

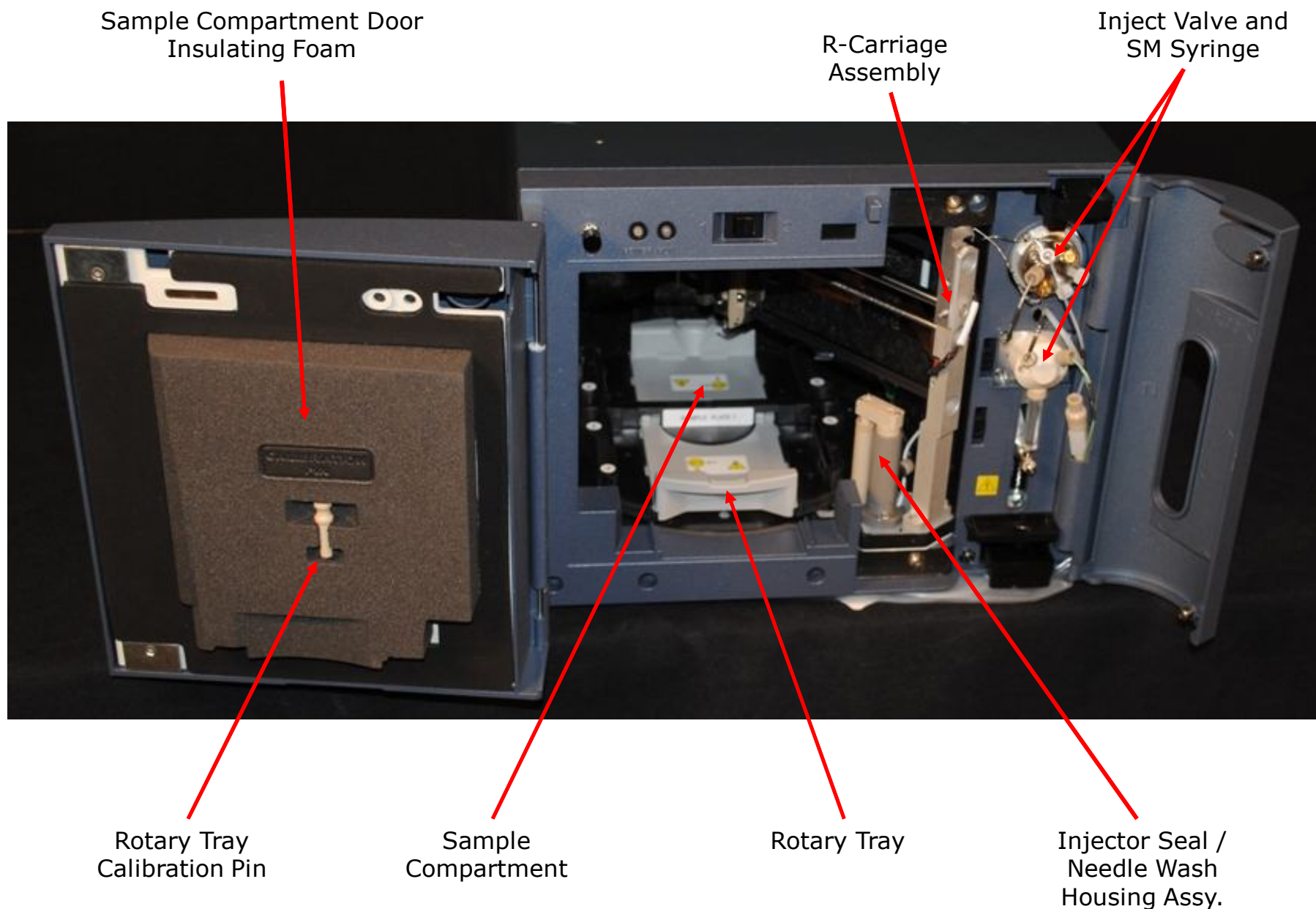


ACQUITY H-Class SM-FTN Overview

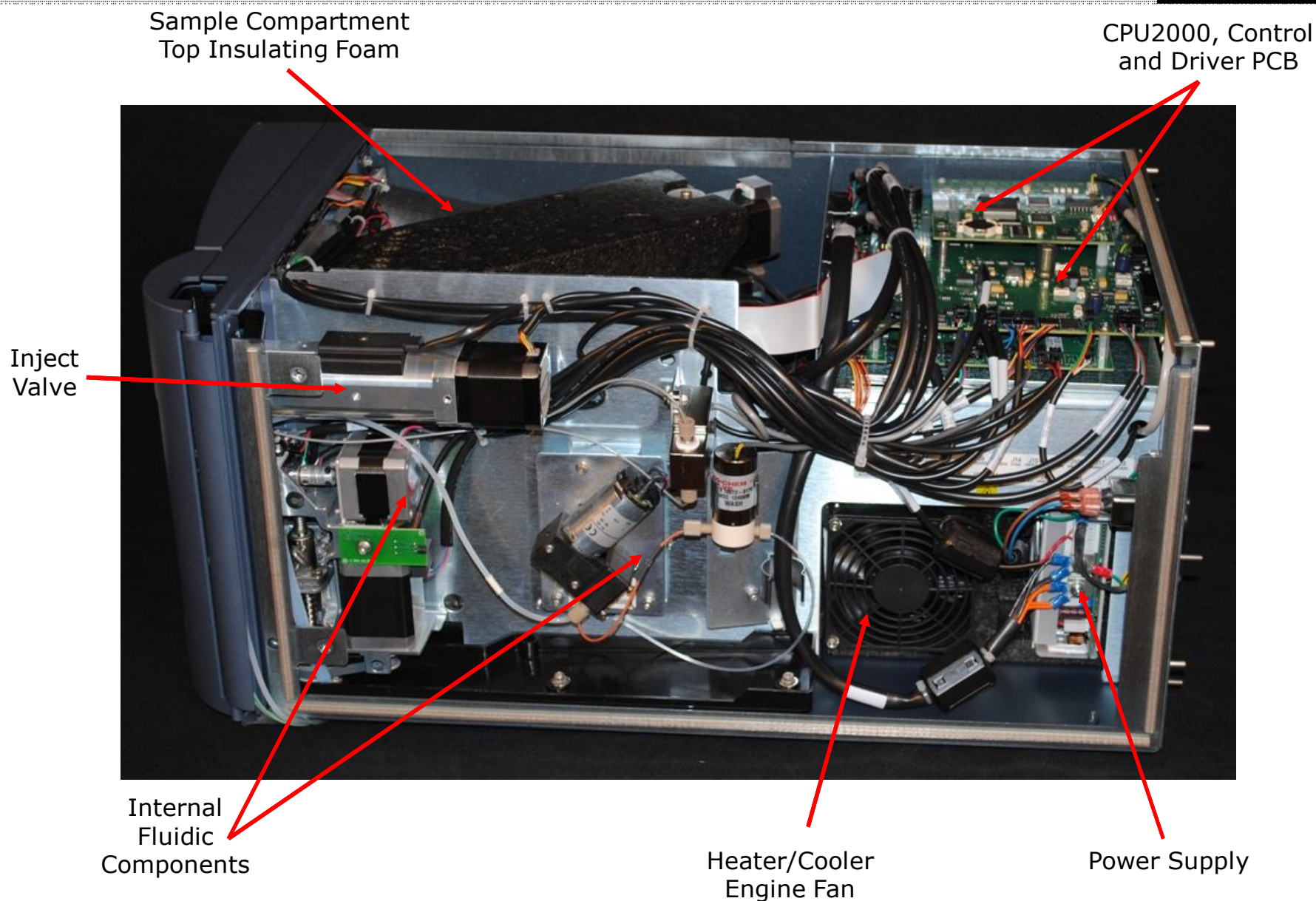


- Adapt the best, most proven design aspects from ACQUITY to create a new UPLC common platform sample manager
 - Implement direct injection technique supporting the full UPLC pressure range
 - Simpler operation
 - Great sample recovery
 - Excellent carryover specifications
 - Using already proven ACQUITY fluidics and software where appropriate for high reliability
 - Simplify sample pickup by designing a new R-Theta movement algorithm
 - Keeping system dwell volume and bandspreading as low as possible
- Make it cost competitive
 - Use common platform for both FTN and Fixed Loop versions
 - Use molded rigid foam panels to insulate and hold components in place

