit of the display and sound an audible alarm. The flashing digit will correspond to a table found in section 5.2. The table gives the cause and remedy for each flashing code number. For problems not found in the table consult the Functional Description of the area in the machine where you are experiencing the problem, there you will find a complete description of the operation of the electronics giving you test points to help pinpoint a problem.

Troubleshooting - Second Version

The second version of eprom has some additional diagnostic capacity. While the machine is switched on you can push the lateral agitation button and the "set 0" button simultaneously, this will cause the two left hand digits in the display window to light up showing a fault code. (See section 5.1 to determine whether the program is running.) The explanation of how to use this code is located in section 5.3. If the problem is not covered by this table refer to the functional description section for the area of the machine you are repairing. There you will find a complete operation sequence which will enable you to determine what the cause of the defect is.

5.2 Processor Faults

INDICATION	CAUSE	REMEDY
Water bath does not heat up	RESET was not pressed after programming the process.	Push RESET (13)
Water bath does not heat up	SET/RUN in set position SET	Turn switch (20) to RUN.
Program does not start	not enough remaining solution.	Refill bottles, enter new volume in display.
Program does not start	Water bath not full	Turn on cold water.
Program does not start	Water bath or chemistry not up to temperature.	Wait or recalibrate the temperature or check heating elements.
Red triangle (not blinking) with audible beep.	Rinse water off? Bottles empty? Bottle caps tight?	Turn on. Refill bottles. Tighten caps.
Red triangle/led(s) next to chemical step flashing.	In the step where the LED flashes the chemical quantity was too low.	Before starting refill chemistry.
Red triangle blinking	Indicates a momentary loss of power to the machine.	Push RESET or ignore. The process will not be affected if only for a few seconds. Triangle will be off at next process (Note: the ATL's will always do this when first turned on.)

INDICATION	CAUSE	REMEDY
Yellow triangle	Unit finds internal problem w/processor (If it happens often - tell us. If uncommon - don't worry.)	Corrects itself automatically.
Blinking "1"	Front back switch is in wrong position	Switch to correct position.
Blinking "2"		
Drum motor stopped.	Drum motor defective? Lower interface board defective? Transformer board defective? Rotation motor sensor defective? Magnet loose? Drum binding?	Service; see chapter 3 or 6. If for less than 5 seconds unit will reverse motor to free up any obstruction. If it doesn't free up see chapter 3 or 6.
Motor turns at 50 rpm w/out reversing and does not respond to speed changes.	Motor is overburdened.	It should work normally after it cools for a while. If problem occurs often see chapter 6.
Blinking "3"		
Air distributor defect.	Magnet on star (indexing) gear broken? Connector not plugged in? Sensor Defective? Stepping motor defective? Frayed Wire? Cam finger broken (just runs if star magnet over sensor)?	See chapter 6.
Blinking "4"		
Lift arm cannot raise	Sensor defective(sensitivity/short circuit)? Magnet defective? Connector loose or Broken wire? Lift motor defect (can lift motor be operated via solenoid voltage?)? Upper interface board defective? Lower sensor did not sense one up & one down motion of arm.	Empty the drum manually, replace drum and press start. Remove any obstruction. If no obvious obstruction appears, stay with machine and see if problem recurs. If so, repeat the above step until process is done, then see chapter 6. Replace lift arm.

Blinking "5" Water temperature sensor defect.	-95% chance defective water sensor (plugs into lower interface board)	See chapter 2.
Blinking "6" Pumped solution quantity is too low.	-ran out of chemistry (set 1L; only had 500ml)	Depress key (15) and (5) together to pump more chemistry. 1 sec. = 100ml. See compressor calibration section chapter 7.
The LED at chemistry step will blink throughout the process.	-air leak -usually a user caused problem	Check bottle cap. Hoses connected to the bottle?
Blinking "7" Chemistry temperature sensor defect.	Broken wire in probe?	Take automatic over-heat feature out of program. Unit can be run w/temp/start override. Test sensor: see chapter 3.
Blinking "8" Cold water 24V solenoid valve staying on.	No cold water (off)?	Turn cold water on, then push reset.
	24V solenoid defective?	Replace.
	Float switch defective?	Replace.
	Water panel is not set to have cold water flow?	Adjust water panel.
Continuous long beep. (ATL-3 4170 & 4171 only)	Filters plugged on automatic refill. (ATL-3 4170/1 old style only)	Change filters.
Continuous long beep. (ATL-3 4170 & 4171 only)	Refill pump defect?	Check complete delivery system for blockage. Replace pump if necessary.
	Bottle lid float switch defective?	Test and replace if necessary.
Continuous long beep. (ATL-3 4170 & 4171 only)	15 L container empty? Refill pump teflon hose is worn.	Refill 15 L containers. Turn refill switch off, then on again.

5.3 Explanation of Fault Code For Second Version Eprom

Programmed into the ATL memory is a code which may be helpful in quickly diagnosing a problem. This code is not intended to be an exclusive method of troubleshooting and will only be useful with a clear understanding of the operation of the ATL which can be found in the instruction manual.

CONSULT THE FOLLOWING PAGE FOR THE CHART CORRESPONDING TO THE INFORMATION BELOW!

Instructions:

A two digit fault code will be displayed for a short period of time at the end of a program. It can be brought back to the display by changing the number 3 dip switch (behind access panel) to the up position and then depressing the lateral agitation key and the step down key simultaneously.

This code represents the error status of the unit at that time. The normal code displayed when everything is working properly is 0 0. If there is a problem with the machine a different code will be displayed, such as 4 0. If 4 0 is displayed this would indicate the Chemical Sensor is either unplugged or defective because a 4 in the left column means a defective Chemical Sensor and a 0 in the right column means OK.

5.3 Fault Code Chart #2

Depress lateral agitation key and step down key together.

1 = front back switch, wrong pos. (ATL-3)
2 = drum motor stopped
3 = air distributor defect
4 = lift arm cannot raise
5 = water temperature sensor defect
6 = pumped solution quanity low
7 = chemistry temperature sensor defect
8 = unassigned

<First Digit/Second Digit>

See Key Above For this column	First Digit	Second Digit	See Key Above For this column
5	0	0	1
6	1	1	2
5 & 6	2	2	1 & 2
7	3	3	3
5 & 7	4	4	1 & 3
6 & 7	5	5	2 & 3
5 & 6 & 7	6	6	1 & 2 & 3
8	7	7	4
5 & 8	8	8	1 & 4
6 & 8	9	9	2 & 4
5 & 6 & 8	A	A	1 & 2 & 4
7 & 8	|	|	3 & 4
5 & 7 & 8	| |	| |	1 & 3 & 4
6 & 7 & 8	⌊	⌊	2 & 3 & 4
5 & 6 & 7 & 8	—	—	1 & 2 & 3 & 6

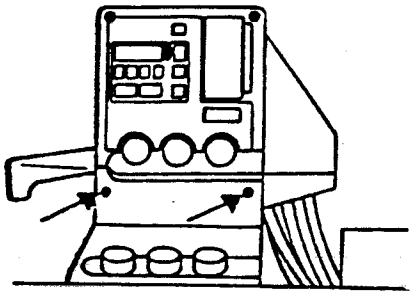
CHAPTER 6

Fuse Replacement

The ATL-2 and ATL-3 both have two fuses. The fuses are located just behind the small access panel which is mid-way between the upper head with the digital display and the lower head with the main power switch. The panel is held on with two Philipps head screws.

RATINGS ARE AS FOLLOWS:

ATL-2	2 X 1.6 amp. Time delay
ATL-3 w/hot water heater	1 - 800ma T.D. and 1 - 1.6 amp. T.D.
ATL-3 w/o hot water heater	2 X 1.6 amp. Time delay
ATL-3 Table top	2 X 1.6 amp. Time delay



CHAPTER 7

Test Points P.C.Boards

The following seven pages contain data needed to accurately test individual components on any of the 5 p.c. boards while in circuit.

CAUTION: **Use extreme caution when testing this electrical device while power is on. Lethal voltages are present. Only qualified, experienced technicians should perform any of the tests found on the next seven pages.**

7.1 Test Points

a) Upper Interface Board, Control Head (94017)

Signal	Nominal Value	Remarks
FSN	with resistor: + 5 V without resistor: O V	Replace filling sensor with 1 M ohm test resistor. (ST 2/Pin 1 + 11) FSN = ST 1/Pin 2
Current limitation IC 1	I = 500-580 mA	Replace MVW solenoid valve with ammeter. Actuate SET 0 and key E 1 (SET)
Current limitation, lift-motor (lifting)	I = 3.4-3.8 A	Replace lift motor with ammeter (+ to ST 2/Pin 10; - to ST 2/Pin 12) Press SET 0 and E 4 key (SET)
Current limitation, lift motor (lowering)	I = 1.2-1.4 A	Replace lift motor with ammeter (- to ST 2/Pin 10; + to ST 2/Pin 12) press SET 0 and E 3 (SET).
Lift motor supply voltage (lifting)	E = 28-30 V	Press SET 0 and E 4 key. Pos.to ST 2/Pin 10; ground ST 2/Pin 12.
Lift motor supply voltage (lowering)	E = 12-14 V	Press SET 0 and E 3 key. Pos.to ST 2/Pin 10; ground to ST 2/Pin 10.
+ 5 V	+ 5 V +/- 0.1 V	Ground to black stranded wire + 5 V to red stranded wire.
+ 24 V	+ 24 V +/- 0.8 V	Voltage regulator IC 6
+ 18 V	17 V	Measure across C 3 without load.

