

Continuous Atmospheric Mercury Sampling



**Asia Pacific Mercury
Monitoring Network**



Center for Environmental
Monitoring and Technology
National Central University

1. MERCURY MONITORING IN AMBIENT AIR

Why the Interest in Atmospheric Mercury?

- ❖ Mercury is one of the most potent neurotoxins known
- ❖ Bio-accumulates up the food chain

Inorganic and ionic mercury can convert to **methyl mercury**

Sub-ppt levels in air can accumulate to toxic ppm levels in fish

- ❖ Global levels are not decreasing despite emission controls in the Western Hemisphere and Europe
- ❖ Long life in the atmosphere means that mercury emissions are of **global concern**

Ambient Air Mercury Speciation – Why?

❖ Types of mercury in ambient air:

- Elemental mercury: Hg^0 , (GEM)
- Reactive (ionic) mercury: Hg(II) , RGM, Hg^{2+} , (GOM)
- Particulate bound mercury: PHg, TPM, (PBM)

❖ Different forms of gaseous Hg have very different behaviors

❖ Forms can interconvert in the atmosphere and in various reservoirs

Mercury Detection - The Challenges

❖ Sensitivity

Mercury is present in the low ppt range

❖ Selectivity

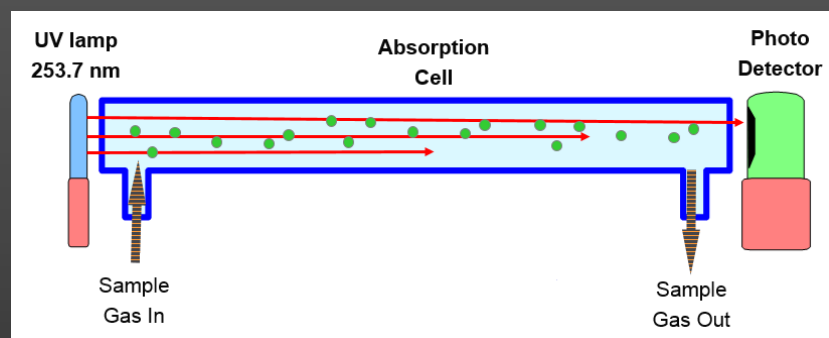
Potential interferents are present at *1000's of times* higher concentration than mercury: O_3 , SO_2 , NO_x , HCl .



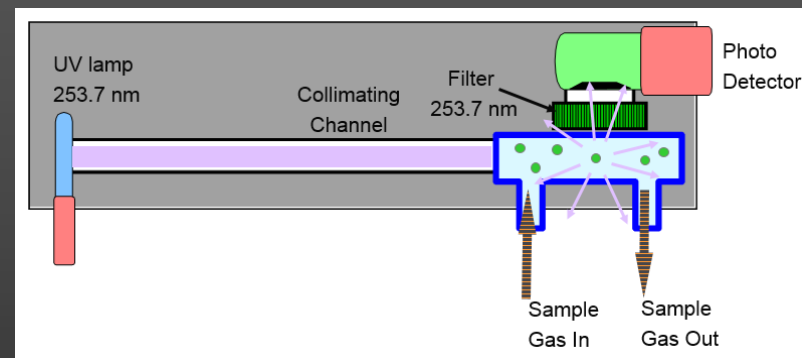
Mercury Detection Techniques

Two spectroscopic techniques used for analysis

Atomic Absorption (AA)

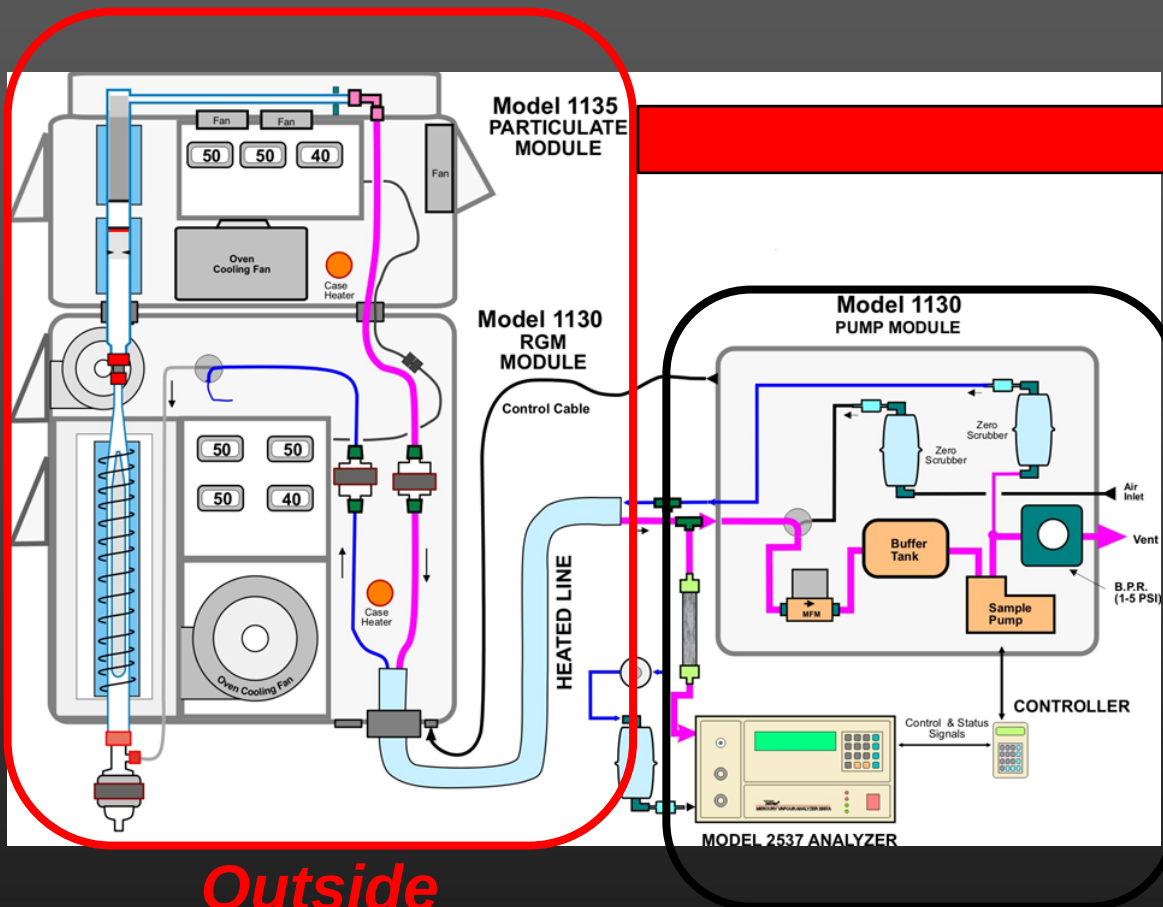


Atomic Fluorescence (AF)



- Much more sensitive than atomic adsorption (MDL < 0.1 pg absolute)
- Not subject to interferences
- Inherently linear

TEKRAAN SYSTEM 2537/1130/1135



Outside

Inside

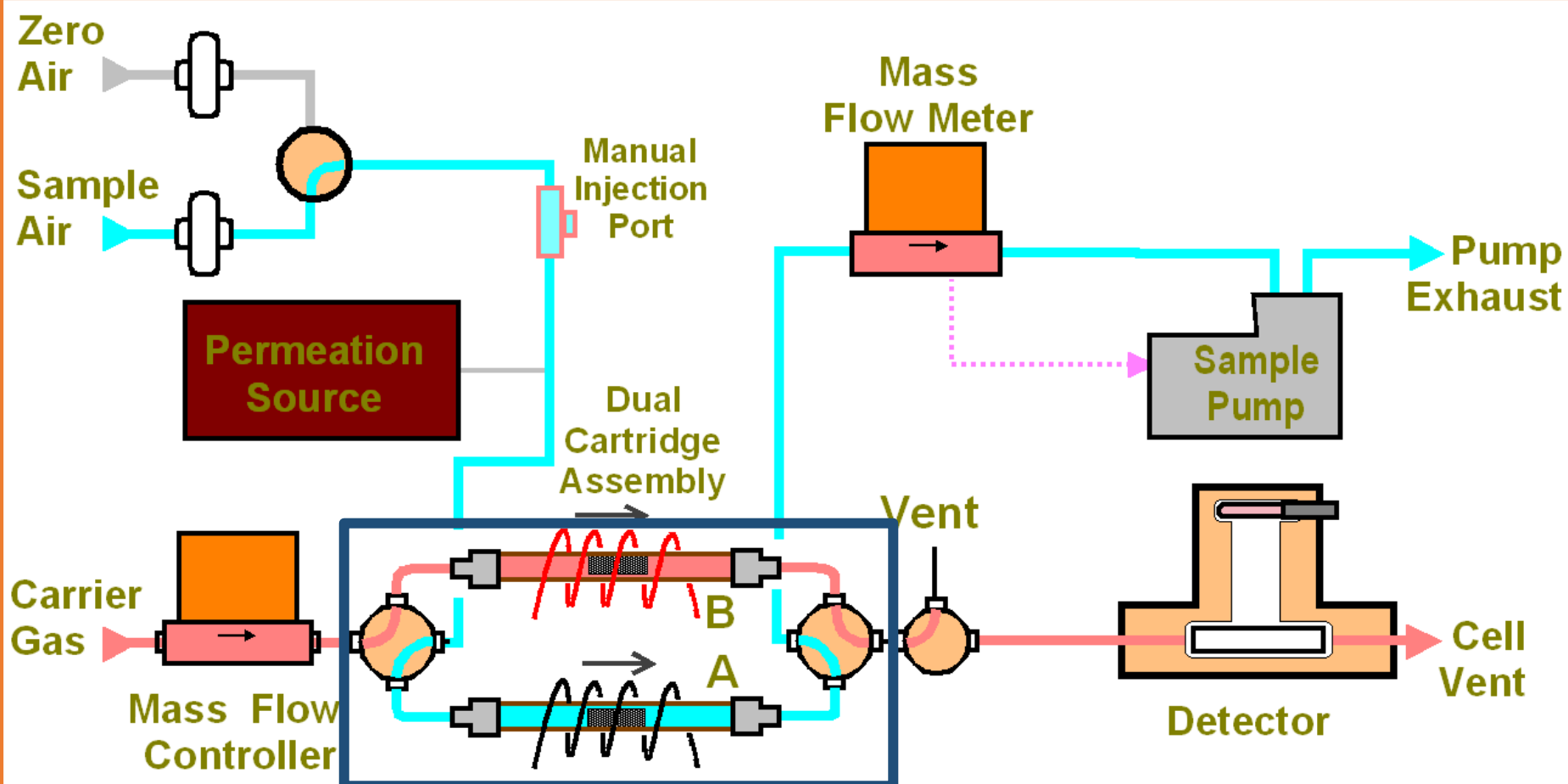


Model 2537 Analyzer

- ❖ Automated implementation of gold/AF manual method
 - ❖ Has largely supplanted manual cartridge methods
 - ❖ Detection limit **< 0.1 ng/m³** (5 min. samples)
 - ❖ Automatic recalibration with internal Hg⁰ permeation source
 - ❖ Capable of unattended operation for extended periods
 - ❖ Two cartridges are used to alternately sample and desorb
- No gaps in data stream



Diagram of Tekran Model 2537

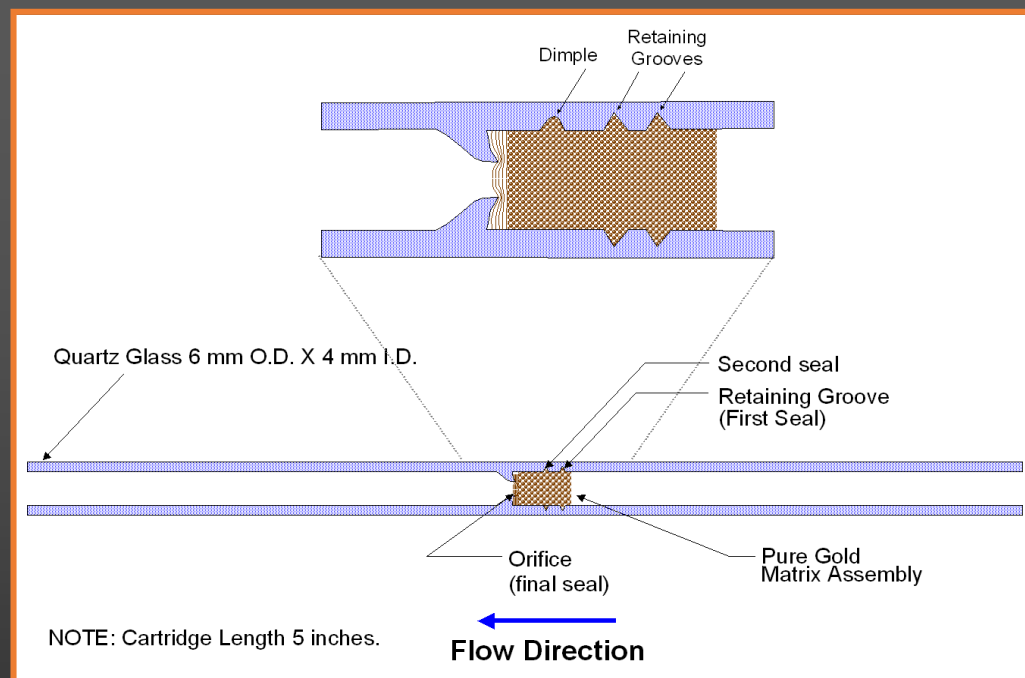


Tekran Pure Gold Cartridge

❖ Pure gold is used as the mercury adsorbent

No quartz wool or silica

No memory effect



❖ Extremely durable design

Lasts for years of continuous use

Internal Permeation Source

- ❖ Allows automated, unattended calibrations

Ensures that analyzer results are always accurate

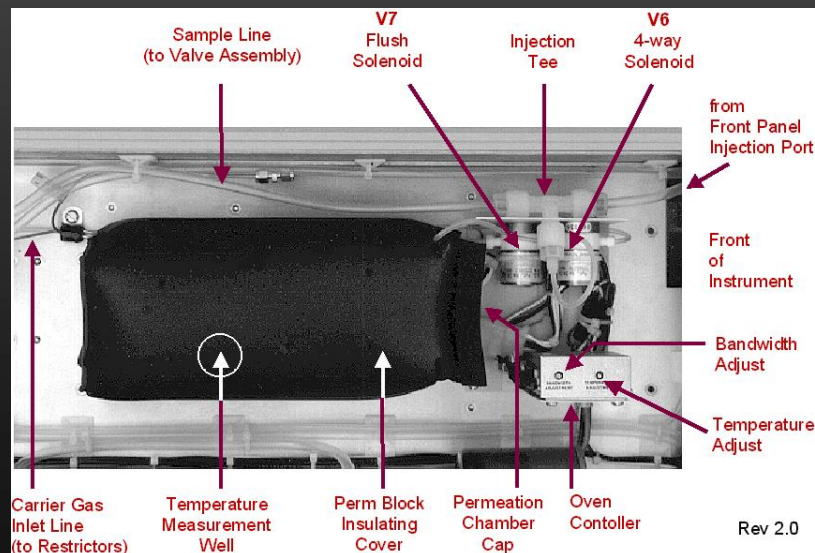
- ❖ Allows standard additions to sample gas

Ensures that analyzer is working properly

- ❖ Long life permeation tube

Low emission rate: Approx 30 $\mu\text{g}/\text{yr}$

Theoretical life: thousands of years!