SM-FTN Component Overview



SM-FTN Component Overview

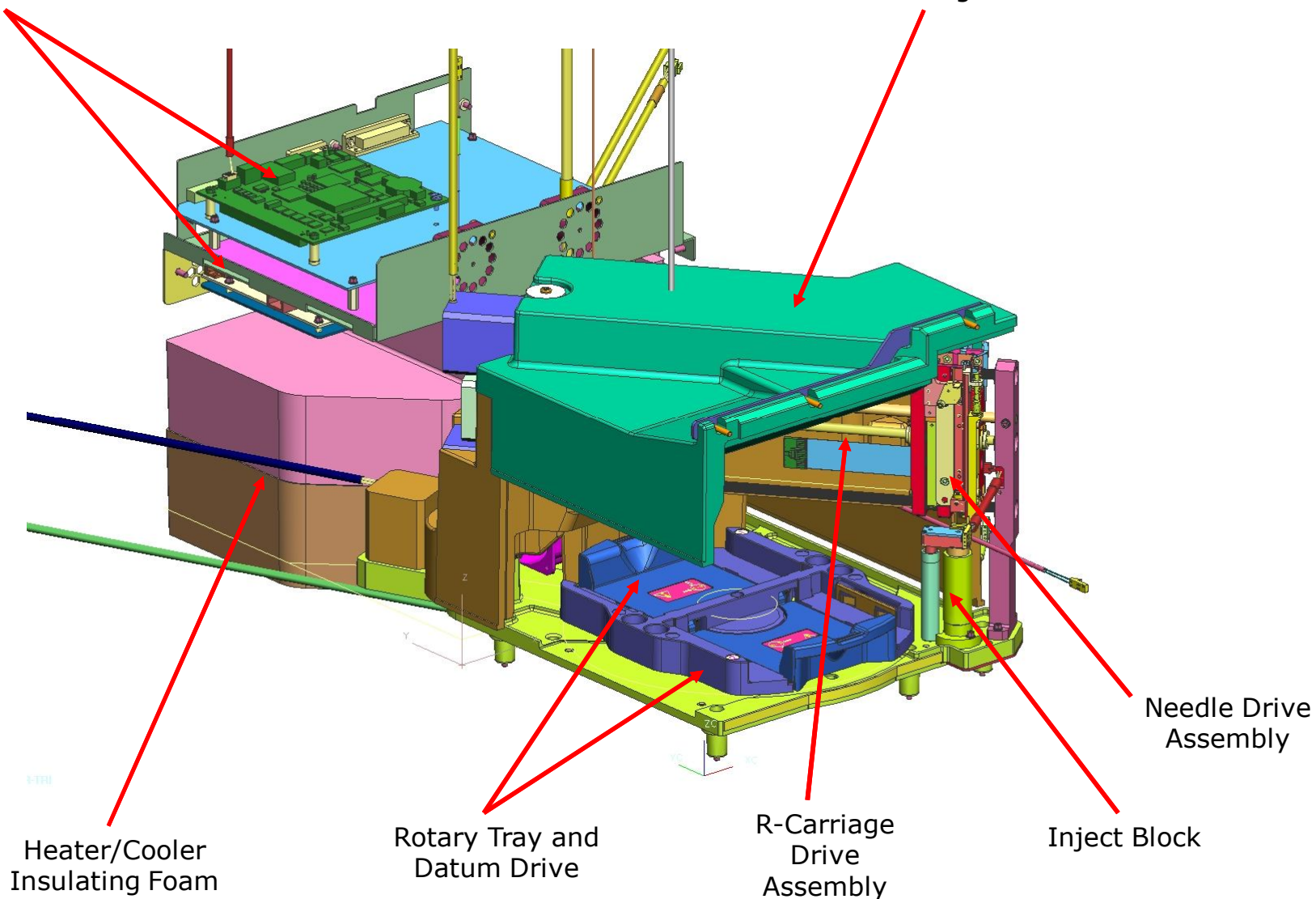


SMDI Component Overview



CPU2000, Control
and Driver PCB

Sample Compartment
Insulating Foam



Major Assemblies



- Fluidics
- R-Theta Drive Assembly
- Sample Heater/Cooler Assembly
- Electronics
- Software Components