+ 18 V (with load)	15 V ripple 2.5 VPP	Measure across C 3 with load. Load by pressing SET 0 and E 3 key (= lower lifting arm). Allow lift arm to rest against lower stop.
+ 36 V (without load)	34 V	Measure across C 2 without load
+ 36 V (with load)	30 V ripple 4.5 VPP	Measure across C 2 with load. Load by pressing SET 0 and and E 4 key (= lift arm)
V out IC 7	+ 5 V +/- 3 %	IC 1/Pin 1. TO IC 1/Pin 4

7.2 ATL 2 Control Board (94022)/ATL 3 (94023)

Signal	Nominal Value	Remarks
+ 5 V	+ 5 V +/- 0.1 V	Measuring ground to IC 15/ Pin 4; and + 5 V to IC 15/ Pin 8.
V,C-mos	+ 3.6 V + 0.2 V - 0.0 V	Measure voltage across lithium battery with unit connected.
V Ref	+ 2.5 V	Measuring ground to IC 15/ Pin 4; 2.5 V to IC 15/Pin 1
OSC (oscillator)	1 MHz +/- 100 ppm Vpp min 3.5 V	IC 2/Pin 37 (CPU) Ground Pin 1/IC 1.
IRQ (interrupt request) (ground IC 1/Pin 1)	a. tL 1- 2 ms tH 48-49 ms b. tL 4- 5 ms tH 45-46 ms	IC 1 Pin 4 (CPU) a. idling (press reset button previously) b. while program is running
STRB (strobe)	tH 5-6 ms	IC 16/Pin 40 (can only be measured when a key is pressed. Reset key in RUN or SET mode, start key in RUN mode, SET keys, arrow key or TSR key in SET mode. (ground IC 16/Pin 1)
Sync	tH = 900 ns tL = 800 ns/5 us irregular sequence of H/L pulses	IC 1/Pin 7 (a "stable" oscillogram cannot be recognized because the pulse sequence is irregular depending on the program). (ground IC 1/Pin 1)
SEDA	a. pulse group 8 low pulses each with duration of 16 us. Repetition every 50 ms. b. low level	IC 16/Pin 19 (oscillo-scope setting: 2 V/div; 50 us/div; trig. neg. edge) (ground IC 16/Pin 1). a. measure with display 55:55 b. measure with display 00:00

Signal	Nominal Value	Remarks
Clock	Pulse group 16 low pulses with duration of 5 us each. Structure independent of display. Repetition every 50 ms.	IC 16/Pin 19 (oscilloscope setting: see SEDA measurement)
PHI 2	Square pulse f = 1 MHz Vpp = 5 V	IC 16/Pin 25 (ground IC 16/Pin 1)

7.3 Display Board (94018)

Signal	Nominal Value	Remarks
+ 5 v	+ 5 V +/- 0.1 V	Ground to SL 1/Pin 12; 5 V to IC 6/Pin 18
+ 24 V	+ 24 V +/- 0.8 V	24 V to BZ 1/+
SEDA	a. pulse group 8 low pulses each with duration of 16 us. Repetition every 50 ms. b. low level	IC 6/Pin 5 (oscilloscope setting; 2 V/div; 50 us/div trig. neg. edge) a. measure with display 55:55 b. measure with display 00:00
Clock	Pulse group 16 low pulses each with duration of 5 us.	IC 7/Pin 2 (oscilloscope setting: see SEDA measurement)
MPX	Pulse tH = 1.5 - ms tL = 4.5-6 ms	IC 9/Pin uO
Enable IC 6	Pulse tH = 49.7 ms tL = 300 us	IC 6/Pin 12 (ground IC 6/Pin 9)
CLOCK	Pulse group 16 low pulses each with duration of 11 us.	IC 6/Pin 13 (oscilloscope setting: see SEDA measurement)
STRB	tH 5-6 ms	IC 9/Pin 13 (can only be measured when a key is pressed, reset key in RUN or SET mode, start key in RUN mode, SET keys, arrow key or TRS key in SET mode.
Dark/bright switching level	light = H-level dark = L-level	IC 4/Pin 10 Dim R 34 for L-level at IC 4/Pin 10
Dark/bright	light = H-level dark = H-pulse 3-6 ns each.	IC 9/Pin 4

7.4 Lower Interface Board (94015)

Signal	Nominal Value	Remarks
+ 5 V; AN	+ 5 V +/- 3%	IC 5/Pin 7; ground = temperature sensor shield
+ 5 V; DIG	+ 5 V +/- 4%	IC 10/Pin 20
V ref: DAC	2.5 - 3 V	IC 7/Pin 5; ground = temperature shield
V ref; ADC	2.45 +/- 1.5 %	IC 11/Pin 8; ground = temperature shield
Lever switch (ST 2)	a. low b. high	IC 1/Pin 8 a. float up b. float down
V/H sens. (ST 3)	a. low b. high	IC 1/Pin 11 a. "front" position b. "rear" position
TMT - sens.	Square wave: f 5 HZ	IC 16/Pin 6 (motor switch on disc, start program, e.g chemical 1 = 10 min.
TMT-monoflop	a. H-level b. L-level	IC 16/Pin 6 (motor switch, any position, start program, e.g. chemical number 1 = 10 min. a. ST 9 plugged in b. ST 9 pulled
Input voltage CH 0	0.73 V +/- 2% Temperature display = 29.8-30.2 degrees C.	IC 6/Pin 6; ground to C 11/ Pin 9 replace temperature sensor WA with 2.2 K ohm trimmer and set trimmer to 0.73 V +/- 2%
Input voltage CH 1	0.73 V +/- 2%	IC 5/Pin 6; ground to C 11/ Pin 9 replace temperature sensor CH with 2.2 k ohm trimmer and set trimmer to 0.73 V +/- 2%

Signal	Nominal Value	Remarks
Overheating protection	a. low b. high c. high d. low	a. IC 15/Pin 7 b. T 1/collector c. IC 15/Pin 7; pull ST 6 d. T 1/collector; pull ST 6 Collector T 1 remains at low MTLST 6 is plugged in again and the power switched off momentarily
ANALOG output	1.30-1.34 V	IC 7/Pin 4 (start program, e.g. chemical 1 = 10 min., motor switch on disc).

7.5 Transformer Board (94016)

Signal	Nominal Value	Remarks
+ 5 V	+ 5 V +/- 3%	Ground to C 3; + 5 V to IC 5/Pin: Out
+ 24 V	+ 24 V +/- 0.8 V	Ground to C 1; + 24 V to IC 4/Pin: Out
+ 18 V (w/o load)	17 V	Ground to C 1 (-); + 18 V to C 1 (+)
+ 36 V (w/o load)	34 V	Ground to C 1 (-); + 36 V to C 1 (+)
Power supply IC 2/IC 2	+ 28 V +/- 10%	IC 1/Pin 7
Test relay 1	a. Relay 1 pulled in b. Relay 1 dropped out	Actuate bottom float switch (float up), pull plug ST 2. a. Connect R 14 (ST 2/Pin 11) to + 5 V. b. Connect R 14 (ST 2/Pin 11) to ground and/or float down.
Test relay 2	a. Relay 2 pulled in b. Relay 2 dropped out	Actuate bottom float switch (float up), pull plug ST 2. a. Connect R 13 (ST 2/Pin 15) to + 5 V. b. Connect R 13 (ST 2/Pin 15) to ground and/or float down.
Test relay 3	a. Relay 3 pulled in. b. Relay 3 dropped out	Pull plug ST 2. a. Connect R 12 (ST 2/Pin 7 to + 5 V. b. Connect R 12 (ST 2/Pin 7) to ground.
Test relay 4	a. Relay 4 pulled in b. Relay 4 dropped out	Pull plug STS 2. a. Connect R 11 (ST 2/Pin 9) to + 5 V. b. Connect R 11 (ST 2/Pin 9) to ground.

Signal	Nominal Value	Remarks
Test - H1	a. H 1 = on b. H 2 = off	Pull plug ST 2, actuate bottom float switch (float up). a. R 21 (ST 2/Pin 18) and R 14 (ST 2/Pin 12) to + 5 V. b. R 21 (ST 2/Pin 18) and/or R 14 (ST 2/Pin 12) to ground and/or float down.
Test - H 2	a. H 2 = on b. H 2 = off	Pull plug ST 2, actuate bottom float switch (float up). a. R 13 (ST 2/Pin 16) and R 14 (ST 2/Pin 12) to + 5 V. b. R 23 (ST 2/Pin 16) and/or R 14 (ST 2/Pin 12) to ground and/or float down.
Test - Capacitors c 1/C 2		Start any program, pull ST 9 (TMT-sens.) on interface board, motor head. Wait for error message 2 and continue operating unit with error message for approx. 2 min. If a power failure or watch-dog display appears during this time, C 1 or C 2 is defective.