Model 1130 Speciation System

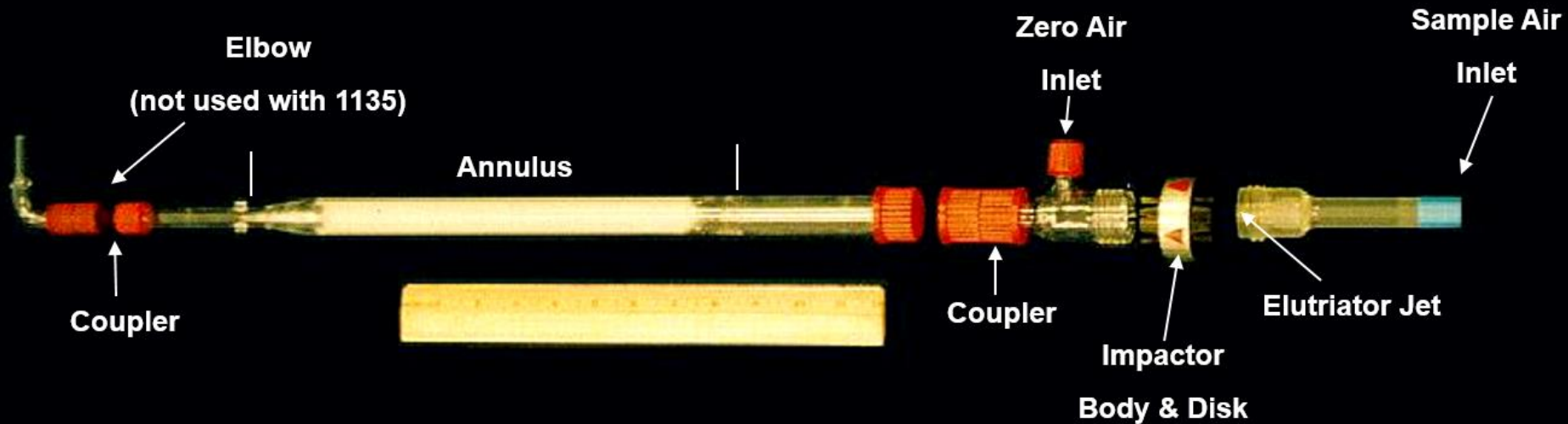
Denuder Module (highlighted)

- Located out of doors
- Contains denuder element within high performance oven
- Impactor inlet removes coarse particles ($> 2.5 \mu\text{m}$)
- Climate controlled enclosure



Quartz Denuder Assembly

Quartz, KCl coated annular denuder is thermal desorbed and regenerated.



Model 1130 Speciation System

1130 Pump Unit

- Located beside 2537
- Provides extra flow required during sampling
- Generates the zero air required during desorption
- Also provides all zero air required by Model 2537



Heated line (not shown)

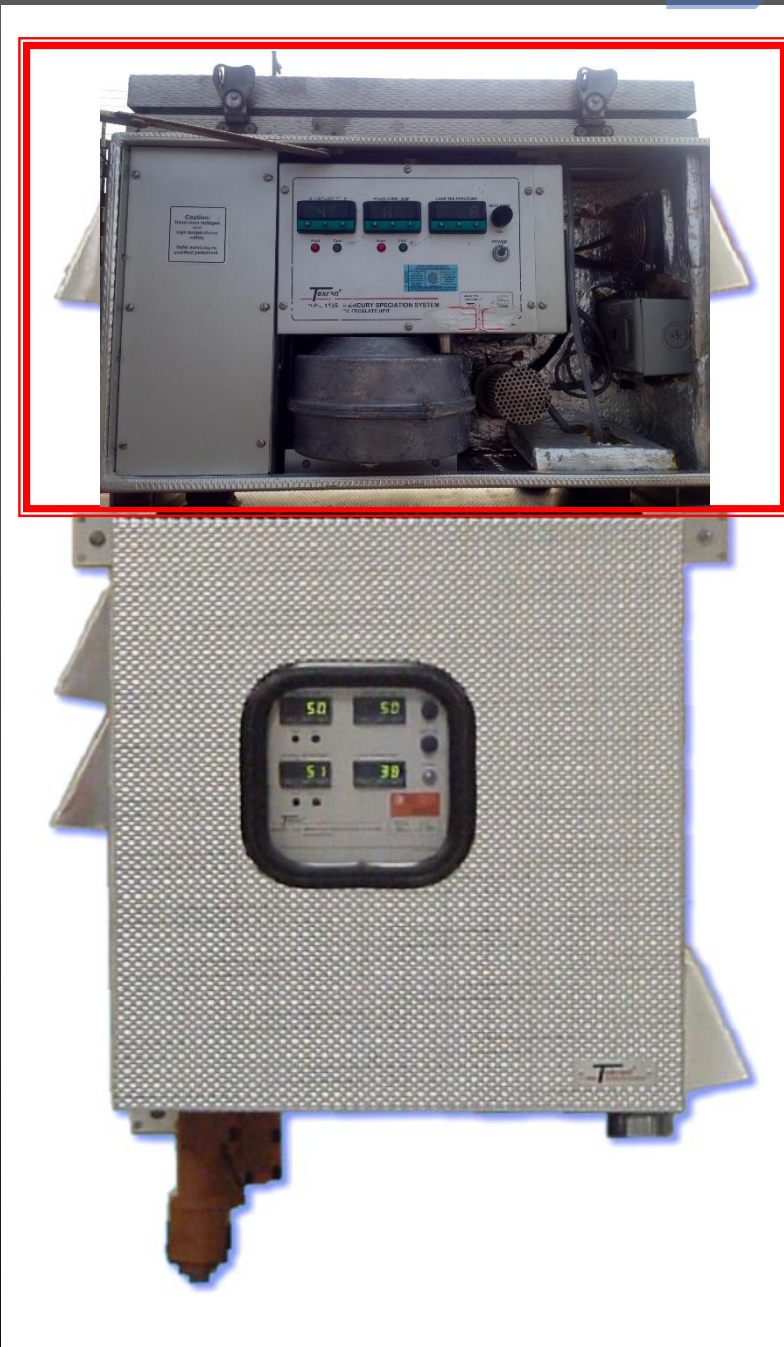
- 25 ft. length connects the two modules

Model 1130 - Principles of Operation

- ❖ Quartz, KCl coated annular denuder is thermally desorbed and regenerated
- ❖ Sampling Phase
 - Absorbs GOM while passing all GEM
 - Model 2537 reads **GEM** during this phase
- ❖ Desorption/Analysis Phase
 - Zero air used as carrier
 - GOM released as elemental mercury

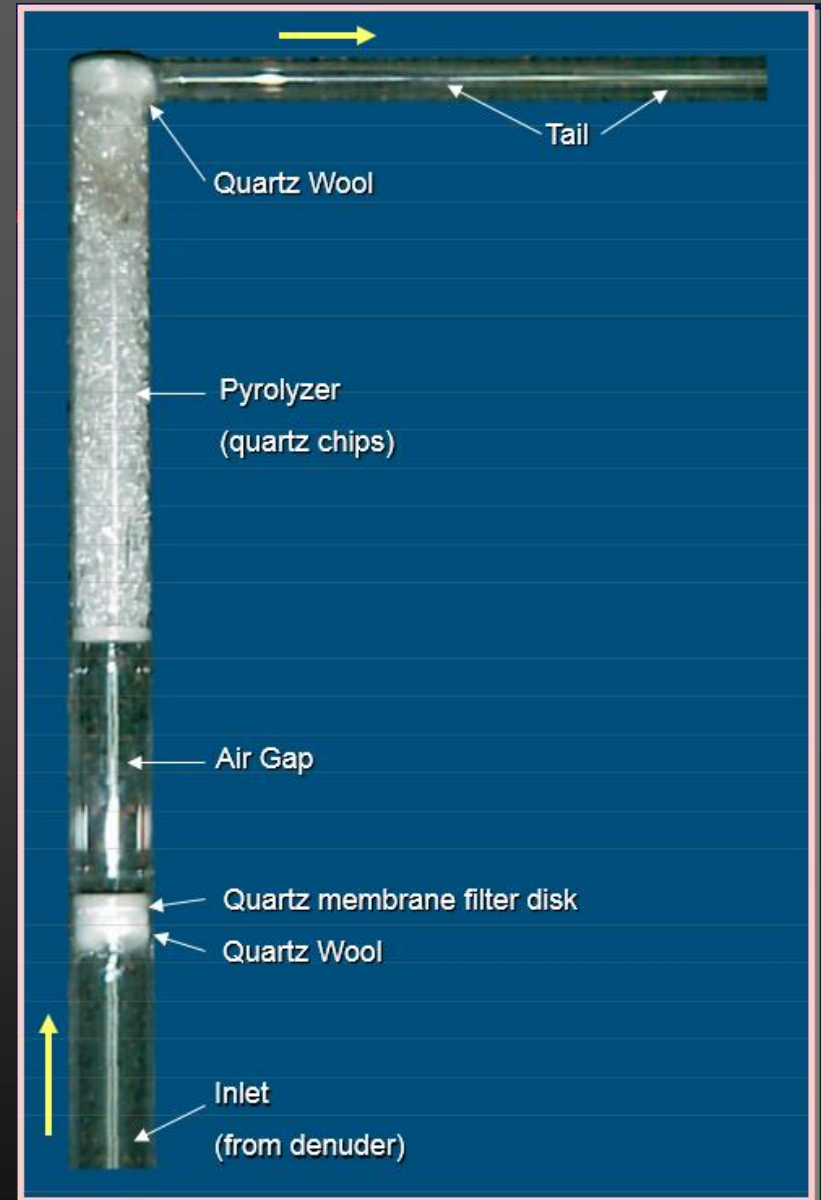
Model 1135 – Particulate Mercury Monitor

- ❖ Unit stacks on top of Model 1130
- ❖ Allows *simultaneous* determination of GEM, GOM and PBM
- ❖ Detection limit $< 2 \text{ pg/m}^3$



RPF

- ❖ Quartz wool captures bulk of particulate matter
- ❖ Quartz filter membrane provides sharp cut-off ($<0.1 \mu\text{m}$)
- ❖ Built in pyrolyzer section converts desorbed species to elemental Hg
- ❖ Tail provides cooling



Model 1135 - Principles of Operation

Sampling Phase

Sample passes through impactor to eliminate coarse particles ($> 2.5 \mu\text{m}$)

Quartz, **Regenerable Particulate Filter (RPF)** captures fine fraction ($< 2.5 \mu\text{m}$) particulates

