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SECTION 2 HYDRAULICS AND MECHANICAL SYSTEM

2.1 HYDRAULIC SYSTEM BLOCK DIAGRAM

2.1.1 Block Diagram (Whole Blood Mode)

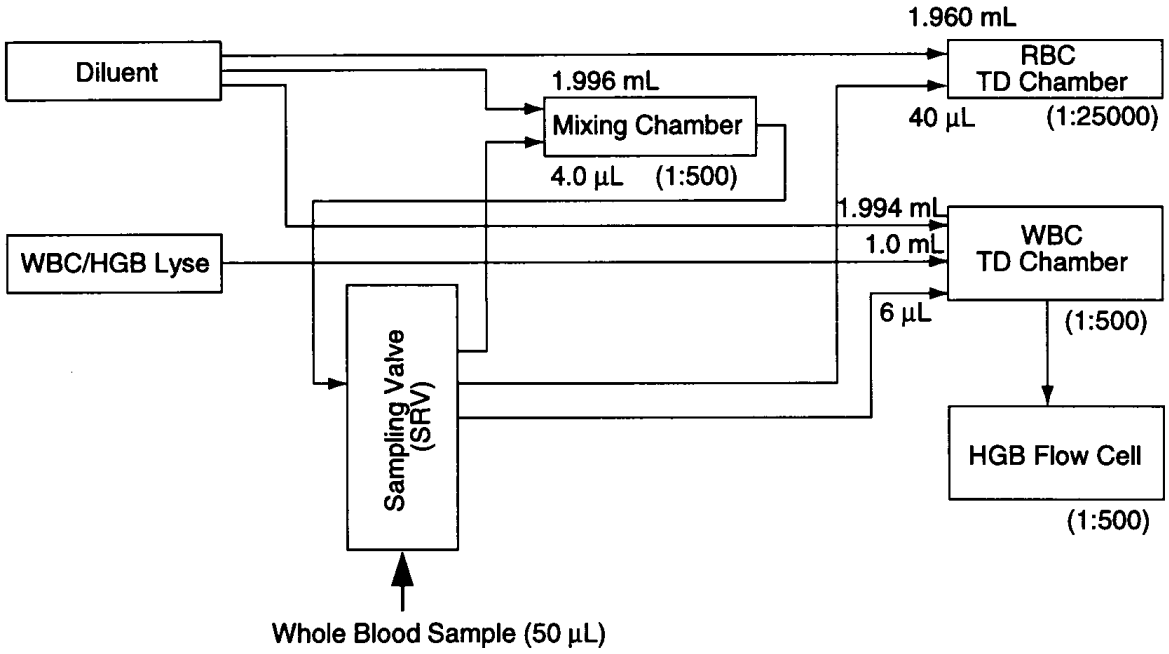


Figure 2-1: Whole Blood Mode Block Diagram

2.1.2 Block Diagram (Pre-diluted Mode)

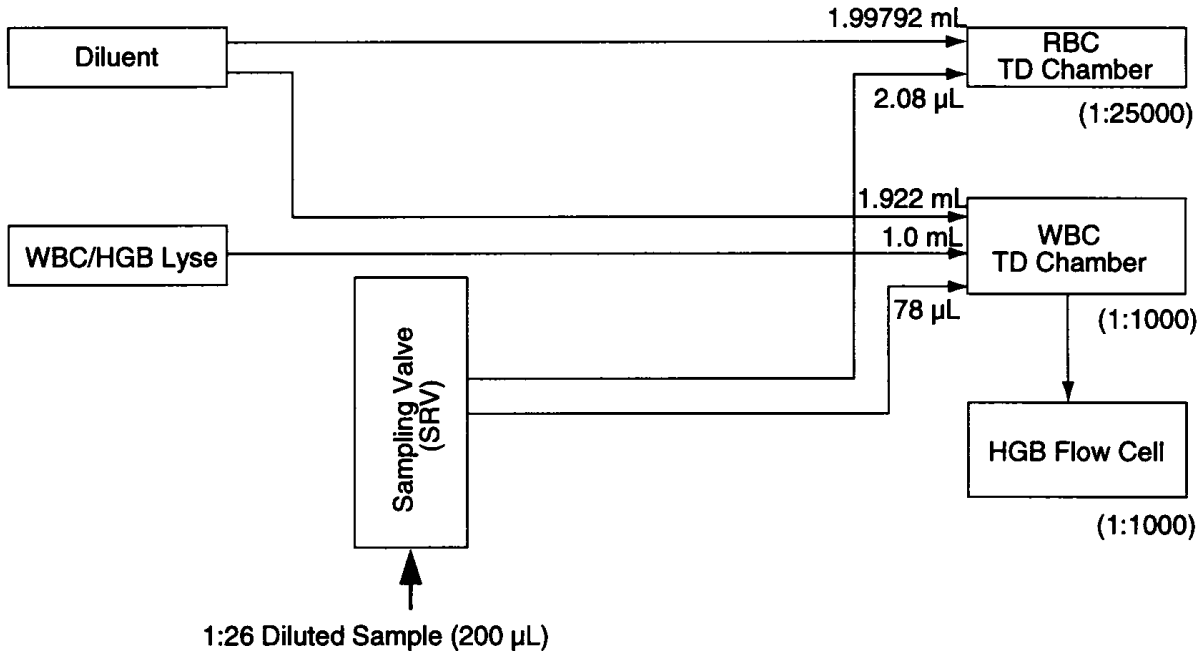


Figure 2-2: Pre-diluted Mode Block Diagram

2.2 ANALYSIS FLOW

2.2.1 WBC/HGB Analysis Flow

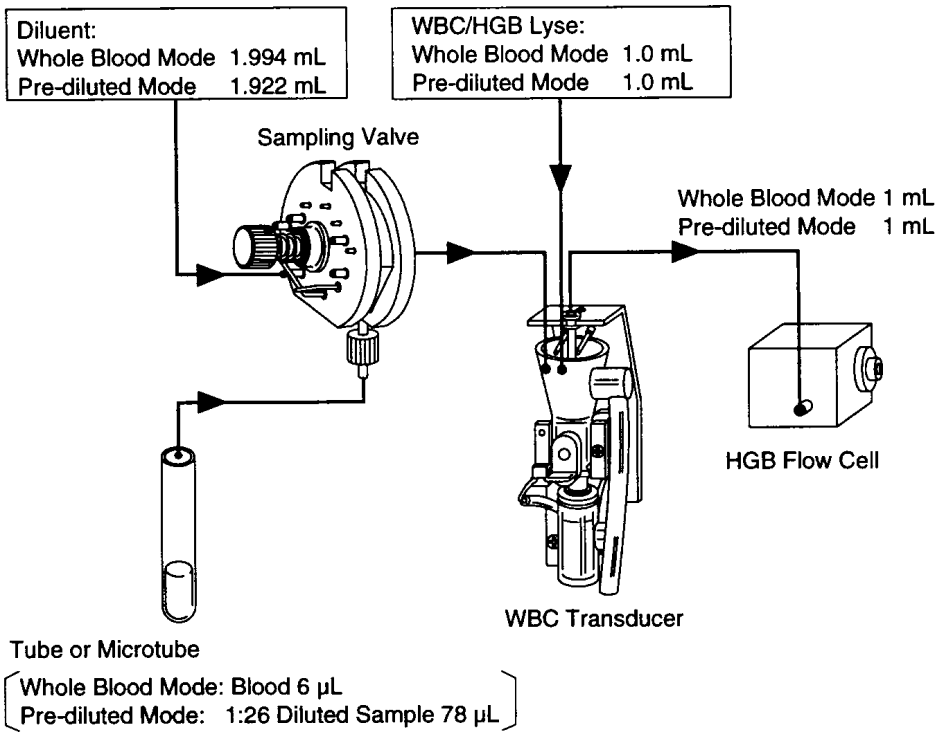


Figure 2-3: WBC/HGB Analysis Flow

2.2.2 RBC/PLT Analysis Flow

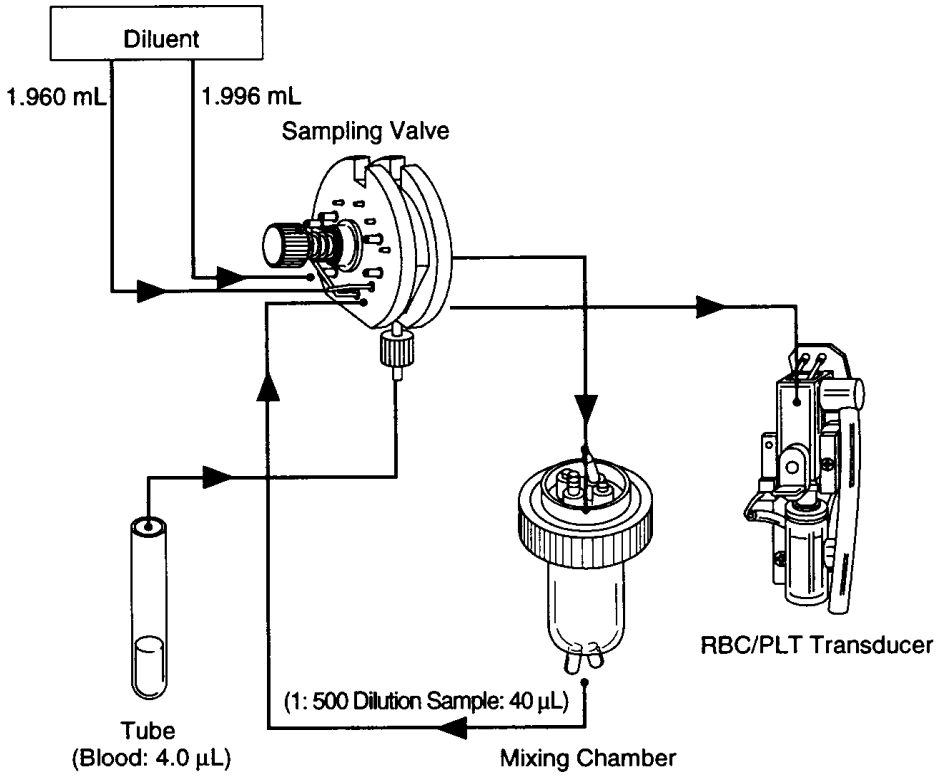


Figure 2-4: RBC/PLT Analysis Flow (Whole Blood Mode)

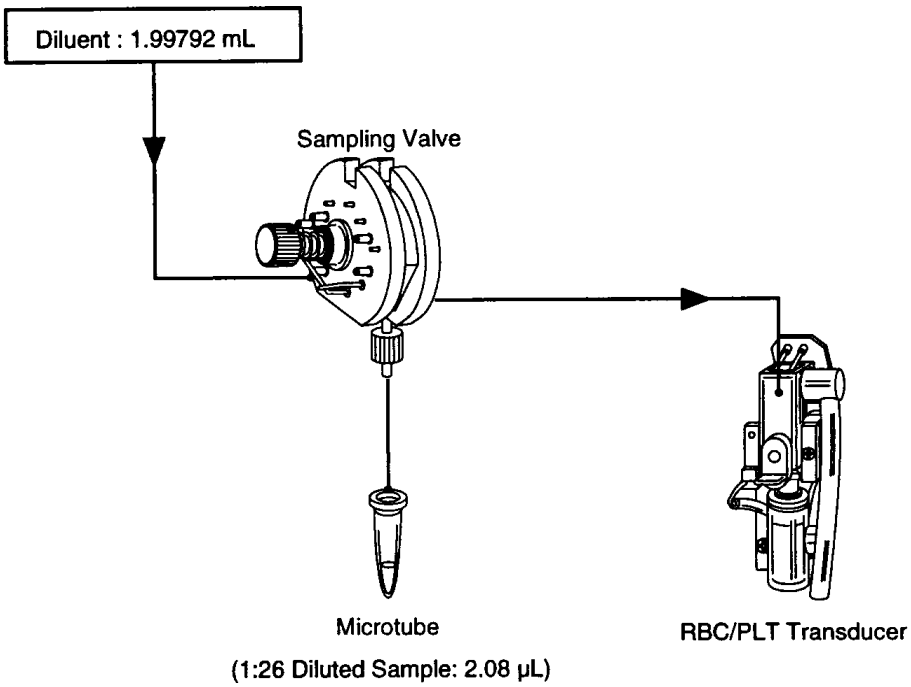


Figure 2-5: RBC/PLT Analysis Flow (Prep-diluted Mode)

2.3 SAMPLE FLOW IN SRV

2.3.1 Sample Path

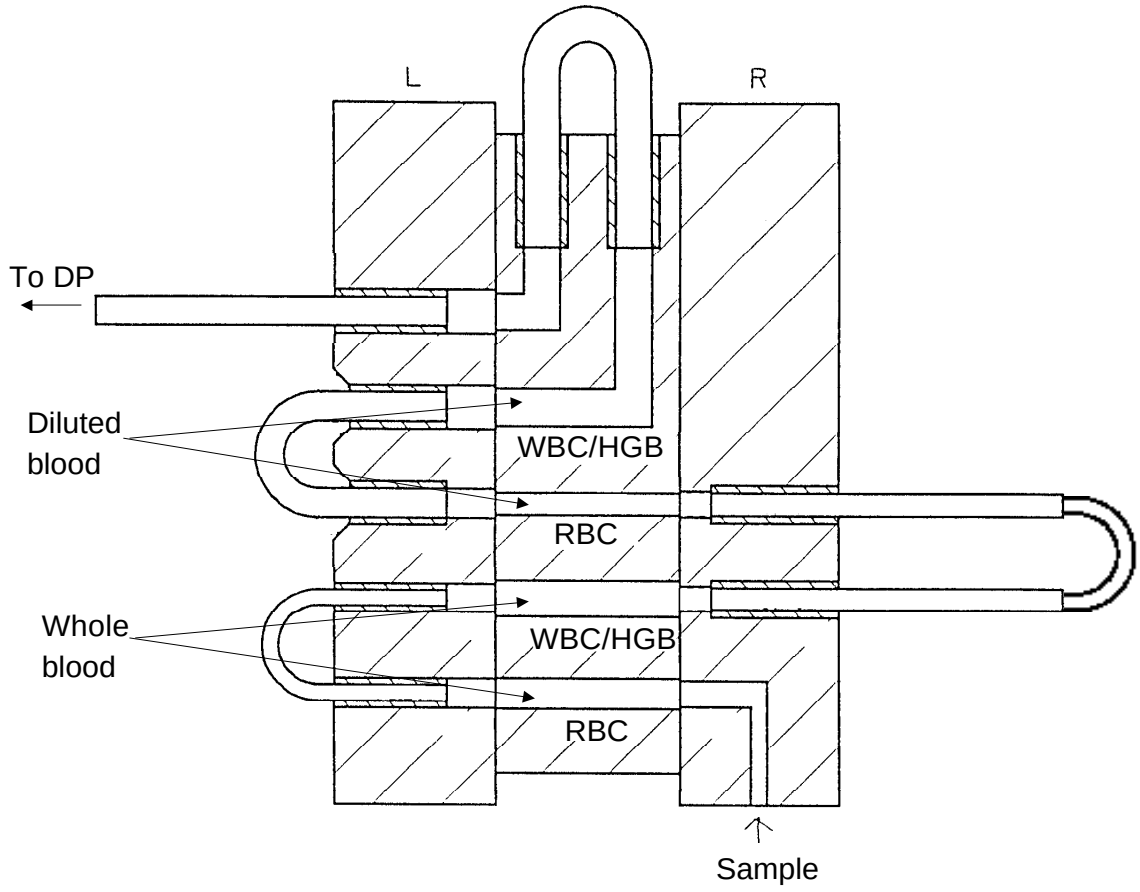


Figure 2-6: Sample Flow in SRV

2.3.2 Sample Path (Whole Blood Mode)

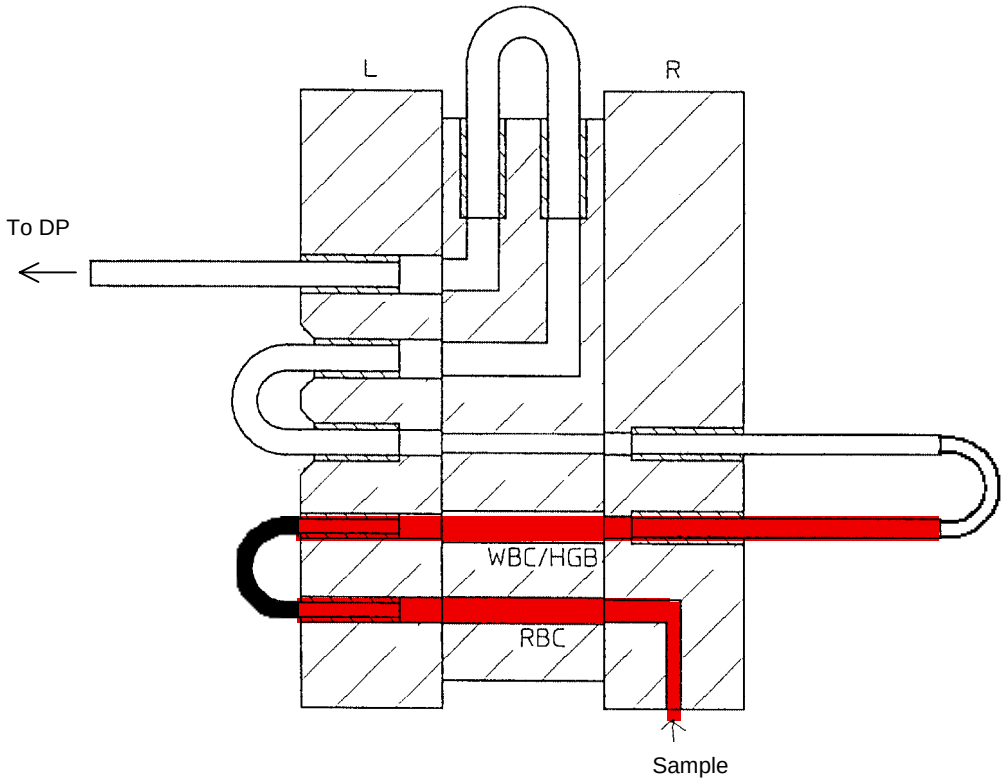


Figure 2-7: Sample Flow in SRV (Whole Blood Mode)

2.3.3 Sample Path (Pre-diluted Mode)

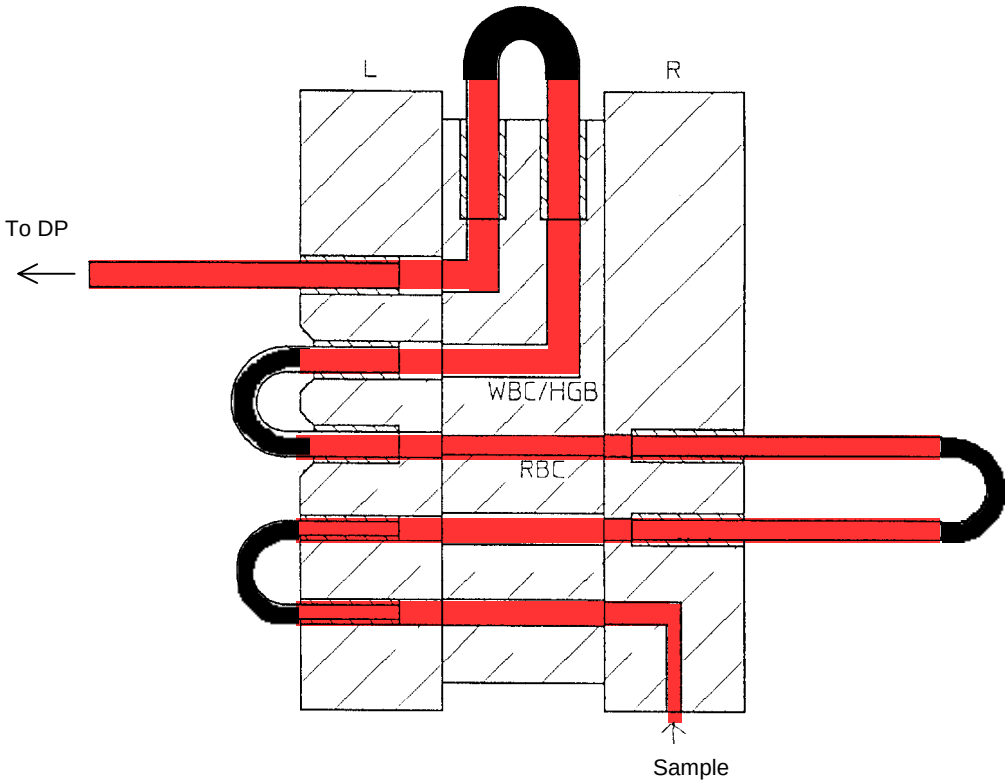


Figure 2-8: Sample Flow in SRV (Pre-diluted Mode)