CHAPTER 8

Servicing the Upper Electronic Control Head

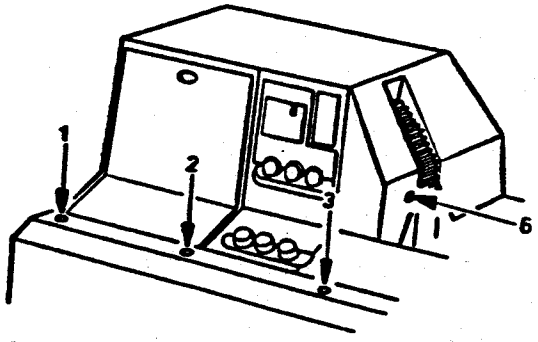
Note: It is not necessary to remove the electronic control head if it is known which of the three circuit boards is defective or if you are simply replacing a known defective component or changing the Eprom to a different version. The three circuit boards can all be removed by taking the front plate with the membrane panel off.

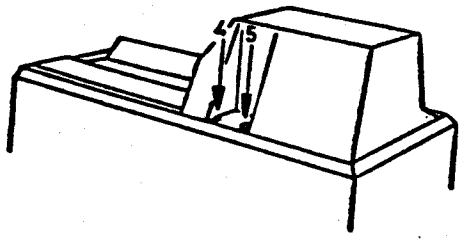
If you are unable to determine which of the three boards is defective it may be necessary to remove the entire electronic head. See section 8.1

8.1 ATL-3 Head Removal
(ATL-2 Starts at section 8.3)

Remove ATL 3 hood (95294) - by unscrewing the six slotted screws shown in drawing.

(diagram)

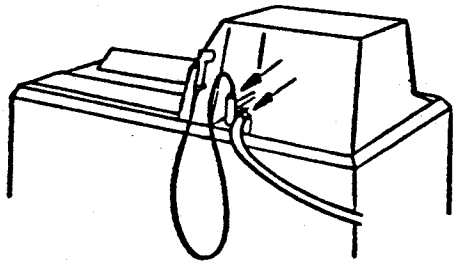




8.2 ATL-3 Hose Removal

Remove manual sprayer (95321) and cold water hose - use pliers if necessary.

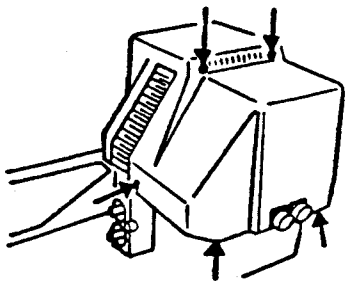
(diagram)



8.3 (ATL-2 begins here.)
Remove motor cover (92028) by unscrewing the five screws shown in drawing.

Note: The two lower screws are finger tightened wing nuts or similar.

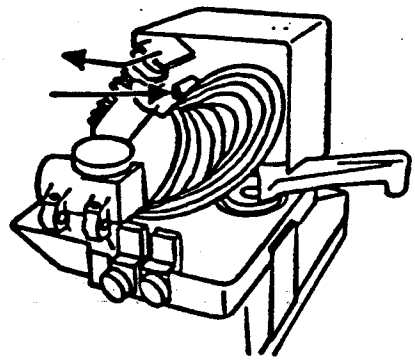
(diagram)



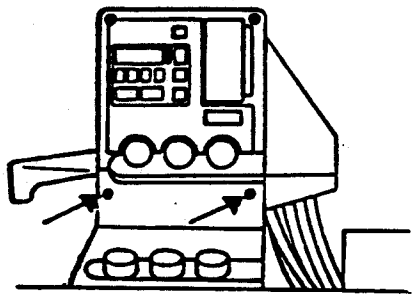
8.4 Control Head Removal

Back of machine
- Pull bellows out of upper guide
- Remove white plastic screw

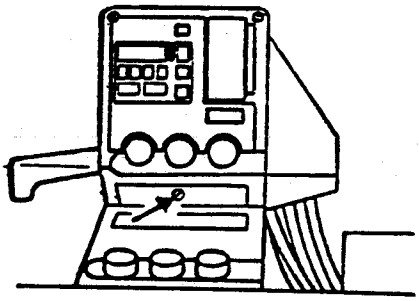
(diagram)



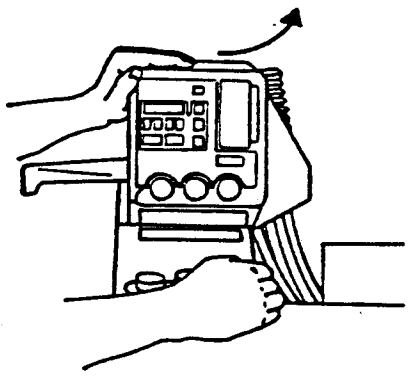
Front of machine
- Remove access panel (92026/07155) by removing the two Phillips screws shown in drawing.



- Remove center screw at bottom edge.



- Disconnect power and ribbon cables in front.
- Press head to right out of mount and lift.
- Disconnect the three cable plugs in the back of electronic head.



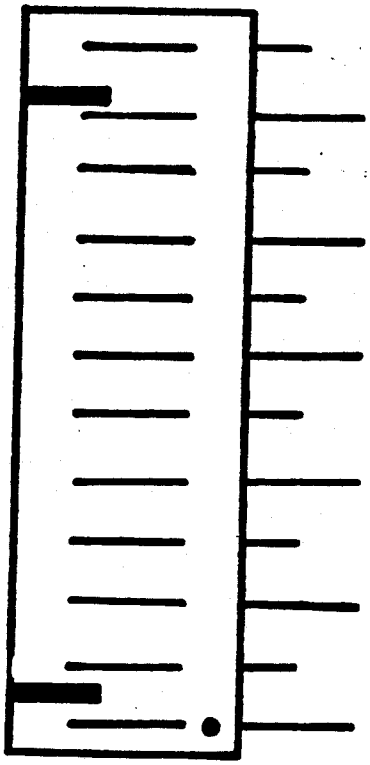
8.5 Wiring Harness Connections (for Upper I/O Devices)

a) Lift Arm Connector

Note: All three of these connectors are plugged into the back of the electronic control head. The text to the right of each connector indicates which I/O device each wire goes to.

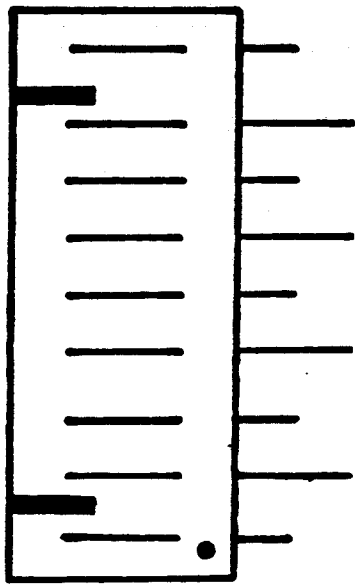
Needle chain pivoting point of arm.

Shield & ground HSTRA



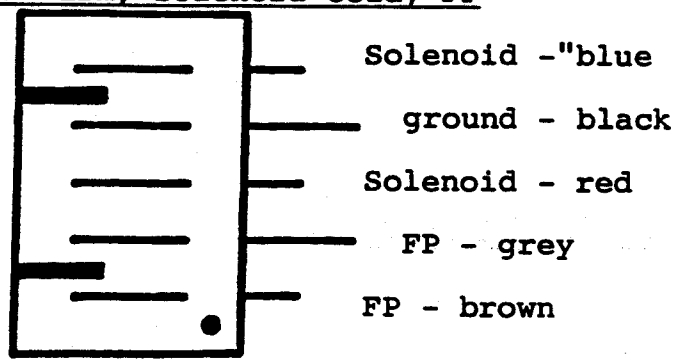
Needle chain - white
Shield chain - white
Bottom hall sensor & shield 2 x white
Bottom hall sensor - green
Bottom hall sensor - yellow
not used
Top hall sensor - yellow
Top hall sensor - green
Top hall sensor - white
Lift motor - black
Needle chain - green
Lift motor - green

b) Air Distributor & Drain Arm



Drain arm motor - black
drain motor - red
Hall sensor #1 - green
Hall sensor #2 - green
not used
Hall sensor #1 - yellow
Hall sensor #2 - yellow
Hall sensor #1 - white
Hall sensor #2 - white

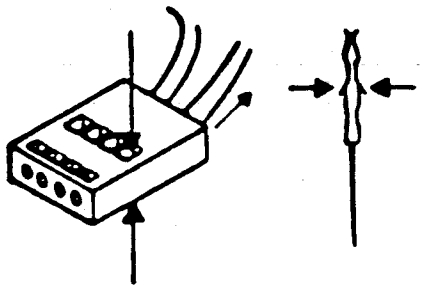
c) Solenoid warm, solenoid cold, FP



8.5.1 Individual wire Replacement

Removal:

- Pull cable connector off electronic control unit.
- Use a small screw driver or a similar tool and insert from both sides through the openings in the cable connector, pressing the barbed hooks inward.
- Pull out wire.



Assembly:

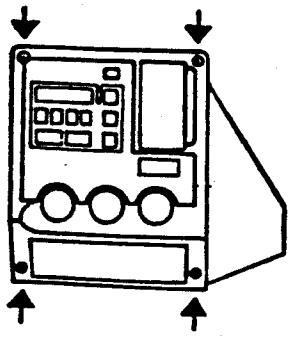
- Bend barbed hooks of wire connector slightly apart.
- Insert wire into cable connector.
- Check with a light pull for firm assembly.