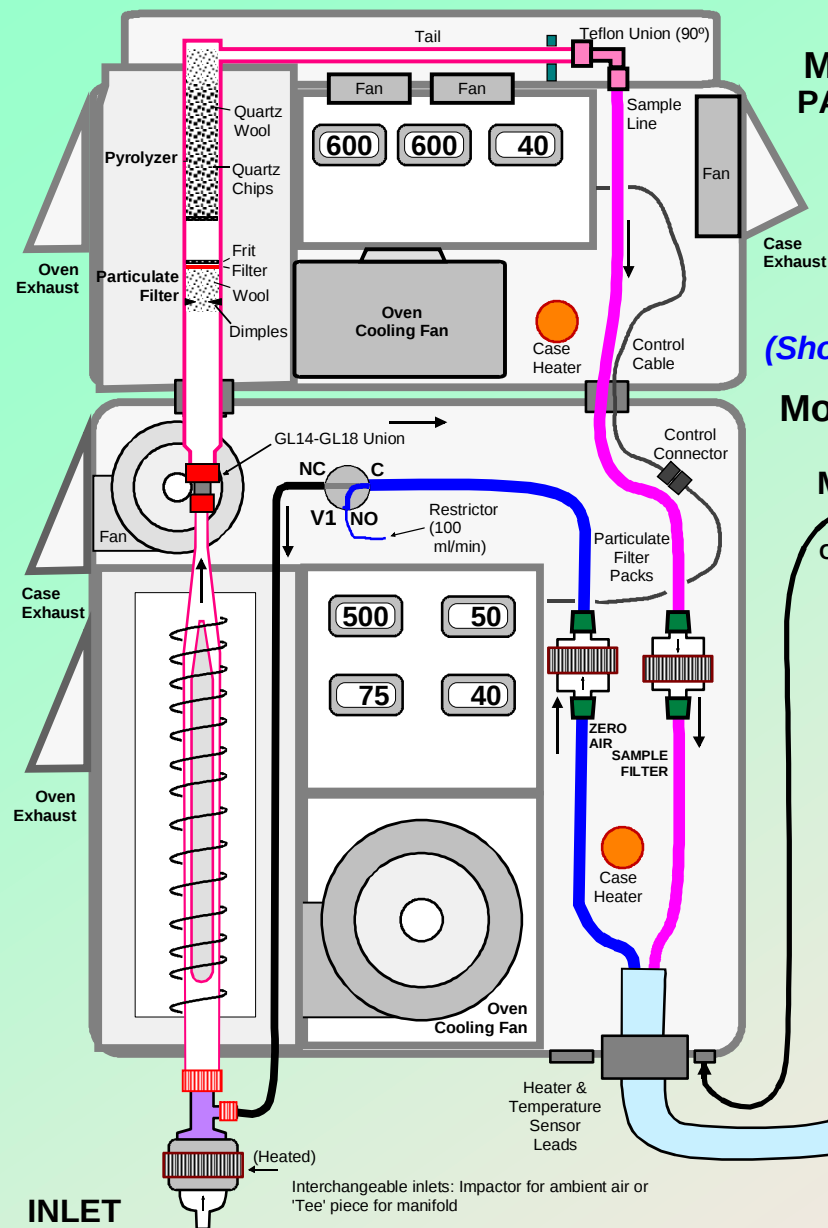
Desorption/Analysis Phase

Zero air used as carrier

Downstream **pyrolyser** is activated first

RPF is then heated to desorb captured particulates

3. SAMPLING & ANALYSIS



**Model 1135
PARTICULATE
MODULE**

(Shown in Sampling Mode)

**Model 1130
RGM
MODULE**

Control Cable

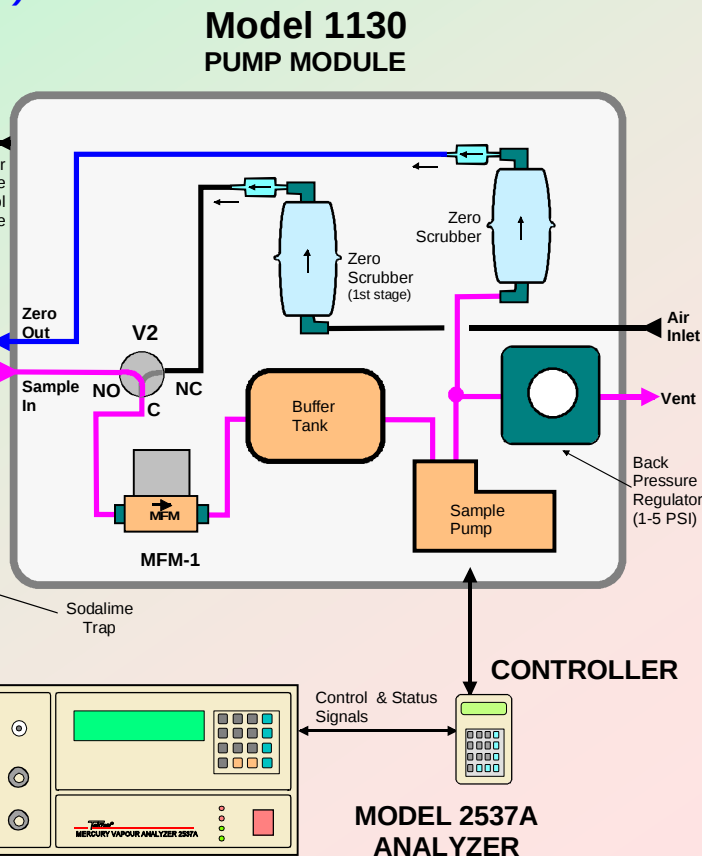
Zero Air (to Denuder Module)