2.4 SOLENOID VALVE LOCATION

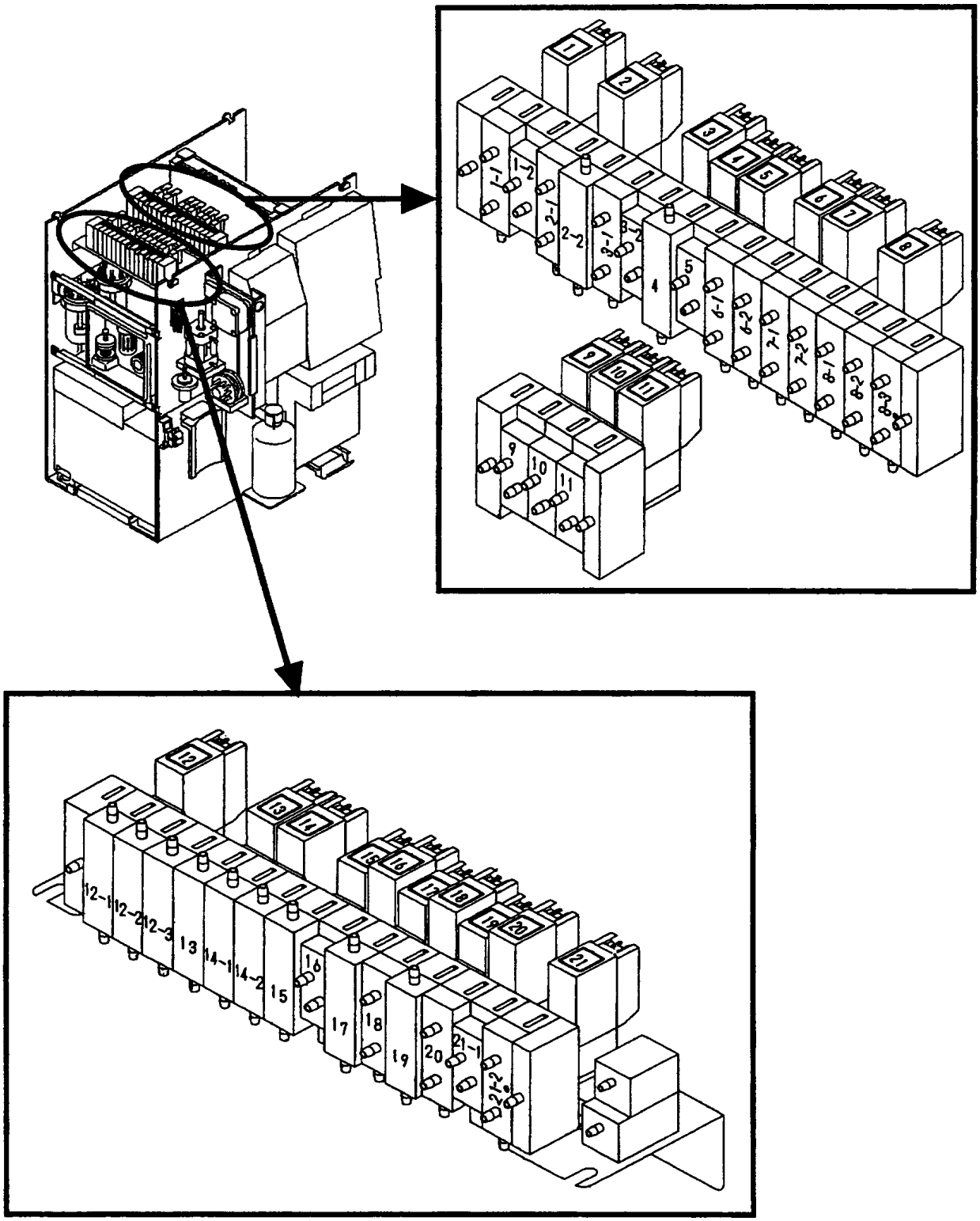


Figure 2-9: Valve Location

2.4.1 Valve Unit Tubing Connections

(1) KX-21 Valve Unit A

MV No.	Function	MV No.	Function
1-1	Waste drain, switch pressure/vacuum	6-1	RBC diluent DP fill/dispense switch
1-2	Waste drain, drive Pinch Valve	6-2	RBC diluent DP drive
2-1	Diluent fill, switch pressure/vacuum	7-1	RBC diluent line switch
2-2	Diluent fill, connect diluent line	7-2	WBC/Hgb diluent line switch
3-1	Diluent chamber pressure cut	8-1	WBC/Hgb diluent DP/lyse DP drive
3-2	Rinse cup drain, drive Pinch Valve	8-2	WBC/Hgb diluent DP switch
4	STR-WH (lyse) dispense control	8-3	WBC/Hgb lyse DP switch
5	Fill Detector Block Master Valve Assy		

< Valve Unit A-1 >

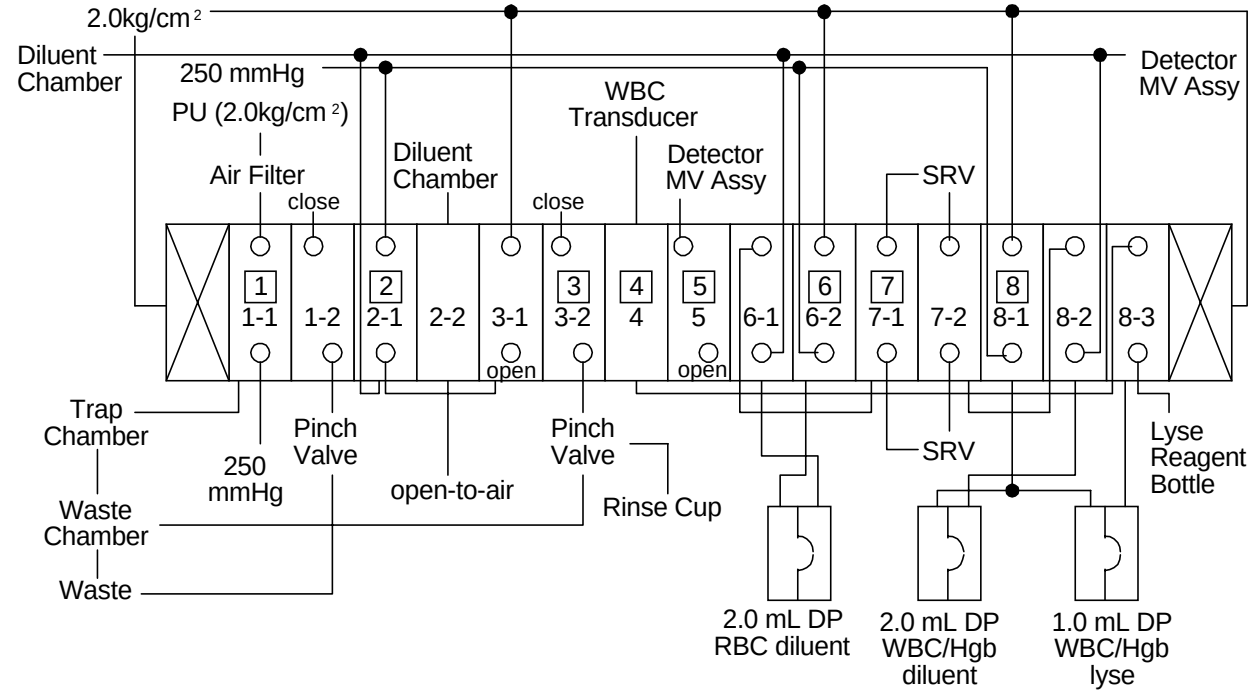


Figure 2-10: Valve Unit A-1 Tubing

< Valve Unit A-2 >

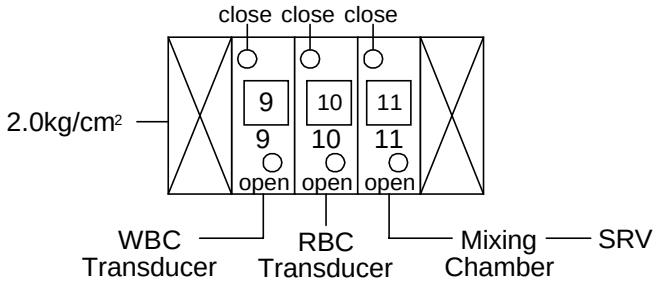


Figure 2-11: Valve Unit A-2 Tubing

(3) KX-21 Valve Unit B

MV No.	Function	MV No.	Function
12-1	Fill Rinse Cup	16	SRV rotation
12-2	SRV vacuum cut	17	RBC charging
12-3	SRV outer rinse	18	PD mode sample aspiration DP drive
13	Mixing Chamber drain	19	Supply rinse into sample aspiration line
14-1	RBC Transducer drain	20	WB mode sample aspiration DP drive
14-2	WBC Transducer drain	21-1	Air gap generation
15	Hgb Flow Cell drain	21-2	Detector DP drive for counting

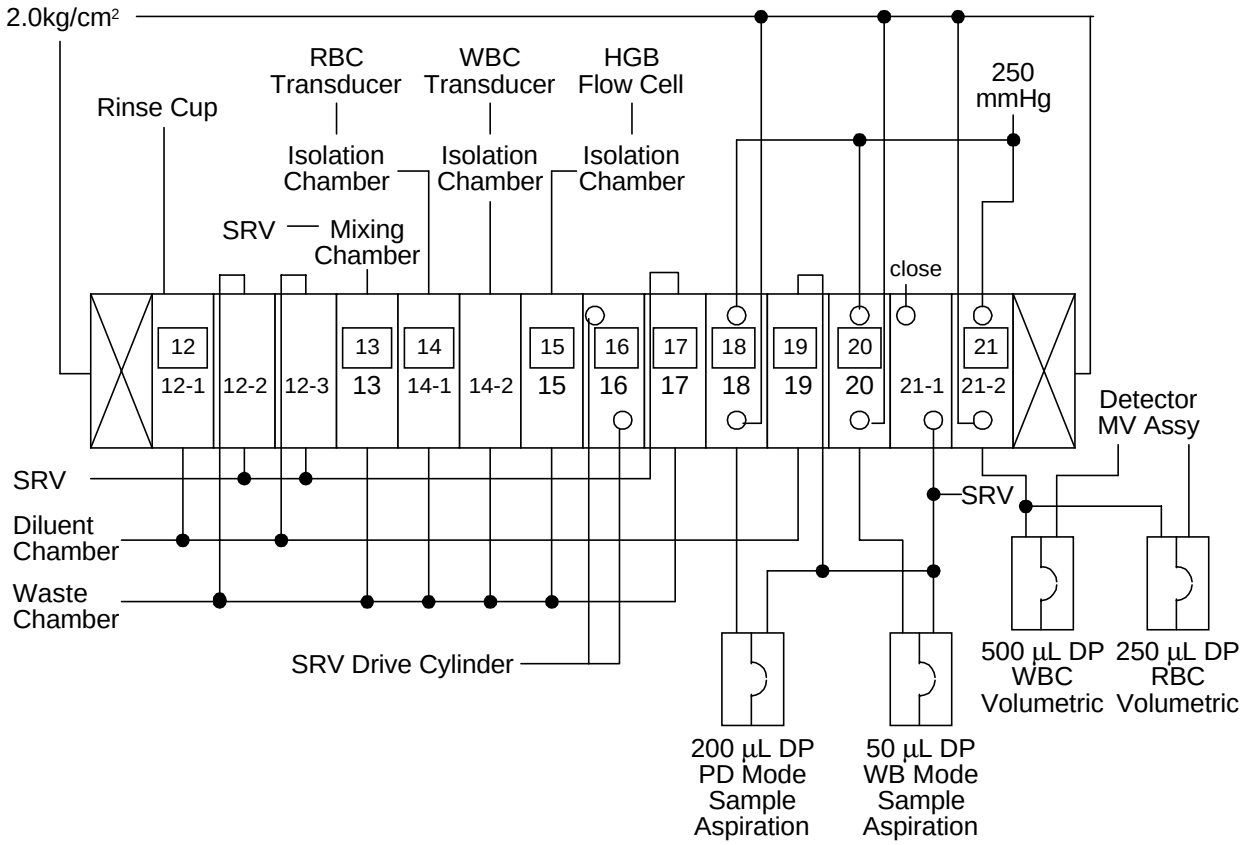
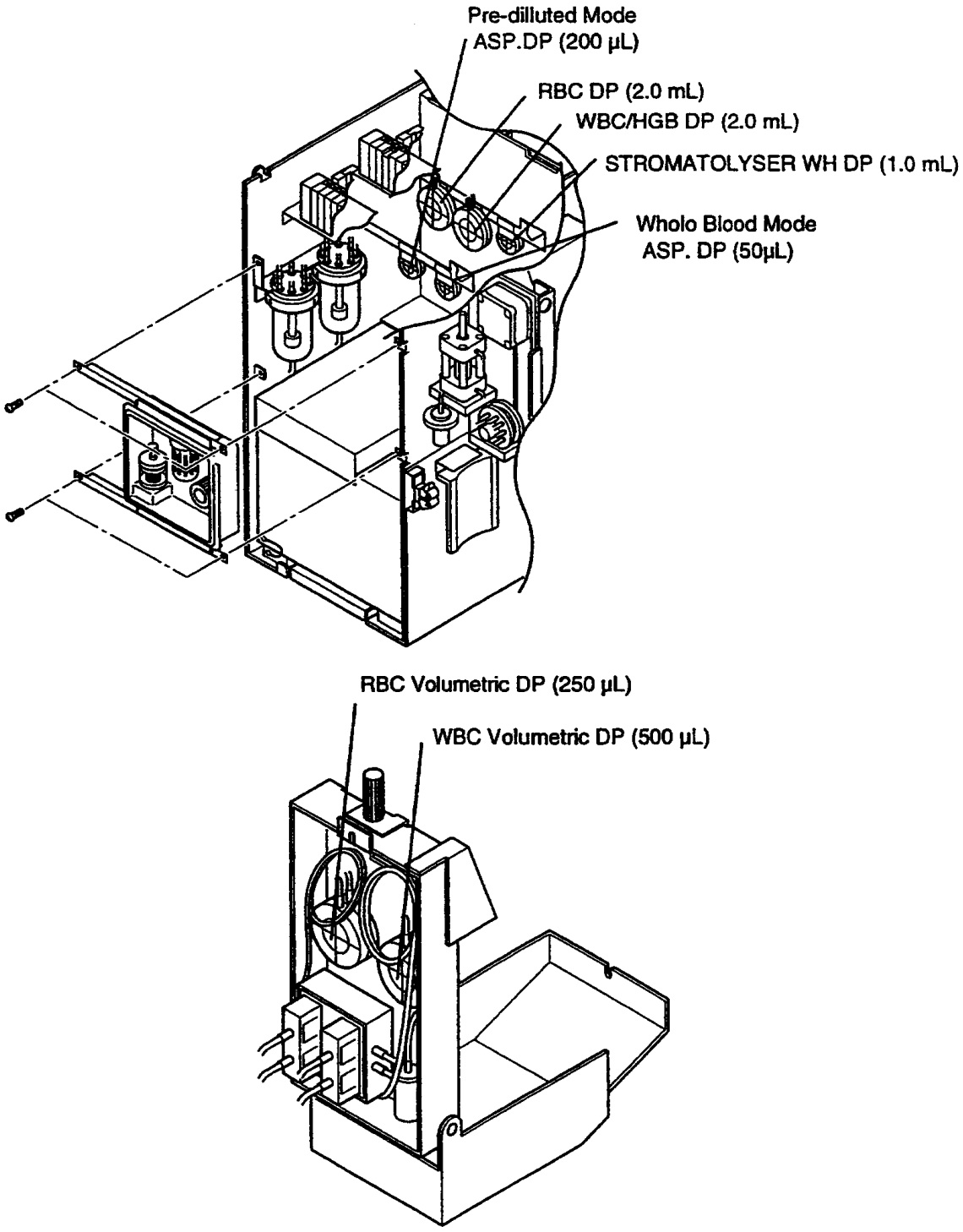


Figure 2-12: Valve Unit B Tubing

2.5 DIAPHRAGM PUMP LOCATION



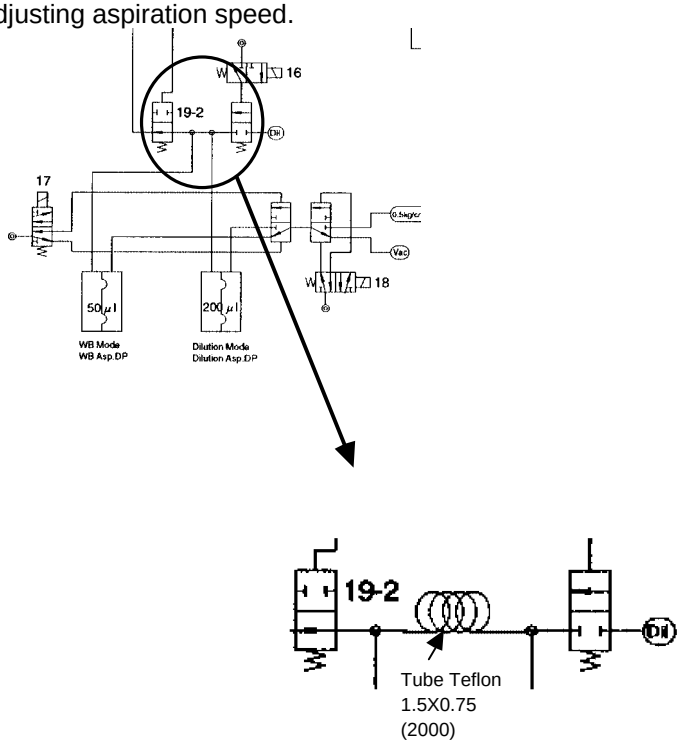
A **Figure 2-13:** Diaphragm Pump Location

2.6 PNEUMATIC SYSTEM

Pressure is only monitored for 0.5 kg/cm^2. (2.2 Kg/cm^2 is not monitored.)
Vacuum is only monitored for 250 mmHg. (Vacuum source is not monitored.)

2.6.1 Sample Aspiration System

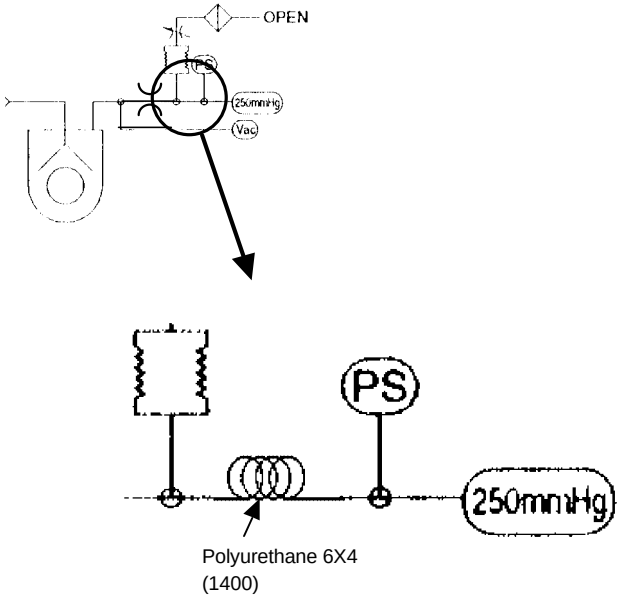
Aspiration speed is adjusted to Whole Blood mode. Tube Teflon is inserted between Whole Blood DP and Diluted Blood DP for adjusting aspiration speed.



A **Figure 2-14:** Sample Aspiration System

2.6.2 Vacuum System

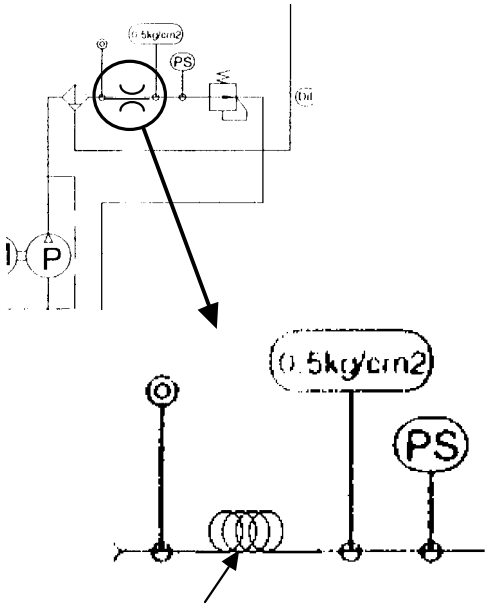
KX-21 has no tank for Vacuum system therefore Polyurethane tubing is inserted between bellows and pressure switch for stabilizing the vacuum.



A **Figure 2-15:** Vacuum System

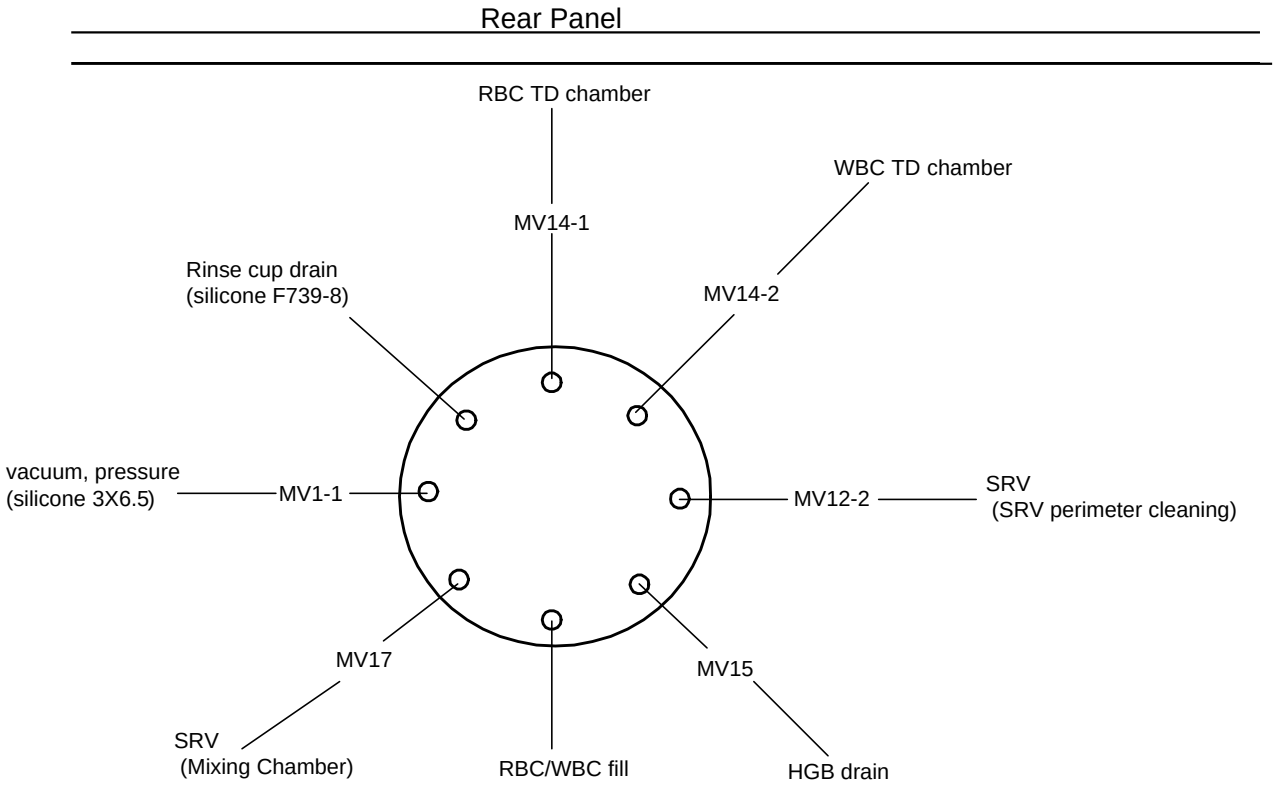
2.6.3 Pressure System

KX-21 has no tank for pressure system therefore Teflon tubing is inserted between compressor and 0.5 kg/cm^2 regulator for stabilizing the pressure.