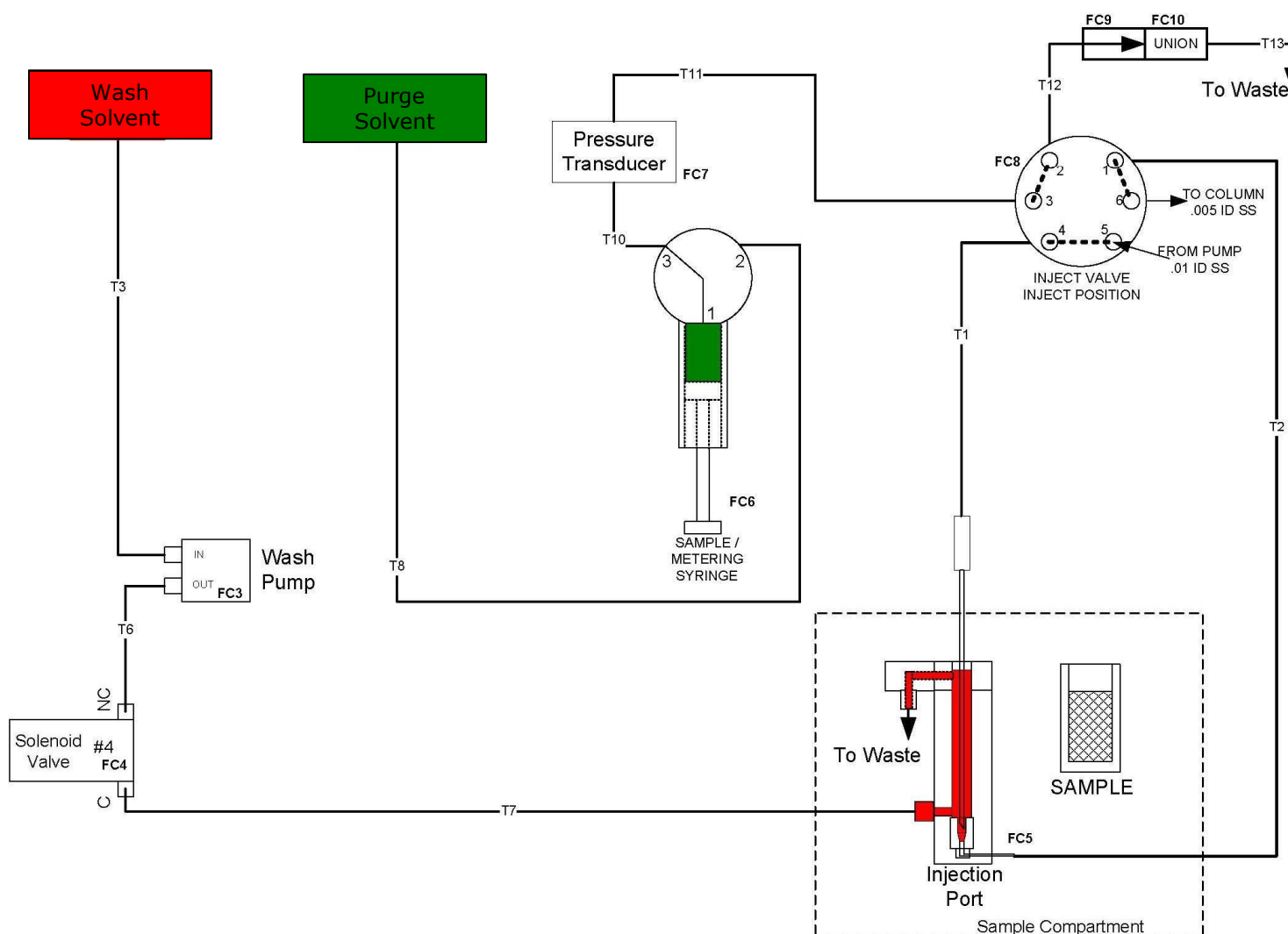
Fluidics



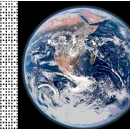
SM-FTN Flow Diagram



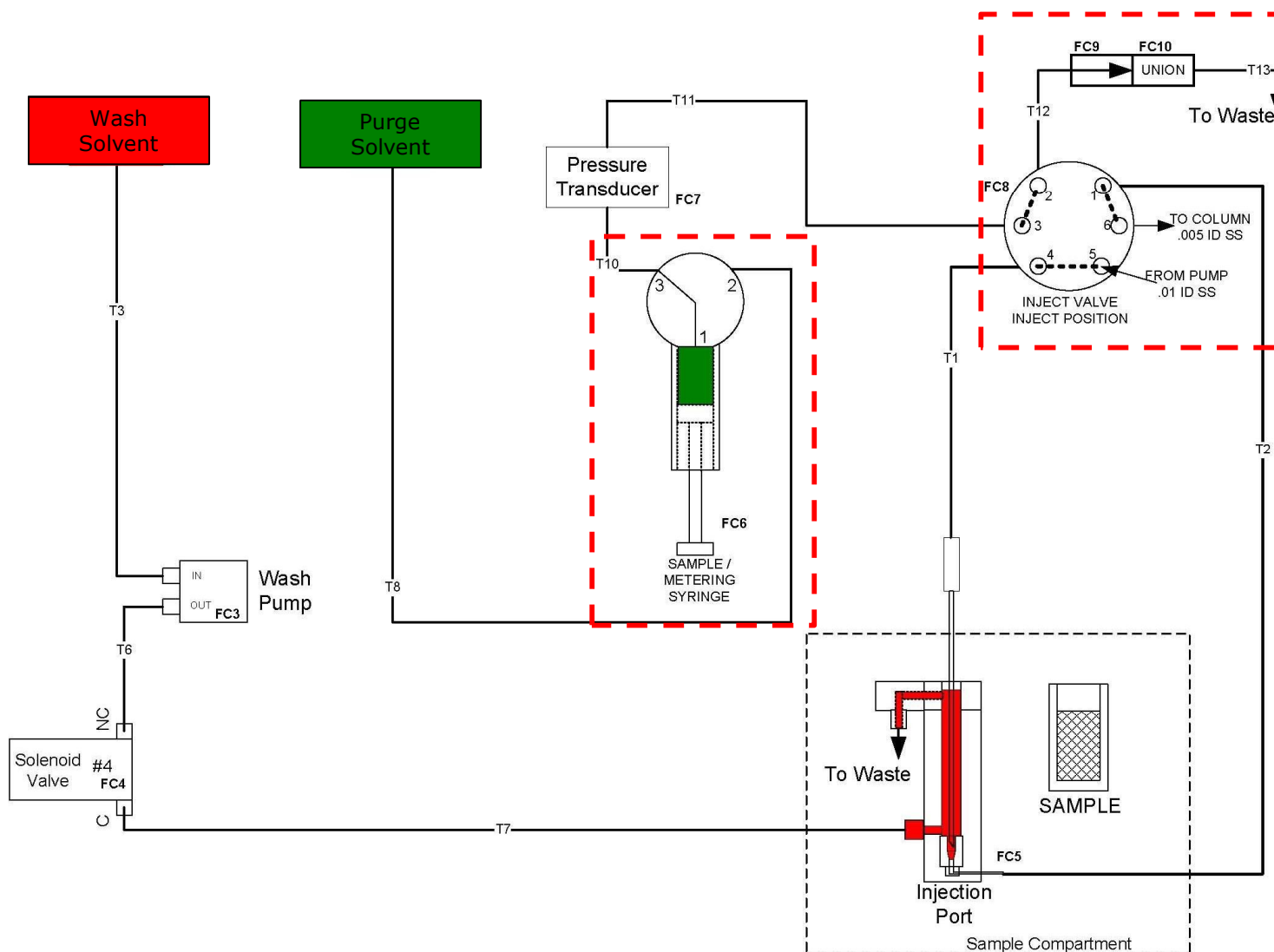
Global Training
& Development



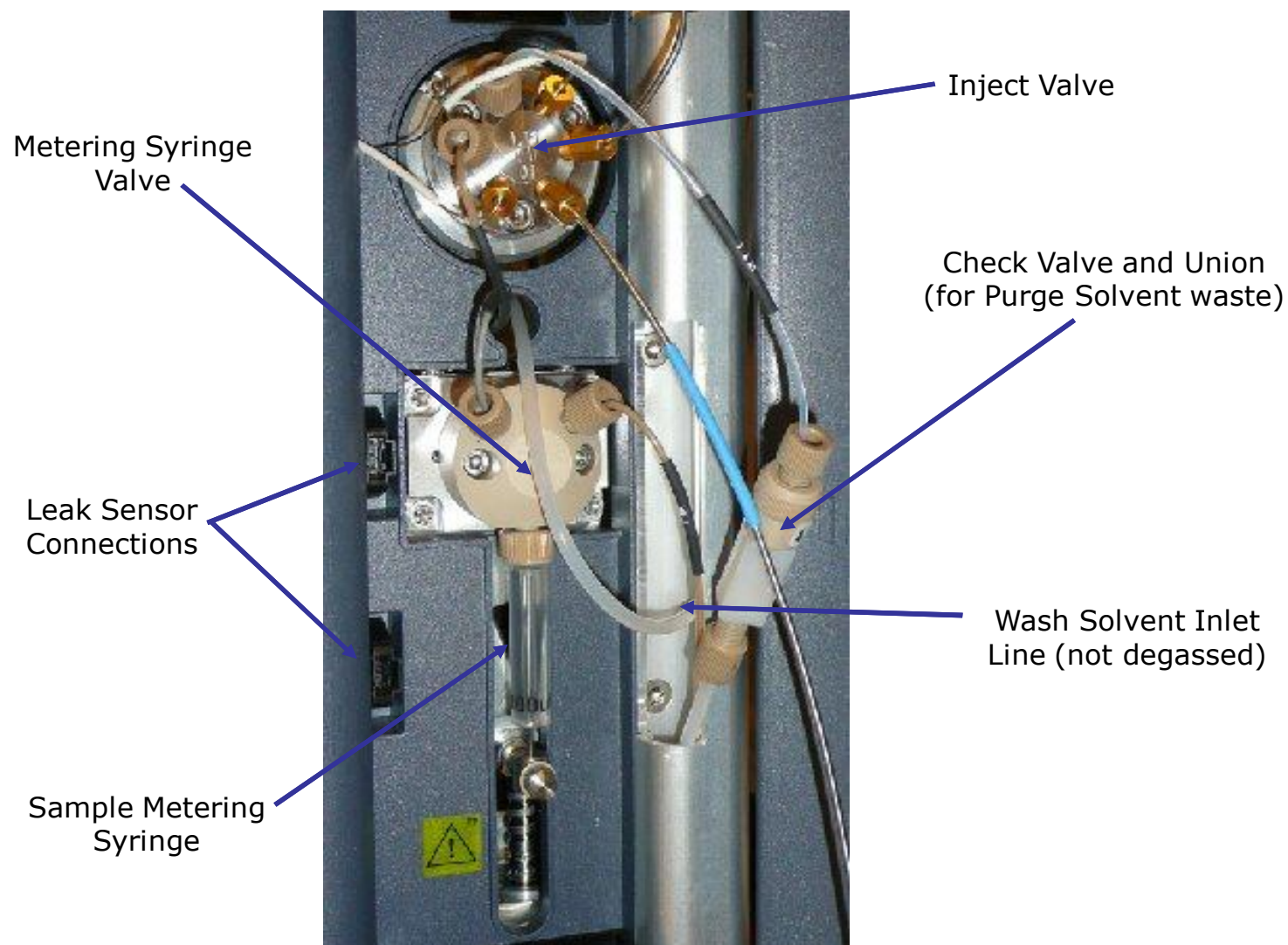