8.6 Servicing The Upper Electronic Control Head

- Display board, control head (94018)
- Control board, control head (94022/94023)
- Interface board, control head (94017)

If work is required on the upper electronic control

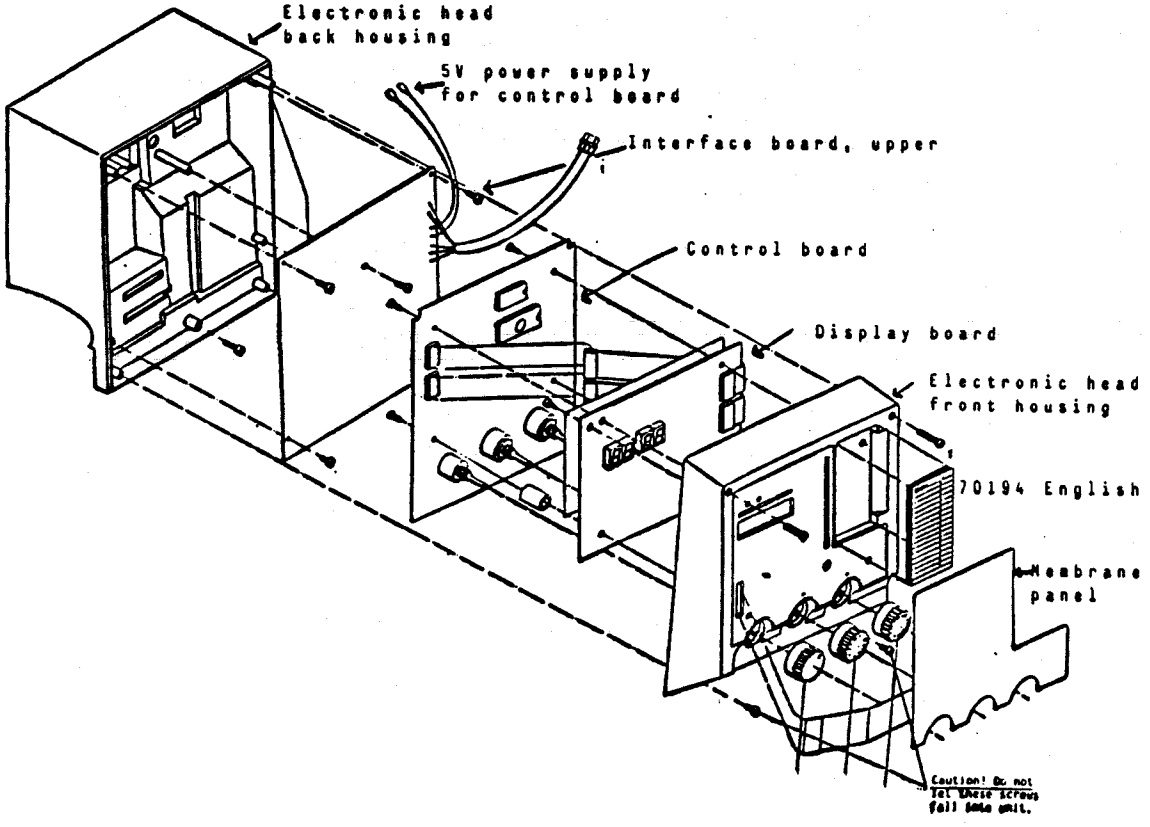
(diagram)



- remove the four Phillips screws shown in drawing

Exploded Drawing, Control Head (95274/95290)

(illustration)



8.7 Replacing Membrane Switch Panel

a) To remove the membrane switch panel, the control and display PC-boards must first be removed from the front housing section

b) The defective membrane switch panel is lifted at one corner with a knife and pulled off.

c) Remove remaining glue and any uneveness (use an adhesive solvent, not a plastic solvent)

d) Remove protective backing from new membrane switch panel, guide cables through opening in housing, and align panel without pressure.

e) When pressing membrane switch panel into place, avoid excessive pressure on touch buttons and display window.

Assembly:

Assembly takes place in reverse sequence.

8.8 Replacing upper electronic head P.C. Board

Display Board

- Connect the connector for the membrane switch panel
- Check positions of the LED's; if bent, correct position.

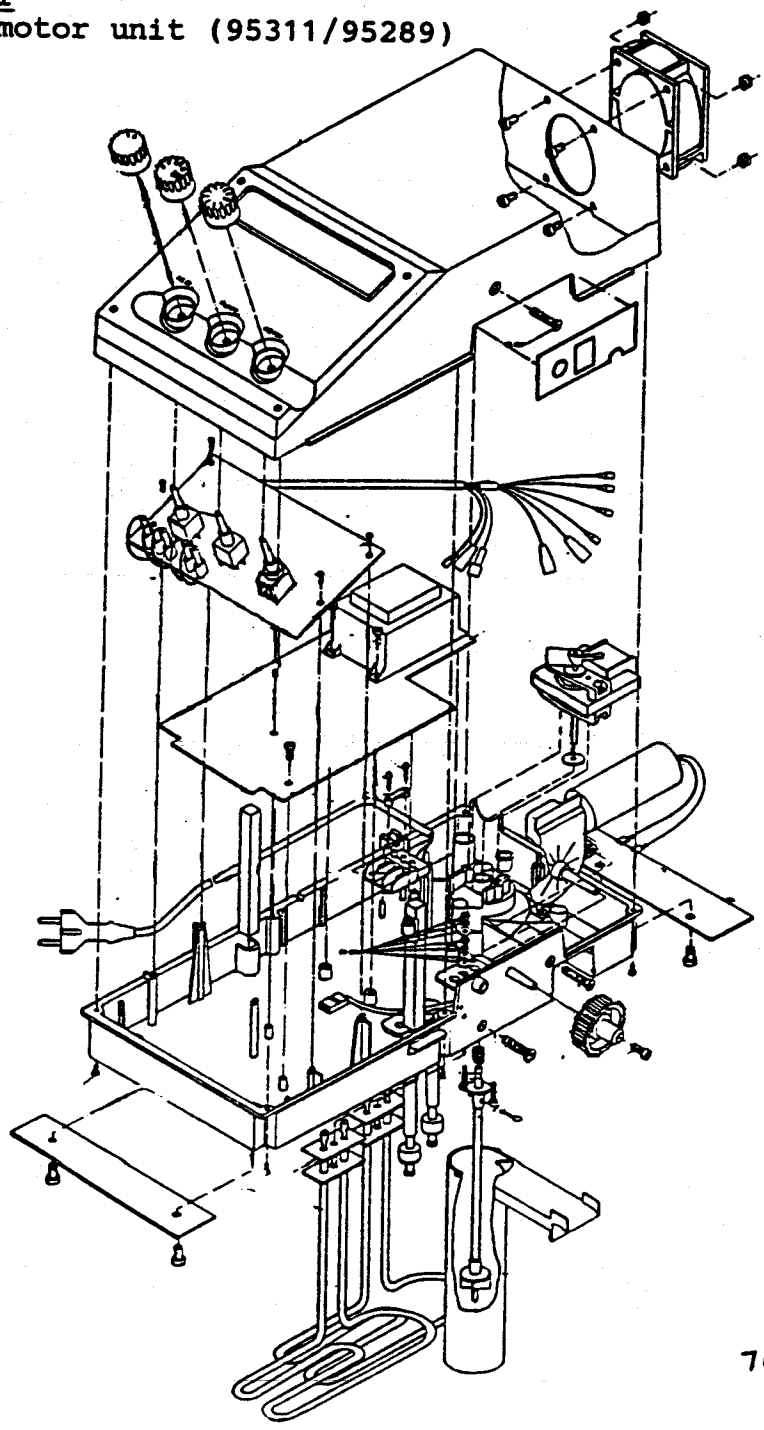
Insertion of control PC-board:

- Align SET/RUN knob properly with flattened shaft.

Assembling halves of housing:

- Avoid pinching of cables.

9.3 Servicing Lower Motor Unit
-Interface board, motor unit (94015)
-Transformer board, motor unit (94016)
If work is required on the lower motor control unit,
-remove the four Philipps screws shown in drawing
-remove 3 knobs by pulling straight off
-remove front panel
Exploded drawing, motor unit (95311/95289)



Refer to pump motor replacement section for instructions on getting into the motor unit.

The rotation motor is held in by one screw and is connected electrically by two different colored wires. (polarity of these wires is critical)

9.5 Heating element removal:

Refer to pump motor replacement section for instructions on getting into the motor control unit. There are two heating elements used in the ATL-2,3. They are each held in by one 7mm brass nut and have two non-polarized wires attached to the heating element terminals.

9.6 Circuit board removal:

See either the section on Motor unit which is the lower piece or the section on the electronic Control head, which is the upper piece.

9.7 Temperature Calibration:

Turn the ATL on and program the temperature for 32.0 C. Turn the unit to run and press reset. When the temperature in the display stabilizes (regardless of the actual temp) make these adjustments.

1. Chemical bottle sensor: The chemical bottle sensor should be adjusted so that the display is the actual temp. of the chemistry (or water) in the bottle (any bottle). Use a high quality mercury thermometer for calibration. The adjusting point is a black potentiometer in-line with one of the wires to the sensor located near the point of attachment to the circuit board.