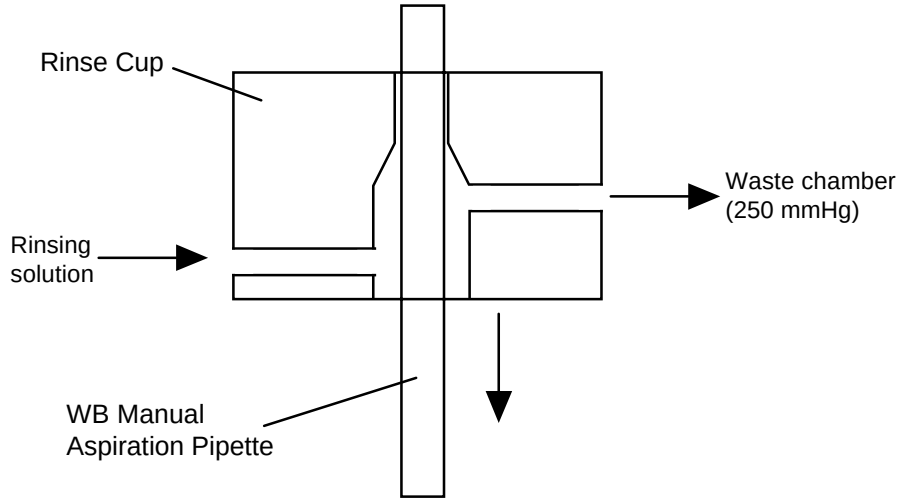
A **Figure 2-16:** Pressure System

2.7 WASTE CHAMBER TUBING



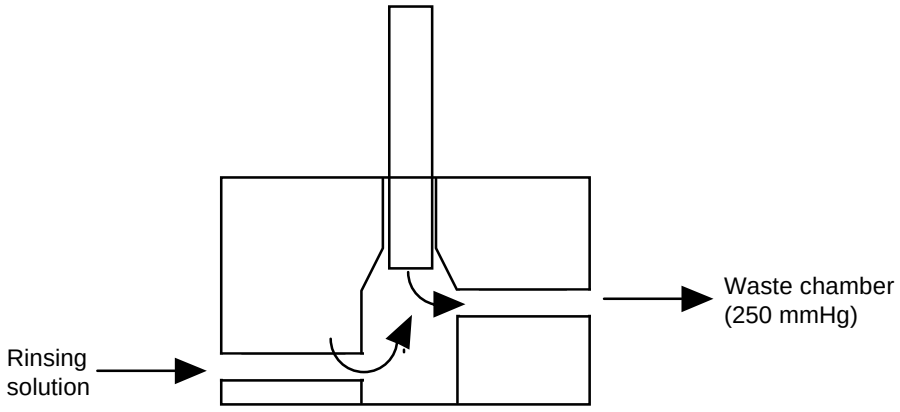
A **Figure 2-17:** Waste Chamber Tubing

2.8 RINSE CUP



A **Figure 2-18:** Rinsing Pipette Exterior

Rinsing solution is injected while the rinse cup is going down and any blood adhering to the pipette exterior is aspirated into the waste chamber.

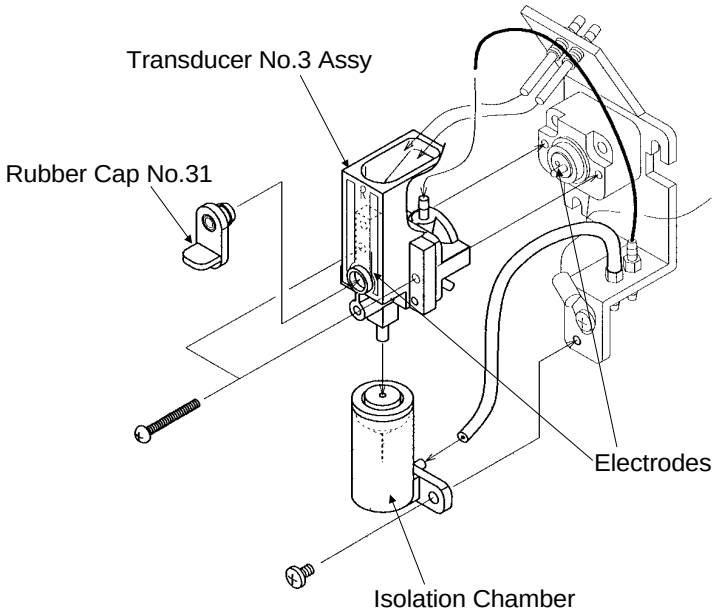


A **Figure 2-19:** Rinsing WB Line

To clean the whole blood line, rinsing solution (containing whole blood) is discharged from the pipette tip and aspirated into the waste chamber when the rinse cup reaches the lower end point. When the rinse cup goes up, rinsing solution will not be discharged nor aspirated into the pipette.

2.9 RBC DETECTOR UNIT

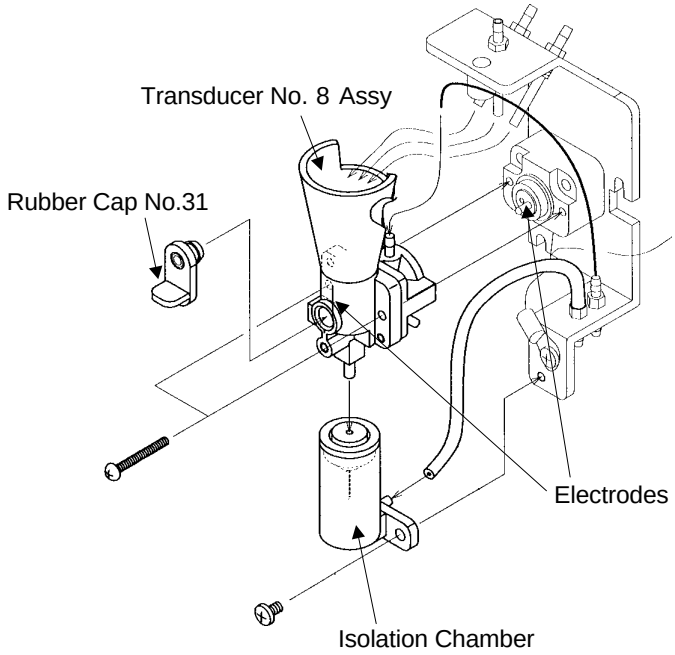
A Aperture size: 75 µm



A **Figure 2-20:** RBC Detector Unit

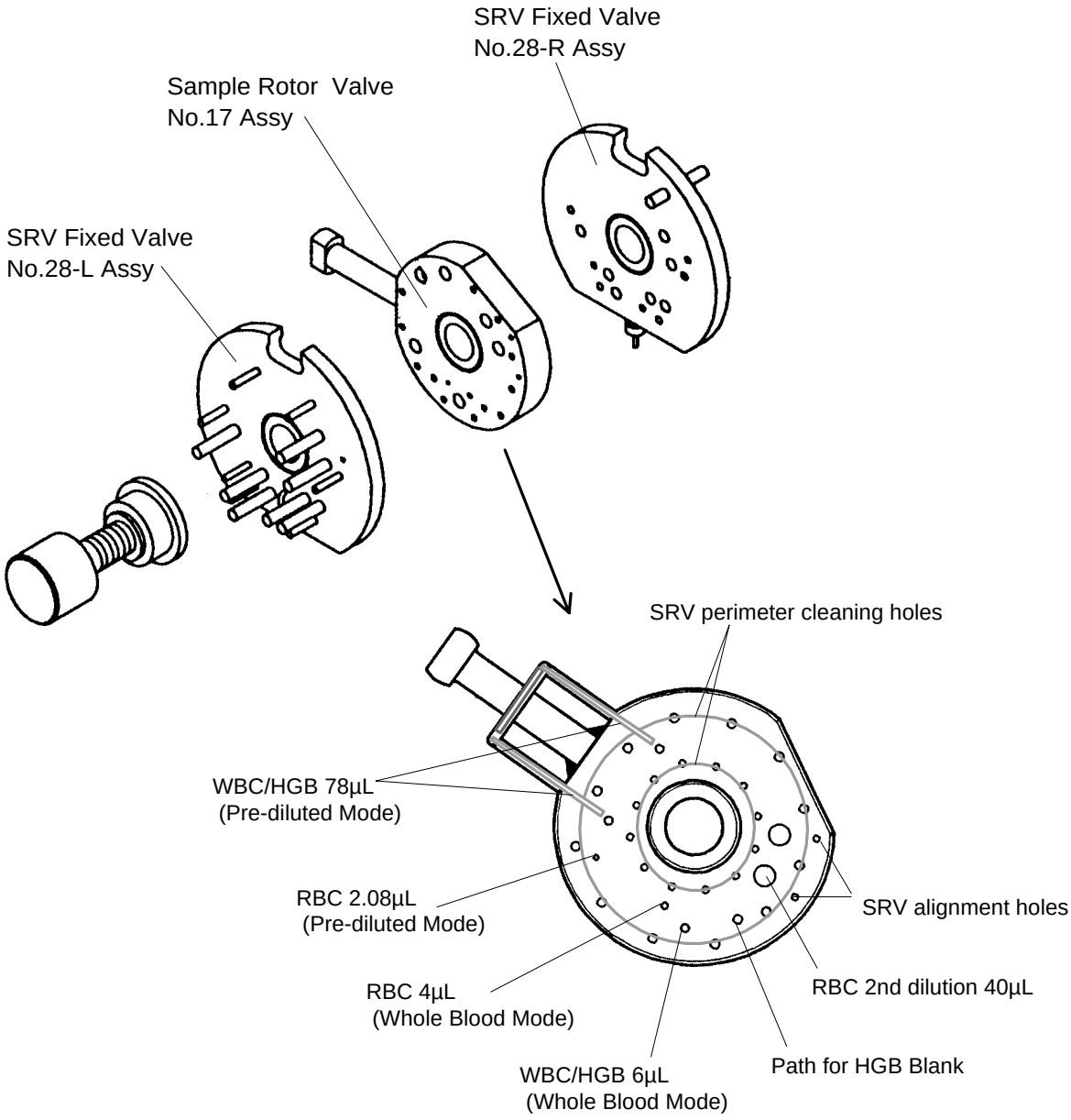
2.10 WBC DETECTOR UNIT

A Aperture size: 100 µm



A **Figure 2-21:** WBC Detector Unit

2.11 SRV UNIT



A **Figure 2-22:** SRV Unit

2.12 HYDRAULIC FLOW DESCRIPTION

Many solenoid valves inside instrument control every operation on KX-21. The solenoid valve positions are shown in Hydraulic Diagram.

2.12.1 Whole Blood Mode

The following is the analysis flow in KX-21 Whole Blood Mode described in detail in accordance with Timing Charts in *Section 7*.

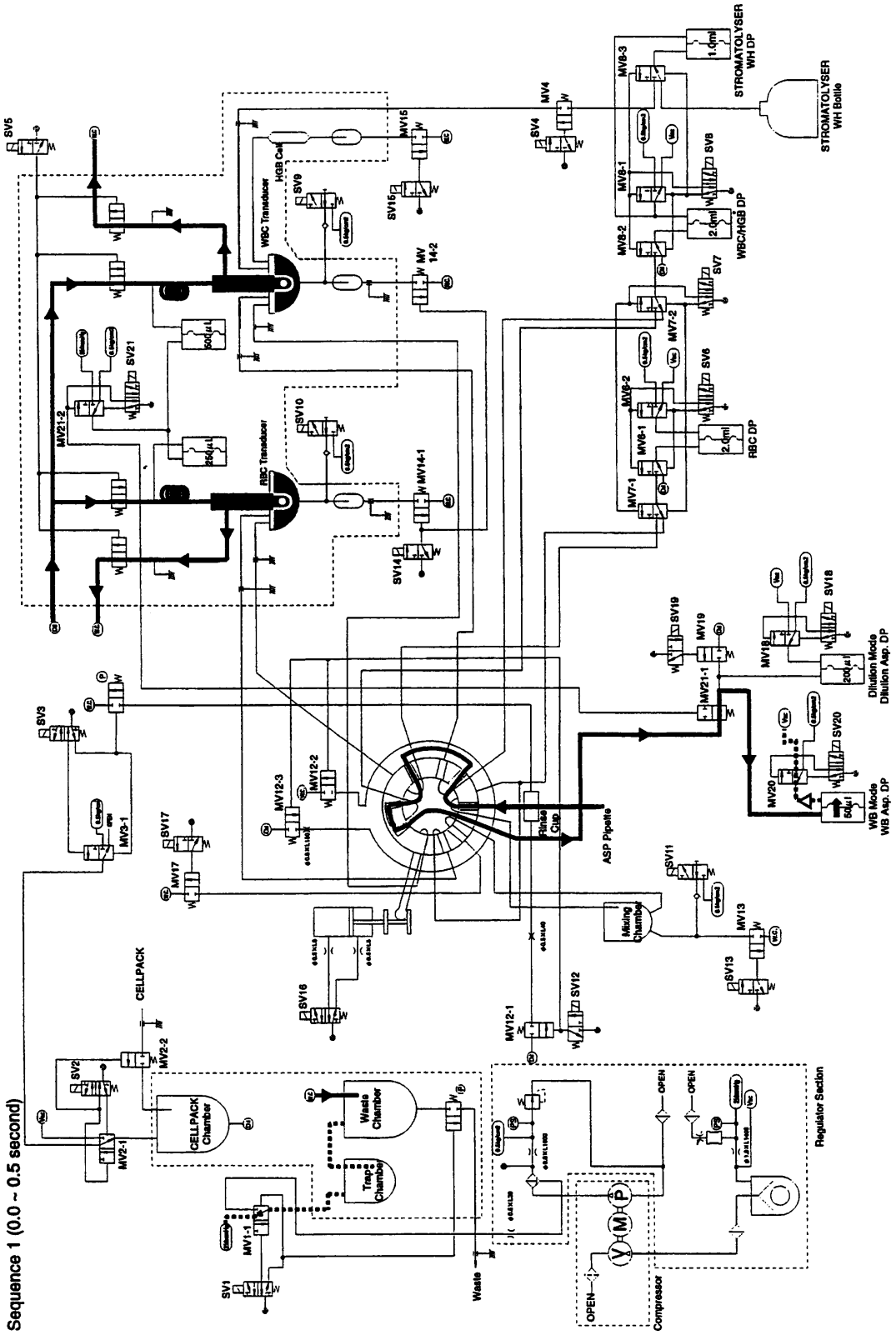
Sequence 1 (0.0 - 0.5 sec.)

(1) Sample Aspiration

Pressing Start Switch activates SV20, applies vacuum on DP (Diaphragm Pump), and then aspirates 50 µL of sample blood through Aspiration Pipette. The aspirated sample passes through SRV (Sample Roter Valve) and waits for the volumetric dispensing afterward. SV20 is operating between 0.0 sec. and 19.5 sec. of Sequence 1.

(2) Air Bubble Removal in WBC/RBC TD (Transducer)

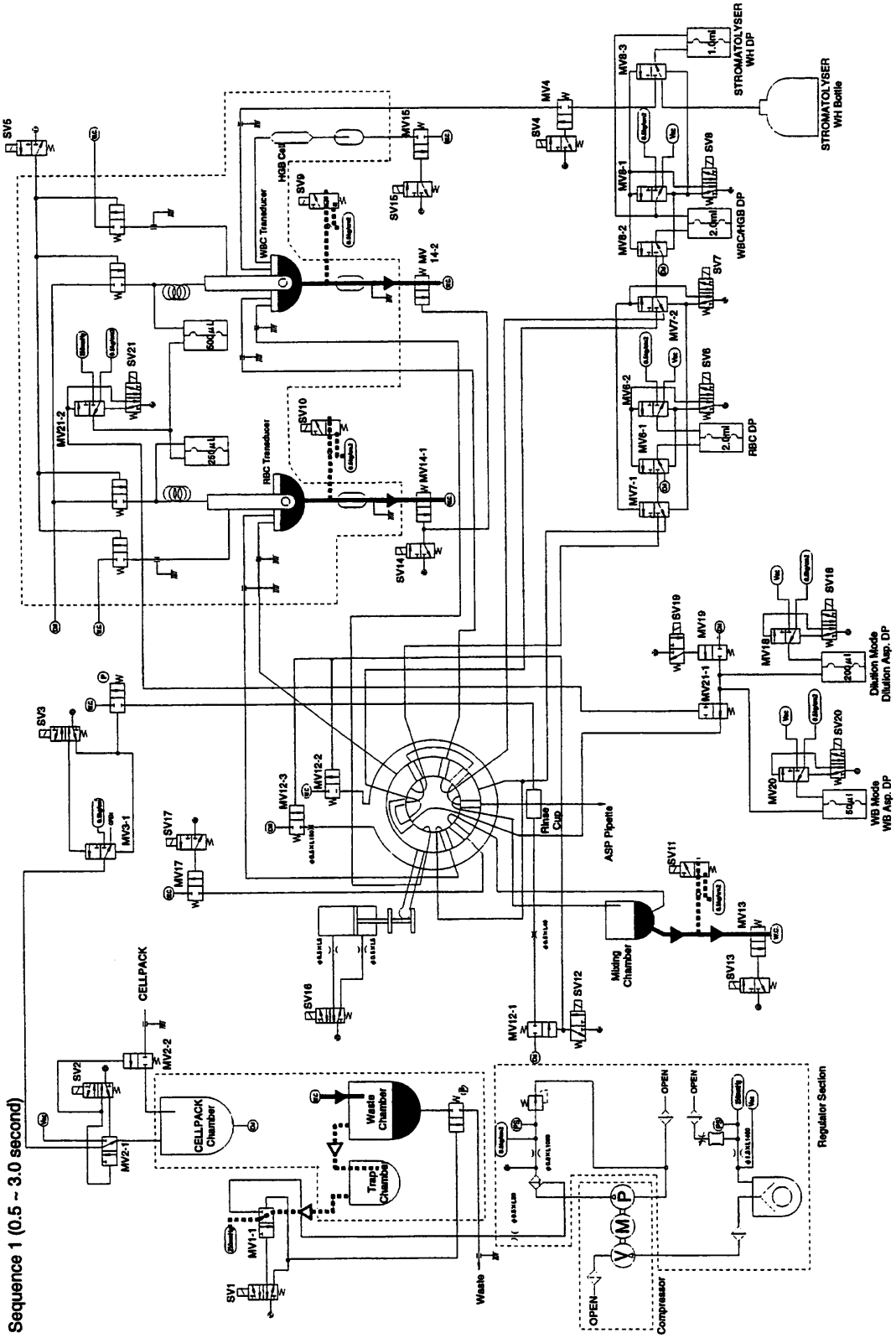
During Sequence 1 operation, between 0.0 sec. and 0.5 sec., SV5 is activated to apply vacuum on Waste Chamber and fill the diluent in WBC/RBC TD. This operation enables the air bubble remained around the aperture in the previous sequence to be removed.


Sequence 1 (0.0 ~ 0.5 second)
SV5
MV4
SV4
MV15
SV16
SV9
HGB Cell
WBC Transducer
MV 14-2
MV8-3
1.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV8
2.0ml
WBC/HGB DP
MV8-2
SV7
MV7-2
SV21
MV21-2
50μl
SV10
RBC Transducer
MV14-1
SV14
SV6
2.0ml
RBC DP
MV7-1
SV19
MV19
MV21-1
MV18
SV18
200μl
Dilution Mode
Dilution Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV20
MV20
50μl
WB Mode
WB Asp. DP
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 1 (0.5 - 3.0 sec.)

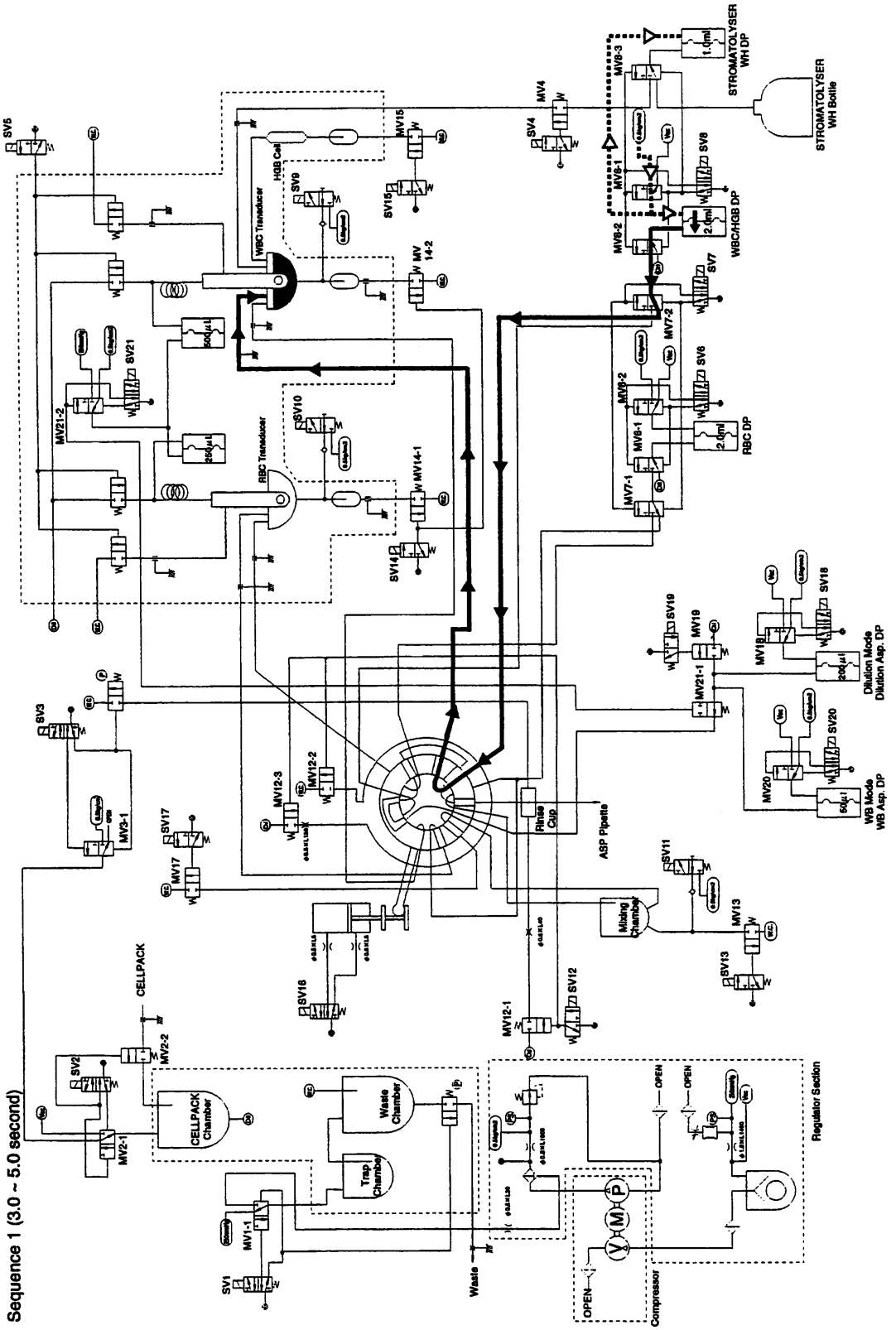
(1) Draining Mixing Chamber
SV13 is activated at the timing of 0.7 sec. to open MV13, which connects Mixing Chamber Draining line and Waste Chamber. As 250 mmHg vacuum is applied on Waste Chamber, the liquid in Mixing Chamber flows into Waste Chamber and is drained finally. This operation continues between 0.7 sec. and 3.0 sec.
In order to remove the remained liquid in Air Bubble Mixing line (between Non-Return Valve and T-Joint), SV11 operates 4 times (with 0.2 sec. interval) with high speed. Once SV is activated, it operates 3 times continuously to avoid Air Bubble Mixing line to be contaminated by the waste.

(2) Draining WBC/RBC TD Chamber
At the timing of 0.7 sec., SV14 is activated to open MV14-1 and MV14-2, which connects Draining line of WBC/RBC TD Chamber and Waste Chamber. As 250 mmHg vacuum is applied on Waste Chamber, the liquid in TD Chamber flows into Waste Chamber and is drained finally. This operation continues between 0.7 sec. and 3.0 sec.
In order to remove the remained liquid in Air Bubble Mixing line (between Non-Return Valve and T-Joint), SV11 operates 4 times (with 0.2 sec. interval) with high speed. Once SV is activated, it operates 3 times continuously to avoid Air Bubble Mixing line to be contaminated by the waste. SV9 operates twice continuously between 1.2 sec. and 1.6 sec. to avoid Air Bubble Mixing line to be contaminated by the waste.