SM-FTN Flow Diagram



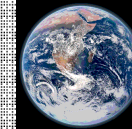
Global Training
& Development



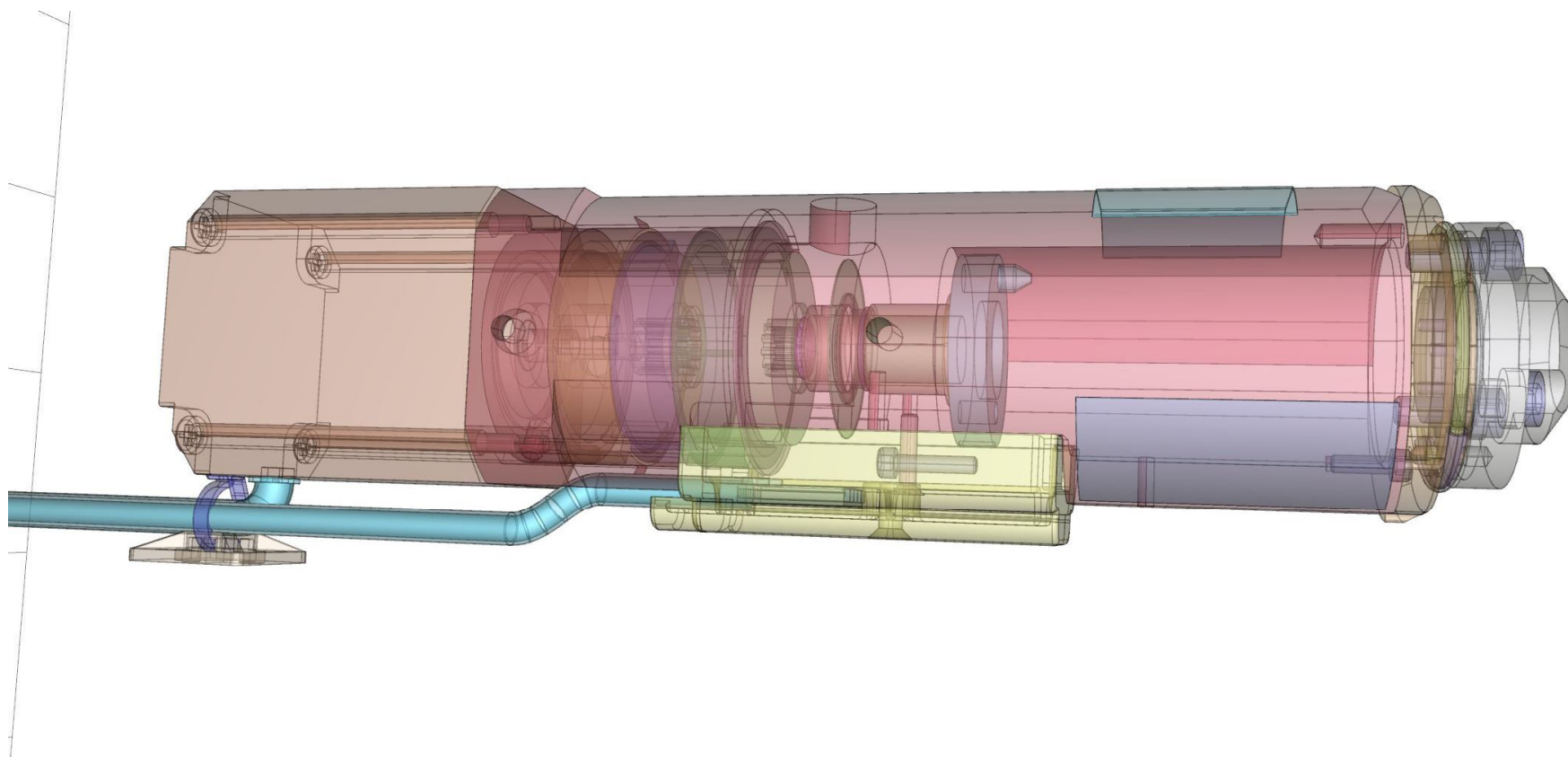
SMDI Front Panel Fluidics



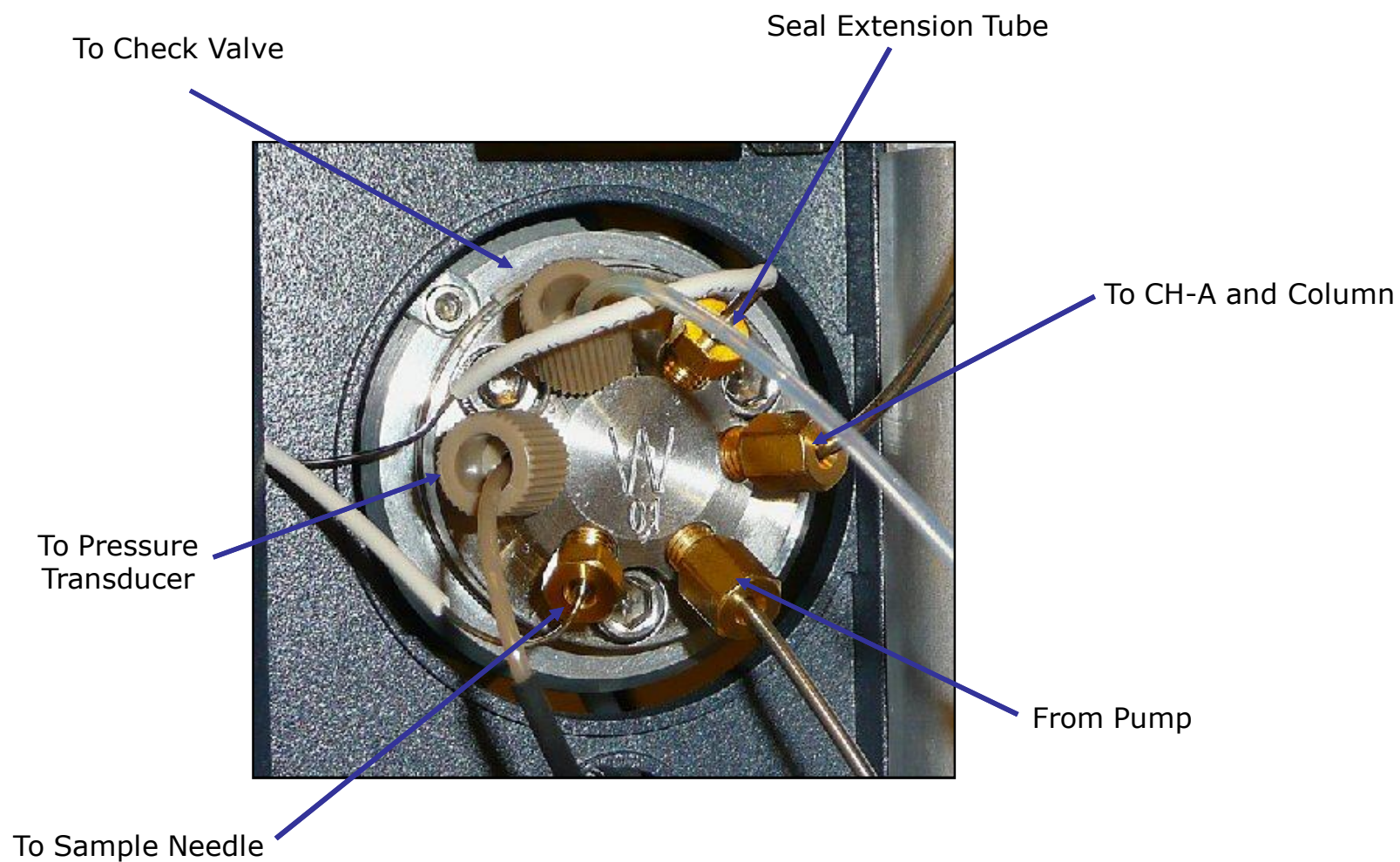