2. Water bath sensor calibration: This procedure is the same as the chemical sensor calibration. Adjustments for the water bath calibration are made to the water bath sensor potentiometer which is in-line with one of the two sensor wires. The actual temp. of the water using a reliable mercury thermometer should be 0.4 degrees higher than the displayed value. (note: this is only true at 32.0 C.measured at the pump output.) This is to compensate for heat loss of the water jacket before tempering of the chemicals can take place.

9.8 Hose Replacement:

It is unlikely that any of the hoses used in the ATL will ever need replacing, in the event they do, consult the exploded diagrams for hose routing.

9.9 Temperature Sensor Replacement:

The temperature sensor is located inside the pump housing. It is a small tube running parallel to the pump shaft.

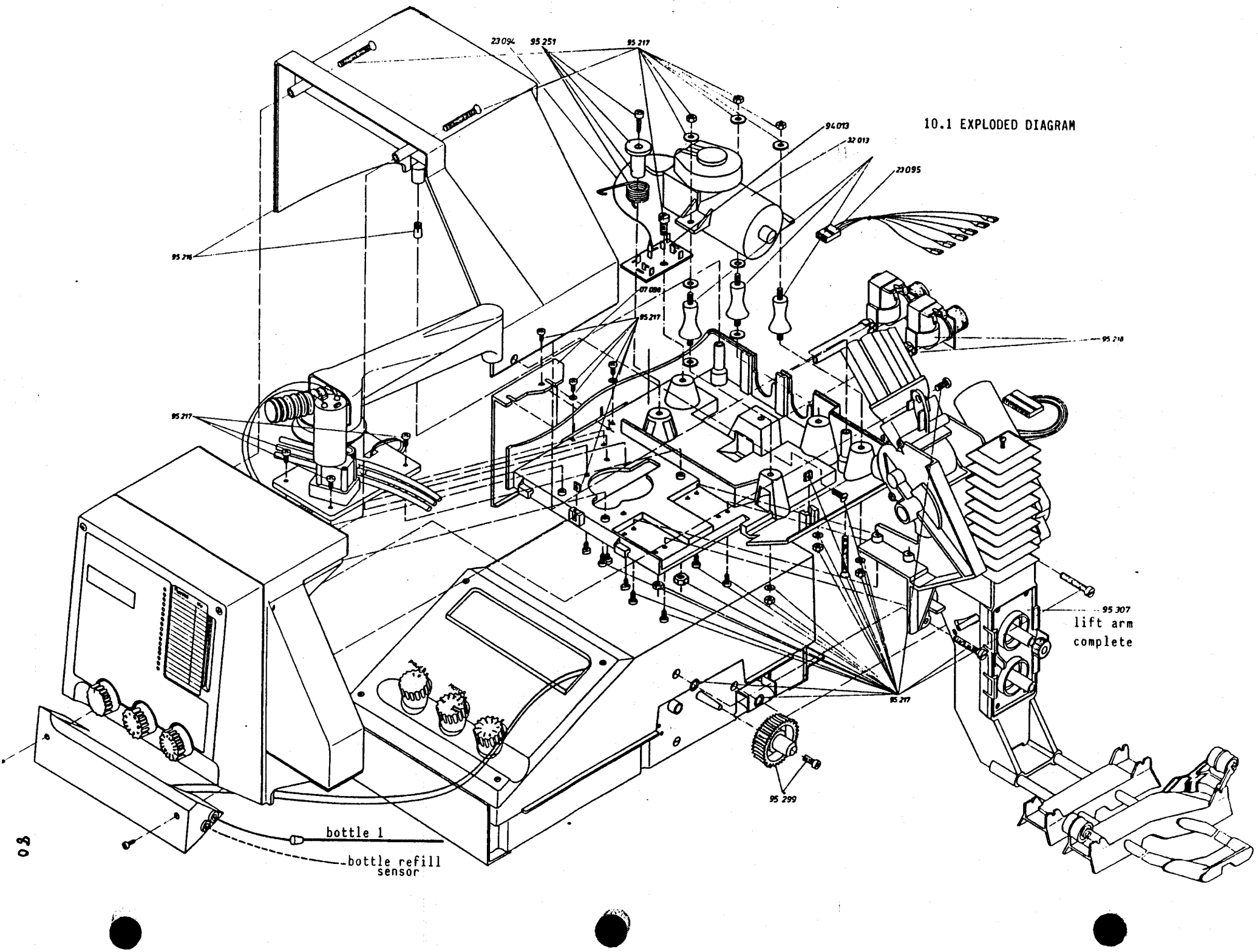
Replacement-

1. Remove motor unit top cover.
2. Disconnect temperature sensor at the Interface Board.
3. Unhook the green ground wire.
4. Remove the pump housing.
5. Using a screwdriver push the old sensor from the pump housing side until it comes loose.
6. Scrape old glue and sealant away from the opening.
7. Place a bead of Isarplast glue (Part# 16019) around the opening for the sensor and place the sensor into the hole. Make sure to push the sensor down firmly so it seats properly.
8. Reattach the green ground wire.
9. Reconnect the wires to the interface board. (Polarity is not a concern.)
10. Replace the pump housing.
11. Recalibrate the temperature. (See Calibration Section.)
12. Replace motor housing top cover.

CHAPTER 10
Servicing upper Control head

On the following pages you will find a detailed exploded drawing for disassembly and assembly of the upper control head.

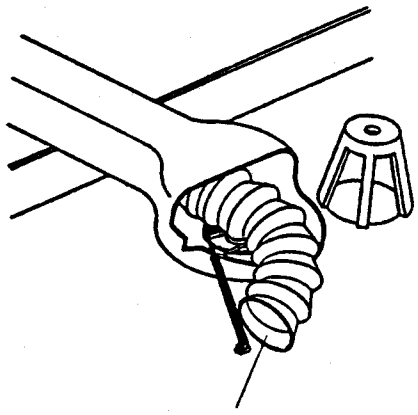
This section is not exhaustive and assumes a general mechanical aptitude on the part of the technician. All components are easily accessible and are assembled with standard hardware for easy replacement.


10.1 EXPLODED DIAGRAM
23094
95 251
95 217
94013
32 013
23095
95 216
07 0196
95 217
95 218
95 217
95 307
lift arm
complete
95 217
95 299
bottle 1
bottle refill
sensor
08

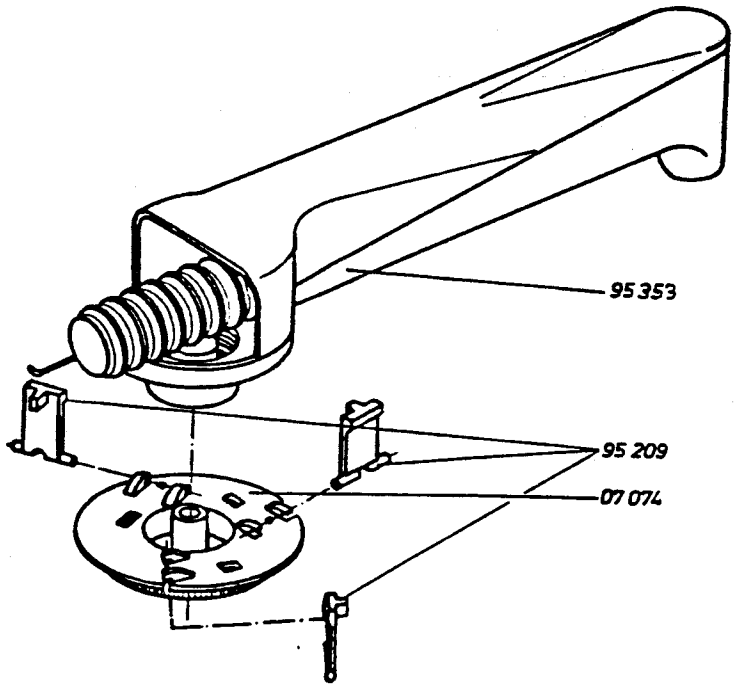
10.2 Chemistry Distributor Arm (95353)

Disassembly of the Chemical Distributor Arm:
-Move chemical distributor arm to position "1" by pressing reset button.
-Unscrew Philipps screw at pivoting point of arm and remove washer and retaining pin under screw.
-Release return spring by pulling up and away form air distributor motor.
-Hold down black plate #07074 to prevent motion and pull chemical distributor arm up and off.
-Remove drain hose from lift arm drain opening by pulling and twisting to break the glue seal.