Sequence 1 (0.5 ~ 3.0 second)
SV5
MV4
SV4
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-1
MV8-2
SV8
WBC/HGB DP
SV7
MV7-2
MV7-1
MV6-2
MV6-1
SV6
RBC DP
WBC Transducer
HGB Cell
SV9
MV15
SV15
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
SV19
MV19
MV21-1
SV18
MV18
Dilution Mode
Dilution Asp. DP
SV20
MV20
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
Compressor
Regulator Section

Sequence 1 (3.0 - 5.0 sec.)

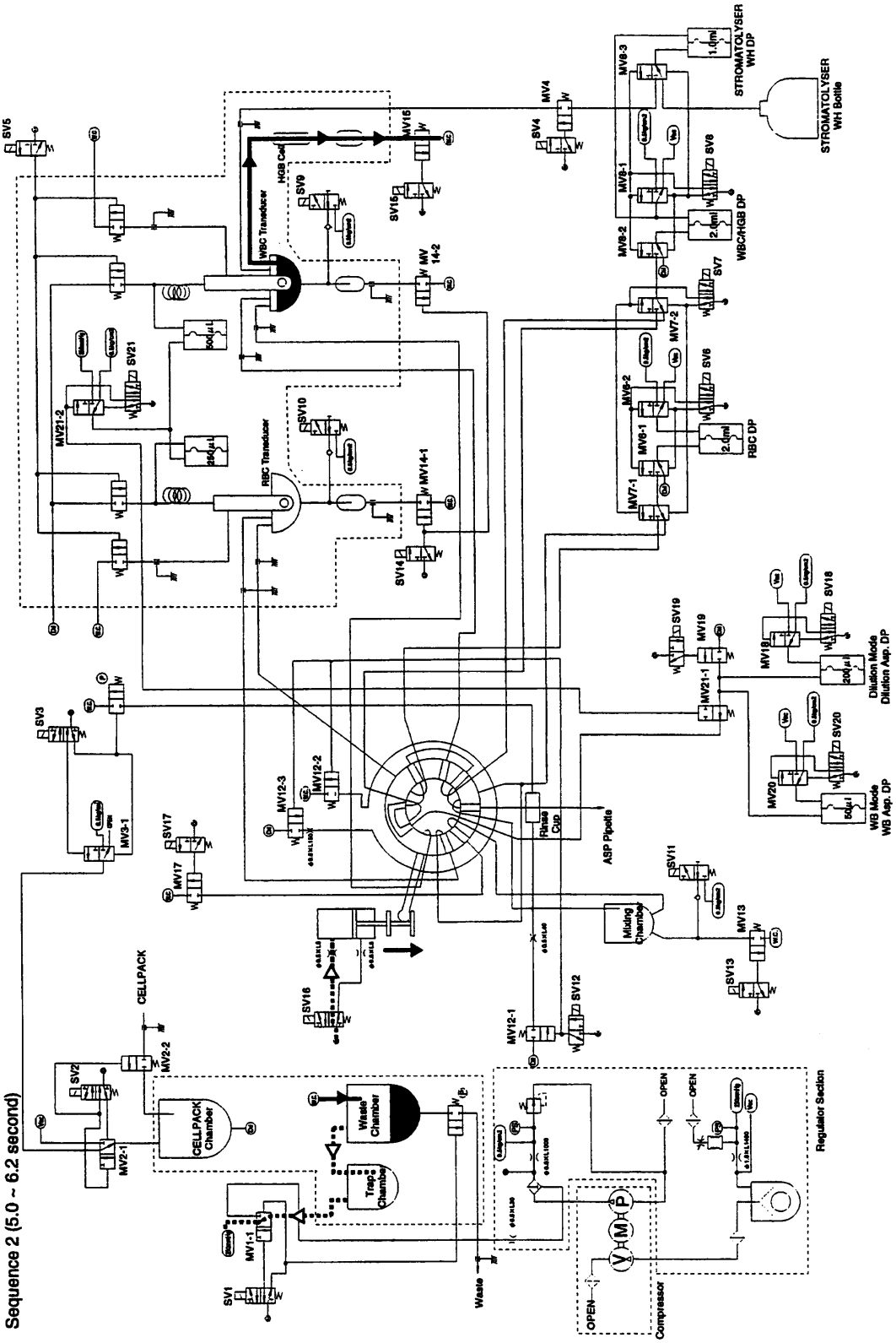
(1) Dispensing Diluent into WBC TD Chamber
At the timing of 3.0 sec., SV8 is activated to make WBC/HGB DP dispense 2.0 mL of diluent into WBC TD Chamber through SRV.


Sequence 1 (3.0 ~ 5.0 second)
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
Dilution Mode Dilution Asp. DP
WB Mode WB Asp. DP
Rinse Cup
ASP Pipette
Mixing Chamber
CELLPACK
CELLPACK Chamber
Waste Chamber
Trap Chamber
Waste
Compressor
Regulator Section
OPEN
WBC Transducer
RBC Transducer
HGB Cell

Sequence 2 (5.0 - 6.2 sec.)

(1) Dispensing Sample (SRV Rotation)
SV16 is activated at the timing of 5.0 sec. to drive the piston controlling the SRV rotation. SRV rotates in CCW direction (seeing from the left side of the instrument). This rotation enables 4 µL of sample to be dispensed for RBC parameter analysis, and 6 µL for WBC/HGB. The dispensed sample blood remains each Dilution line. SRV keeps this position until the timing of 14.5 sec.

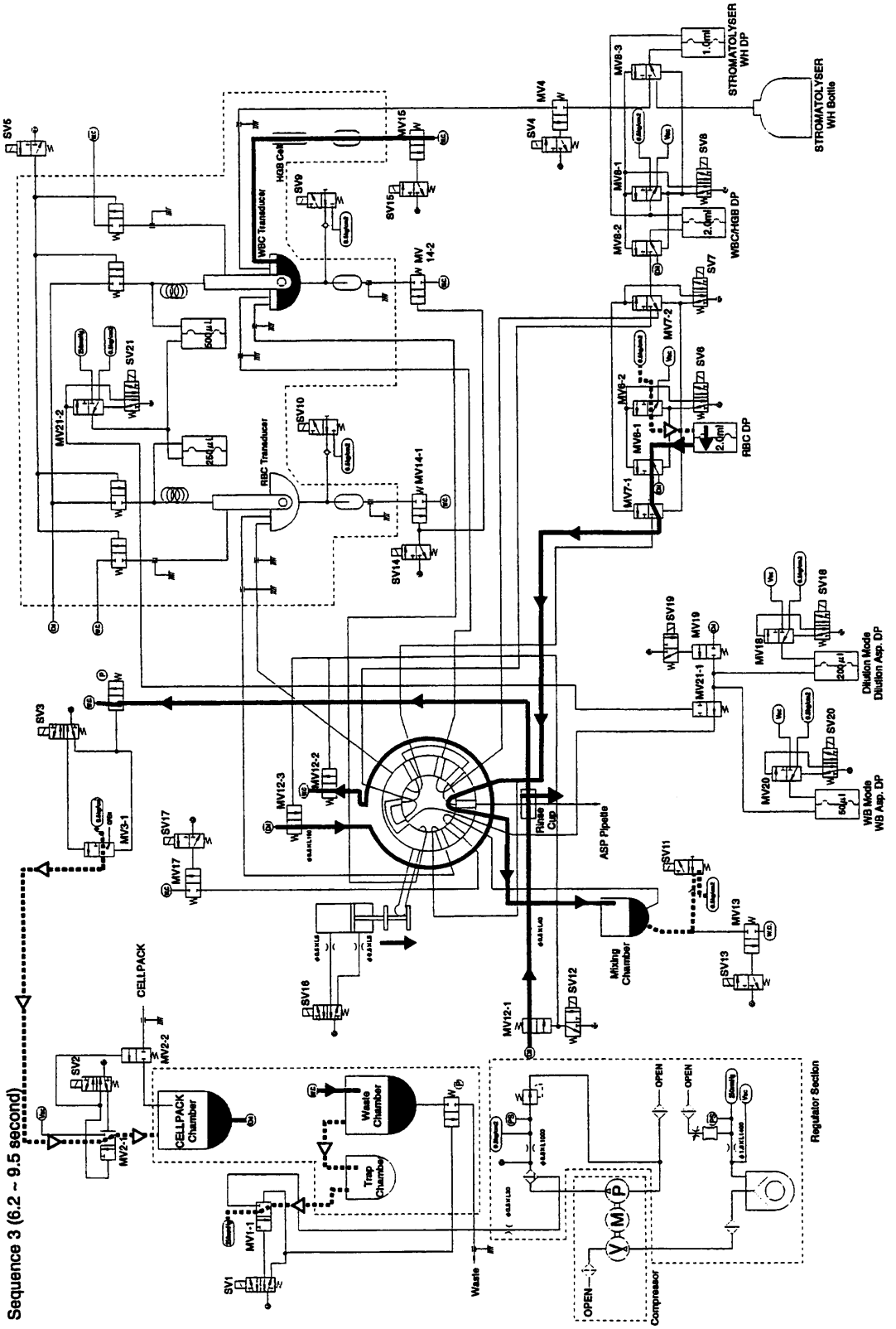
(2) Aspirating Diluent into HGB Analysis Line for Blank Measurement
SV15 operates between 5.5 sec. and 6.1 sec. to open MV15. By applying the vacuum (250 mmHg) on Waste Chamber, the diluent in WBC TD Chamber is aspirated into HGB Flow Cell, prepared for the blank measurement afterward.


Sequence 2 (5.0 ~ 6.2 second)
SV5
SV4
MV4
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-1
MV8-2
SV8
WBC/HGB DP
SV7
MV7-2
MV7-1
SV6
RBC DP
HGB Cell
WBC Transducer
RBC Transducer
SV9
SV15
MV16
MV 14-2
SV10
MV14-1
SV14
SV21
MV21-2
SV3
MV3-1
SV17
MV17
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV19
MV19
MV21-1
SV18
Dilution Mode
Dilution Asp. DP
SV20
MV20
WB Mode
WB Asp. DP
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap2 Chamber
MV1-1
SV1
Waste
OPEN
Compressor
Regulator Section

Sequence 3 (6.2 - 9.5 sec.)

(1) RBC/PLT First Diluting
SV6 is activated at the timing of 6.2 sec. to disconnect the Diluent line from MV6-1 and connect MV6-1 and RBC/PLT First Diluting line. RBC DP makes 2 mL of diluent with 4 µL sample dispensed on SRV flow into Mixing Chamber. At the same time, SV11 performs the operation of 0.2 sec. with 0.2 sec. intervals four times continuously to mix the diluted sample with air bubbles in Mixing Chamber. The dilution ratio of the sample in Mixing Chamber is 1 : 500.

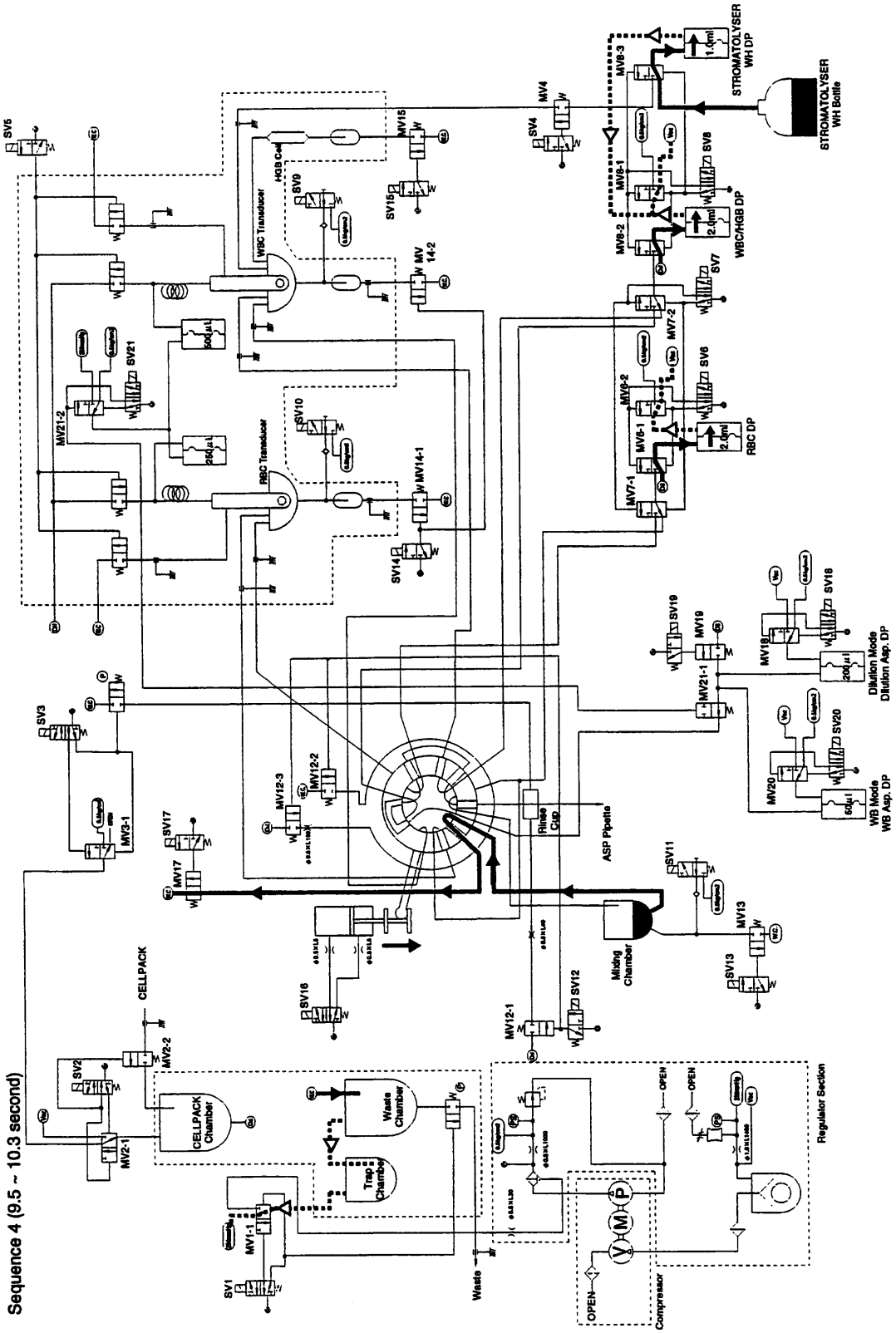
(2) Rinsing SRV and Sample Aspiration Pipette
SV3 operates between 7.0 sec. and 9.3 sec. to switch the air release of MV3-1 to 0.5 kg/m^2 pressure, which applies pressure on CELLPACK Chamber.
SV12 operates between 8.0 sec. and 8.6 sec. to open MV12-2 and MV12-3 at the same time. CELLPACK flows through the peripheral part of SRV to rinse it by the simultaneous application of the pressure on CELLPACK Chamber and the vacuum on Waste Chamber. Opening MV12-1 and Pinch Valve controlled by SV3 enables CELLPACK to pass through Rinse Cup and be aspirated into Waste Chamber. At the same time, Rinse Cup goes up and down along Aspiration Pipette by Stepper Motor, which enables Aspiration Pipette to be rinsed.


Sequence 3 (6.2 ~ 9.5 second)
SV5
SV4
MV4
MV8-3
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV8
MV8-2
WBC/HGB DP
SV7
MV7-2
SV6
MV6-2
MV6-1
RBC DP
MV7-1
HGB Cell
WBC Transducer
MV15
SV15
SV9
MV 14-2
500µl
SV21
MV21-2
SV10
RBC Transducer
250µl
MV14-1
SV14
SV19
MV19
MV21-1
SV16
MV16
200µl
Dilution Mode
Dilution Asp. DP
SV20
MV20
50µl
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV17
MV17
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
CELL PACK Chamber
MV2-1
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 4 (9.5 - 10.3 sec.)

(1) Sample Aspiration for RBC Second Diluting
SV17 is activated between 9.5 sec. and 10.3 sec. to open MV17. The first diluted sample in Mixing Chamber passes through SRV by the vacuum (250 mmHg) in Waste Chamber to prepare for the RBC second diluting.

(2) Reagent Aspiration by DP
At the timing of 9.3 sec., SV6 and SV8 close, and RBC DP and WBC/HGB DP aspirate 2.0 mL each of CELLPACK, and STROMATOLYSER WH DP aspirates 1.0 mL of Lyse Reagent respectively to prepare for the next sequence.

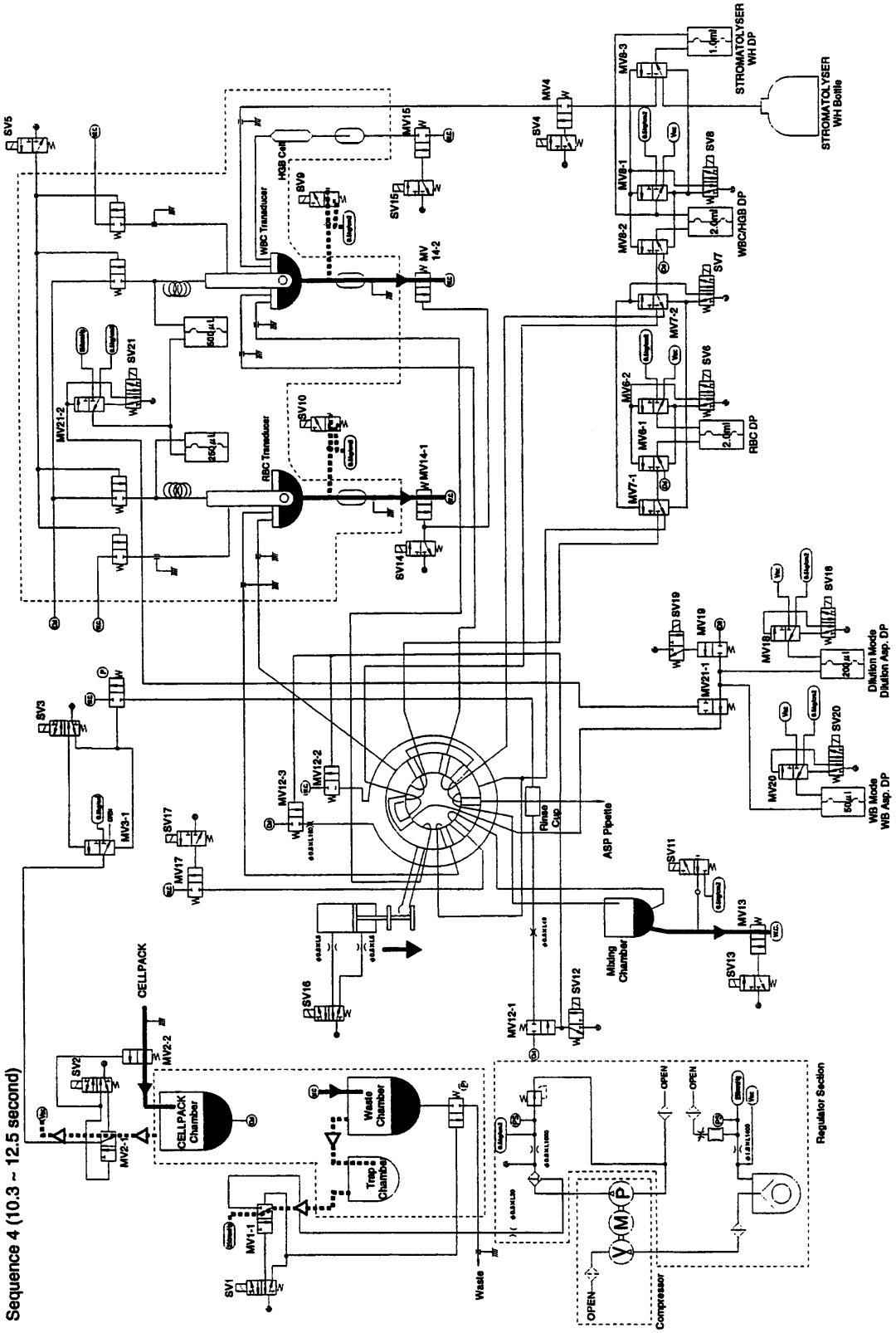

Sequence 4 (9.5 ~ 10.3 second)
SV5
MV4
SV4
MV15
SV15
SV9
WBC Transducer
HGB Cell
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
MV9-3
MV9-1
MV9-2
1.0ml
2.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
SV8
SV7
MV7-2
MV7-1
MV6-1
MV6-2
SV6
RBC DP
SV19
MV19
MV21-1
SV18
MV18
200µl
Dilution Mode
Dilution Asp. DP
SV20
MV20
60µl
WB Mode
WB Asp. DP
SV3
MV3-1
SV17
MV17
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 4 (10.3 - 12.5 sec.)

(1) Aspirating CELLPACK into CELLPACK Chamber
SV2 is activated between 10.3 sec. and 11.5 sec. to connect MV2-1 and VACUUM line, which enables CELLPACK in the reagent cubitainer outside Main Unit to be aspirated into CELLPACK Chamber.

(2) Draining RBC/WBC TD Chamber
SV14 is activated between 10.5 sec. and 12.5 sec. to connect MV14-1 and MV14-2 to Waste Chamber. As the vacuum (250 mmHg) is applied on Waste Chamber, the liquid in RBC/WBC TD Chamber flows into Waste Chamber to empty the TD Chamber. To remove the remained liquid in Air Bubble Mixing line (between Non-Return Valve and T-Joint), SV9 and SV10 perform the open/close operation twice continuously with an interval of 0.2 sec.

(3) Draining RBC First Diluted Sample in Mixing Chamber
SV13 is activated between 10.7 sec. and 12.5 sec. to connect MV13 and Waste Chamber. As the vacuum (250 mmHg) is applied on Waste Chamber, the RBC first diluted sample in Mixing Chamber flows into Waste Chamber to empty Mixing Chamber. To remove the remained liquid in Air Bubble Mixing line (between Non-Return Valve and T-Joint), SV11 operated 3 times with high speed. The first operation is performed between 10.5 sec. and 10.7 sec. and the second and third operations are between 11.7 sec. and 12.3 sec. respectively with an interval of 0.2 sec.