Inject Valve Assembly



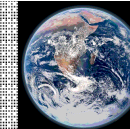
Global Training
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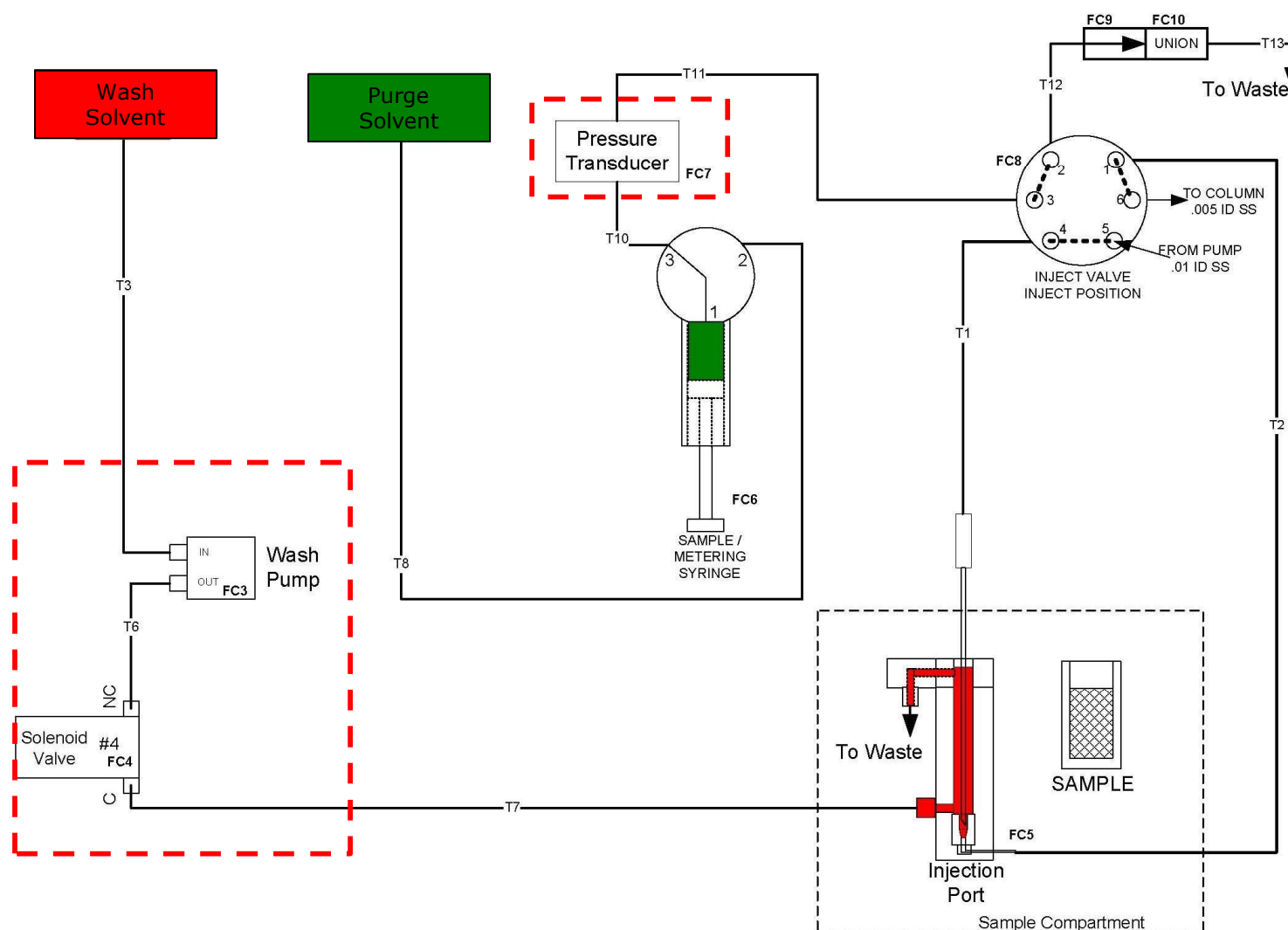
SDMI Inject Valve Connections