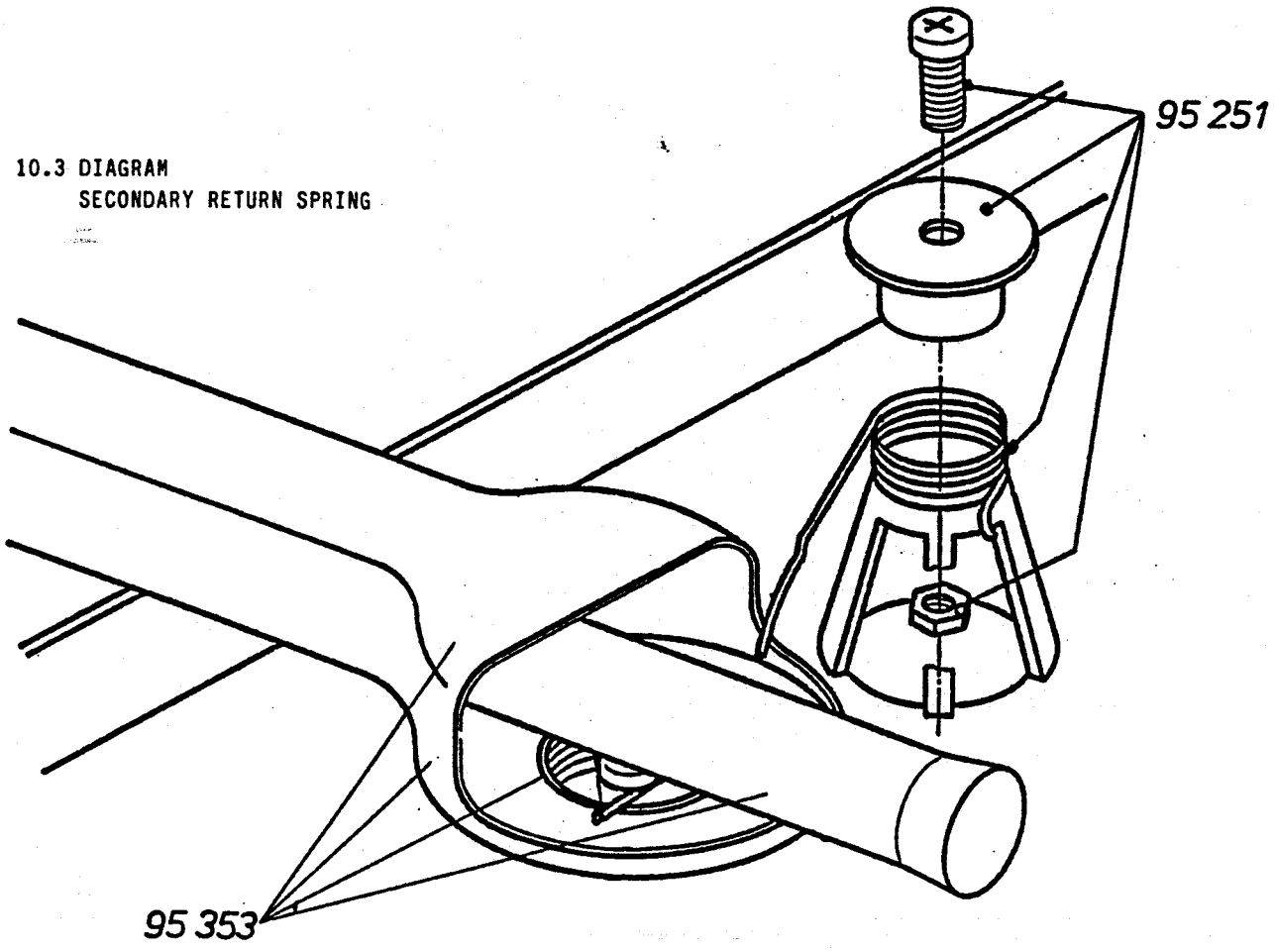
Installation of Chemical Distributor Arm:
-Attach hose to drain opeing of lift arm with silicon glue, position chemical distributor arm on plate #07074.
-Position retaining pin in groove and install screw with washer.
-The retaining pin end must not drag on the edge of the chemical distributor arm bottom part!
-Clamp spring behind gear motor It must not drag on edge of chemical distributor (bend if required).
-Check position of arm after assembly.



Widen before mounting apply thin coat of glue to the mounting spout.



10.3 DIAGRAM
SECONDARY RETURN SPRING



10.3 Air Distributor (95344)

Functional Description

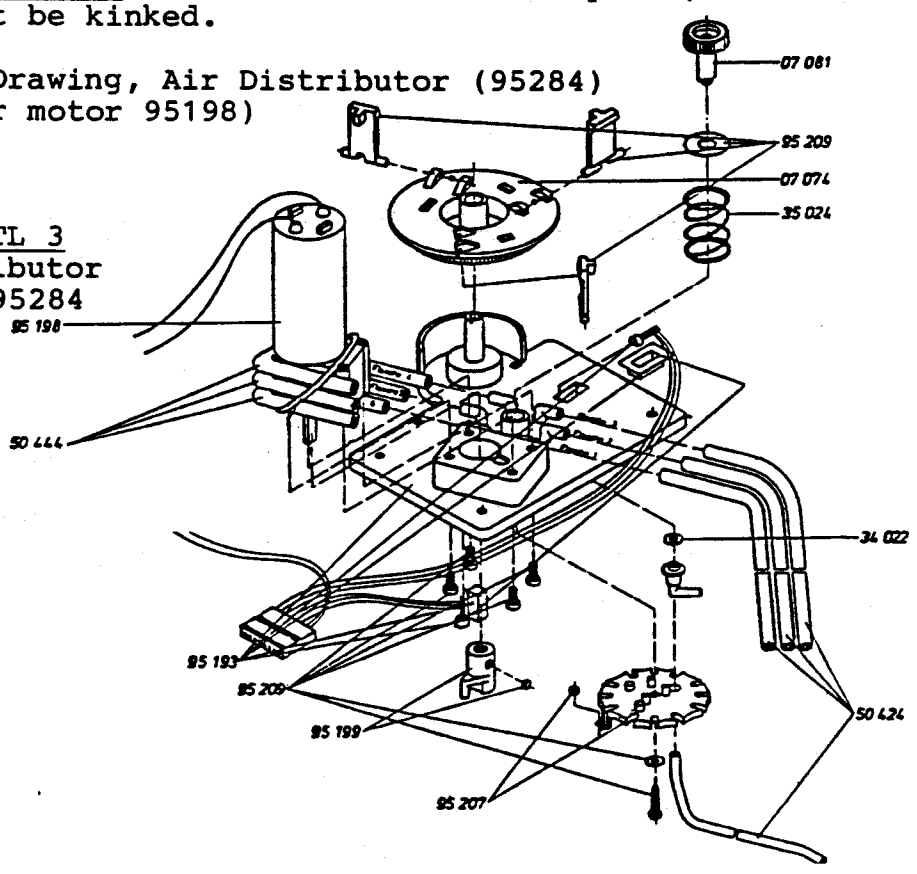
- The air coming from the pump is fed to the upper part of the air switch-over stage by the air distributor. The indexing wheel (95207) has 6 locking positions. An O-ring located in the indexing wheel is used as a seal.
  The indexing wheel is driven by the motor (95198) via an indexing finger (95199). The chemical distributor is moved to the proper position simultaneously by gear (07081).

Special assembly instructions

- The 6 holes in the air distributor plate must be deburred
- The O-ring (34022) must be coated with vaseline before installation
- The square shaft on gear (07081) must be correctly positioned in the opening of the indexing wheel when screwed on
- The indexing finger (95199) must be positioned against the stop on the motor shaft
  The air hose to the pump must have a <u>sufficient amount of play</u> below the installation plate, and must not be kinked.

Exploded Drawing, Air Distributor (95284)
(with gear motor 95198)

<u>Autolab ATL 3</u>
Air distributor
assembly 95284



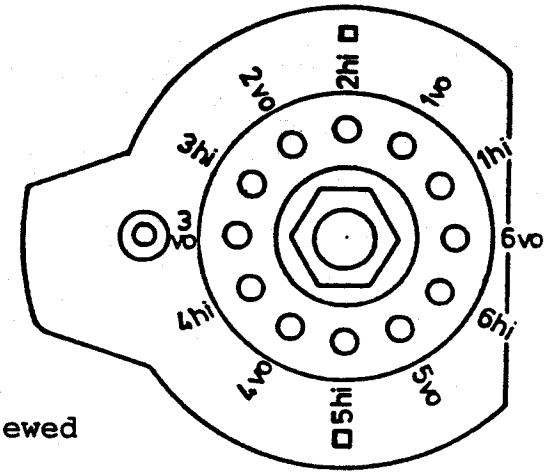
10.4 Air Switching Unit (ATL-3)

Functional description:
- The air switching-stage switches the compressed air to the front or rear bottles as desried.

Disassembly of the Air Switching Stage
- remove center plastic screw
- The hall sensor (95286) is fastened with a machine screw and 4mm brass nut (hall sensor serves for monitoring the position of the air switching stage)

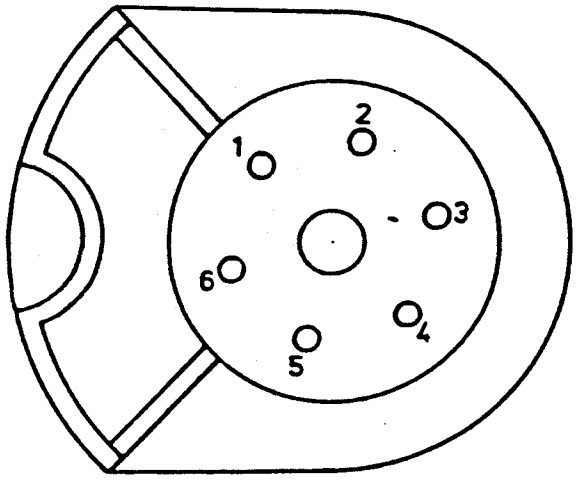
Connection of Air Hoses on Bottom part of Air Switching Stage