Sequence 4 (10.3 ~ 12.5 second)
SV5
SV4
MV4
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-1
MV8-2
SV8
WBC/HGB DP
SV7
MV7-2
MV7-1
MV6-2
MV6-1
SV6
RBC DP
MV15
SV15
HGB Cell
WBC Transducer
SV9
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
SV19
MV19
MV21-1
SV18
MV18
Dilution Mode
Dilution Asp. DP
SV20
MV20
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

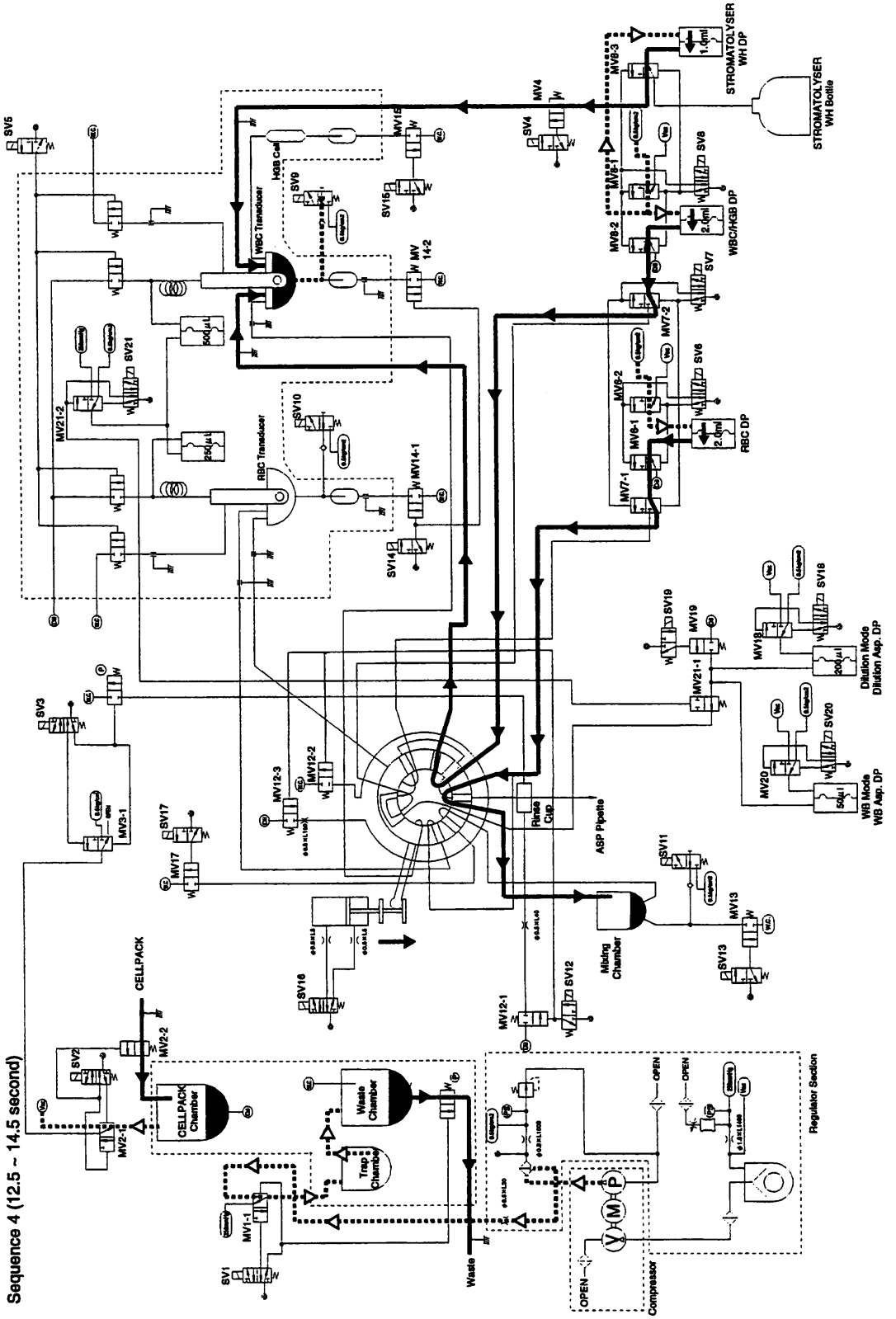
Sequence 4 (12.5 - 14.5 sec.)

(1) Draining Waste Chamber
SV1 is activated between 12.7 sec. and 14.0 sec. to release Pinch Valve controlling the Waste Chamber drain. At the same time, MV1-1 and PRESSURE line are connected to apply pressure on Waste Chamber to drain the waste outside instrument via the waste tube.

(2) Aspirating CELLPACK into CELLPACK Chamber
SV2 is activated between 12.5 sec. and 14.0 sec. to connect MV2-1 and VACUUM line, which enables CELLPACK in the reagent cubitainer outside Main Unit to be aspirated into CELLPACK Chamber.

(3) Rinsing Inside Mixing Chamber
SV6 is activated at the timing of 12.5 sec. to make RBC DP dispense 2.0 mL of CELLPACK into Mixing Chamber and rinse RBC First Diluting line and Mixing Chamber. The other purpose of this operation is to avoid the precipitated crystals, etc. in the remained liquid after the previous rinsing to affect on the analysis result.

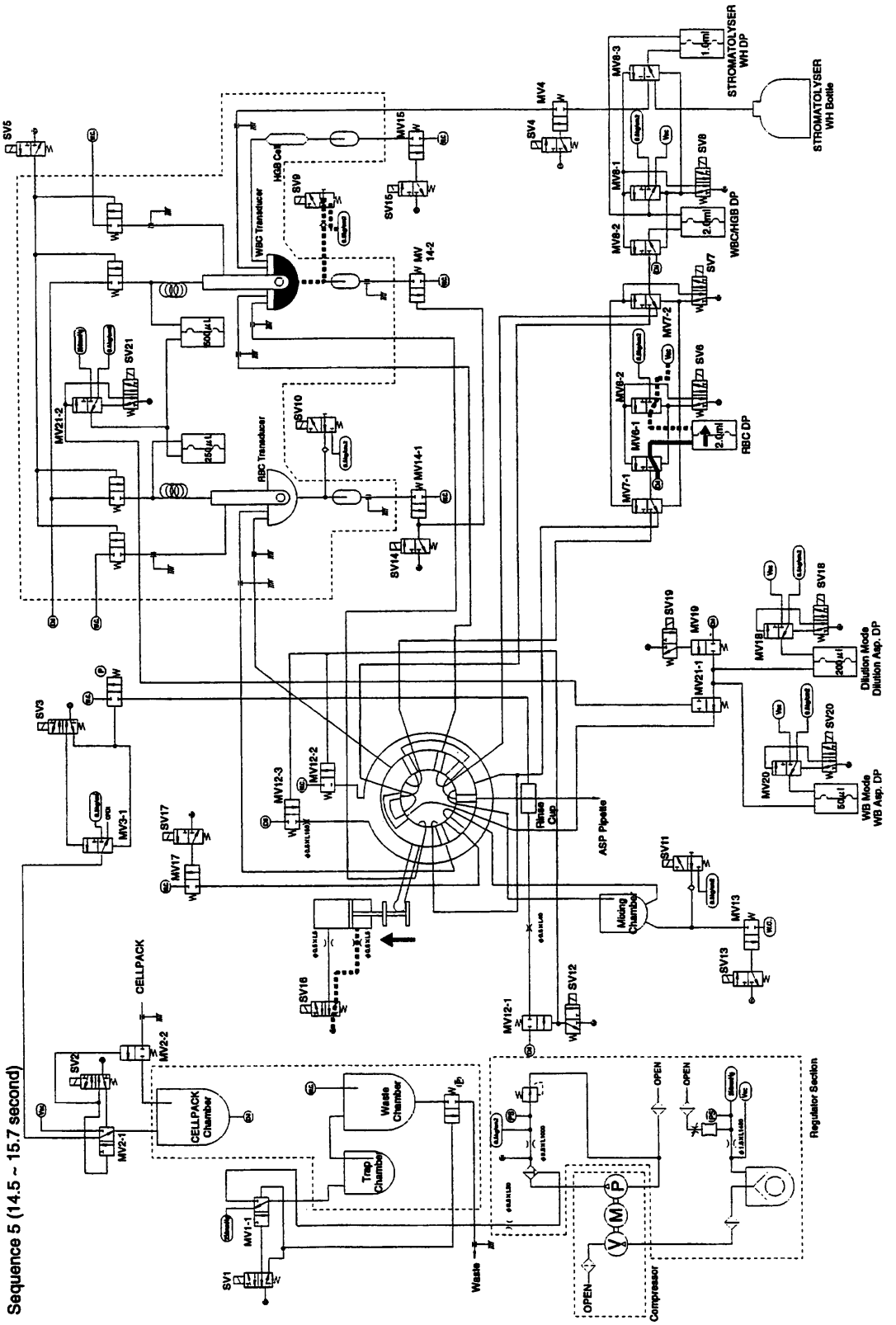
(4) WBC Diluting/Lysing
SV8 is activated at the timing of 12.5 sec. to make WBC/HGB DP dispense 2.0 mL of CELLPACK with 6 µL of sample blood cut away by SRV via WBC Dilution line into WBC TD Chamber. At the same time, SV4 is activated to drive STROMATOLYSER-WH DP to dispense 1.0 mL of Lyse reagent into WBC TD Chamber.
After the diluted sample and Lyse reagent are dispensed into WBC TD Chamber, SV9 operates 10 times with an interval of 0.2 sec. from the timing of 13.5 sec. to mix the sample with air bubble in TD Chamber. This makes the sample in WBC TD Chamber diluted by 500 times.


Sequence 4 (12.5 ~ 14.5 second)
SV5
SV4
MV4
MV15
SV15
WBC Transducer
HGB Cell
SV9
MV 14-2
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-1
SV8
MV8-2
2.0ml
WBC/HGB DP
SV7
MV7-2
MV21-2
SV21
500µl
SV10
RBC Transducer
MV14-1
SV14
MV6-2
SV6
MV6-1
RBC DP
MV7-1
SV19
MV19
MV21-1
SV18
MV18
200µl
Dilution Mode
Dilution Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV20
MV20
50µl
WB Mode
WB Asp. DP
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
Regulator Section
OPEN
Compressor

Sequence 5 (14.5 - 15.7 sec.)

(1) SRV Rotation
SV16 is deactivated at the timing of 14.5 sec. to make SRV rotate in the CW direction and return to the home position.

(2) Aspirating Diluent by RBC DP
SV6 is deactivated at the timing of 14.0 sec. to enable RBC DP to aspirate 2.0 mL of CELLPACK.


Sequence 5 (14.5 ~ 15.7 second)
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
Dilution Mode Dilution Asp. DP
WB Mode WB Asp. DP
ASP Pipette
Rinse Cup
Mixing Chamber
CELLPACK
CELLPACK Chamber
Waste Chamber
Trap Chamber
Waste
Compressor
Regulator Section
OPEN
WBC Transducer
RBC Transducer
HGB Cell

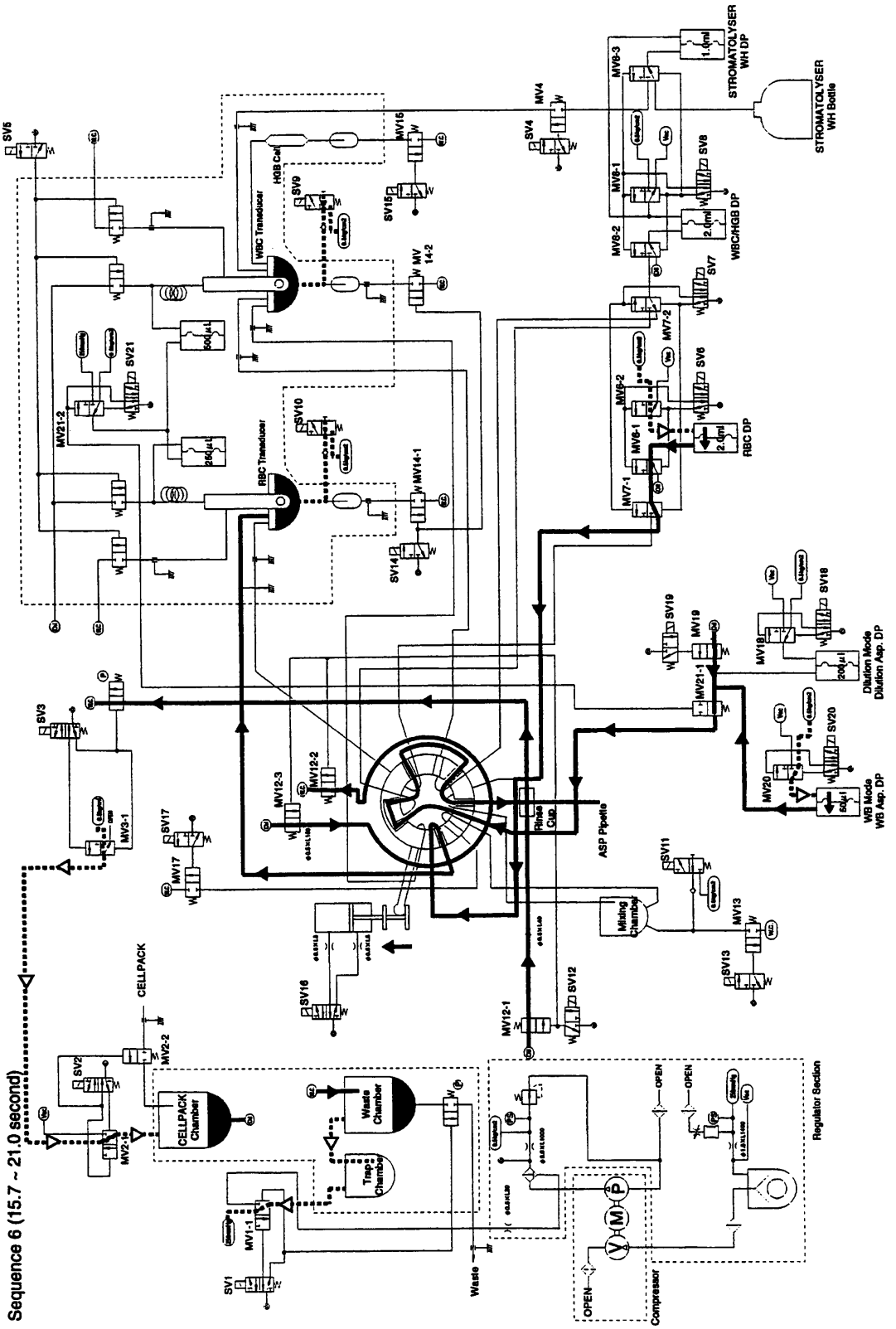
Sequence 6 (15.7 - 21.0 sec.)

(1) Rinsing Whole Blood Aspiration Line and Outside Aspiration Pipette
At the timing of 15.7 sec., the rinsing of the outside of Aspiration Pipette and the inside of WB Aspiration line starts at the same time. SV3 is activated to switch MV3-1 to the pressure of 0.5 kg/cm^2 to apply pressure on CELLPACK Chamber. Also, the pinch valve controlled by SV3 is released to connect WB Aspiration line and Waste Chamber. SV12 is activated to connect MV12-1 to CELLPACK Chamber. The diluent passes through Rinse Cup, rinses outside Aspiration Pipette and is aspirated finally into Waste Chamber by the vacuum application.
SV19 is activated between 16.0 sec. and 20.6 sec. to connect MV19 to CELLPACK Chamber. As the pressure is applied on CELLPACK Chamber, the diluent passes through WB Aspiration line and SRV, and is drained from the end of Aspiration Pipette. The vacuum on Waste Chamber makes the drained diluent passes through Rinse Cup and flow into Waste Chamber.

(2) Rinsing SRV
SV12 is activated between 15.7 sec. and 20.5 sec. to open MV12-2 and MV12-3 at the same time. CELLPACK flows through the peripheral part of SRV to rinse it by the simultaneous application of the pressure in CELLPACK Chamber and the vacuum in Waste Chamber (250 mmHg).

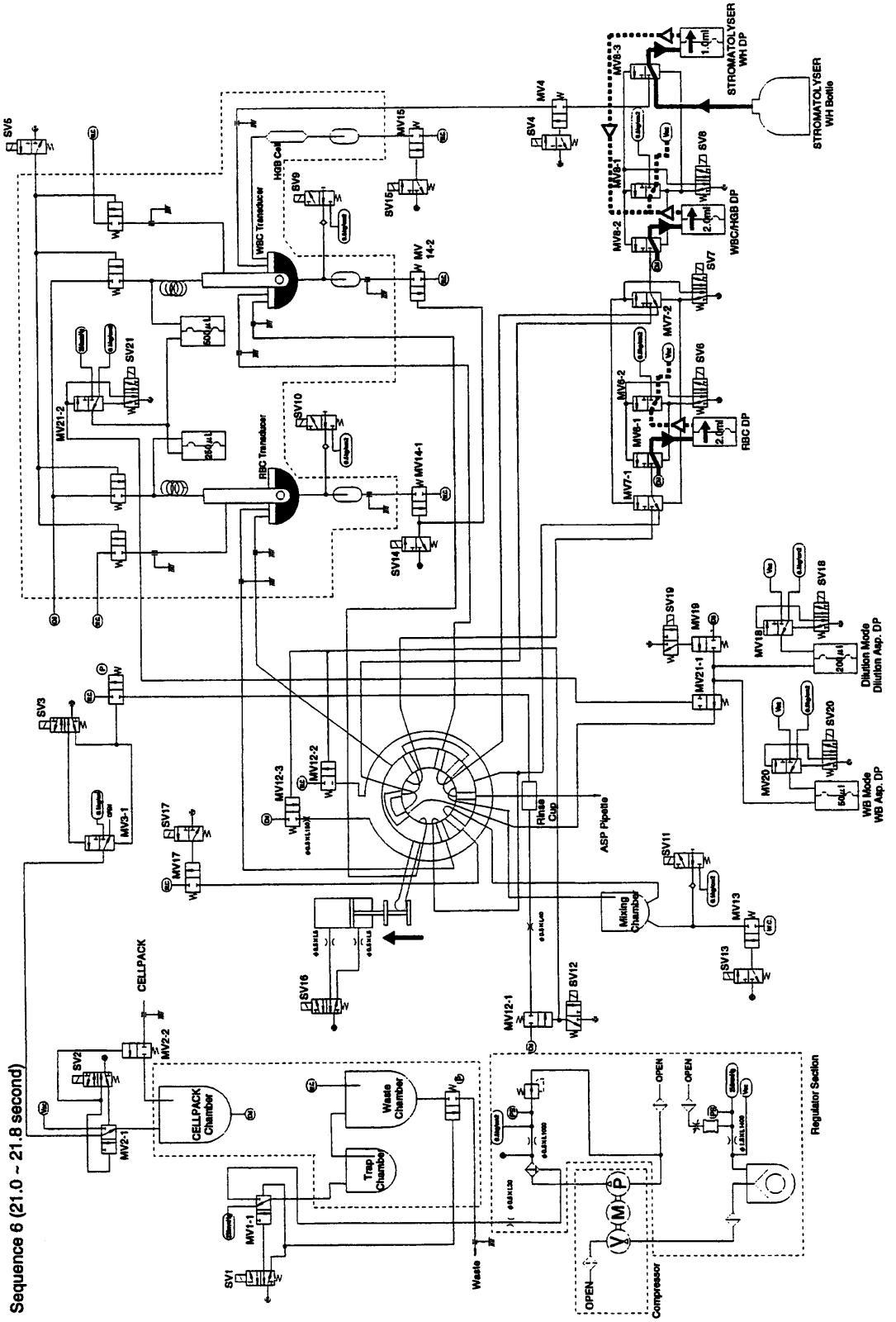
(3) RBC Second Diluting
SV6 is activated at the timing of 15.7 sec. to make RBC DP dispense 2.0 mL of CELLPACK and dispense with 40 µL of 1 : 500 RBC diluted sample into RBC TD through RBC Second Dilution line. This makes the sample in RBC TD Chamber diluted by 25000 times. SV10 performs the open/close operation eight times with an interval of 0.2 sec. between 17.0 sec. and 19.6 sec. to mix the sample with air bubble in RBC TD Chamber.

(4) HGB Blank Convert
Blank Convert is performed between 10.0 sec. and 10.5 sec. for the diluent in HGB Flow Cell. The operation is performed 5 times with an interval of 0.1 sec. (On blank measurement, the diluent in the HGB Flow Cell does not flow.)


Sequence 6 (15.7 ~ 21.0 second)
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
Dilution Mode Dilution Asp. DP
WB Mode WB Asp. DP
ASP Pipette
Rinse Cup
Mixing Chamber
CELLPACK
CELLPACK Chamber
Waste Chamber
Trap Chamber
Waste
Compressor
Regulator Section
OPEN
WBC Transducer
RBC Transducer
HGB Cell

Sequence 6 (21.0 - 21.8 sec.)

(1) Reagent Aspiration by DP
At the timing of 21.0 sec., SV6 and SV8 are deactivated. RBC and WBC/HGB DPs aspirate 2.0 mL each of diluent, and STROMATOLYSER-WH DP aspirates 1.0 mL of Lyse reagent respectively to prepare for the next sequence.

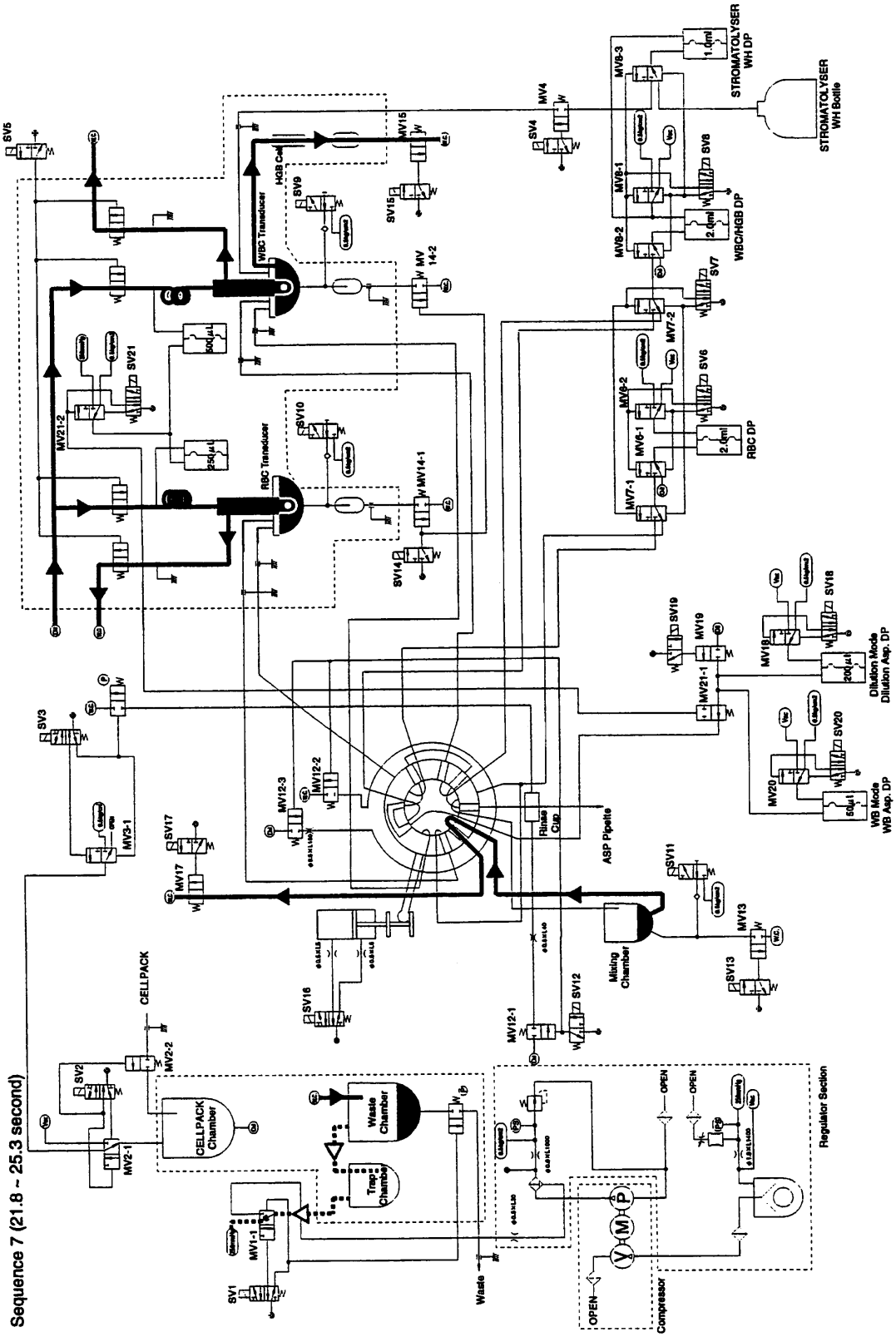

Sequence 6 (21.0 ~ 21.8 second)
SV5
SV4
MV4
MV15
SV15
HGB Cell
WBC Transducer
SV9
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
MV8-3
MV8-1
MV8-2
MV6-1
MV6-2
MV7-1
MV7-2
SV8
SV6
SV7
1.0ml
2.0ml
2.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
SV19
MV19
MV21-1
MV18
SV18
200µl
Dilution Mode
Dilution Asp. DP
SV20
MV20
50µl
WB Mode
WB Asp. DP
SV3
MV3-1
SV17
MV17
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 7 (21.8 - 25.3 sec.)