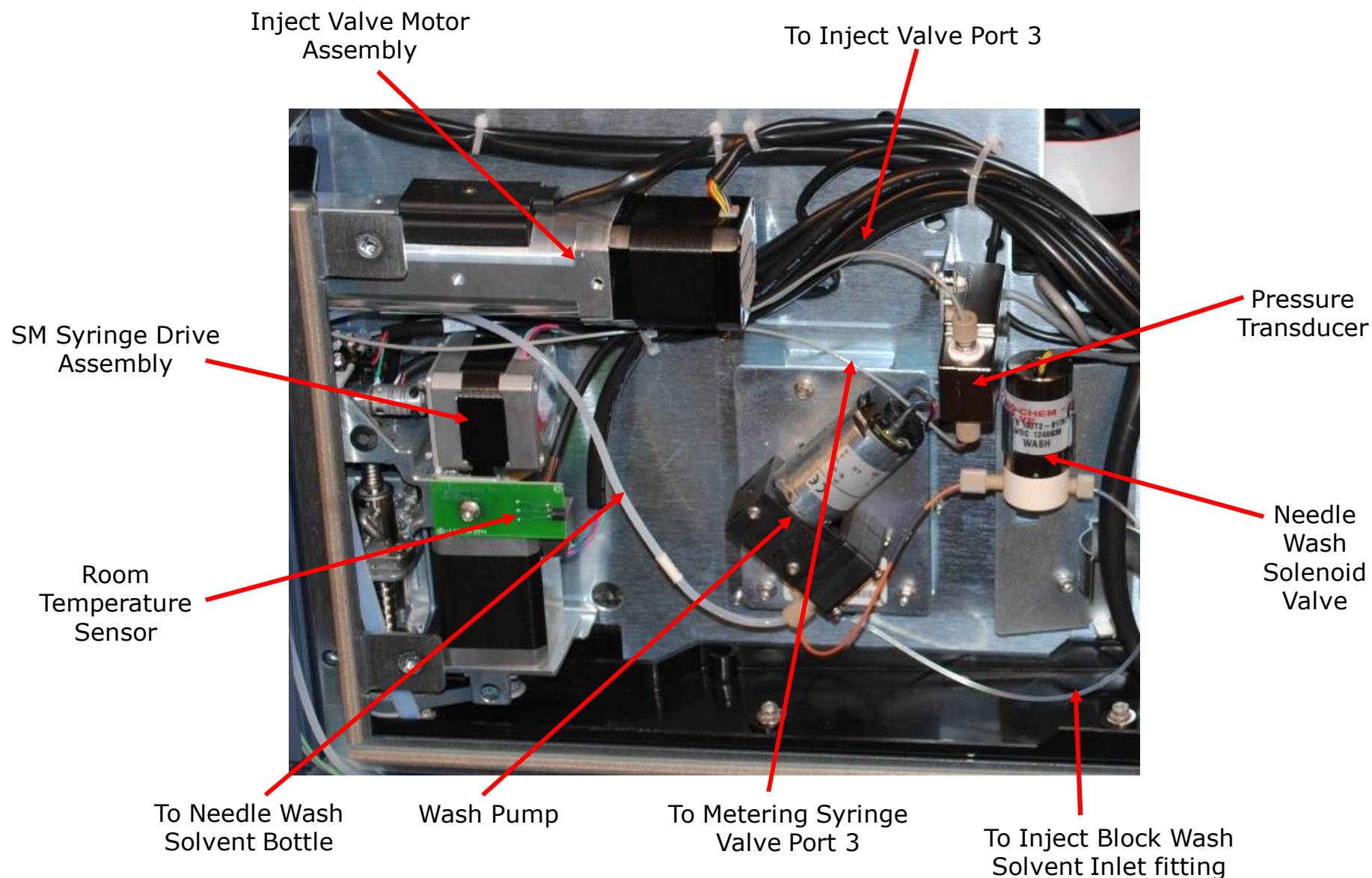
SM-FTN Flow Diagram



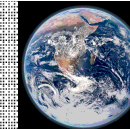
Global Training
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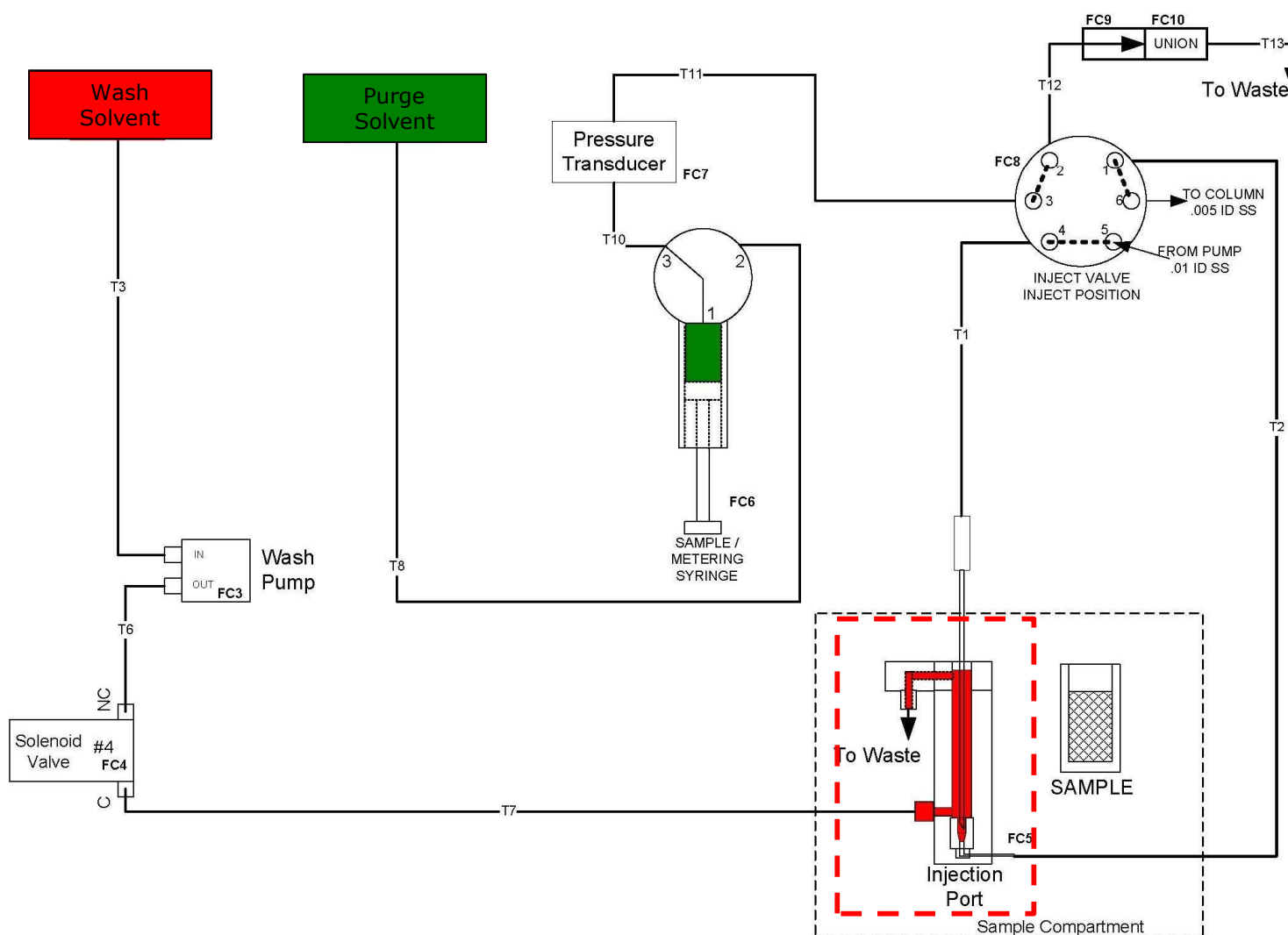
Internal Fluidic Connections