VO=FRONT
HI=BACK



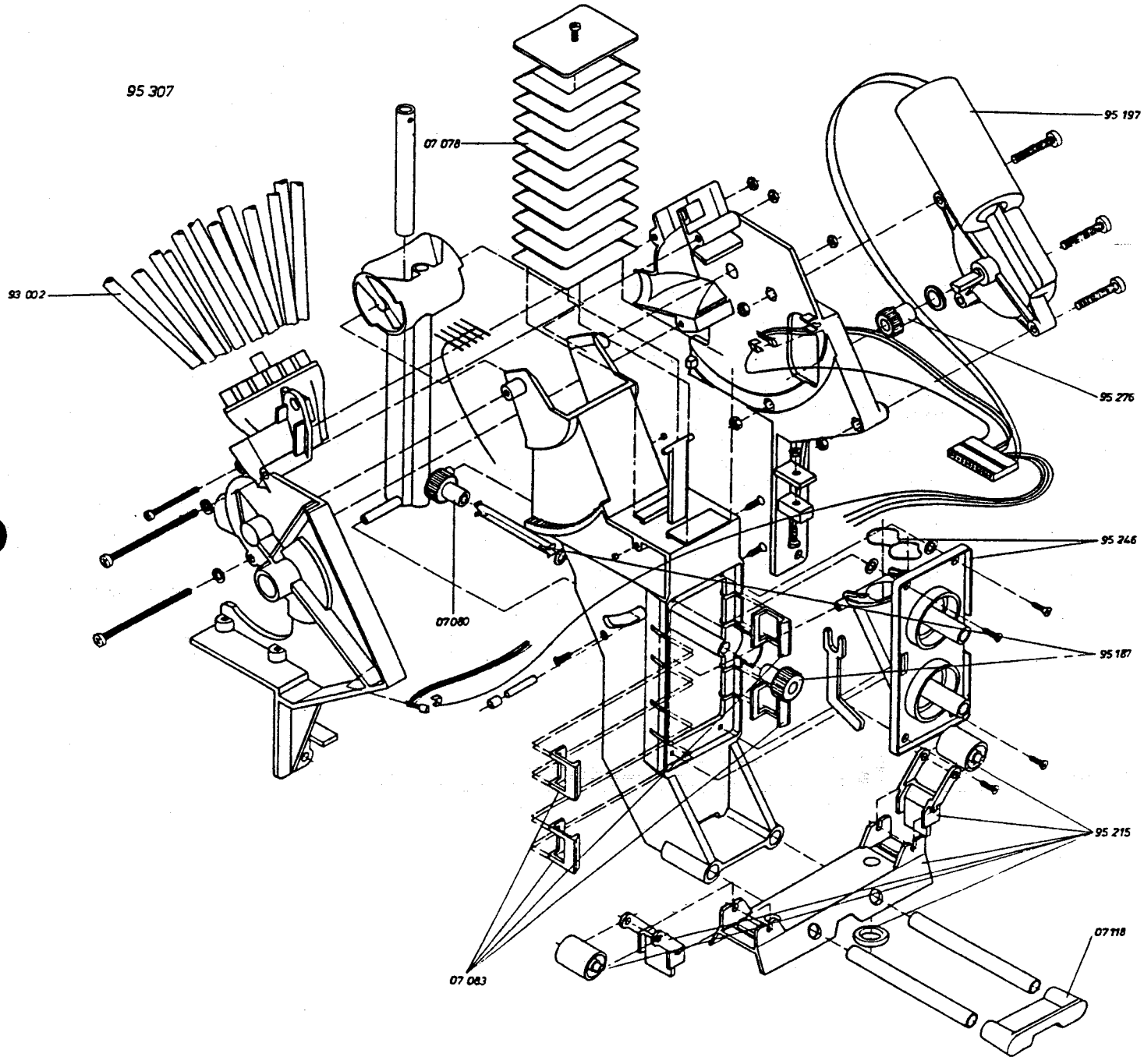
Bottom part of air switching stage viewed from below

Air Hose Connection on Upper Part of Air Switching Stage



Upper part of air switching stage viewed from top

10.5 Exploded Diagram of Lift Arm



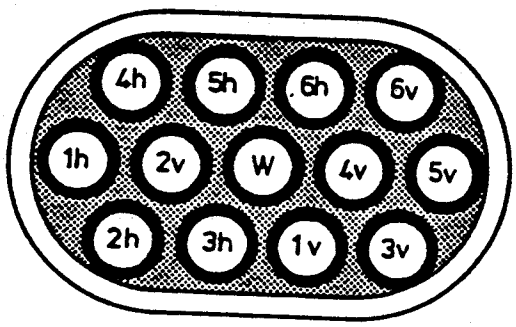
10.7 Removal of Lift Arm

The lift arm is available only as a complete unit tested for proper function and leakage. Replaceable parts are listed in the parts list.

- Pull bellows out of bottom clamp
- Pull hose package with hose manifold (95305) out of lifting arm
- Remove 4 screws for bearing block on bottom of mounting plate
- Pull off hose to chemical distributor arm
- The lift arm can be removed

Connection of Hose Package

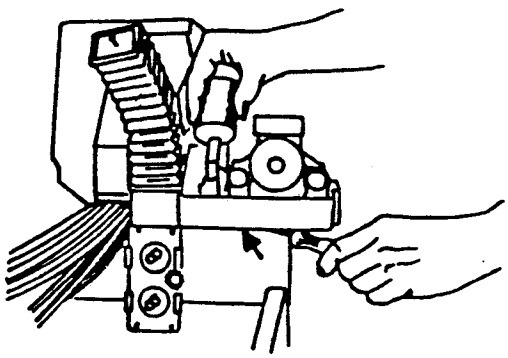
HOSE MANIFOLD ATL 3 (95305)
VIEWED FROM CHEMICAL DISTRIBUTOR



H = rear
V = front
W = water hose

10.8 Removal of Lift Motor

-Remove the back cover of the control head
-with the exception of the cover it is not necessary to remove any further parts for removal of the lift motor of lift gear.
- the lower screw of the 3 Philipp screws can be removed from below through the open side of the bearing block for the pump (see Illus.)
- remove all 3 screws without pressing the nuts on the inside of the bearing block out of their seat
- the wires must be removed from the connecting block to replace the motor. (see chapter 8).

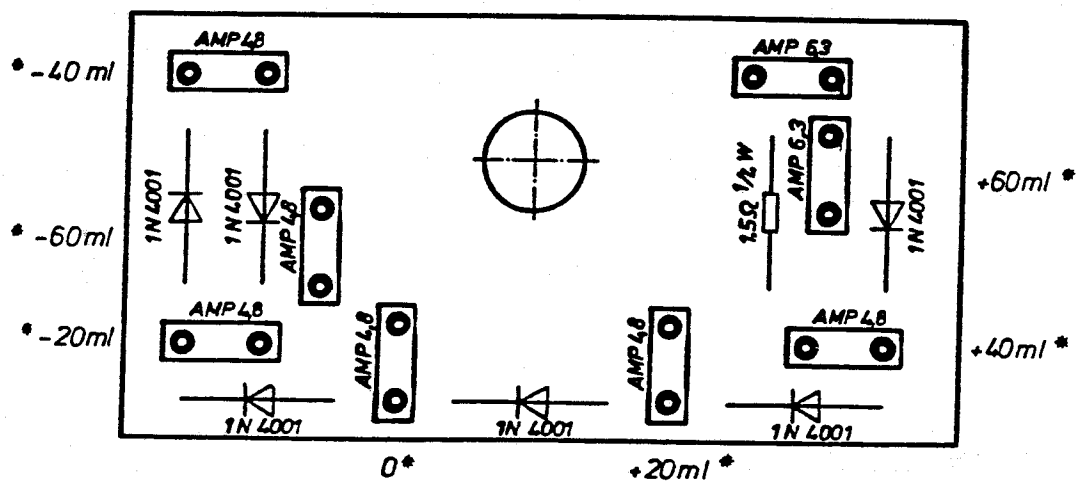


10.9 Replacing the Solenoid Valves (95218)

- cut off the metal clamps with a pair of pliers to pull off the hose
- to reinstall a new clamp must be used (included with solenoid valve)
- the solenoid valve (24 V) regulates the flow quantity and must not be replaced by any other type.

10.10 Fill Quantity Correction

If the Fill Quantity needs to be corrected, the AMP plug 4.8 can be switched to ± 60 ml proceeding from 0.



*Tested at 730ml fill quantity

Circuit board Nr.24032

94013
Diode-board ATL2,3

CHAPTER 11

ATL-3 LOWER UNIT

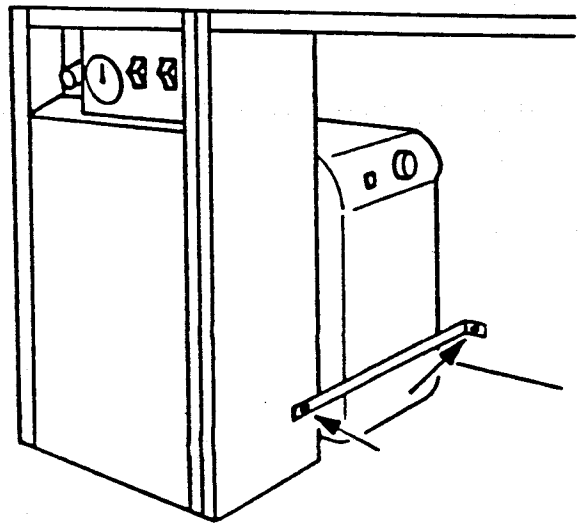
11.1 SERVICING HEATER (95309)

Removing the heater;

- remove chemical cart
- remove aluminum retaining strip in front of boiler
- unscrew right rear boiler mount
- unscrew water connections
- remove heater by lifting up slightly.