(1) Removing Air in WBC/RBC TD
SV5 is activated between 21.8 sec. and 22.8 sec. to aspirate diluent by the vacuum (250 mmHg) in Waste Chamber and fill it in WBC/RBC TD. This operation is performed to remove the air remained around the aperture in the previous sequence.

(2) Rinsing RBC Second Dilution Line
SV17 is activated between 21.8 sec. and 22.5 sec. to connect MV17 and Waste Chamber. By applying vacuum (250 mmHg) on Waste Chamber, the diluent in Mixing Chamber passes through RBC Second Dilution line and flows finally into Waste Chamber, which enables RBC Second Dilution line to be rinsed.

(3) Sample Aspiration into HGB Flow Cell
SV15 is activated between 23.5 sec. and 24.5 sec. to connect MV15 and Waste Chamber. By applying the vacuum (250 mmHg), the sample in WBC TD Chamber flows into HGB Flow Cell.


Sequence 7 (21.8 ~ 25.3 second)
SV5
MV4
SV4
MV8-3
1.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV8
MV8-2
2.0ml
WBC/HGB DP
SV7
MV7-2
SV6
MV6-2
MV6-1
2.0ml
RBC DP
MV7-1
HGB Cell
WBC Transducer
SV9
MV15
SV15
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
SV19
MV19
MV21-1
SV18
MV18
200µl
Dilution Mode
Dilution Asp. DP
SV20
MV20
50µl
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV17
MV17
SV11
MV13
SV13
Mixing Chamber
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

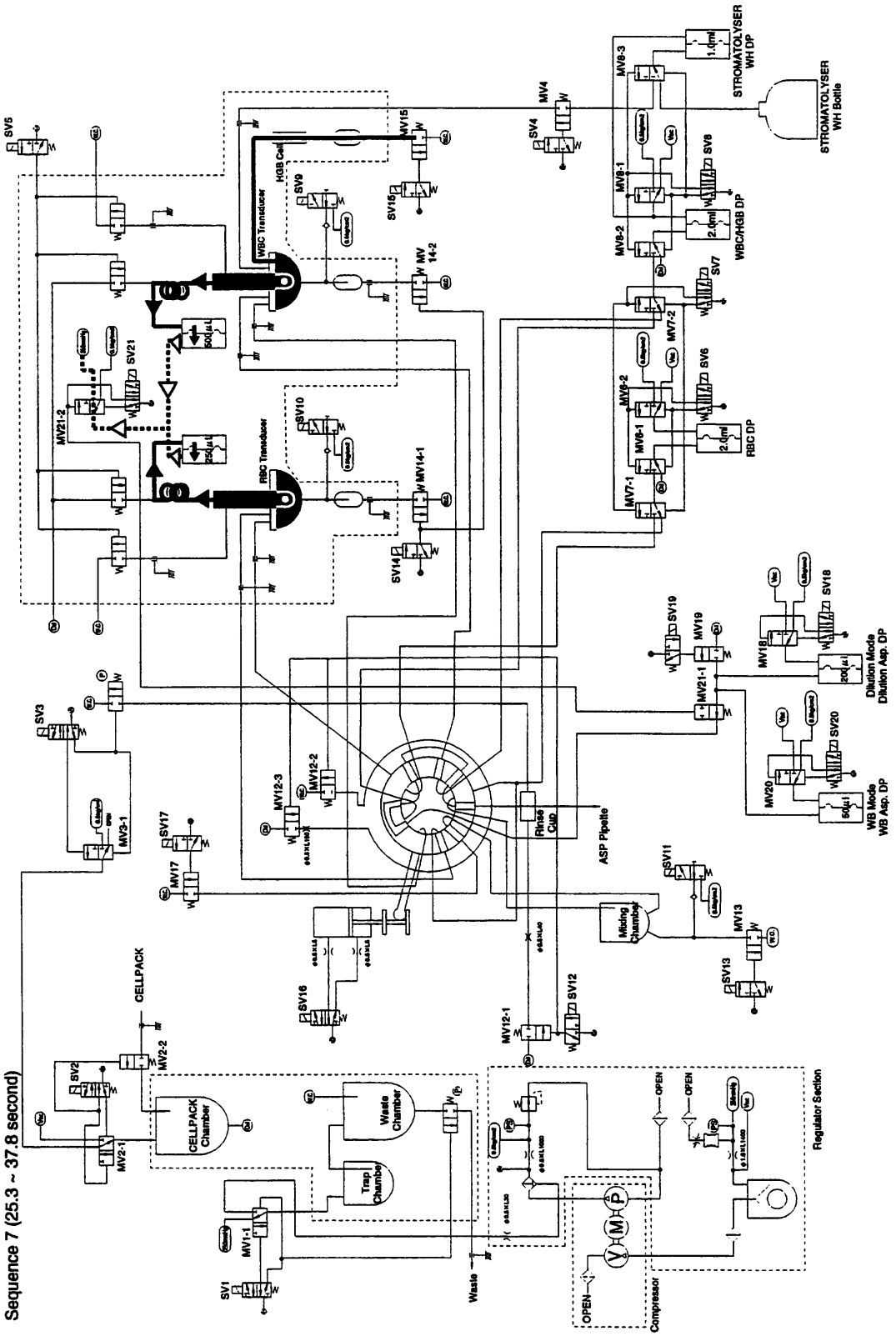
Sequence 7 (25.3 - 37.8 sec.)

(1) RBC Counting
SV21 is activated between 25.3 sec. and the end of Sequence 8 to apply vacuum of 250 mmHg on RBC Counting DP to aspirate the sample in RBC TD Chamber and start counting. By the aspiration of RBC Counting DP, total 250 µL of sample passing through the aperture of the TD is counted.

(2) WBC Counting
SV21 is activated between 25.3 sec. and the end of Sequence 8 to apply vacuum of 250 mmHg on WBC Counting DP to aspirate the sample in WBC TD Chamber and start counting. By the aspiration of WBC Counting DP, total 500 µL of sample passing through the aperture of the TD is counted.

Sequence 8 (37.8 - 39.3 sec.)

(1) HGB A/D Convert
Detector Block detects the emitted light beams in HGB Flow Cell and performs the A/D Convert between 38.3 sec. and 39.3 sec. This operation is performed five times with an interval of 0.2 sec.

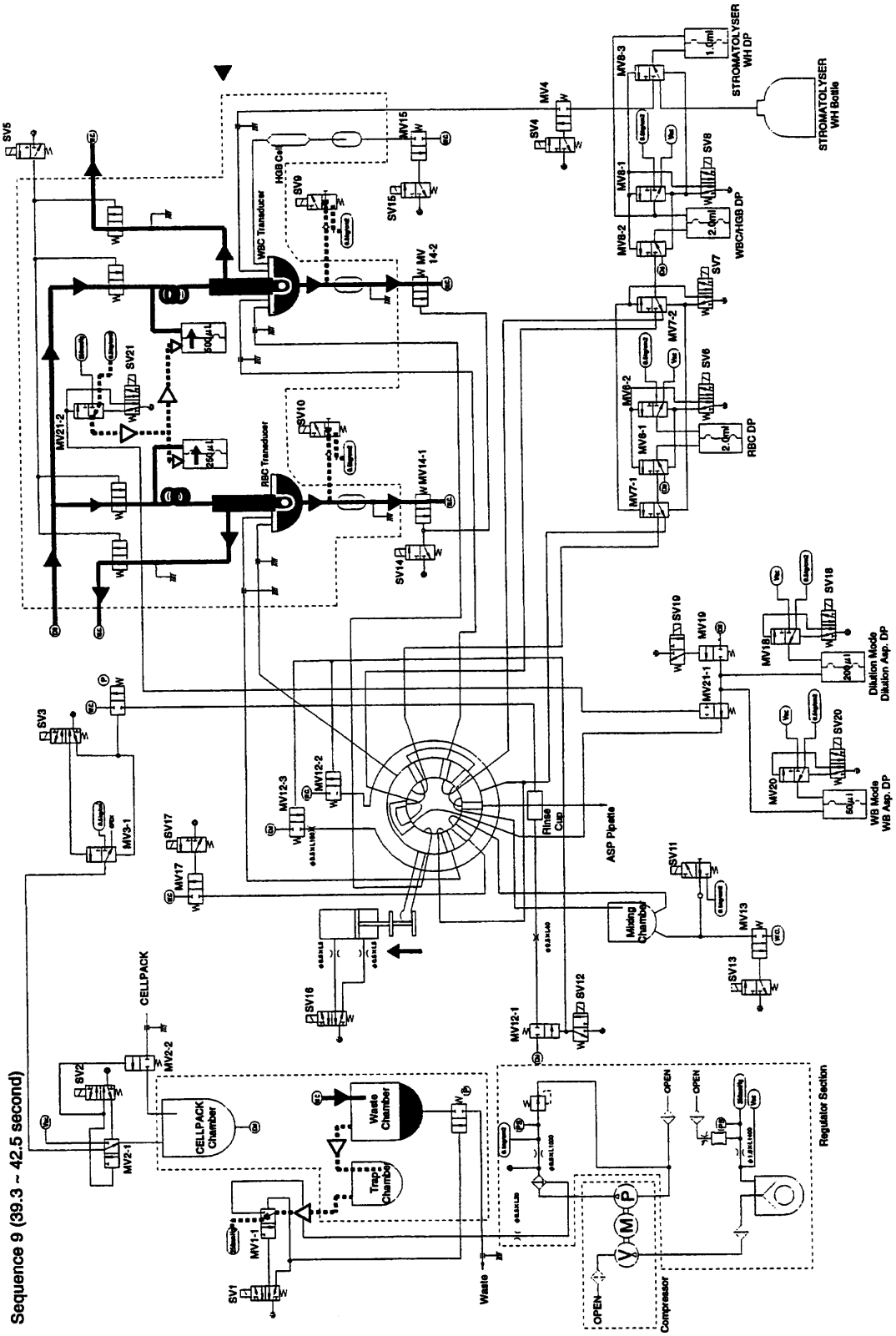

Sequence 7 (25.3 ~ 37.8 second)
SV5
SV4
MV4
MV15
SV15
HGB Cell
WBC Transducer
SV9
MV 14-2
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
1.0ml
MV8-1
SV8
MV8-2
2.0ml
WBC/HGB DP
SV7
MV7-2
SV6
MV6-2
MV6-1
2.0ml
RBC DP
MV7-1
SV21
MV21-2
500µL
250µL
SV10
RBC Transducer
MV14-1
SV14
SV19
MV19
MV21-1
MV18
SV18
20µL
Dilution Mode
Dilution Asp. DP
SV20
MV20
500µL
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 9 (39.3 ~ 42.5 sec.)

(1) Clog Removal
At the end of Sequence 8, SV21 closes to apply 0.5 kg/m^2 pressure on RBC/WBC Counting DP to perform the draining operation and avoid clogs occurred during counting.

(2) Dispensing Diluent into WBC/RBC TD
SV5 is activated between 39.3 sec. and 40.0 sec. to apply vacuum of 250 mmHg on Waste Chamber to flow the liquid in TD into Waste Chamber and fill WBC/RBC TD with clean diluent.

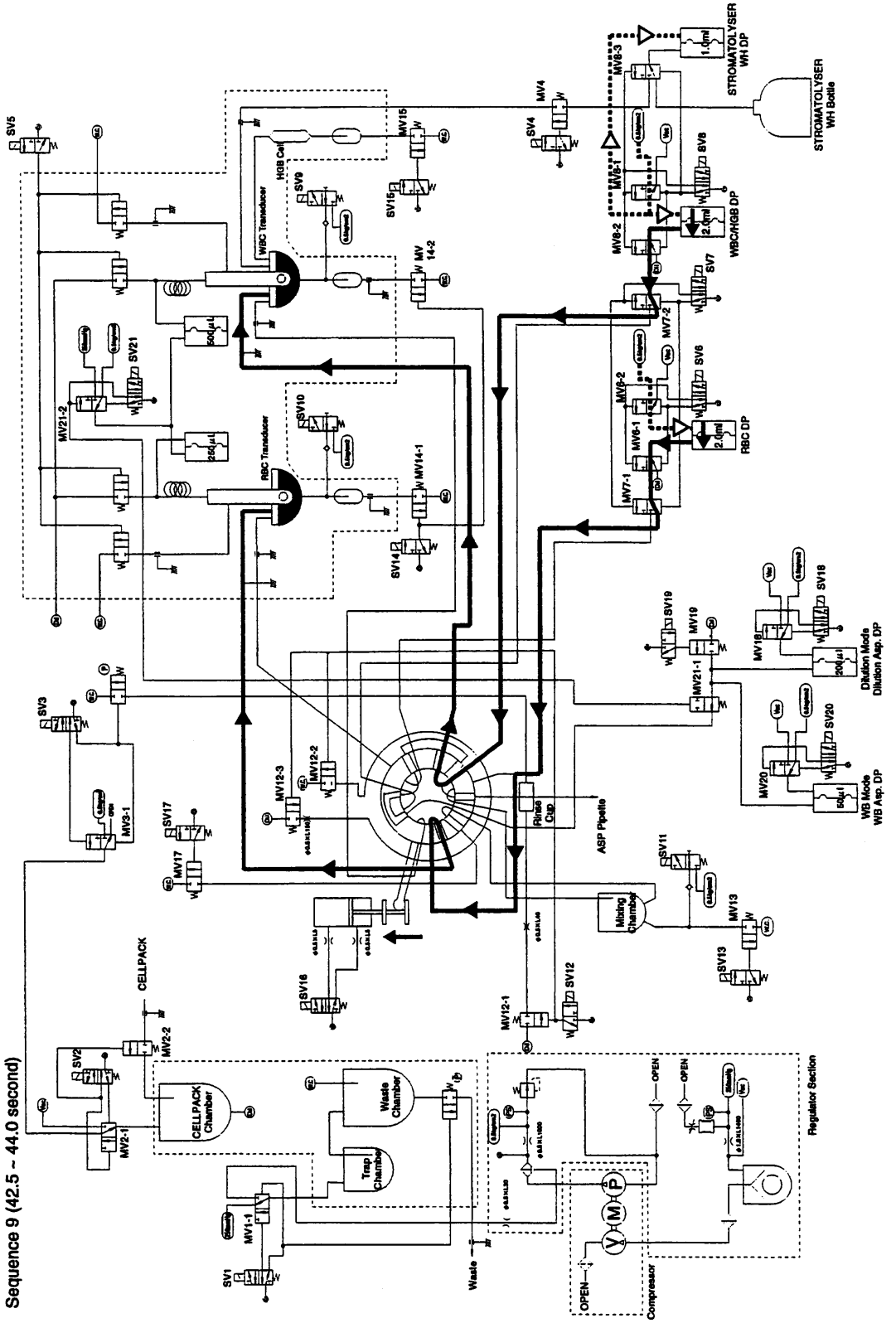
(3) Draining WBC/RBC TD Chamber
SV14 is activated between 40.2 sec. and 42.5 sec. to connect MV14-1 and MV14-2 with Waste Chamber. By applying vacuum (250 mmHg) on Waste Chamber, the liquid in WBC/RBC TD Chamber is drained into Waste Chamber.
In order to remove the remained liquid in Air Bubble Mixing line (between Non-Return Valve and T-Joint), SV9 and SV10 perform the open/close operation four times with an interval of 0.2 sec. with high speed to avoid Air Bubble Mixing line to be contaminated by the waste.


Sequence 9 (39.3 ~ 42.5 second)
SV5
SV4
MV4
MV15
SV15
MV 14-2
SV21
MV21-2
SV10
MV14-1
SV14
SV9
WBC Transducer
HGB Cell
RBC Transducer
MV8-3
MV8-1
MV8-2
SV8
SV7
SV6
MV7-2
MV7-1
MV9-2
MV9-1
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
SV18
MV18
SV19
MV19
MV21-1
Dilution Mode
Dilution Asp. DP
SV20
MV20
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-2
MV12-3
SV17
MV17
SV16
Rinse Cup
ASP Pipette
SV11
MV13
SV13
Mixing Chamber
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
Compressor
Regulator Section

Sequence 9 (42.5 sec. - 44.0 sec.)

(1) Rinsing Second Dilution Line and RBC TD Chamber
At the timing of 42.5 sec., SV6 is activated to enable RBC DP to dispense 2.0 mL of diluent. The diluent passes through RBC Second Dilution line and flows into RBC TD Chamber. By this operation, the Dilution line and TD Chamber are rinsed.

(2) Rinsing WBC Dilution Line and WBC TD Chamber
At the timing of 42.5 sec., SV8 is activated to enable WBC DP to dispense 2.0 mL of diluent. The diluent passes through WBC Dilution line and flows into WBC TD Chamber. By this operation, the Dilution line and TD Chamber are rinsed.

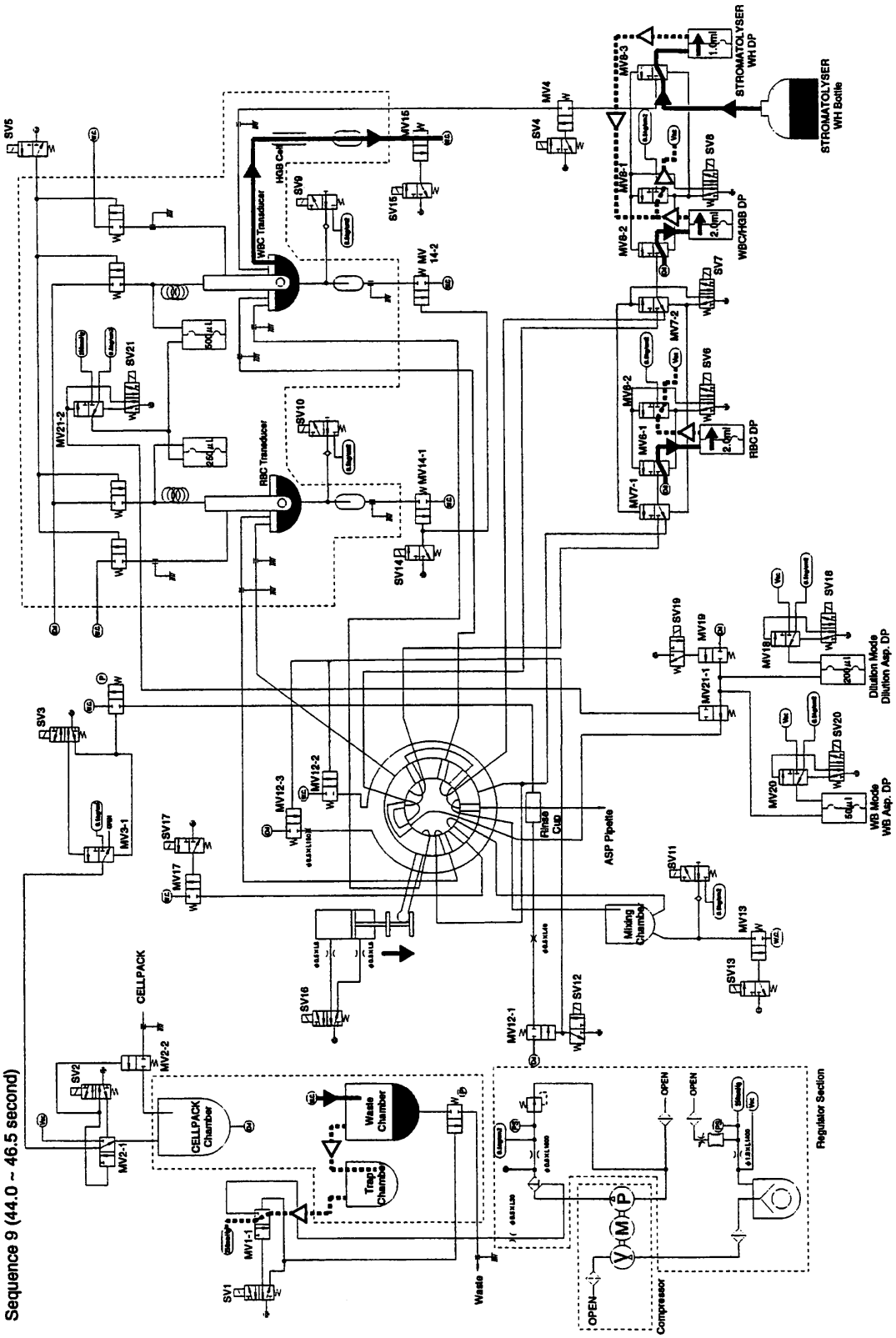

Sequence 9 (42.5 ~ 44.0 second)
SV5
SV4
MV4
MV6-3
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV15
SV15
SV9
HGB Cell
WBC Transducer
MV 14-2
MV8-2
SV8
WBC/HGB DP
SV7
MV7-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
MV9-2
SV6
MV6-1
RBC DP
MV7-1
SV19
MV19
SV18
MV18
MV21-1
Dilution Mode
Dilution Asp. DP
SV3
MV3-1
SV20
MV20
WB Mode
WB Asp. DP
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 9 (44.0 sec. - 46.5 sec.)

(1) Reagent Aspiration
At the timing of 44.0 sec., SV6 and SV8 are deactivated. RBC and WBC/HGB DPs aspirate 2.0 mL each of diluent to prepare for the next sequence.