HEATED LINE

**Zero Filter
(provided with 2537A)**

Sample Inlet

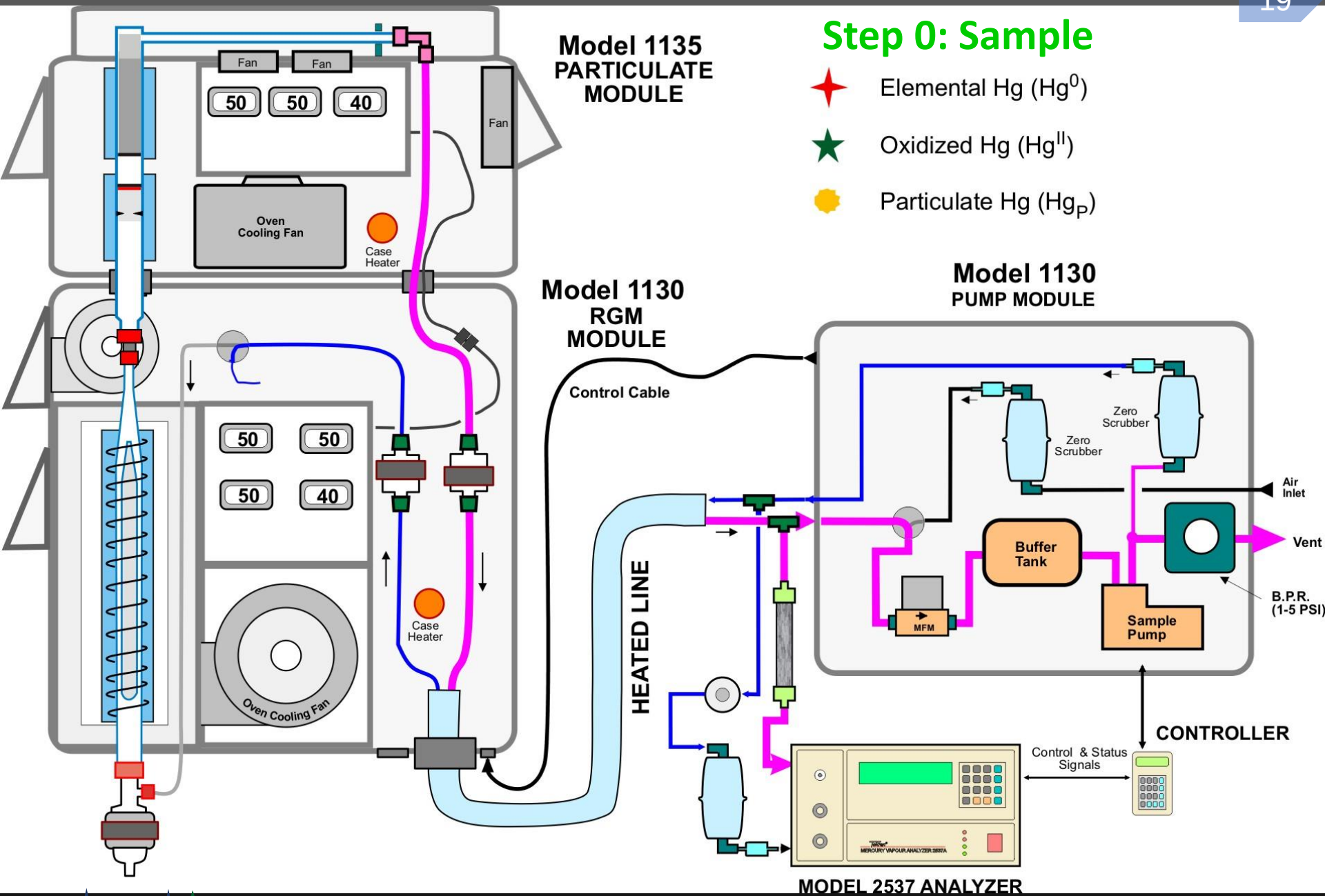
Zero Inlet

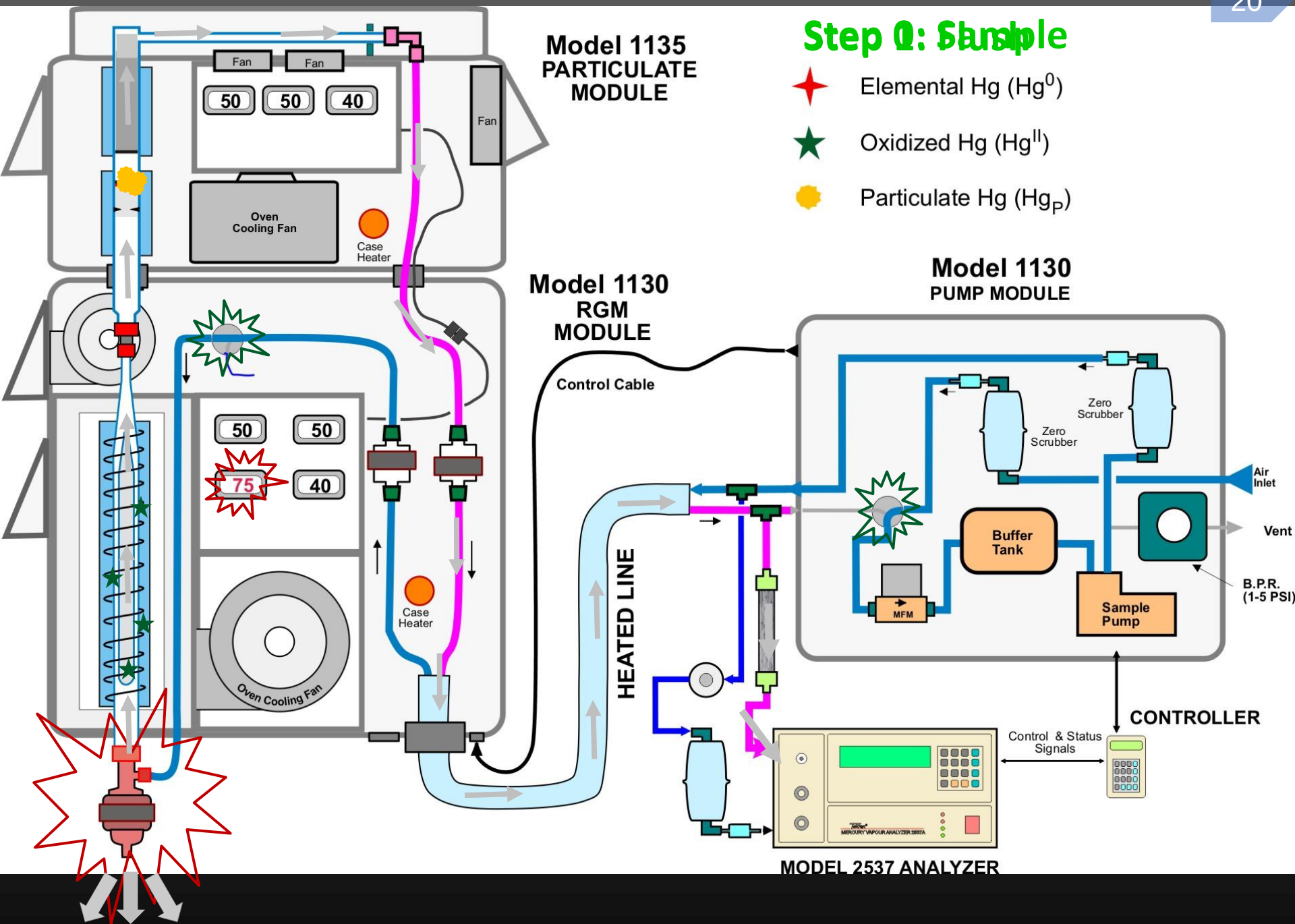


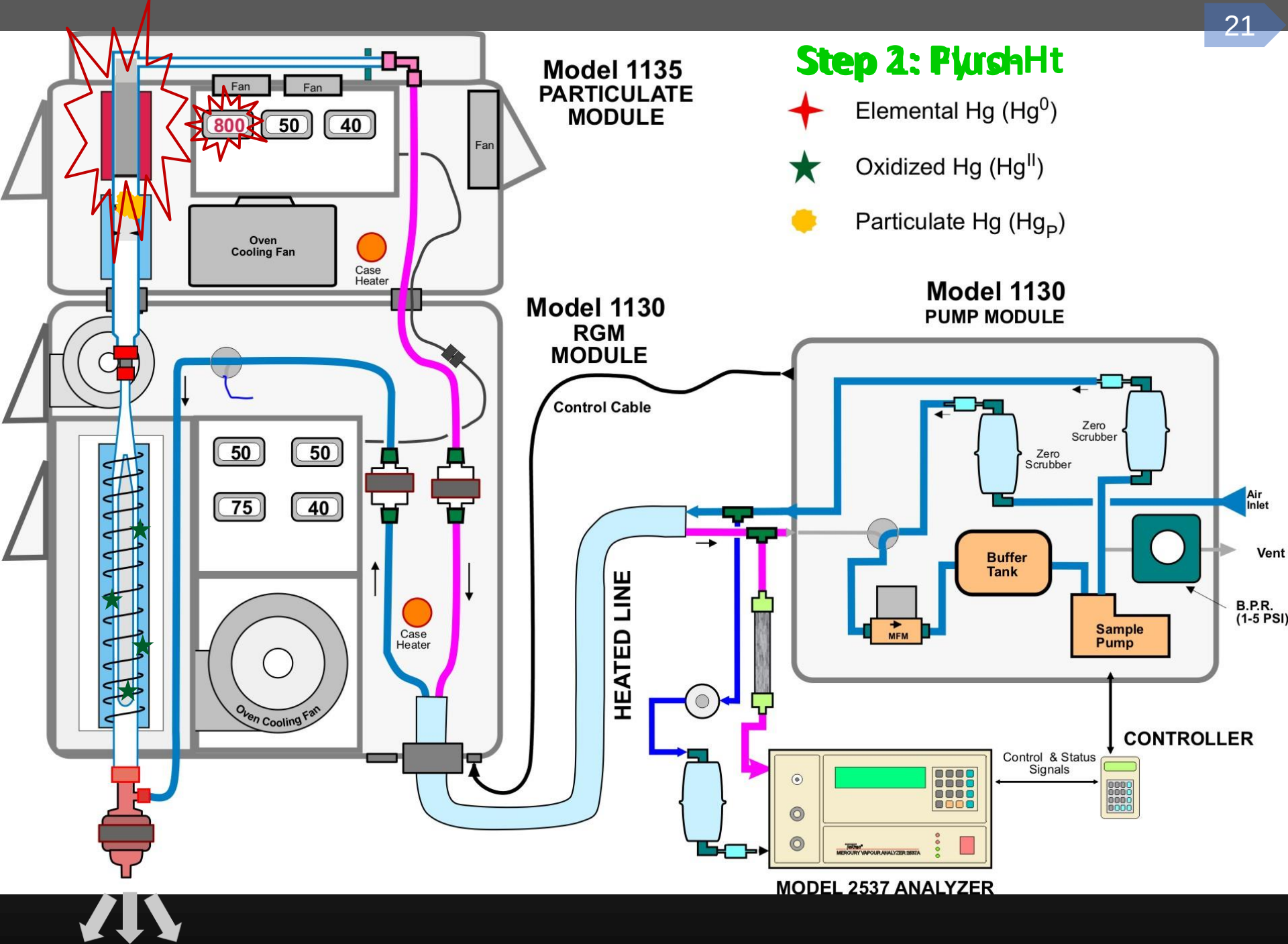
**Model 1130
PUMP MODULE**

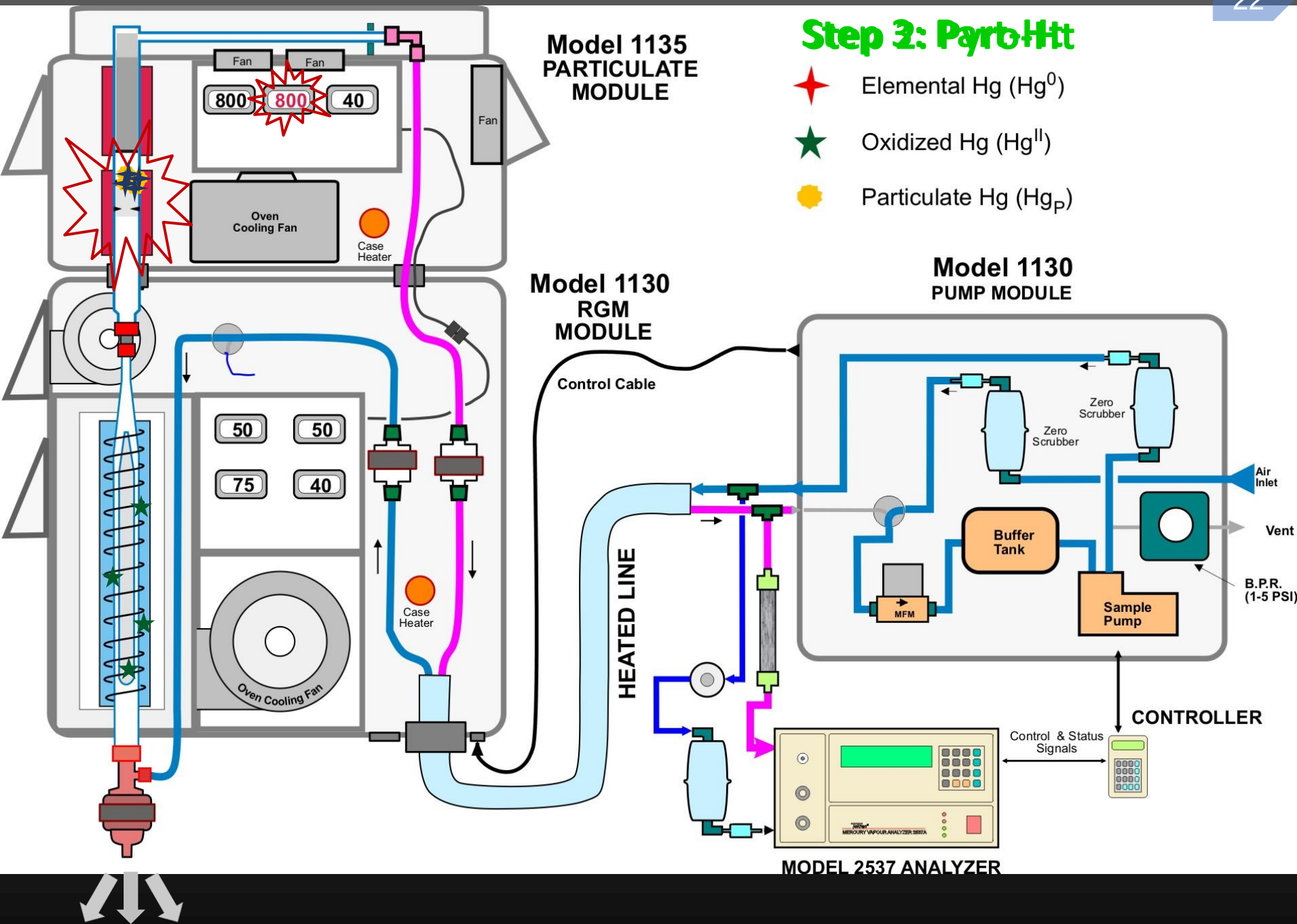
CONTROLLER

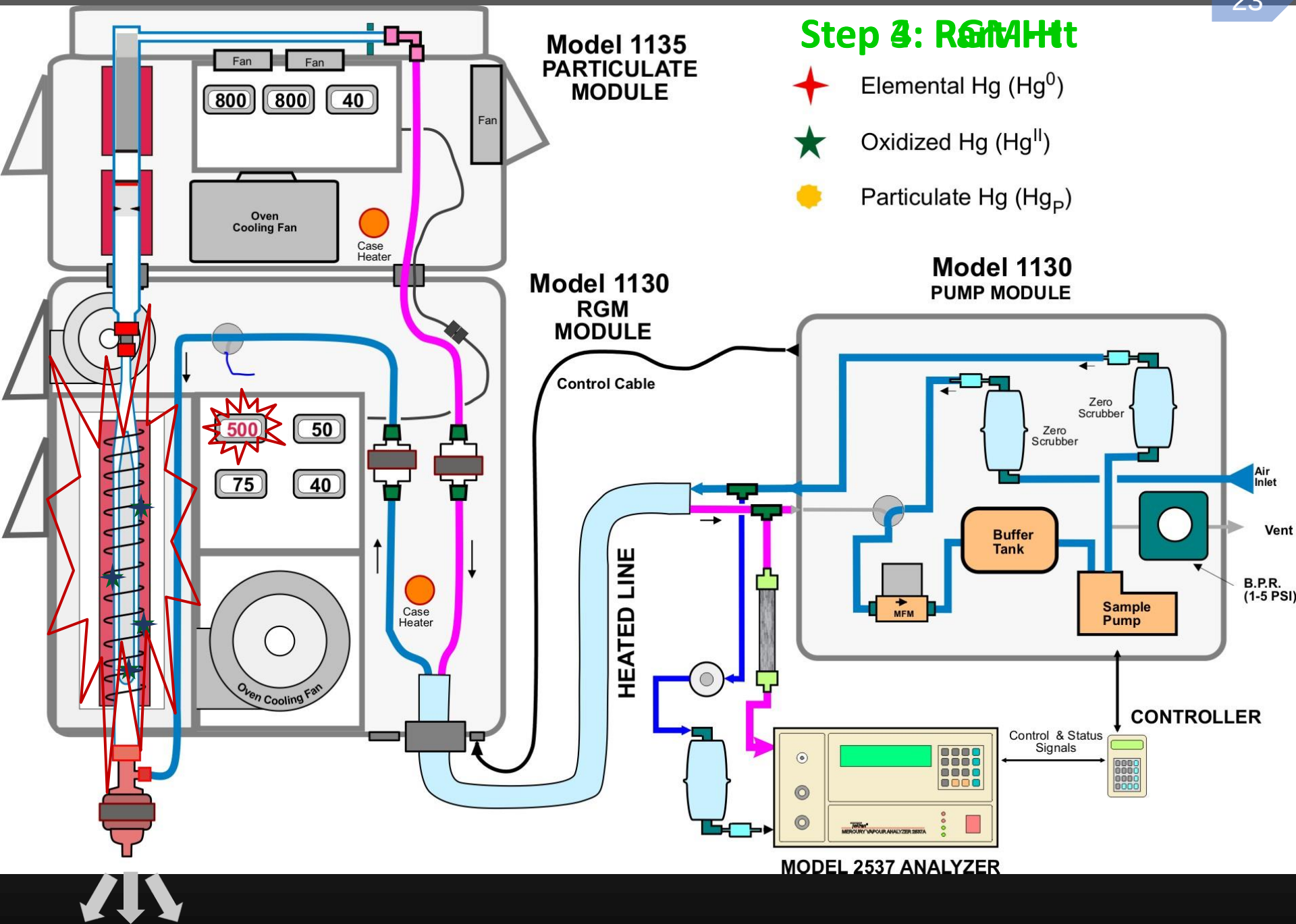
**MODEL 2537A
ANALYZER**

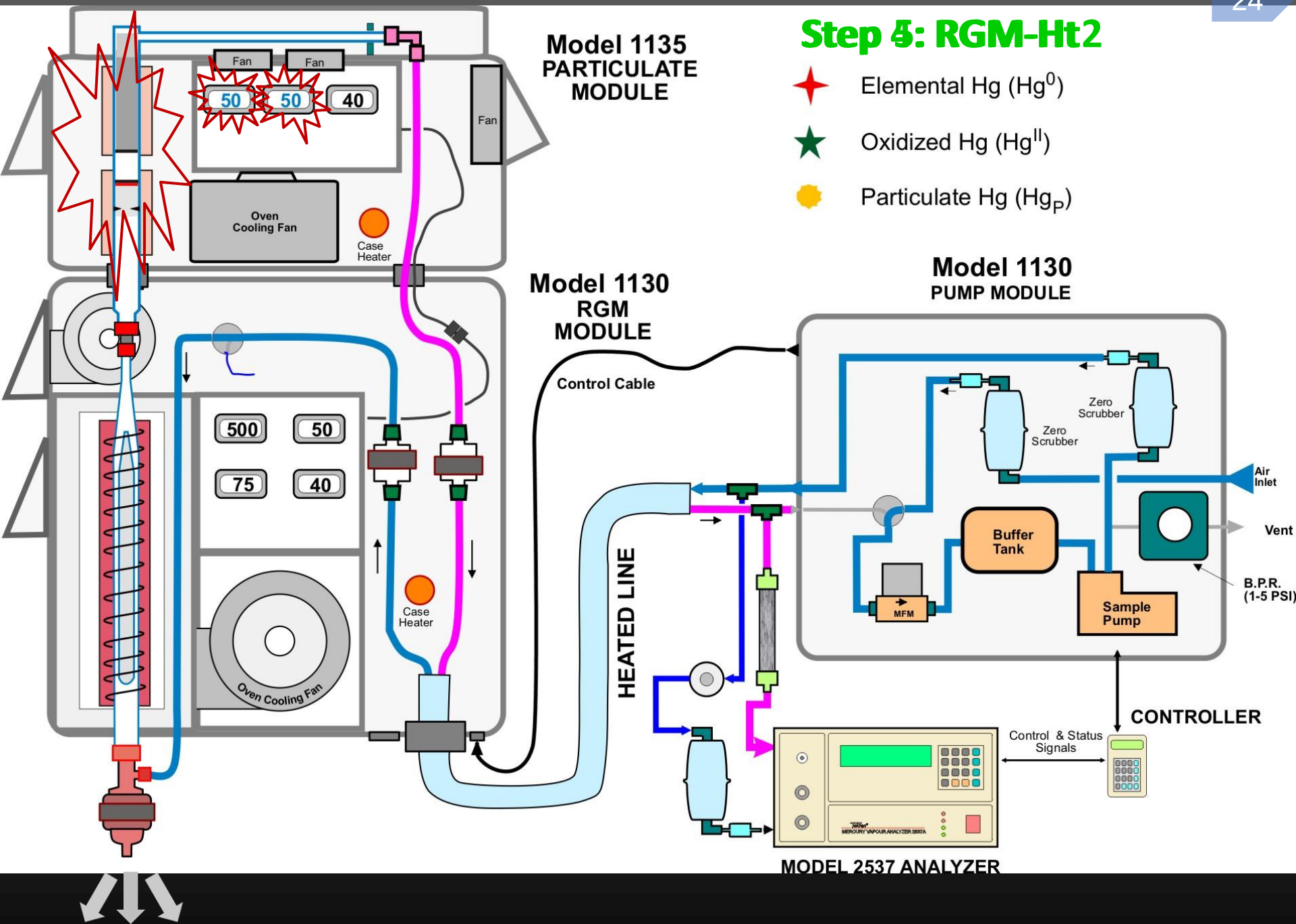


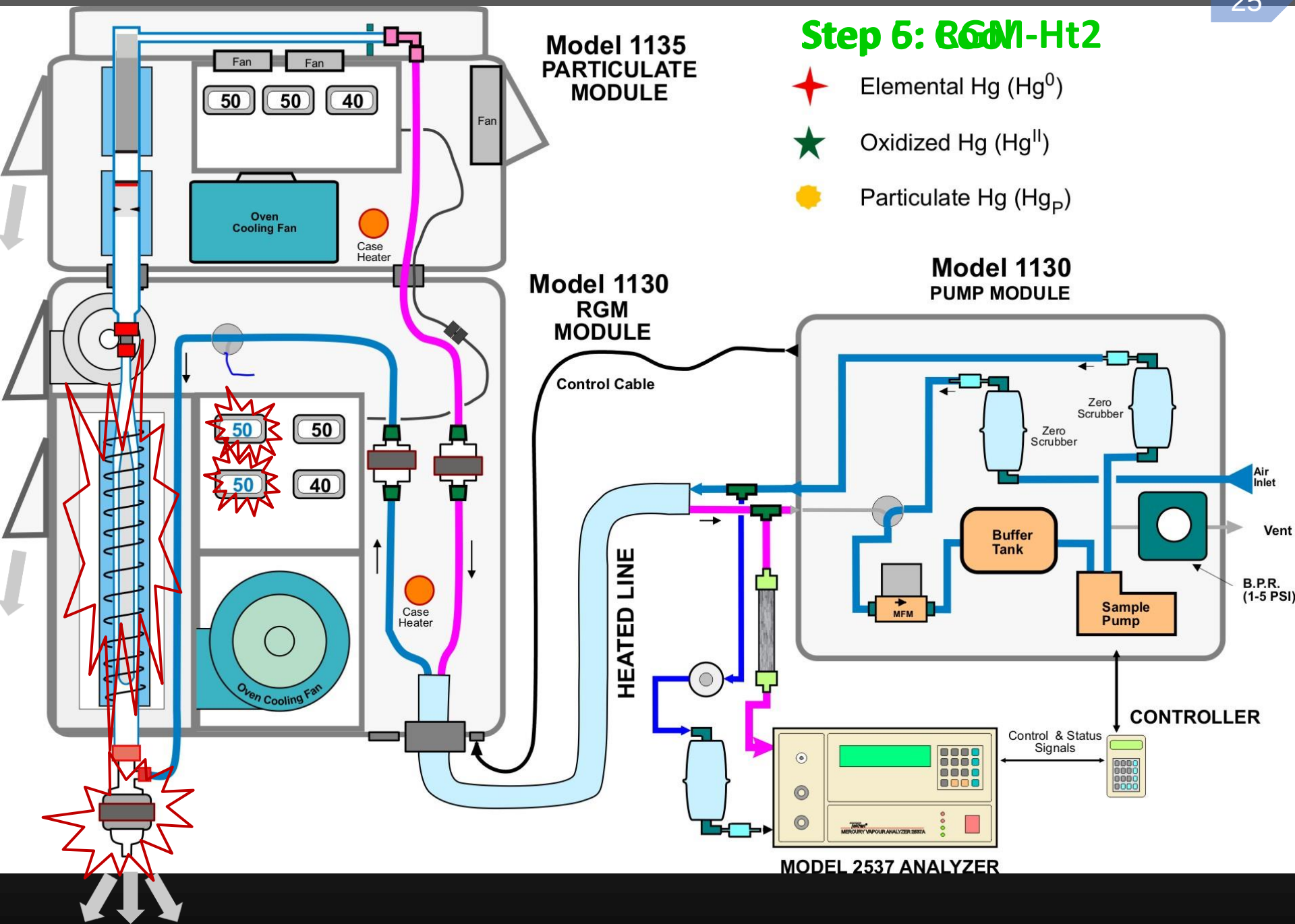