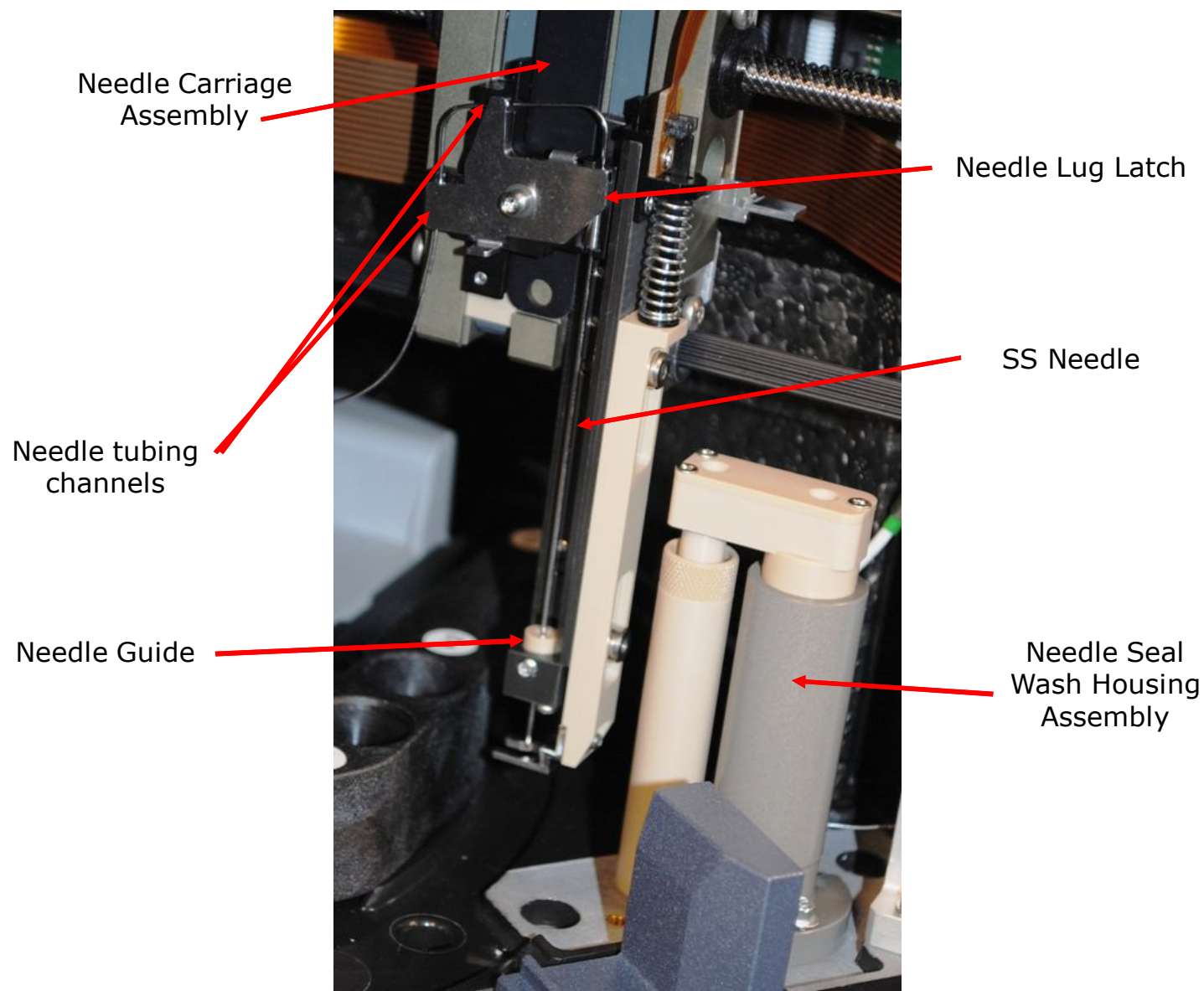
SM-FTN Flow Diagram



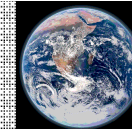
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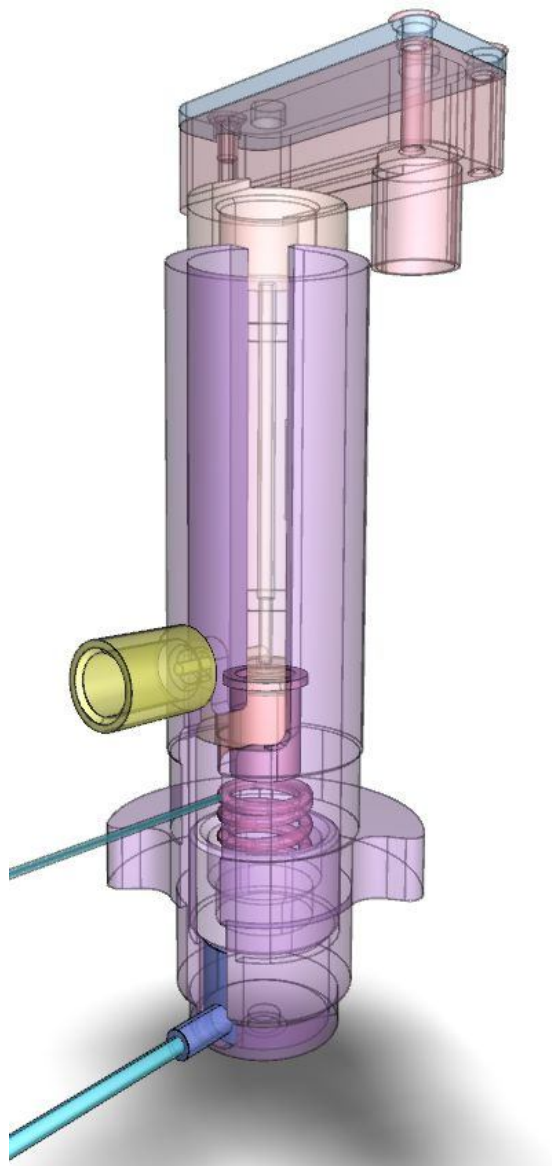
Internal Fluidic Components