(2) SRV Rotation
At the timing of 44.0 sec., SV16 is activated to drive the piston controlling the SRV rotation. SRV rotates in the CCW direction (seeing from the left side of the instrument) to prepare for the line rinsing. SRV keeps this position until the timing of 52.0 sec.

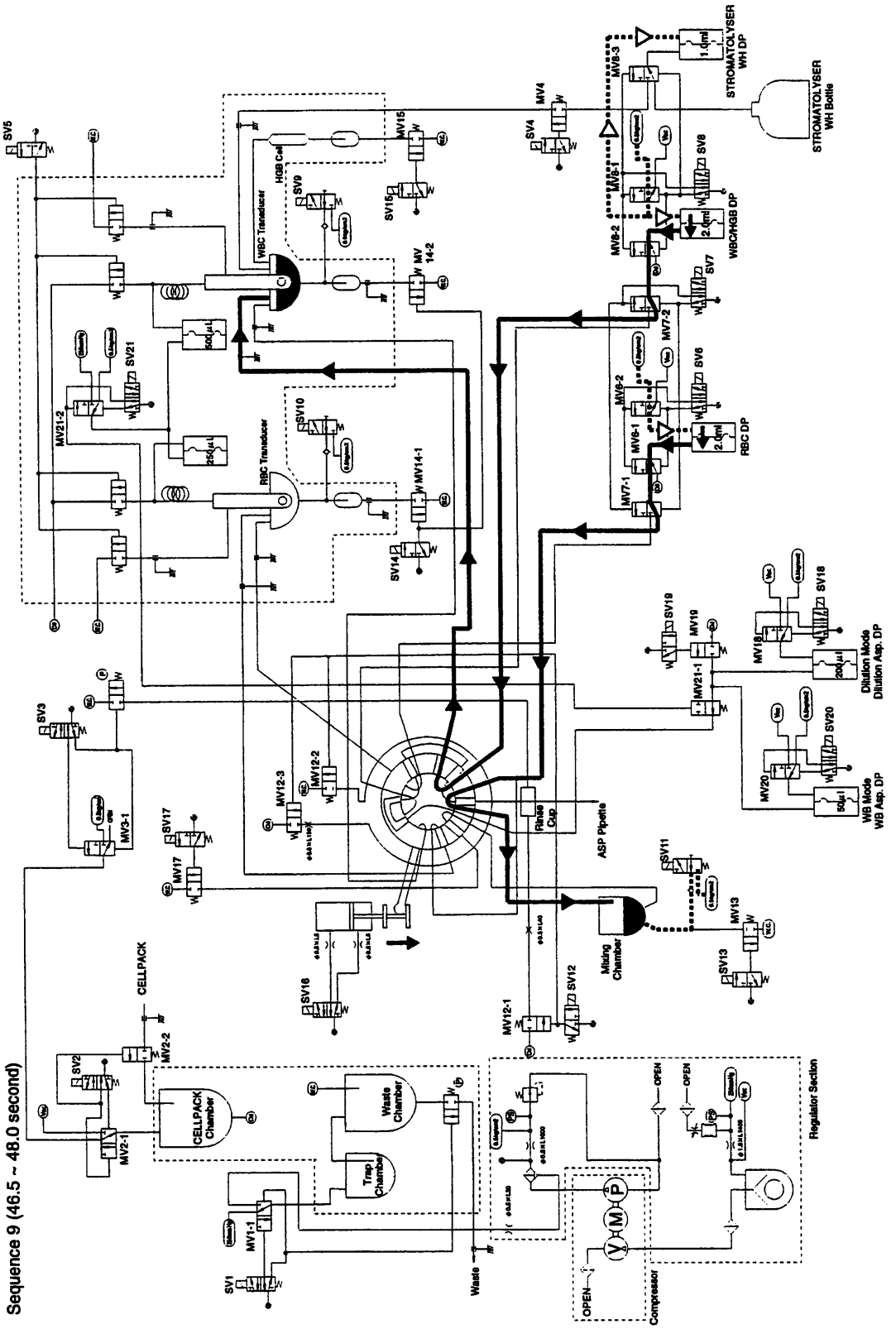
(3) Draining HGB Flow Cell
SV15 is activated between 45.8 sec. and 46.5 sec. to connect MV15 and Waste Chamber. By applying vacuum (250 mmHg) on Waste Chamber, the diluent in WBC TD Chamber is aspirated into HGB Flow Cell and rinses it.


Sequence 9 (44.0 ~ 46.5 second)
SV5
SV4
MV4
MV8-3
1.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV6
MV8-2
2.0ml
WBC/HGB DP
SV7
MV7-2
MV9-2
SV6
MV6-1
2.0ml
RBC DP
MV7-1
HGB Cell
MV16
SV16
SV9
WBC Transducer
SV15
MV 14-2
500µl
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
SV19
MV19
MV21-1
MV18
200µl
Dilution Mode
Dilution Asp. DP
SV18
SV20
MV20
50µl
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 9 (46.5 sec. - 48.0 sec.)

(1) Rinsing WBC Dilution Line and WBC TD Chamber
At the timing of 46.5 sec., SV8 is activated to make WBC DP dispense 2.0 mL of diluent via WBC Dilution line and flow it into WBC TD Chamber, which rinses the Dilution line and TD Chamber.

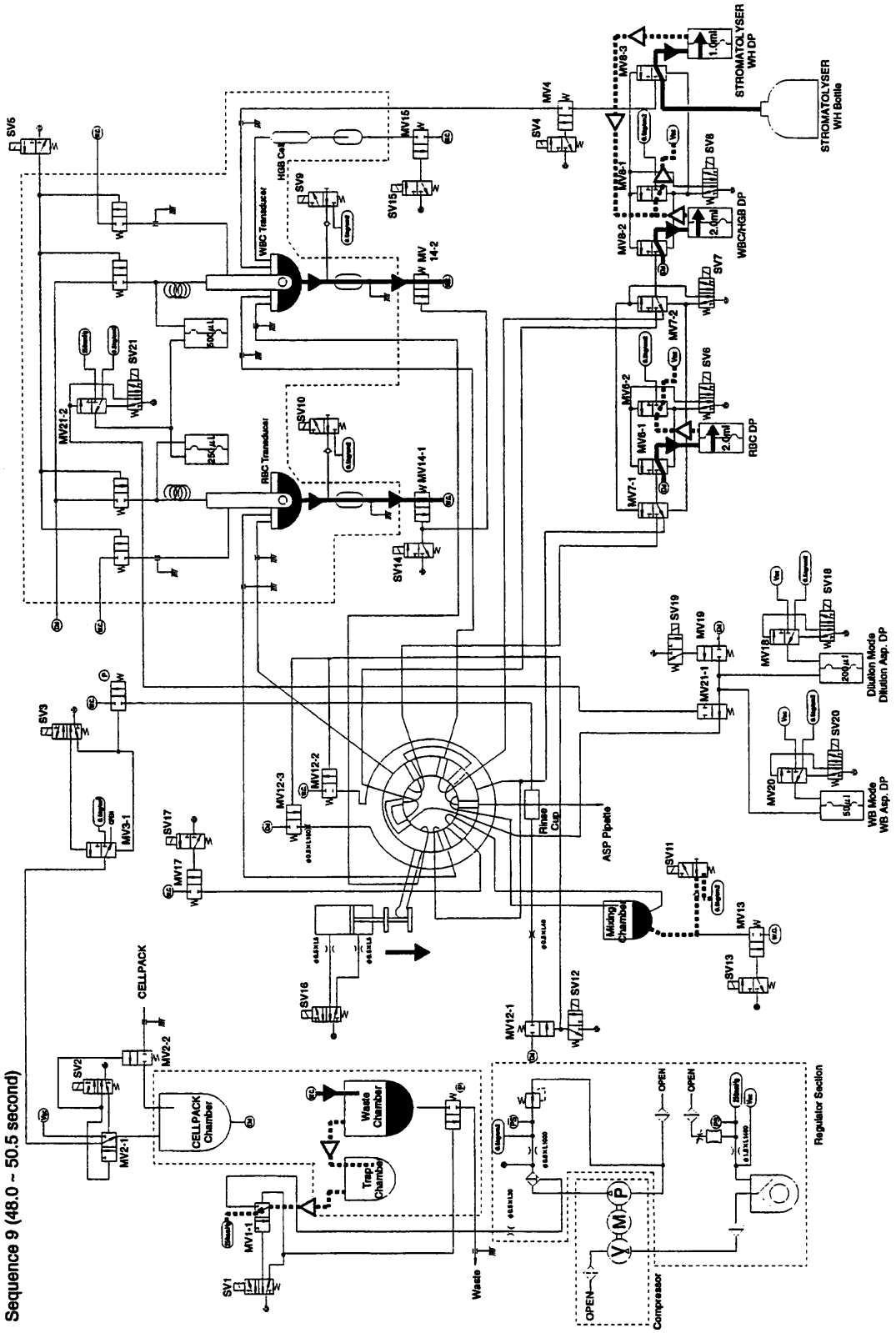
(2) Rinsing RBC Mixing Chamber
At the timing of 46.5 sec., SV6 is activated to make RBC DP dispense 2.0 mL of diluent via RBC First Dilution line and flow it into Mixing Chamber, which rinses the RBC First Dilution line and Mixing Chamber.


Sequence 9 (46.5 ~ 48.0 second)
SV5
SV4
MV4
MV15
SV15
HGB Cell
WBC Tranducer
SV9
MV 14-2
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-2
MV8-1
SV8
WBC/HGB DP
SV7
MV7-2
SV6
MV6-2
MV6-1
MV7-1
RBC DP
SV21
MV21-2
SV10
RBC Tranducer
MV14-1
SV14
SV19
MV19
SV18
MV18
Dilution Mode
Dilution Asp. DP
MV21-1
SV20
MV20
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
MV13
SV13
Mixing Chamber
SV16
SV12
MV12-1
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
Compressor
Regulator Section

Sequence 10 (48.0 sec. - 50.5 sec.)

(1) Reagent Aspiration
At the timing of 48.0 sec., SV6 and SV8 are deactivated. RBC and WBC/HGB DPs aspirate 2.0 mL each of diluent to prepare for the next sequence.

(2) Draining WBC/RBC TD Chamber
SV14 is activated between 48.3 sec. and 50.5 sec. to connect MV14-1 and MV14-2 with Waste Chamber. By applying vacuum (250 mmHg) on Waste Chamber, the liquid in WBC/RBC TD Chamber is drained into Waste Chamber.

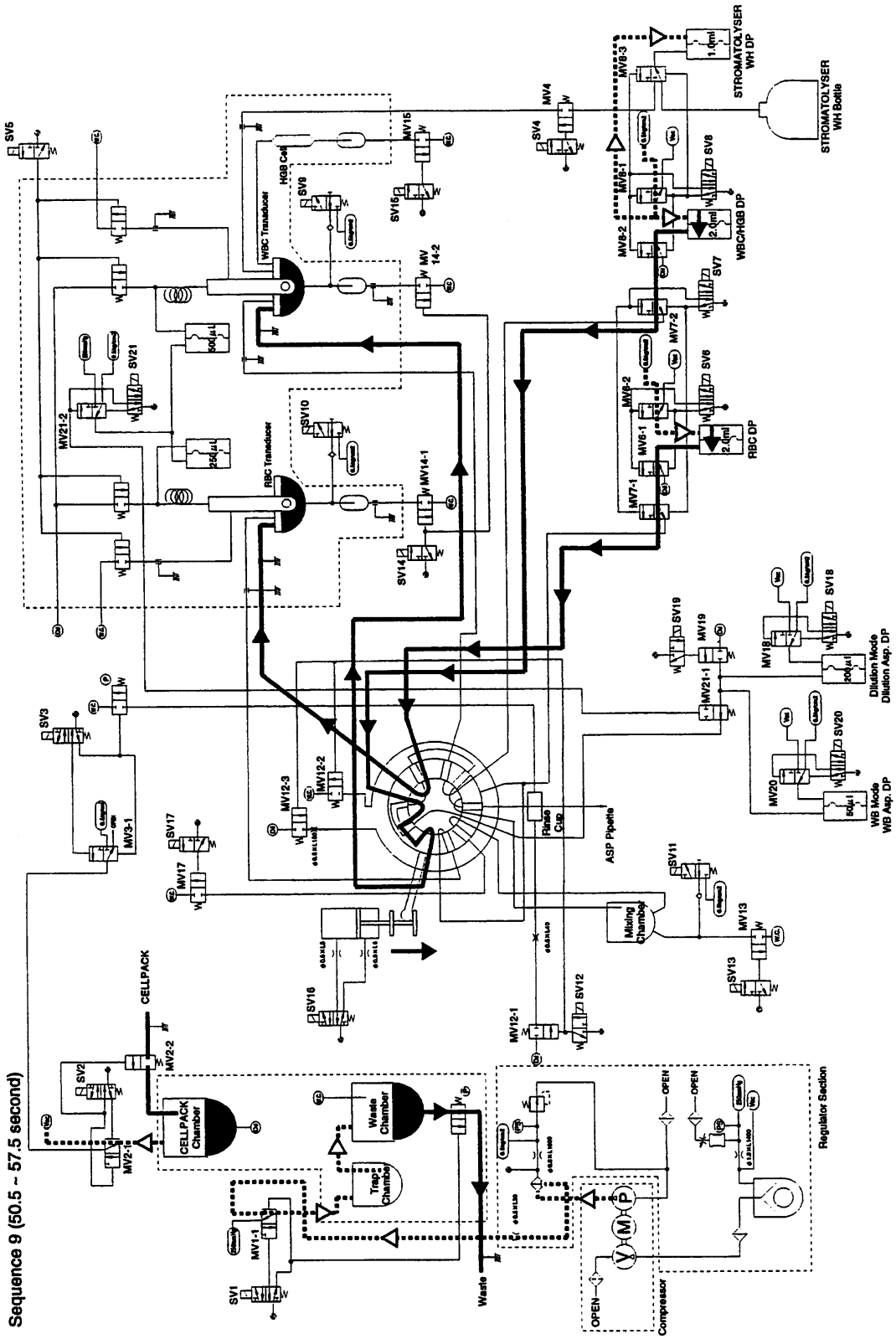

Sequence 9 (48.0 ~ 50.5 second)
SV5
SV4
MV4
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-3
MV8-1
MV8-2
SV8
WBC/HGB DP
SV7
MV7-2
MV7-1
SV6
RBC DP
WBC Transducer
HGB Cell
MV16
SV15
SV9
MV 14-2
SV21
MV21-2
RBC Transducer
SV10
MV14-1
SV14
SV3
MV3-1
SV17
MV17
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV19
MV19
MV21-1
SV18
MV18
Dilution Mode Dilution Asp. DP
SV20
MV20
WB Mode WB Asp. DP
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

Sequence 11 (50.5 sec. - 57.5 sec.)

(1) Aspirating Diluent into CELLPACK Chamber
At the timing of 50.5 sec., SV2 is activated to connect MV2-1 and VACUUM line, which enables the diluent in the reagent cubitainer outside Main Unit into CELLPACK Chamber. This operation continues until Float Switch turns OFF.

(2) Rinsing Dilution Line in RBC/WBC Pre Diluted Mode
At the timing of 50.5 sec., SV6, SV7 and SV8 are activated to make MV7-1 and MV7-2 switch to the PD Mode. RBC and WBC/HGB DPs dispense the diluent into each of RBC/WBC TD Chambers via each of RBC/WBC PD Mode Dilution lines respectively. This operation enables RBC/WBC PD Mode Dilution line to be rinsed.

(3) Draining Waste Chamber
SV1 is activated between 53.5 sec. and 56.5 sec. to release Pinch Valve controlling the draining of Waste Chamber. At the same time, MV1-1 and PRESSURE line are connected to apply pressure on Waste Chamber to drain the waste outside Main Unit via the draining line.


Sequence 9 (50.5 – 57.5 second)
SV5
SV4
MV4
MV8-3
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV15
SV15
HGB Cell
WBC Transducer
SV9
MV 14-2
MV8-1
MV8-2
SV8
2.0ml
WBC/HGB DP
SV7
MV7-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
MV7-1
SV6
2.1ml
RBC DP
SV19
MV19
MV21-1
MV18
SV18
Dilution Mode
Dilution Asp. DP
SV20
MV20
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
CELLPACK Chamber
MV2-1
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

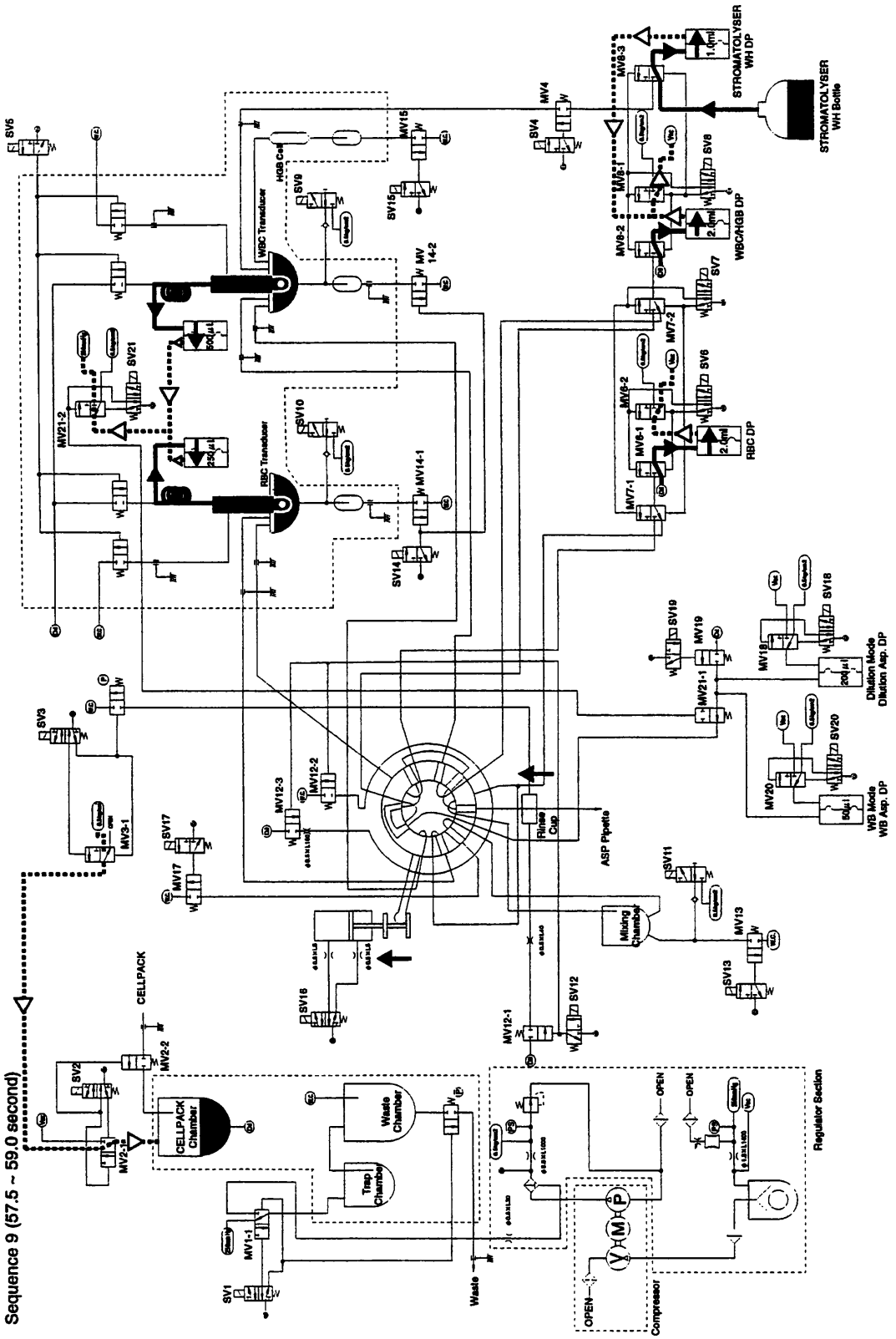
Sequence 9 (57.5 sec. - 59.0 sec.)

(1) Removing Air Bubble in Waste Chamber
SV3 is activated between 57.6 sec. and 58.4 sec. to apply pressure on CELLPACK Chamber to prevent the air bubble generated at the upper part of the chamber when aspirating diluent from flowing back into the vacuum line.

(2) Aspirating Reagent
At the timing of 57.5 sec., SV6 and SV8 close, and then RBC and WBC/HGB DPs aspirate 2.0 mL each of reagent to prepare for the next sequence respectively.

(3) SRV Rotation
At the timing of 52.0 sec., SV16 is deactivated and SRV rotates in the CW direction to return to the home position.

(4) Rinsing RBC/WBC Count Line
At the timing of 57.7 sec., SV21 is activated, and RBC/WBC Counting DPs aspirate the diluent in the TDs and rinse RBC/WBC count lines. At the timing of 58.5 sec., SV21 closes to drain the diluent after rinsing by the DP.

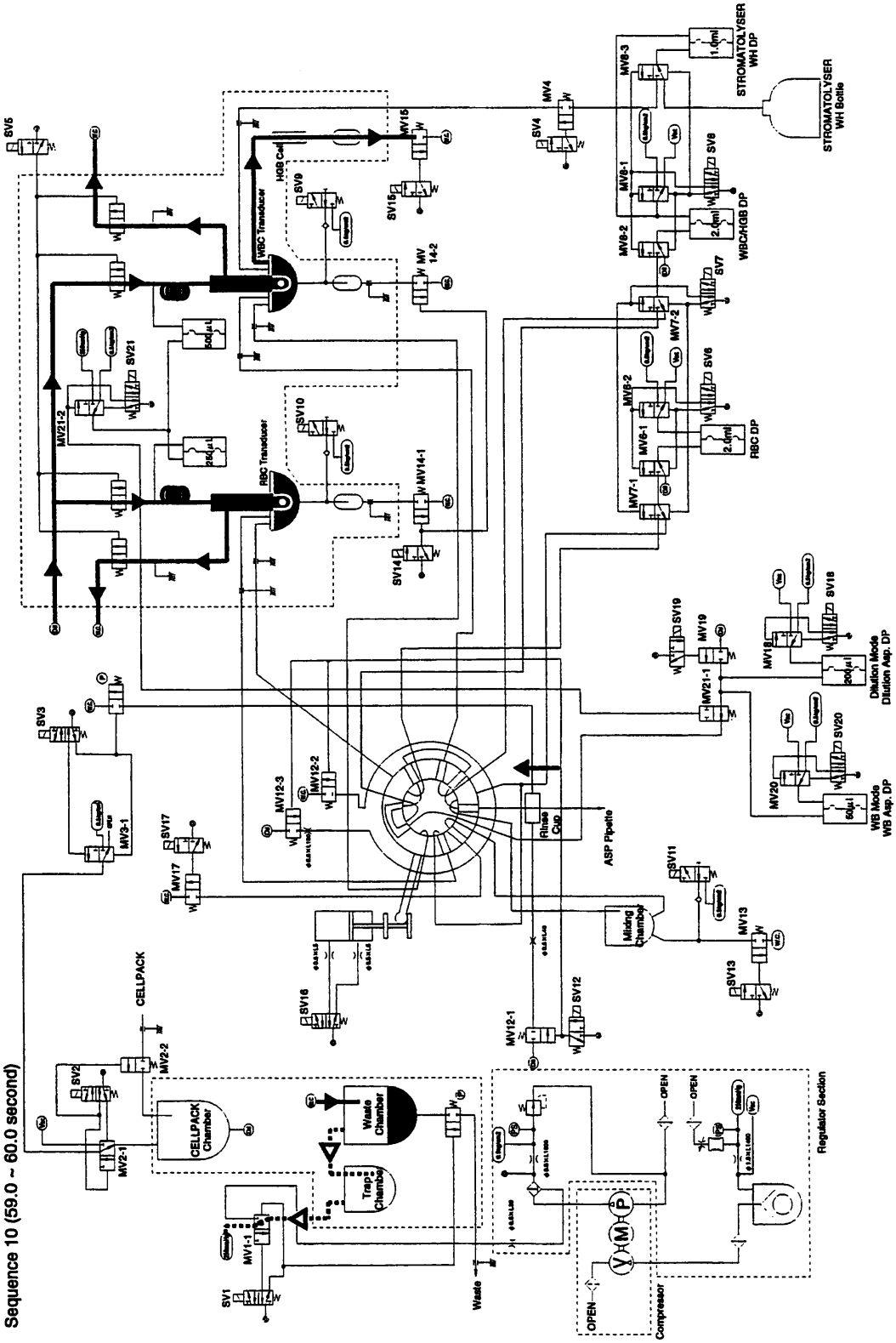

Sequence 9 (57.5 ~ 59.0 second)
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
WBC/HGB DP
RBC DP
WBC Transducer
RBC Transducer
HGB Cell
Dilution Mode Dilution Asp. DP
WB Mode WB Asp. DP
Rinse Cup
ASP Pipette
Mixing Chamber
CELLPACK
CELLPACK Chamber
Waste Chamber
Trap Chamber
Waste
OPEN
Compressor
Regulator Section

Sequence 10 (59.0 sec. - 60.0 sec.)