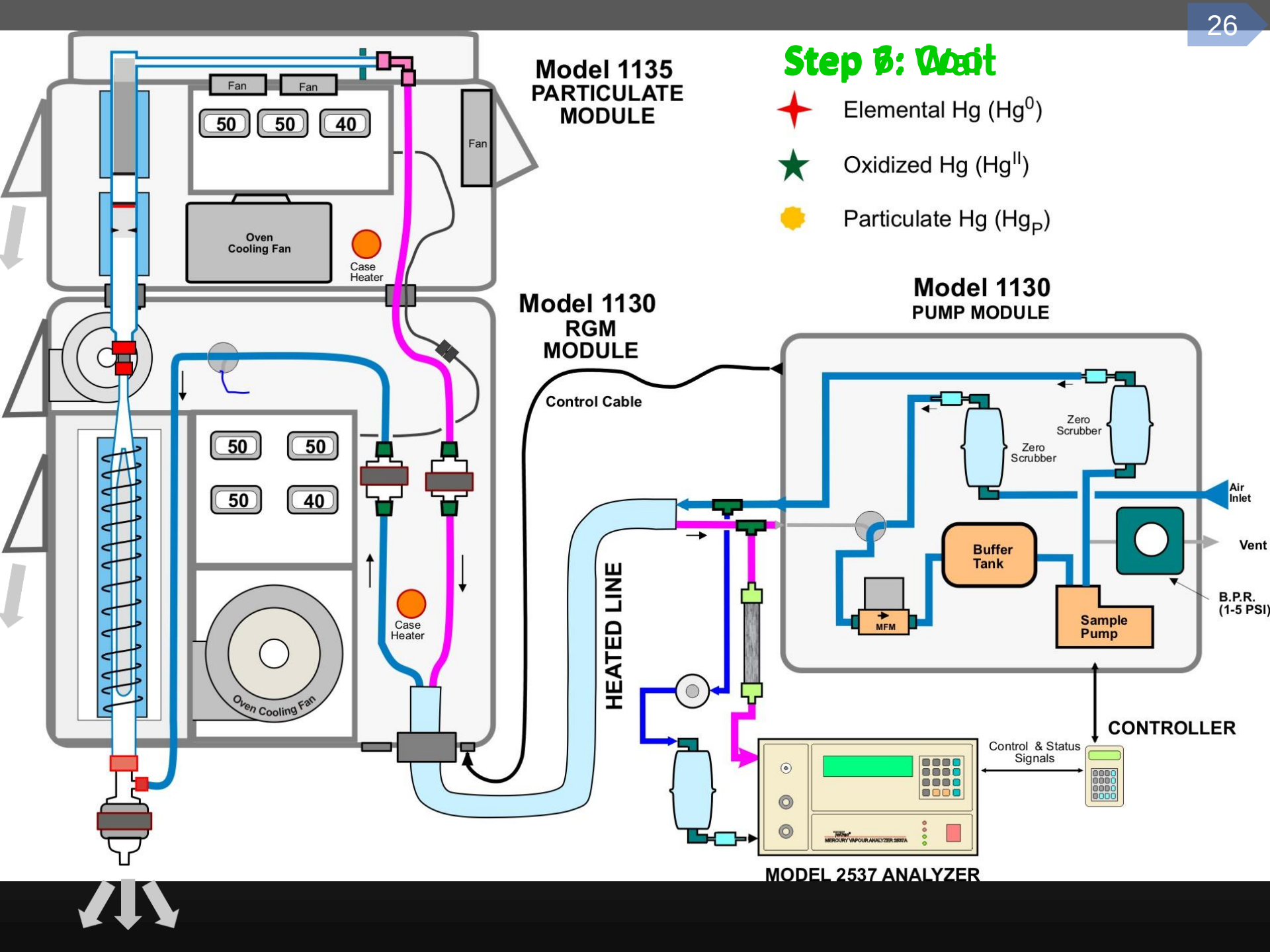


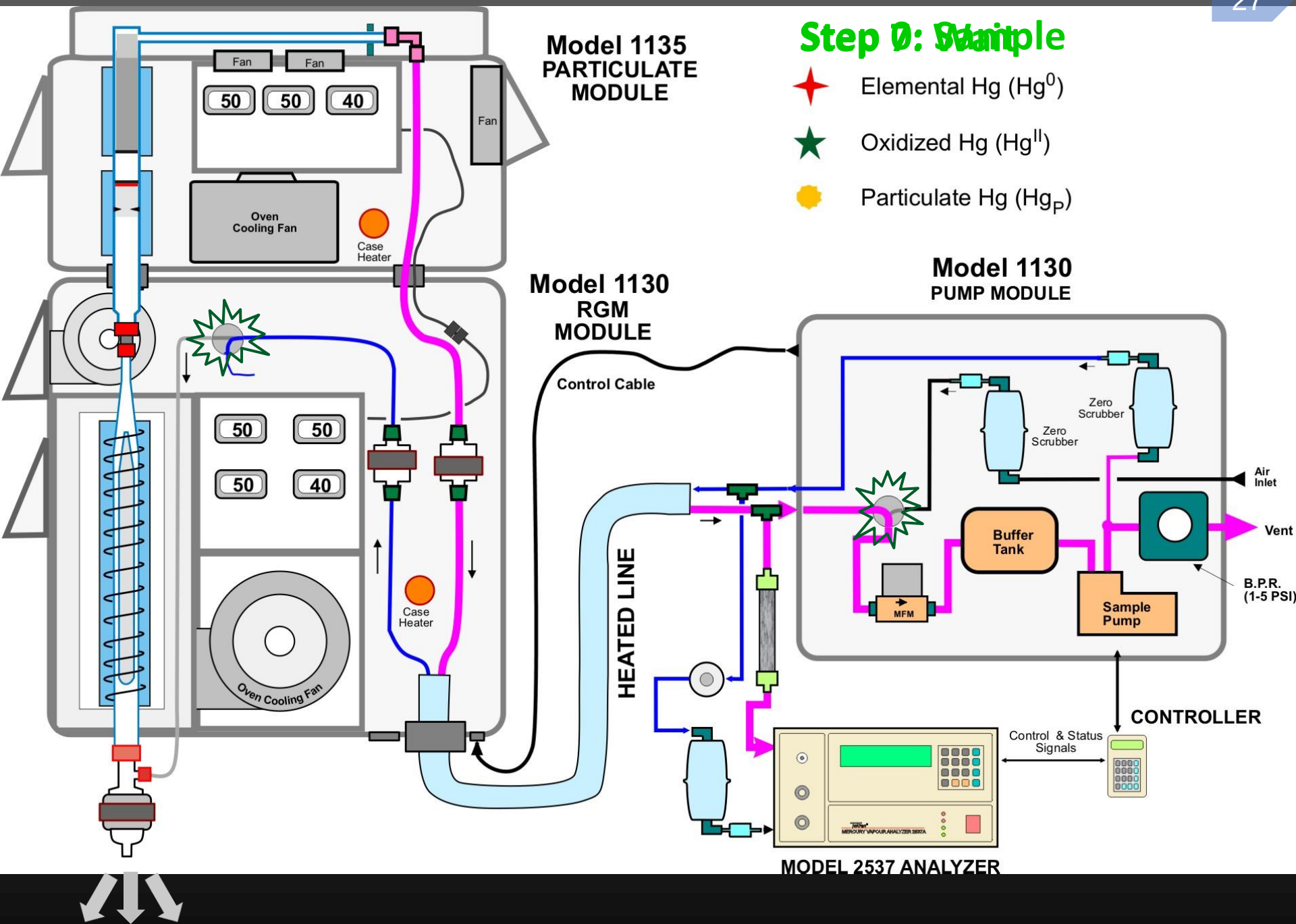




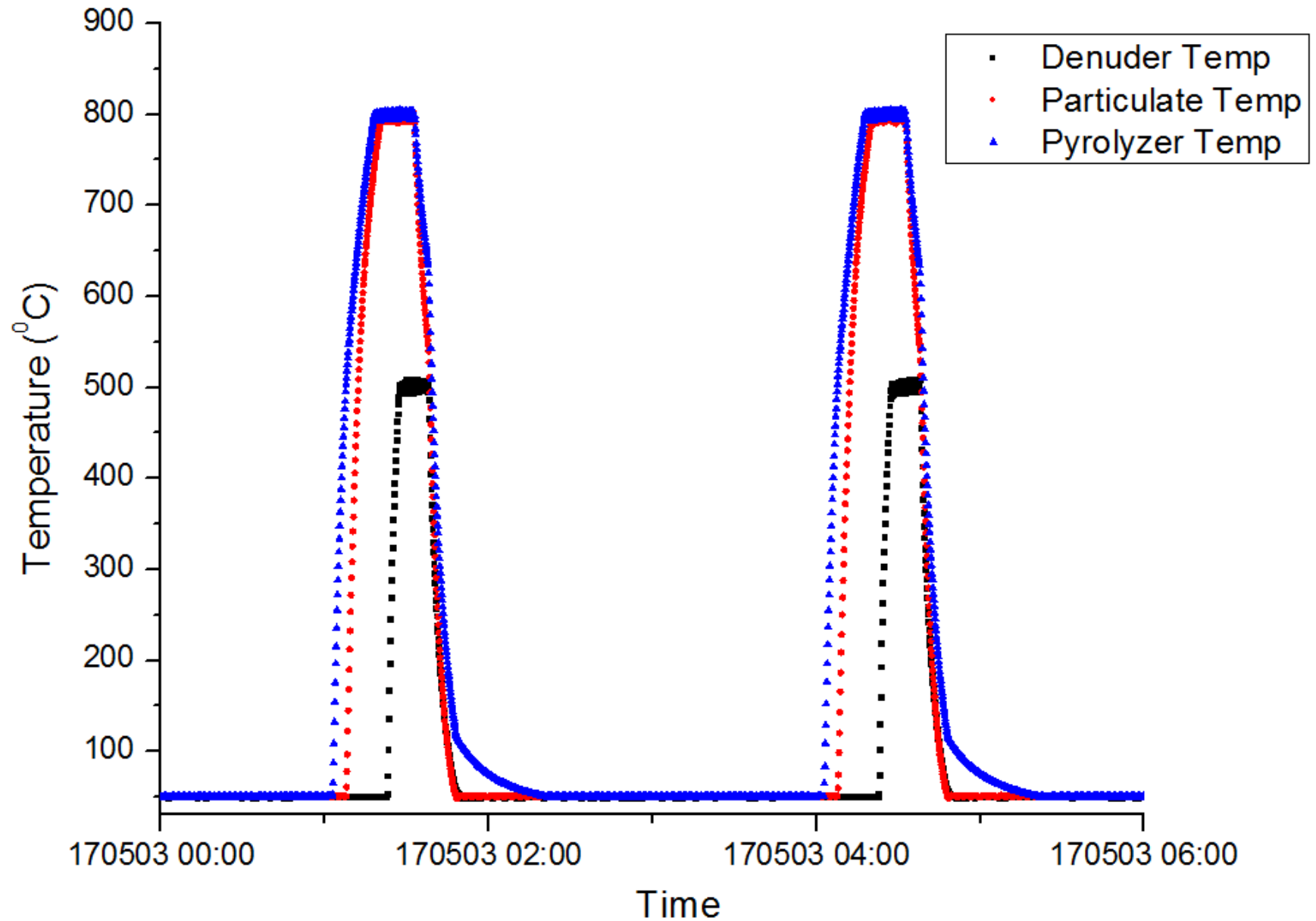








Temperature program



Typical Temperature Settings

- ❖ Temperatures are set directly on the PID controllers
- ❖ System simply selects between the two set-points on analytical PID controllers
- ❖ Case temperature controllers independently actuate either:
case heater, or
cooling fan