If the heater is operated without water, the cover for the safety temperature limiter must be pressed back in with a screwdriver after opening the cover.

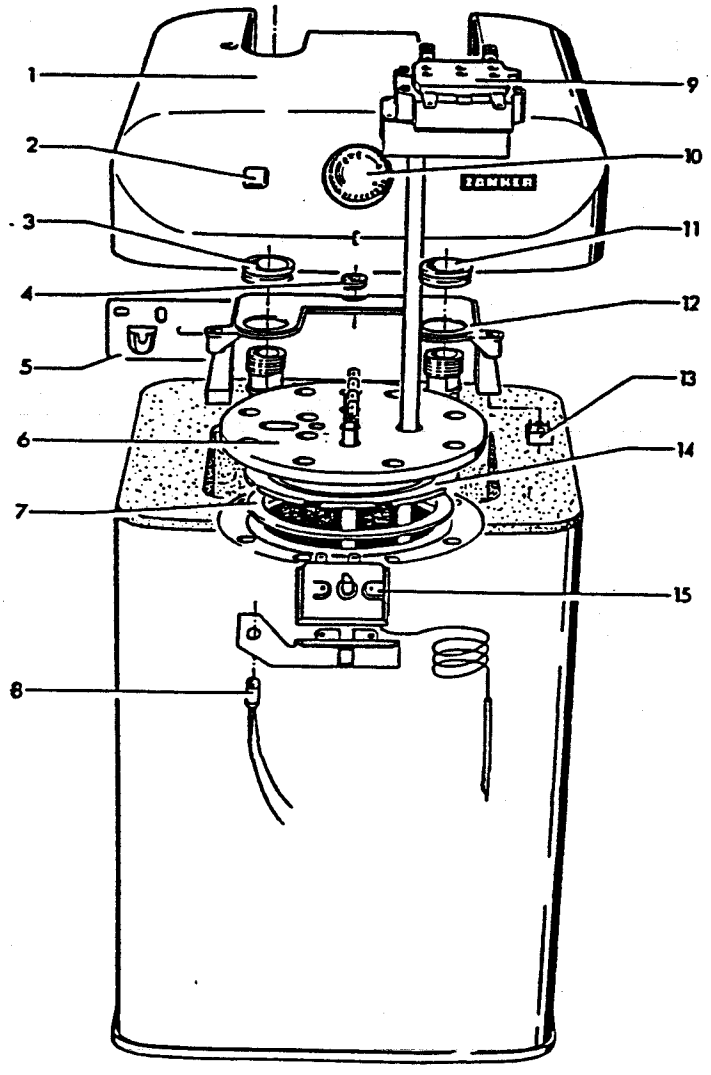
DIAGRAM



11.2 Part Designation

1	cover
2	lamp house
3	bushing, red
4	cable bushing 0 6/10/14
5	hanger
6	strengthening disc
7	gasket
8	pilot light
9	thermal cut-out
10	knob
11	bushing, blue
12	connection plate
13	insulating base
14	heating element 2 kw 220 V
15	thermostat

Exploded Drawing, Boiler (95309)



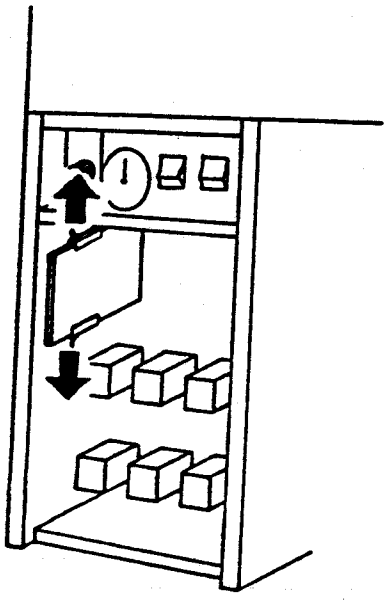
11.3 SERVICING CHEMICAL REFILLING PUMPS

Removal of Chemical Refilling Pumps
- Unplug Unit
- Disconnect main power cord from
- terminal block.
- remove 4 Philipps screws on mounting plate for chemical refilling unit (10085)
- The assembly plate can then be pulled out
- Remove chemical refilling pump mounting screws
- Pull off hose with aid of hose puller (07162)
- Pull off cable
- Remove pump

11.4 Removal of Chemical Refilling Circuit Board (94021)

- Open hinged door on ATL 3 lower cabinet (95348) by loosening top screw
- release upper and lower catches (35064) on circuit board mounting (35063).
- the circuit board is then free and can be pulled toward the front

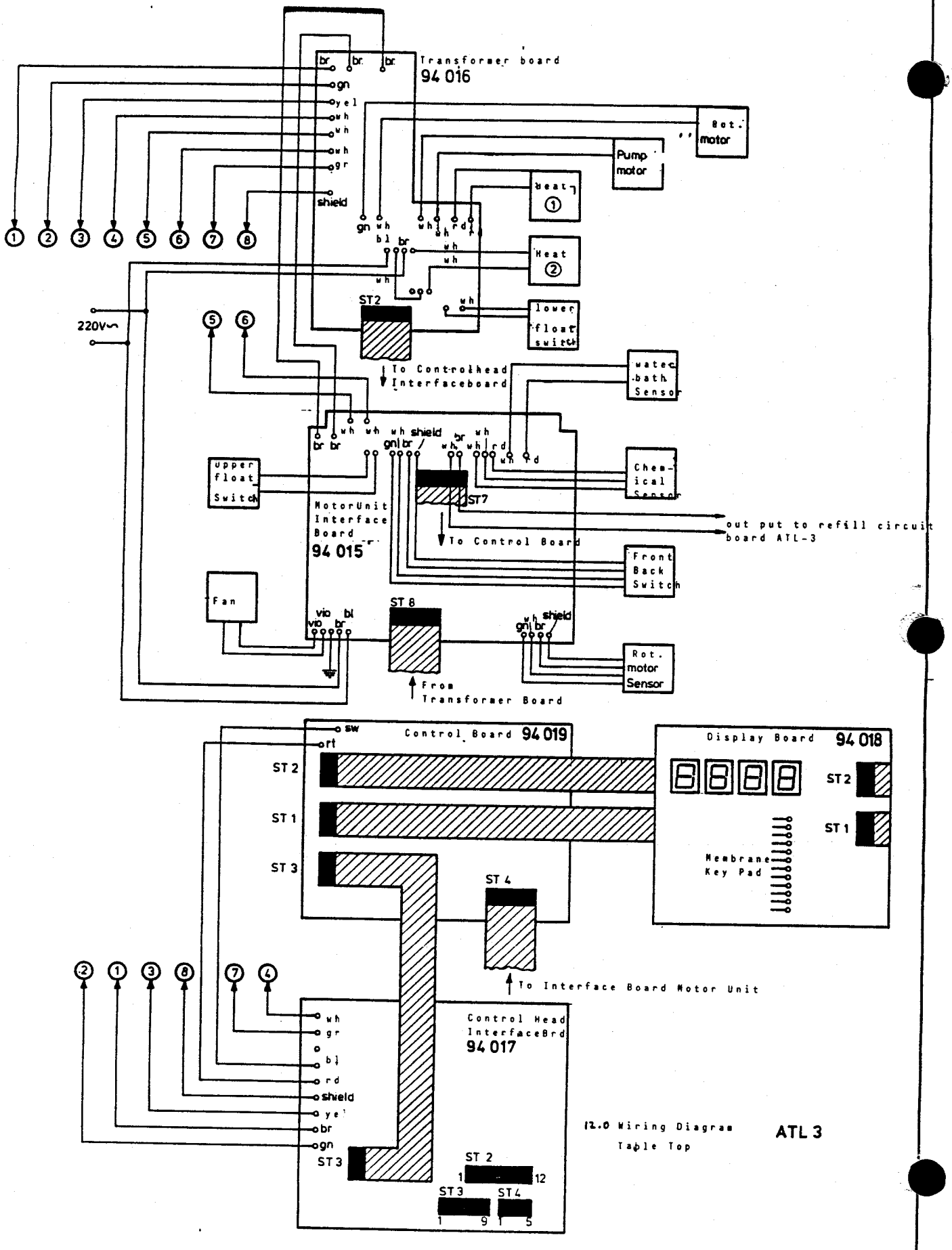
DIAGRAM



CHAPTER12

WIRING DIAGRAM

12.0 Wiring Diagram ATL 3 - Table Top


Transformer board
94 016
Rot. motor
Pump motor
Heat ①
Heat ②
lower float switch
ST2
220V~
To Control Head Interface board
water bath Sensor
upper float Switch
Motor Unit Interface Board
94 015
ST7
Chem-ical Sensor
out put to refill circuit board ATL-3
To Control Board
Front Back Switch
Fan
ST 8
Rot. motor Sensor
From Transformer Board
Control Board 94 019
Display Board 94 018
ST 1
ST 2
ST 3
ST 4
Membrane Key Pad
To Interface Board Motor Unit
Control Head InterfaceBrd
94 017
ST 2
ST 3
ST 4
12.0 Wiring Diagram
Table Top
ATL 3