(1) Removing Air in WBC, RBC TDs
SV5 is activated between 59.2 sec. and 60.0 sec. to apply vacuum on Waste Chamber to aspirate the diluent and fill WBC/RBC TDs with it, which enables the air remained around the apertures in the previous sequence to be removed.

(2) Draining HGB Flow Cell
SV15 is activated between 59.2 sec. and 60.0 sec. to connect MV15 and Waste Chamber. By applying the vacuum (250 mmHg) on Waste Chamber, the diluent in WBC TD Chamber is dispensed into HGB Flow Cell to clean the Cell. At the same time, the clean diluent remains in Flow Cell to avoid the precipitation of the crystals.

(3) Initializing Rinse Cup Position (Returning to the Home Position)
From the timing of 57.7 sec., the stepper motor is driven to return Rinse Cup to the home position.


Sequence 10 (59.0 ~ 60.0 second)
SV5
SV4
MV4
MV8-3
1.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV8
MV8-2
2.0ml
WBC/HGB DP
MV6-2
SV7
MV7-2
SV6
MV8-2
MV6-1
2.0ml
RBC DP
MV7-1
HGB Cell
HGB Transducer
MV15
SV15
SV9
MV 14-2
500µl
SV21
MV21-2
250µl
RBC Transducer
SV10
MV14-1
SV14
SV19
MV19
MV21-1
MV18
SV18
200µl
Dilution Mode
Dilution Asp. DP
SV20
MV20
60µl
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
Regulator Section
OPEN
Compressor

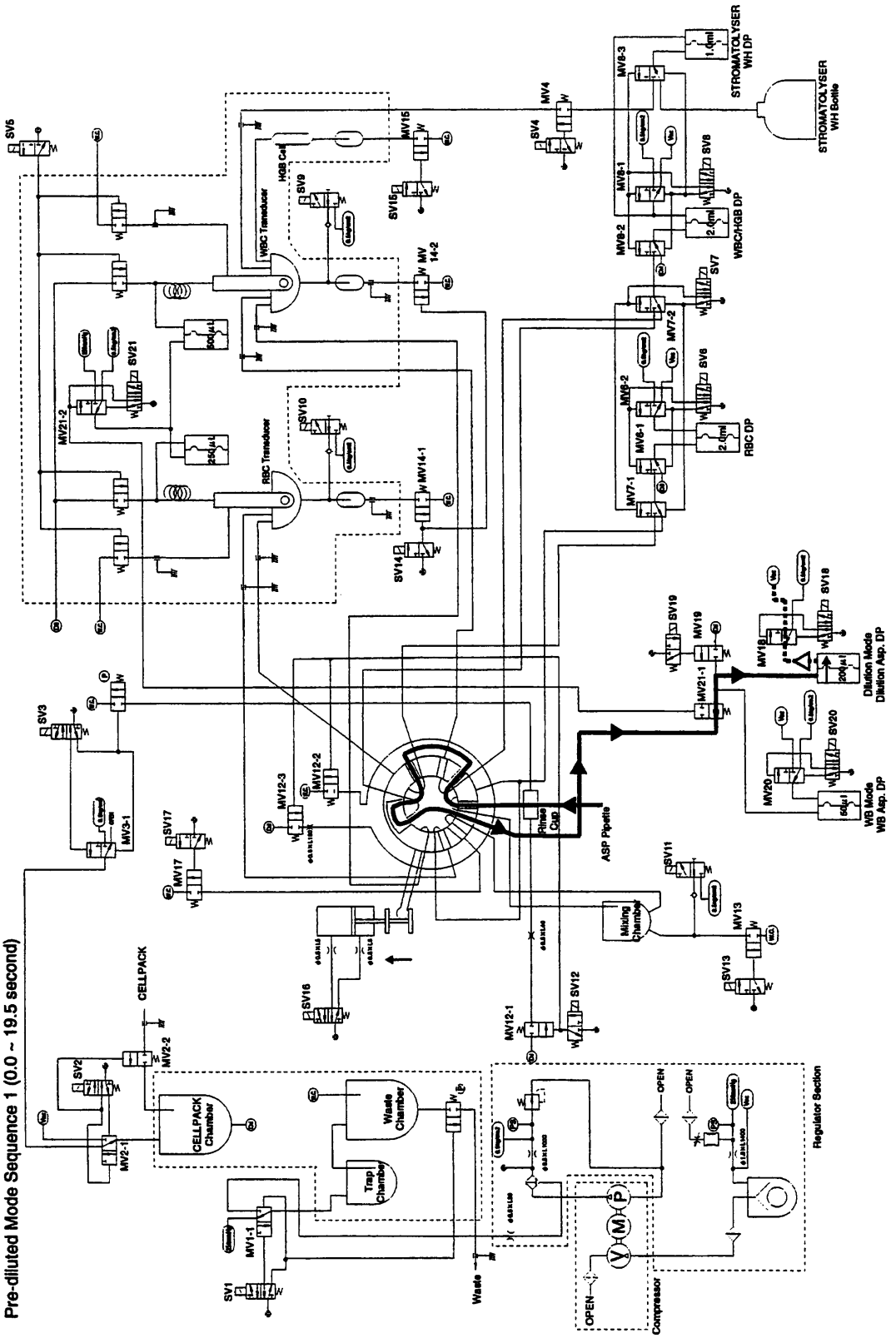
2.12.2 Pre-Diluted Mode

The following is only the different part of the analysis flow in KX-21 Pre-Diluted Mode from Whole Blood Mode in accordance with Timing Charts in *Section 7*.

PD Mode Sequence 1 (0.0 - 19.5 sec.)

(1) Sample Aspiration

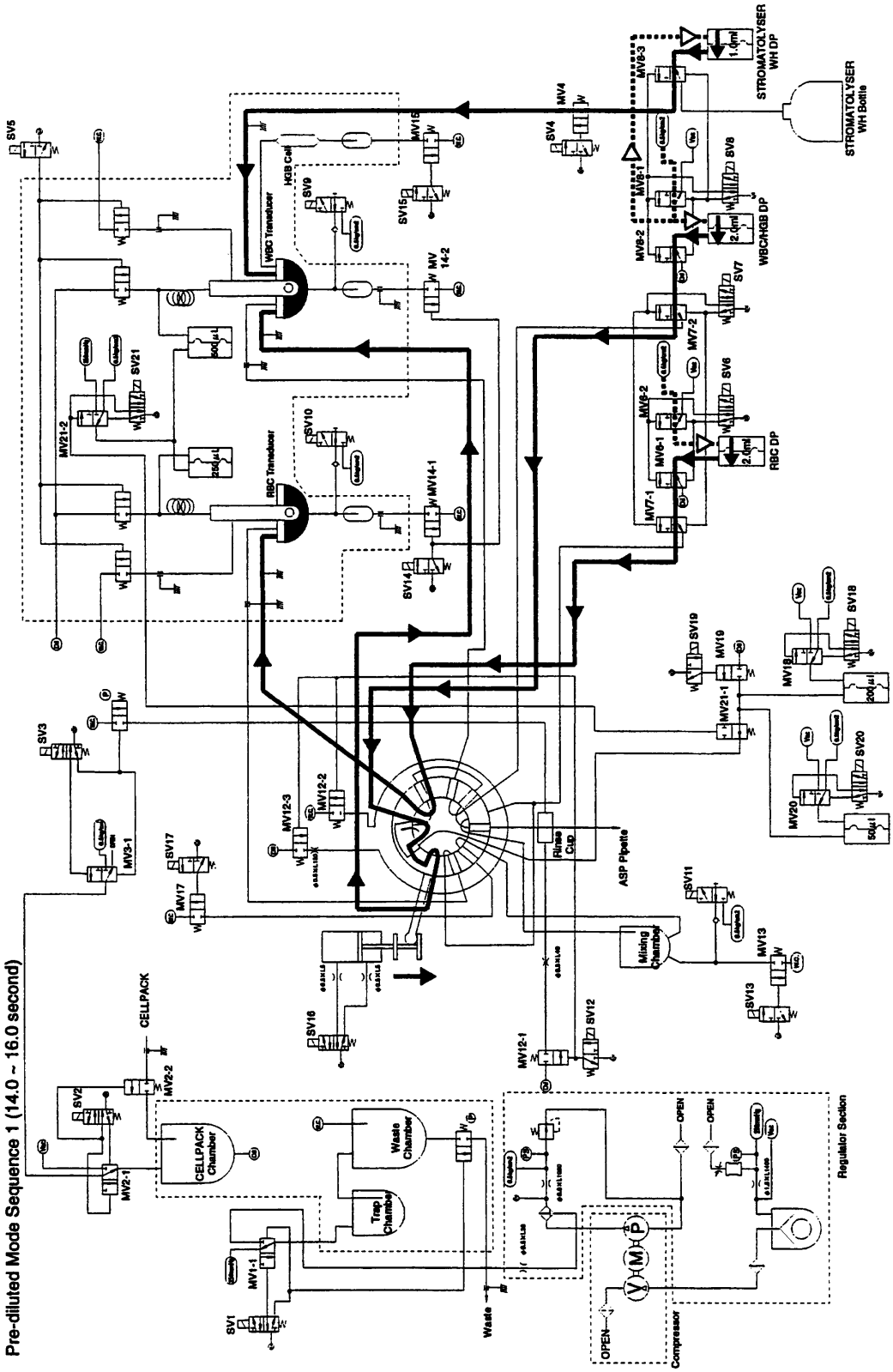
Pressing Start Switch activates SV18, applies vacuum on DP (Diaphragm Pump) for aspirating the diluted sample, and then aspirates 200 µL of diluted sample blood through Aspiration Pipette. The aspirated diluted sample passes through SRV (Sample Roter Valve) and waits for the next sequence. SV18 is operating from 0.0 sec. to 19.5 sec. of Sequence 1.


Pre-diluted Mode Sequence 1 (0.0 ~ 19.5 second)
SV5
SV4
MV4
MV15
SV15
SV9
HGB Cell
WBC Transducer
MV 14-2
SV21
MV21-2
SV10
RBC Transducer
MV14-1
SV14
MV8-3
1.4ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-1
SV8
MV8-2
2.4ml
WBC/HGB DP
SV7
MV7-2
MV6-2
SV6
MV6-1
2.4ml
RBC DP
MV7-1
SV19
MV19
MV18
SV18
200µl
Dilution Mode
Dilution Asp. DP
MV21-1
SV20
MV20
60µl
WB Mode
WB Asp. DP
SV3
MV3-1
MV12-3
MV12-2
Rinse Cup
ASP Pipette
SV17
MV17
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
OPEN
OPEN
Compressor
Regulator Section

PD Mode Sequence 5 (14.0 - 16.0 sec.)

(1) Diluting RBC Sample
At the timing of 14.0 sec., SV6 and SV7 are activated, which enables RBC DP to dispense 2.0. mL of diluent and 2.08 µL of 1 : 26 RBC Sample cut away by SRV into the RBC TD Chamber through the RBC PD Mode Dilution line. This enables the sample to be diluted by 25,000 times in RBC TD Chamber.

(2) Diluting WBC Sample
At the timing of 14.0 sec., SV7 and SV8 are activated, which enables WBC DP to dispense 2.0. mL of diluent and 78 µL of WBC Sample cut away by SRV into the WBC TD Chamber. At the same time, STOROMATOLYSER-WH DP dispenses 1.0 mL of Lyse reagent into WBC TD Chamber, which enables the sample to be diluted by 10,000 times in WBC TD Chamber.


Pre-diluted Mode Sequence 1 (14.0 ~ 16.0 second)
SV5
SV4
MV4
MV16
SV15
SV9
WBC Transducer
HGB Cell
MV 14-2
MV8-3
1.0ml
STROMATOLYSER WH DP
STROMATOLYSER WH Bottle
MV8-2
MV8-1
SV8
2.0ml
WBC/HGB DP
SV7
MV7-2
MV21-2
SV21
SV10
RBC Transducer
MV14-1
SV14
MV6-2
SV6
MV6-1
2.0ml
RBC DP
MV7-1
SV19
MV19
SV18
MV18
MV21-1
SV20
MV20
SV3
MV3-1
MV12-3
MV12-2
SV17
MV17
Rinse Cup
ASP Pipette
SV11
Mixing Chamber
MV13
SV13
SV16
MV12-1
SV12
CELLPACK
MV2-2
SV2
MV2-1
CELLPACK Chamber
Waste Chamber
Trap Chamber
MV1-1
SV1
Waste
OPEN
Compressor
Regulator Section

2.13 PNEUMATIC & HYDRAULIC PARTS

Pneumatic Controls are used to regulate the air-flow, and to change the direction of flow.

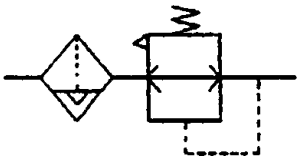
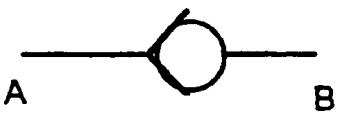
Name & Symbol	Figures	Used for
Regulator 		Regulator is used to regulate airflow rate, which is adjusted by turning the Adjustment Knob. Only on regulator, which is shown in left figure, is used in the KX-21. This regulator is used to regulate 2.0 kg/cm^2 air pressure into 0.5 kg/cm^2 pressure with an air filter and auto draining mechanism.
Non-Return Valve 		The Non-return Valve permits hydraulic flow in only one direction from A to B. No hydraulic flow will occur from B to A.
Orifice 		An orifice controls the rate of airflow or the volume of air with respect to time. These orifices are identical to those used in the pneumatic and hydraulic system. There are several kinds of orifice each of which permits a different flow rate.

Table 2-1 Pneumatic and Hydraulic Parts (1)

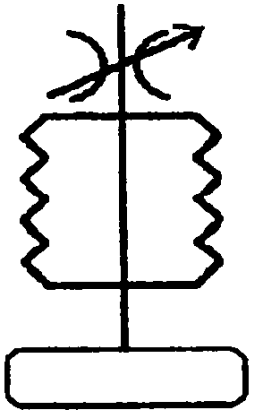
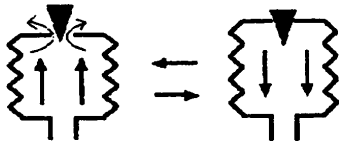
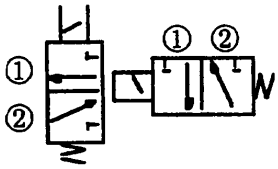
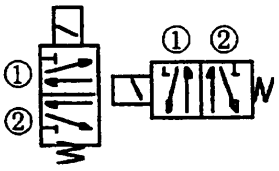
Name & Symbol	Figures	Used for
Bellows 		The bellows unit in the KX-21 is used to regulate the vacuum (480 mmHg or more) into 250 mmHg. This unit consists of bellows and small air tank. If the inner vacuum exceeds the mechanical pressure of bellows, vacuum is released from its top port. If the mechanical pressure exceeds the inner vacuum of bellows, vacuum increases after the top port is closed by the needle valve. (See below figures.) 
3-ports type Solenoid Valve  **5-ports type Solenoid Valve**  Status of Solenoid Valve ① SV is turned ON. ② SV is OFF.		Two types of Solenoid valves (3-port and 5-port type) are used in the hydraulic system. Solenoid Valves are driven by applying 12 VDC which are controlled by computer program, and are used to control the pneumatic pressure to drive Master valves, Air cylinder, or Air Bubble Mixing. Solenoid valve symbol has two boxes in its drawing. Arrows in these boxes indicate the status of connection. Status (1) or (2) shown in “Name & Symbol” column will be switched by the activation of solenoid valve by the activation or deactivation of solenoid valve respectively.

Table 2-1 Pneumatic and Hydraulic Parts (2)

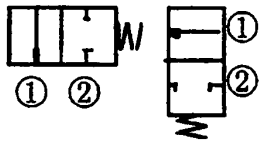
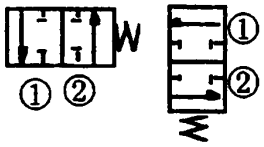
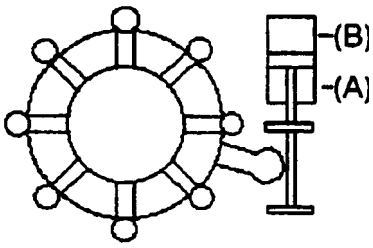
Name & Symbol	Figures	Used for
2 ports type Master Valve  **3 ports type Master Valve**  Status of Master Valve ① MV is turned ON. ② MV is OFF.		Master valves in KX-21 are used to switch Hydraulic lines (liquid, 0.5 kg/cm^2 pressure, and 480 mmHg/250 mmHg vacuum). Two types of Master Valve (2-port and 3-port type) are used in the hydraulic system. Master Valves are driven by 2 kg/cm^2 air pressure controlled by Solenoid valves. Master valve symbols has also two boxes in its drawing. Arrows and lines in these boxes indicates hydraulic ways. Status (1) or (2) shown in "Name & Symbol" column will be switched by the activation or deactivation of master valve, respectively.
Sample Rotor Valve & Air Cylinder **Sample Rotor Valve & Air Cylinder**  		Sample Rotor Valve Mechanism is driven by the air cylinder. The air cylinder is provided with two (A and B) ports, (A) for pneumatic activation to rotate the SRV counter clockwise and the other (B) for pneumatic deactivation to reset the SRV. The 2 kg/cm^2 pressure for these action are supplied by a 3-port type solenoid valve.

Table 2-1 Pneumatic and Hydraulic Parts (3)

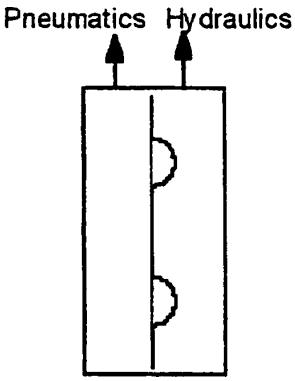
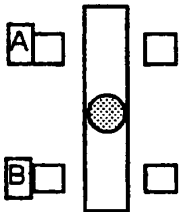
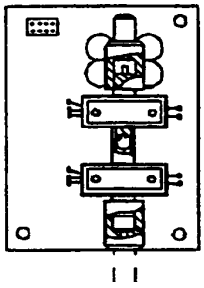
Name & Symbol	Figures	Used for
Diaphragm Pump 		Seven Diaphragm Pumps are used in the hydraulic system. Diaphragm Pumps are driven by 0.5 kg/cm^2 air pressure and 480 mmHg vacuum controlled by Master valves, and dispenses or aspirates constant volume of liquid. Diaphragm Pumps are drawn by left symbols in sequence flow charts. Diaphragm Pump has two nipples on it. One is to connect to pneumatic system (0.5 kg/cm^2 pressure or 480 mmHg vacuum), and the other is to hydraulic system. Either of pressure or vacuum is always supplied to the pneumatic side nipple. If the vacuum is supplied to pneumatic side nipple, the fixed volume of liquid is aspirated into the diaphragm pump. If the pressure supplied, the fixed volume of liquid is dispensed from the diaphragm pump.
Manometer 		Ball float manometers are located in detector blocks, and are used to detect constant volume of diluted sample, which are aspirated through the transducer aperture.
Isolation Chamber 		These Isolation Chambers are used to isolate the liquid in detector block from the remaining hydraulic line in the system in order not to be influenced by the external noise through the hydraulic line.

Table 2-1 Pneumatic and Hydraulic Parts (4)

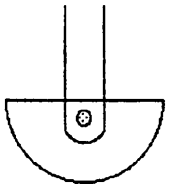
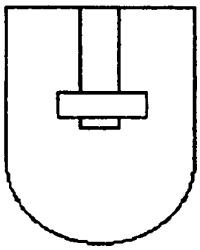
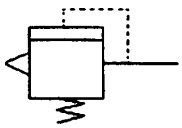
Name & Symbol	Figures	Used for
Transducer Chamber 		Diluted samples of WBC or RBC are dispensed into each transducer chamber, mixed by air bubbles, and constant volume of the sample is aspirated through the aperture.
Pressure Gauge 		Four pressure gauges are used in the system to check the following pressures or vacuums. Pneumatic unit 1: 2.0 kg/cm^2 2: 480 mmHg vacuum Main unit 3: 0.5 kg/cm^2 4: 250 mmHg vacuum
2.0 kg/cm^2 pressure source 		2 kg/cm^2 pressure is used to drive the master valves and SRV air cylinder. To make simple the hydraulic flow chart, the symbol in the "Name & Symbol" column is used.
Glass Chamber 		Glass chambers with float switch are used as Waste Chamber, Diluent Chamber, and lyse reagent chamber. 480mmHg or 250 mmHg vacuum is applied into these chambers to aspirate or prime liquid. When exhausting the waste liquid in Waste Chamber, 0.5 kg/cm^2 is applied instead of vacuum. Float switch is provided with these chambers to prevent overflow of these chambers.
Relief Valve 		The Relief Valve releases air pressure if the supplied air pressure exceed the preset value. This valve is adjusted by turning the knurled knob.

Table 2-1 Pneumatic and Hydraulic Parts (5)