Model 1130 Denuder Module Temperature Settings (deg C)

SP1	Case Heater:	38
SP2	Case Fan:	40
SP1	Heated Line:	50
SP1	Denuder Keep Warm:	50
SP2	Denuder Heat:	500
SP1	Ext. Heat:	60
SP2	Ext Keep Warm:	50

Model 1135 Particulate Module Temperature Settings (deg C)

SP1	Pyrolyzer Keep Warm	50
SP2	Pyrolyzer Heat:	800
SP1	Part-Trap Keep Warm	50
SP2	Part-Trap Heat:	800
SP1	Case Heater:	38
SP2	Case Fan:	40

Method Calculated Values

- ❖ Values are calculated both by the controller and by XLS spread sheet
- ❖ Most are for info only
- ❖ **Factors** must be entered into 2537 to ensure direct reading in pg/m^3

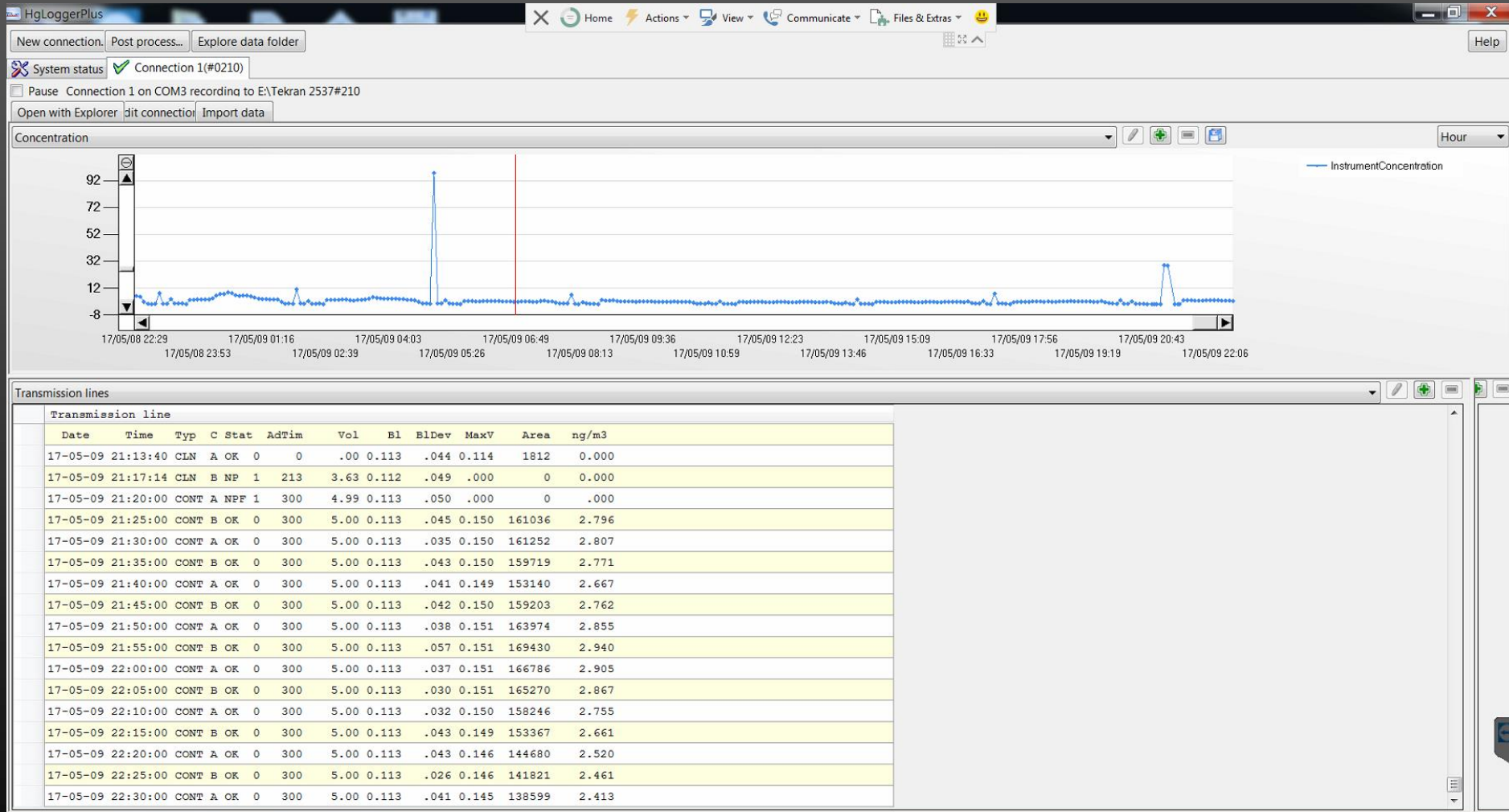
Calculated Values

5 Model 2537 Sample Volume (L)
10 Denuder Flow Rate (L/min)
600 Denuder Total Volume (L)
0.00833 Model 2537 Factor (for ng/m^3)
8.333 Model 2537 Factor (for pg/m^3)
60 Denuder Sample Time (min)
60 Desorb Analysis Time (min)
120 Total Cycle time (min)
24 Auto-Recal interval (hours)

Denuder figures above also apply to the particulate trap.

4. DATA OUTPUT

Software interface



Event Flag Assignments

Flag	Function
0	Sample (GEM analysis)
1	Initial Zero (Flush)
2	Pyro Pre-Heat
3	RPF desorb (PHg analysis)
4	Denuder desorb (GOM analysis)

Data obtained

Date	Time	Typ	C	Stat	AdTim	Vol	Bl	BlDev	MaxV	Area	ng/m3	
17-04-23	06:38:41	CLN	A	NP	0	0	.00	.095	.045	.000	0	0.000
17-04-23	06:42:14	CLN	B	NP	1	213	3.63	.095	.035	.000	0	0.000
17-04-23	06:45:00	CONT	A	OKF	1	300	4.99	.095	.026	.096	1574	0.133
17-04-23	06:50:00	CONT	B	OK	0	300	5.00	.095	.029	0.117	92107	1.875
17-04-23	06:55:00	CONT	A	OK	0	300	5.00	.095	.030	0.119	96178	1.944
17-04-23	07:00:00	CONT	B	OK	0	300	5.00	.095	.028	0.118	93946	1.912
17-04-23	07:05:00	CONT	A	OK	0	300	5.00	.095	.025	0.119	94898	1.918
17-04-23	07:10:00	CONT	B	OK	0	300	5.00	.095	.032	0.118	95039	1.934
17-04-23	07:15:00	CONT	A	OK	0	300	5.00	.095	.028	0.119	96348	1.946
17-04-23	07:20:00	CONT	B	OK	0	300	5.00	.095	.030	0.118	95070	1.934
17-04-23	07:25:00	CONT	A	OK	0	300	5.00	.096	.032	0.119	94958	1.919
17-04-23	07:30:00	CONT	B	OK	0	300	5.00	.096	.035	0.117	93819	1.909
17-04-23	07:35:00	CONT	A	OK	0	300	5.00	.096	.032	0.119	95199	1.924
17-04-23	07:40:00	CONT	B	OK	0	300	5.00	.096	.035	0.118	94134	1.915
17-04-23	07:45:00	CONT	A	OK	0	300	5.00	.096	.023	0.119	95946	1.939
17-04-23	07:50:00	CONT	B	OK	0	300	5.00	.096	.034	0.118	95688	1.947
17-04-23	07:55:00	CONT	A	OK	0	300	5.00	.096	.029	0.119	96002	1.939
17-04-23	08:00:00	CONT	B	OK	0	300	5.00	.096	.028	0.117	93328	1.899
17-04-23	08:05:00	CONT	A	OK	0	300	5.00	.096	.025	0.119	94580	1.911
17-04-23	08:10:00	CONT	B	OK	0	300	5.00	.096	.030	0.117	91966	1.871
17-04-23	08:15:00	CONT	A	OK	0	300	5.00	.096	.030	0.119	92416	1.867
17-04-23	08:20:00	CONT	B	OK	0	300	5.00	.096	.029	0.117	92997	1.892
17-04-23	08:25:00	CONT	A	OK	0	300	5.00	.095	.031	0.119	92715	1.874
17-04-23	08:30:00	CONT	B	OK	0	300	5.00	.095	.029	0.117	91866	1.869
17-04-23	08:35:00	CONT	A	OK	0	300	5.00	.095	.040	0.118	92736	1.874
17-04-23	08:40:00	CONT	B	OK	0	300	5.00	.095	.030	0.116	90733	1.846
17-04-23	08:45:00	CONT	A	OK	0	300	5.00	.095	.027	0.118	91584	1.851
17-04-23	08:50:00	CONT	B	OKF	1	300	5.01	.095	.025	.099	11931	1.011
17-04-23	08:55:00	CONT	A	OKF	1	300	5.00	.095	.028	.097	2163	0.182
17-04-23	09:00:00	CONT	B	NPF	1	300	5.00	.095	.031	.000	0	.000
17-04-23	09:05:00	CONT	A	NPF	2	300	5.00	.095	.027	.000	0	.000
17-04-23	09:10:00	CONT	B	OKF	3	300	5.00	.095	.026	0.103	28657	2.429
17-04-23	09:15:00	CONT	A	NPF	3	300	5.00	.095	.036	.000	0	.000
17-04-23	09:20:00	CONT	B	NPF	3	300	5.00	.095	.024	.000	0	.000
17-04-23	09:25:00	CONT	A	OKF	4	300	5.00	.095	.026	0.117	86936	7.320
17-04-23	09:30:00	CONT	B	OKF	4	300	5.00	.095	.030	.097	3227	0.274
17-04-23	09:35:00	CONT	A	OKF	4	300	5.00	.095	.032	.096	1703	0.143
17-04-23	09:40:00	CONT	B	NPF	1	300	5.00	.095	.033	.000	0	.000
17-04-23	09:45:00	CONT	A	NPF	1	300	5.00	.095	.035	.000	0	.000
17-04-23	09:50:00	CONT	B	OK	0	300	5.00	.095	.027	0.115	88291	1.797
17-04-23	09:55:00	CONT	A	OK	0	300	5.00	.095	.034	0.117	92140	1.862
17-04-23	10:00:00	CONT	B	OK	0	300	5.00	.095	.029	0.116	89602	1.823
17-04-23	10:05:00	CONT	A	OK	0	300	5.00	.095	.035	0.117	91134	1.841
17-04-23	10:10:00	CONT	B	OK	0	300	5.00	.095	.030	0.117	91183	1.855

GEM (ng/m³)

PHg (pg/m³)

RGM (pg/m³)

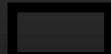
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17-04-23	06:50:00	CONT	B	OK	0	300	5.00	.095	.029	0.117	92107	1.875
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17-04-23	07:55:00	CONT	A	OK	0	300	5.00	.096	.029	0.119	96002	1.939
17-04-23	08:00:00	CONT	B	OK	0	300	5.00	.096	.028	0.117	93328	1.899
17-04-23	08:05:00	CONT	A	OK	0	300	5.00	.096	.025	0.119	94580	1.911
17-04-23	08:10:00	CONT	B	OK	0	300	5.00	.096	.030	0.117	91966	1.871
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17-04-23	09:15:00	CONT	A	NPF	3	300	5.00	.095	.036	.000	0	.000
17-04-23	09:20:00	CONT	B	NPF	3	300	5.00	.095	.024	.000	0	.000
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17-04-23	09:40:00	CONT	B	NPF	1	300	5.00	.095	.033	.000	0	.000
17-04-23	09:45:00	CONT	A	NPF	1	300	5.00	.095	.035	.000	0	.000
17-04-23	09:50:00	CONT	B	OK	0	300	5.00	.095	.027	0.115	88291	1.797
17-04-23	09:55:00	CONT	A	OK	0	300	5.00	.095	.034	0.117	92140	1.862
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17-04-23	09:15:00	CONT	A	NPF	3	300	5.00	.095	.036	.000	0	.000
17-04-23	09:20:00	CONT	B	NPF	3	300	5.00	.095	.024	.000	0	.000
17-04-23	09:25:00	CONT	A	OKF	4	300	5.00	.095	.026	0.117	86936	7.320
17-04-23	09:30:00	CONT	B	OKF	4	300	5.00	.095	.030	.097	3227	0.274
17-04-23	09:35:00	CONT	A	OKF	4	300	5.00	.095	.032	.096	1703	0.143
17-04-23	09:40:00	CONT	B	NPF	1	300	5.00	.095	.033	.000	0	.000
17-04-23	09:45:00	CONT	A	NPF	1	300	5.00	.095	.035	.000	0	.000

 Blank used on calculation

 Majority of PBM (Most the PBM should come off in the 1st cycle)

 Majority of GOM (Most the PBM should come off in the 1st cycle)

Sample calibration report

Date	Time	Type	C	Stat	AdTim	Vol	Bl	BlDev	MaxV	Area	ng/m3	
17-04-16	07:00:47	CLN	A	NP	0	0	.00	0.105	.028	.000	0	0.000
17-04-16	07:04:21	CLN	B	NP	1	213	3.63	0.105	.030	.000	0	0.000
17-04-16	07:07:07	ZERO	A	NP	1	300	4.99	0.105	.041	.000	0	0.000
17-04-16	07:12:07	ZERO	B	NP	1	300	5.00	0.105	.031	.000	0	0.000
17-04-16	07:17:07	SPAN	A	OK	1	300	5.00	0.105	.034	0.428	1395464	28.848
17-04-16	07:22:07	SPAN	B	OK	1	300	5.00	0.105	.029	0.433	1395255	28.848

Zero
Calibration points

CALIBRATION: S/N:0210 H/W: 2.21 S/W: 1.04 17-04-16 07:25:41

ZERO: A

Sample : 300 sec	BlArea : 0
Volume : 4.99 l	BlCorr : 0/1
Baseline: 0.105 V	PkMax : .000 V
Bl StDev: .04 mv	Pkwid : .0 sec
Start : 17-04-16	07:07:07

ZERO: B

Sample : 300 sec	BlArea : 0
Volume : 5.00 l	BlCorr : 0/1
Baseline: 0.105 V	PkMax : .000 V
Bl StDev: .03 mv	Pkwid : .0 sec
Start : 17-04-16	07:12:07

SPAN: A

SOURCE	Area : 1395464
Sample : 300 sec	AdjArea : 1395464 *
Volume : 5.00 l	<u>RespFctr: 9674597</u>
HgAmt : 144.2pg	PkMax : 0.428 V
Baseline: 0.105 V	Pkwid : 20.9 sec
Bl StDev: .03 mv	07:17:07
Start : 17-04-16	

SPAN Response Factor $> 6 \times 10^6$ *RespFctr*

SPAN Difference A vs. B $< 5\%$

$(RF A - RF B) / RF A$

$(9674597 - 9673148) / 9674597 = 0.015\%$

SPAN: B

SOURCE	Area : 1395255
Sample : 300 sec	AdjArea : 1395255 *
Volume : 5.00 l	<u>RespFctr: 9673148</u>
HgAmt : 144.2pg	PkMax : 0.433 V
Baseline: 0.105 V	Pkwid : 21.0 sec
Bl StDev: .03 mv	07:22:07
Start : 17-04-16	

Date	Time	Typ	C	Stat	AdTim	Vol	Bl	BlDev	MaxV	Area	ng/m3	
17-04-16	07:28:41	CLN	A	NP	0	0	.00	0.105	.030	.000	0	0.000
17-04-16	07:32:14	CLN	B	NP	1	214	3.63	0.105	.025	.000	0	0.000
17-04-16	07:35:01	CONT	A	OKF	1	300	5.00	0.105	.031	0.109	11265	0.970
17-04-16	07:40:01	CONT	B	OK	0	300	5.00	0.105	.031	0.148	180842	3.738
17-04-16	07:45:01	CONT	A	OK	0	300	5.00	0.105	.032	0.147	179833	3.716
17-04-16	07:50:01	CONT	B	OK	0	300	5.00	0.105	.030	0.144	172022	3.555

Data evaluation

Flag criteria

- ❖ The 24 hour average for cartridge A vs. B
 - A1 – Warning $> 10\%$ difference
 - A2 – Invalid $> 15\%$ difference
- ❖ Baseline
 - B0 – Invalid if baseline < 0.010
 - B1 – Warning if baseline < 0.050 or > 0.250
 - B2 – Warning if baseline change > 0.010
 - B3 – Warning 5 consecutive BLDev > 0.100
 - B5 – Invalid if BLDev > 0.200
- ❖ Peak
 - M2 – Warning double peak detected
 - M3 – Invalid $>$ double peak detected
 - NP – Invalid for GEM only, No peak detected
 - OL – Warning overloaded detector ($> 5.125V$)

Data evaluation

Flag criteria

❖ GEM

E1 – Warning GEM < 1.0 ng/m³

E5 – Warning GEM change > 50%

❖ Volume

V5 – Warning volume > 5% from expected

V7 – Invalid volume > 7% from expected

❖ Calibration Frequency

F1 – Warning last calibration > 3 days ago

F2 – Control last calibration > 6 days ago

After a power failure – need to calibrate once perm source is stable

Data evaluation

Flag criteria

❖ Response Factor

R1 – Warning RF < 6 m or > 12 million

R2 – Invalid RF < 4 million

❖ Calibration Cartridge Bias

C1 – Warning calibration trap bias $> 10\%$

C2 – Invalid calibration trap bias $> 20\%$

❖ Calibration Zero

Z1 – Warning zero > 1500 PA

Z2 – Invalid zero $> 1\%$ of SPAN

Find the NADP AMNet Data Management Manual 2015-10 for more detail

Data evaluation

datetime	channel	status	flag	sample_v	baseline_v	baseline_v	maximum	integrated	chg_con	notes	validation	QaStatus	Liaison_N	RevDate
7/11/2007 2:51	B	OK	0	3.47	0.098	0.049	0.101	12633	0.809	E1R1	V		2 NULL	NULL
7/11/2007 2:56	A	OK	0	3.33	0.098	0.056	0.101	11217	0.708	E1R1	V		2 NULL	NULL
7/11/2007 3:01	B	OK	0	3.48	0.098	0.045	0.102	15418	1.002	R1	V		2 NULL	NULL
7/11/2007 3:06	A	OK	0	3.34	0.099	0.061	0.102	12610	0.803	E1R1	V		2 NULL	NULL
7/11/2007 3:11	B	OK	0	3.48	0.099	0.045	0.102	10645	0.705	E1R1	V		2 NULL	NULL
7/11/2007 3:16	A	OK	0	3.35	0.099	0.059	0.102	15235	1.007	R1	V		2 NULL	NULL
7/11/2007 3:21	B	OK	0	3.48	0.099	0.042	0.103	12484	0.807	E1E5R1	V		2 NULL	NULL
7/11/2007 3:26	A	OK	0	3.36	0.099	0.039	0.103	11415	0.805	E1R1	V		2 NULL	NULL
7/11/2007 4:31	B	OK	0	3.24	0.1	0.044	0.102	5214	0.302	E0V7E1E5R1	E		2 NULL	NULL
7/11/2007 4:36	A	OK	0	3.11	0.1	0.057	0.103	9511	0.704	E0V7E1R1	E		2 NULL	NULL
7/11/2007 4:41	B	OK	0	3.3	0.1	0.048	0.103	12711	0.809	V5E1E5R1	V		2 NULL	NULL
7/11/2007 4:46	A	OK	0	3.17	0.1	0.045	0.103	14050	1.009	V7R1	I		2 NULL	NULL
7/11/2007 4:51	B	OK	0	3.35	0.099	0.066	0.103	12544	0.804	E1R1	V		2 NULL	NULL
7/11/2007 4:56	A	OK	0	3.21	0.099	0.047	0.102	10393	0.706	V7E1R1	I		2 NULL	NULL
7/11/2007 5:01	B	OK	0	3.39	0.099	0.044	0.103	15226	1.007	R1	V		2 NULL	NULL
7/11/2007 5:06	A	OK	0	3.25	0.099	0.053	0.102	12910	0.901	V7E1R1	I		2 NULL	NULL
7/11/2007 5:11	B	OK	0	3.42	0.099	0.046	0.103	14665	0.909	E1R1	V		2 NULL	NULL
7/11/2007 5:16	A	OK	0	3.27	0.099	0.048	0.102	11765	0.801	V5E1R1	V		2 NULL	NULL
7/11/2007 5:21	B	OK	0	3.45	0.099	0.044	0.102	19046	1.204	E5R1	V		2 NULL	NULL
7/11/2007 5:26	A	OK	0	3.3	0.099	0.037	0.102	13087	0.004	V5E1R1	V		2 NULL	NULL
7/11/2007 6:31	B	OK	0	3.4	0.098	0.047	0.1	7549	0.503	E0E1E5R1	E		2 NULL	NULL
7/11/2007 6:36	A	OK	0	3.25	0.098	0.045	0.101	10630	0.704	E0V7E1R1	E		2 NULL	NULL
7/11/2007 6:41	B	OK	0	3.43	0.098	0.045	0.101	11492	0.703	E1E5R1	V		2 NULL	NULL
7/11/2007 6:46	A	OK	0	3.28	0.098	0.048	0.101	9564	0.009	V5E1R1	V		2 NULL	NULL
7/11/2007 6:51	B	OK	0	3.45	0.098	0.04	0.101	13975	0.904	E1R1	V		2 NULL	NULL

5. Routine Maintenance and instrument problems



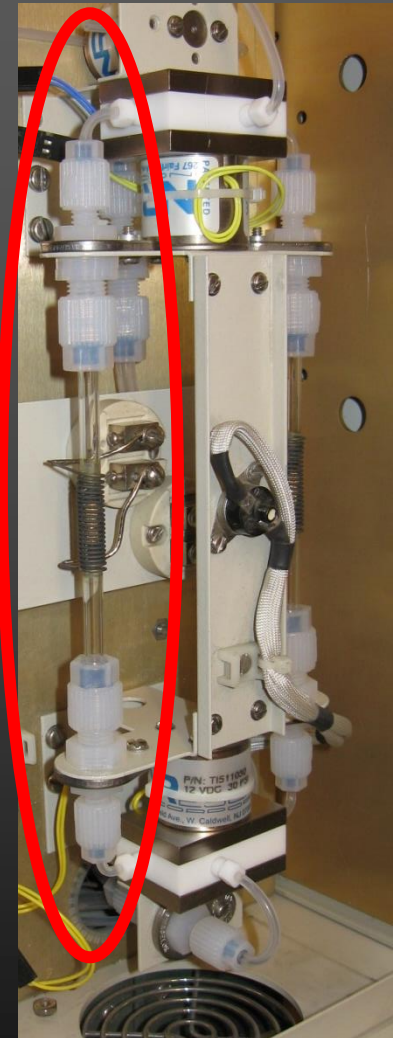
2537

2537 Routine checks

- ❖ Date time correct – *Date Time*
- ❖ Peak Status (OK, OKF or NP) – *Stat*
- ❖ Sample Volume 5.0 L (adjustable) - *Vol*
Within 2% of set point
- ❖ Baseline - *BI*
Within 0.100 – 0.250 Volts
- ❖ Baseline Deviation – *BLDev*
 $BLDev < 0.100$ Volts
- ❖ Calibration check (criteria show on above)
- ❖ Argon tank > 200 psi
Sufficient volume until next visit

2537 Instrument Problem Indicators

- ❖ Does 2537 pump work hard?
 - Only on one cartridge?
 - Both cartridges?
- ❖ 2537 flow bias on one channel →
 - Valves check
 - Trap restrictive
- ❖ 2537 flow bias on both channels
 - Pump diaphragm
 - Pump check valves
 - Common restriction (Soda lime, filter)



Baseline Deviation Problems and Solutions

❖ High BLDev

- Lamp
- Lamp Stabilizer Board

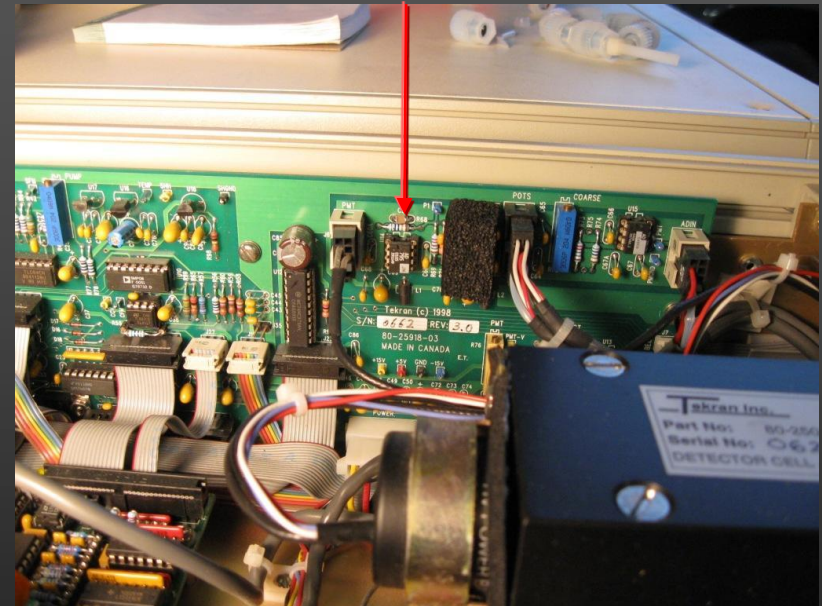
Photo Diode

Baseline fluctuation

- Cuvette
- Argon purge line
- C-59 Chip on Main Board

Baseline deviation is very high (>1)

C-59 Chip Needs to be soldered



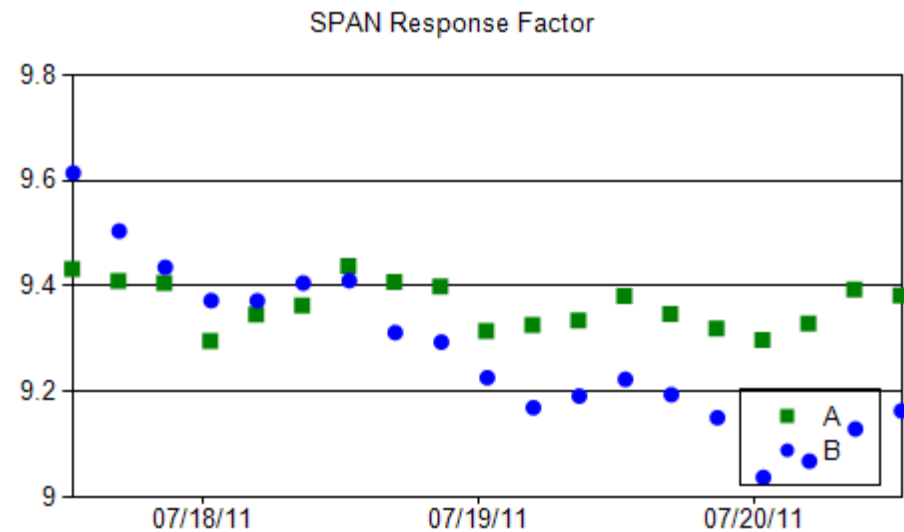
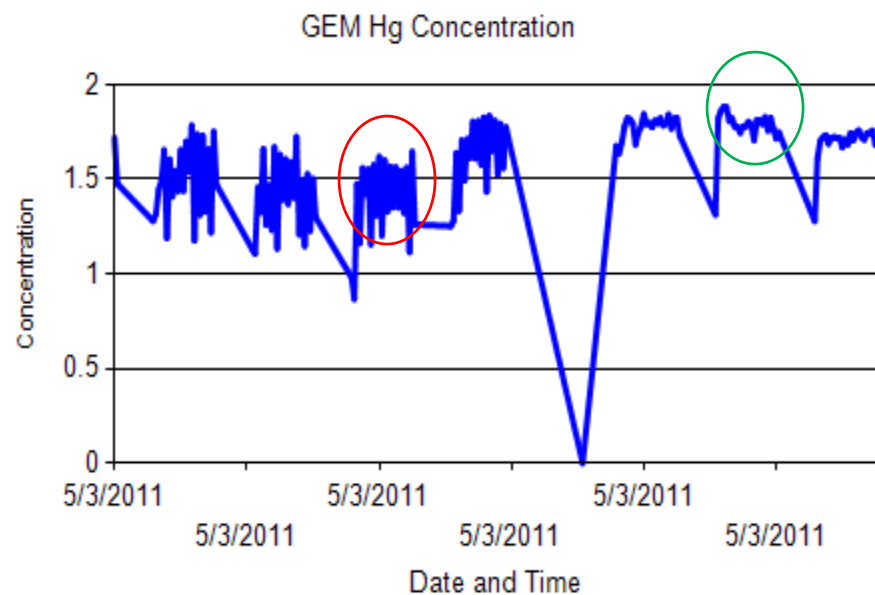
Cartridge Bias, A vs. B

- ❖ Ambient air concentration
- ❖ SPAN Calibration

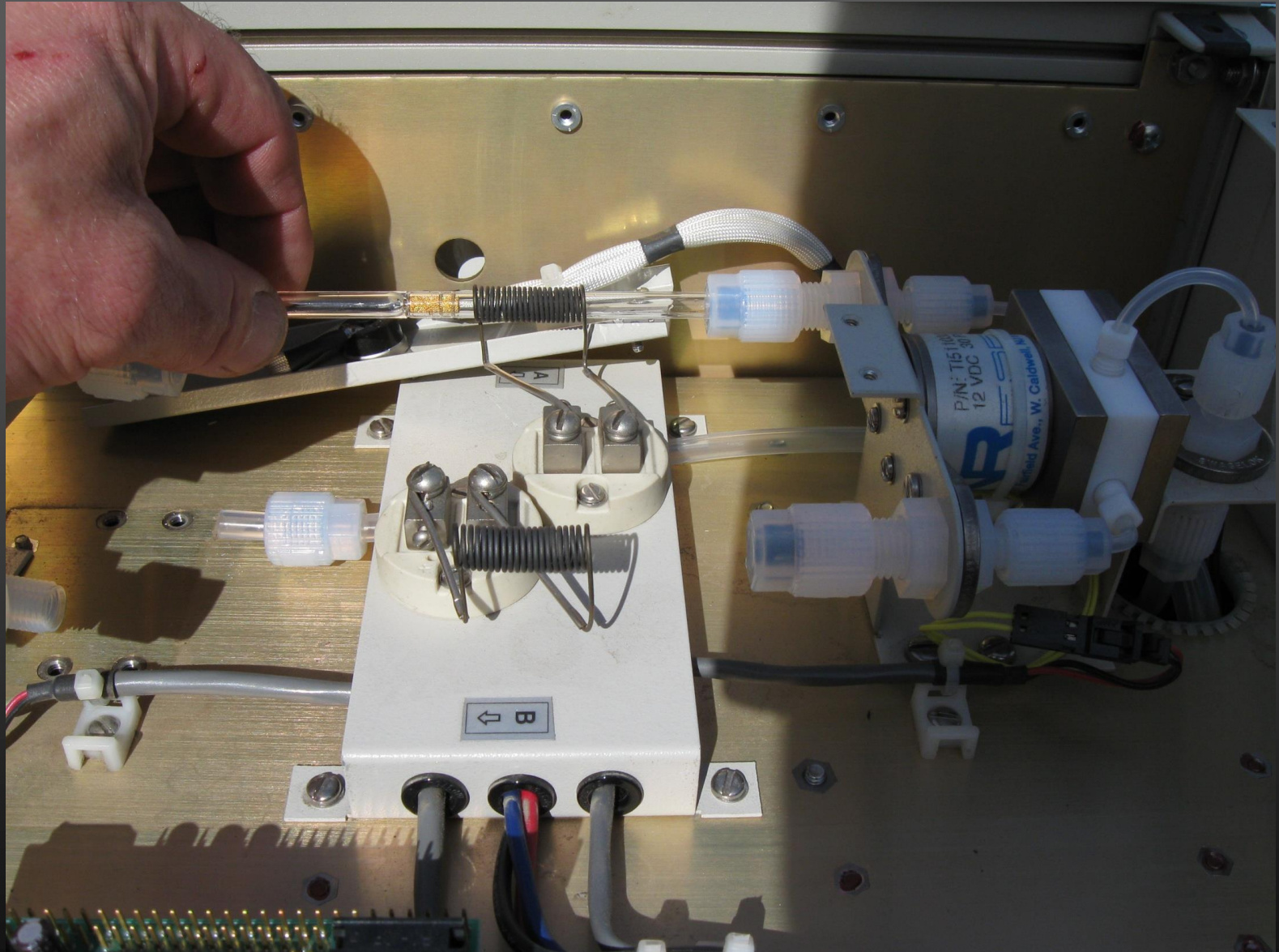
Cartridge passivation?

Swap A and B Cartridges

Does bias follow cartridge? => Yes = cartridge passivation



Replace the Cartridges



Lamp Adjustment



Unable to reduce lamp voltage
High Baseline Deviation (*BLDev*)

External calibration

Tekran 2505 Calibrator





1130/1135

Operational Requirements

- ❖ Denuder requires changing every week or two
- ❖ RPF requires exchanging every 2 months
- ❖ Weekly or bi-weekly site visits recommended
- ❖ Filter changes, leak checks, etc. as required during site visits

1130/1135 Routine checks

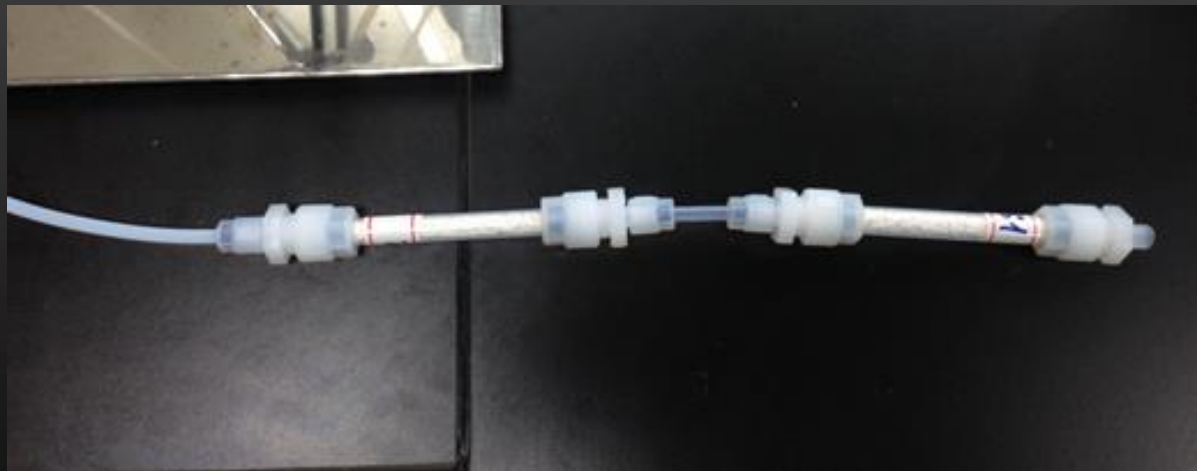
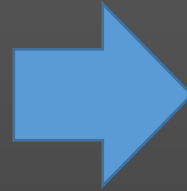
- ✓ Final desorption blank C ~ 0.000 pg/m³
- ✓ PHg and GOM clear peak

Most the PHg and GOM should come off in the 1st cycle

- ✓ Check pump, temp.
- ✓ Denuder changed
- ✓ RPF changed
- ✓ 1130/1135 filter changed
- ✓ Leak check < 0.3 ng/m³
- ✓ Flow check (1130 pump check with in 3% set point)
- ✓ RPF elbow and tubing replaced
- ✓ 1130 pump diaphragm replaced
- ✓ 1130 pump brushes > 1 cm
- ✓ Denuder to RPF (14/18) union replaced



Filter and soda lime reparation



Ar purge in 8 hours

Denuder reparation

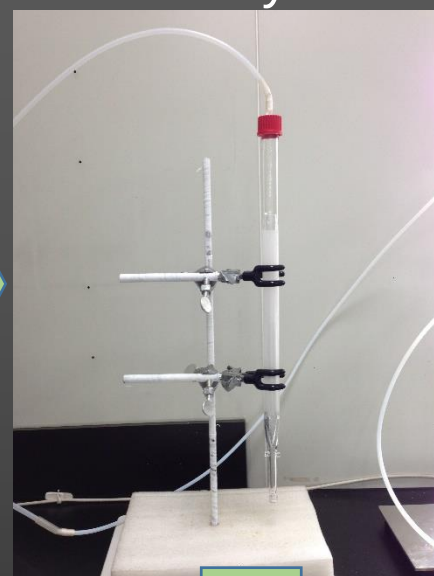
54



Clean



Dry



Beak 30 min, max temp 500°C. Ar purge

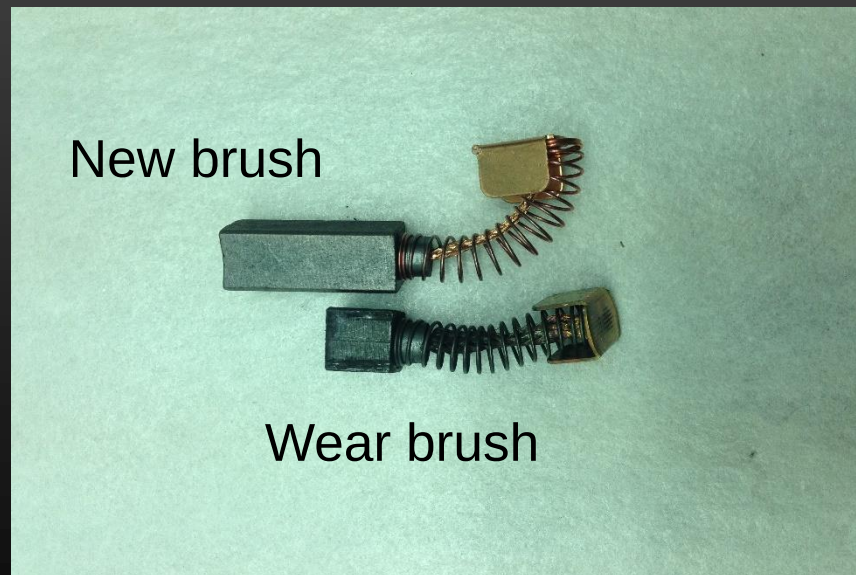


Coating

1130 pump diaphragm and brushes replaced



Broken diaphragm



RPF

Frosting on RPF Tail



Dirty RPF



Zero Canisters

❖ Two zero canisters inside 1130 PM

Likely to require changing rarely (if ever)

Usually best to get your air supply from outdoors

Lower Hg levels

Drier (especially in Arctic)

Exception for hot, humid areas

❖ Most high blanks are due to

- Leaks
- Contamination
- BPR problem



Lab Support

❖ Extra denuders & RPF's are usually kept on hand

Several units recoated / restuffed at one time

Blanked, capped and shipped to site

Tube furnace required for blanking

Source of DIW is required

❖ Elements may be exchanged in the field using relatively unskilled personnel

Summary 1130/1135

- ❖ Model 1130 & 1135 require somewhat more time to run and maintain than the Model 2537 alone
- ❖ Plan on at least bi-weekly site visits to change denuder, RPF and filters
- ❖ Data handling and validation also require more time
- ❖ Determining why the species behave the way they do may be the biggest challenge