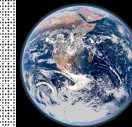
Needle Seal Wash Housing Assembly



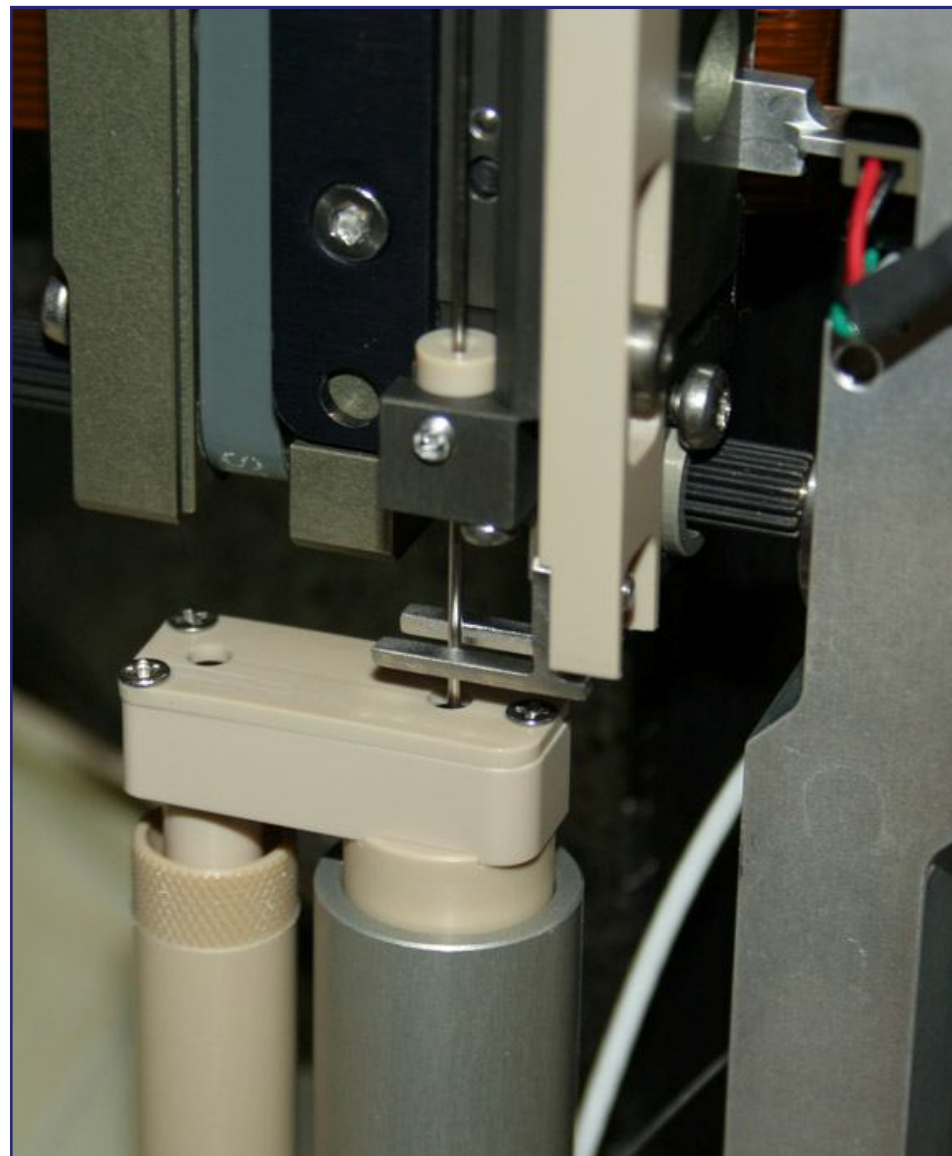
Global Training
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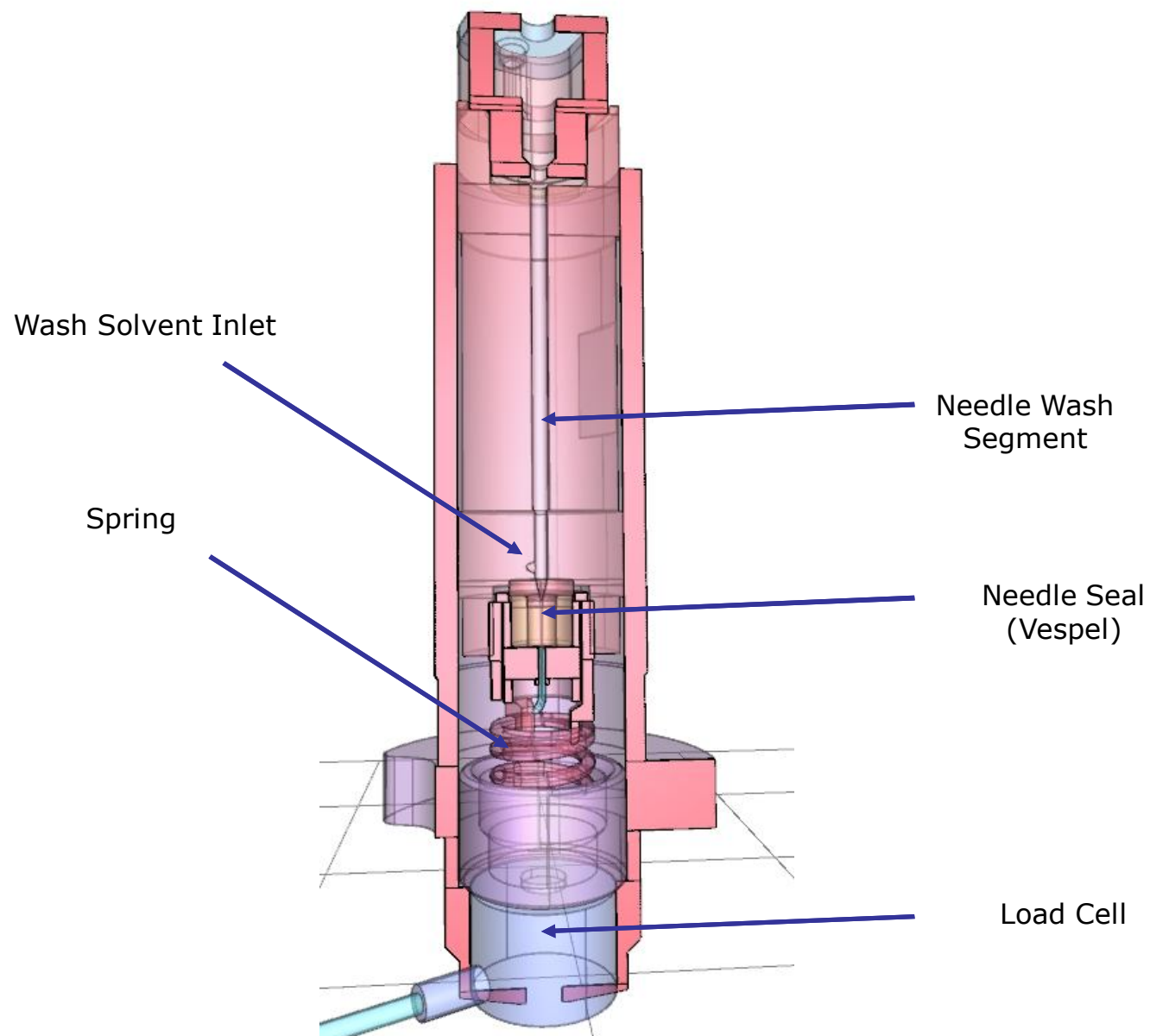
NSW Assembly- Needle in Inject Position



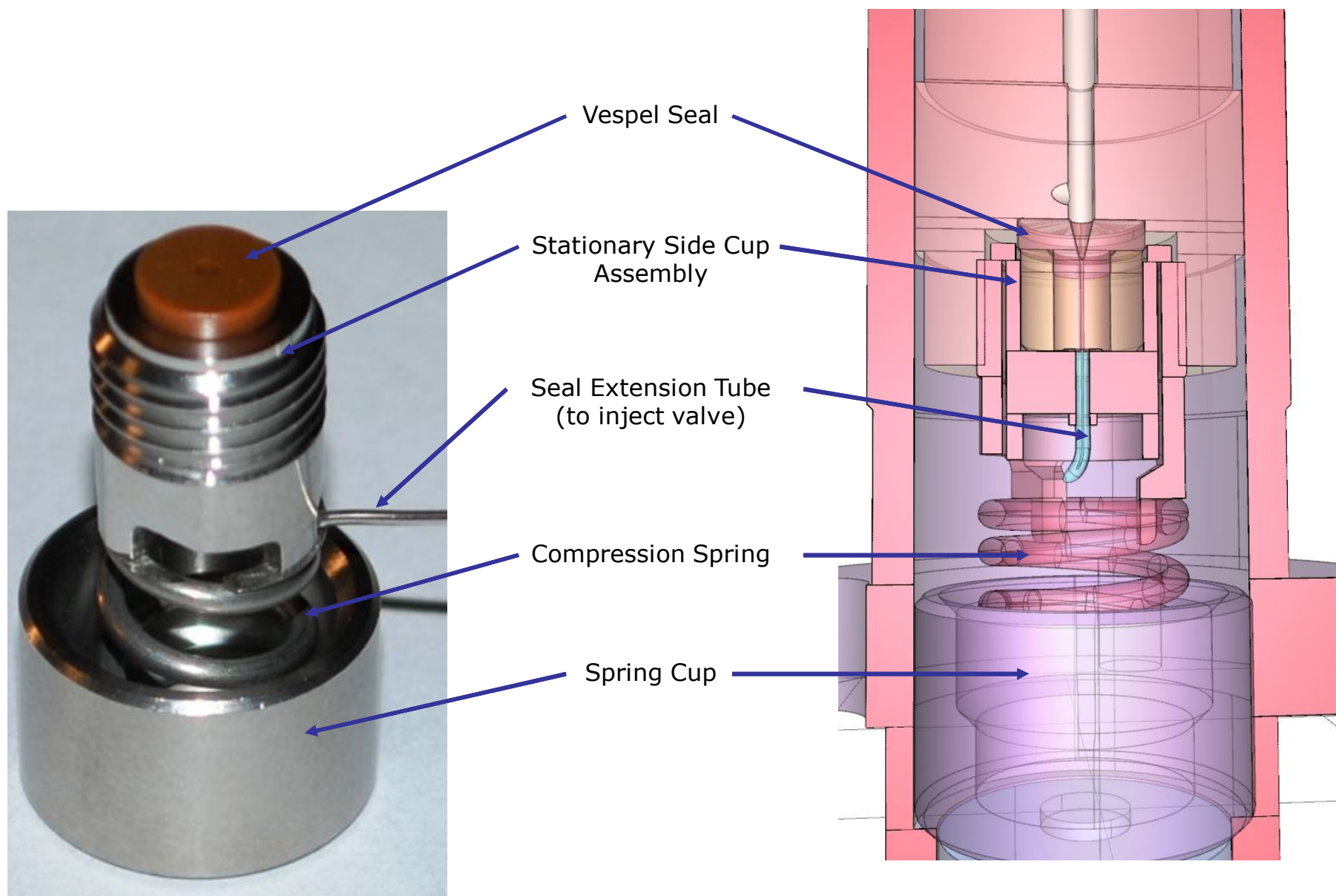
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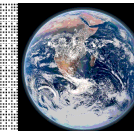
NSW Assembly- Transparent View



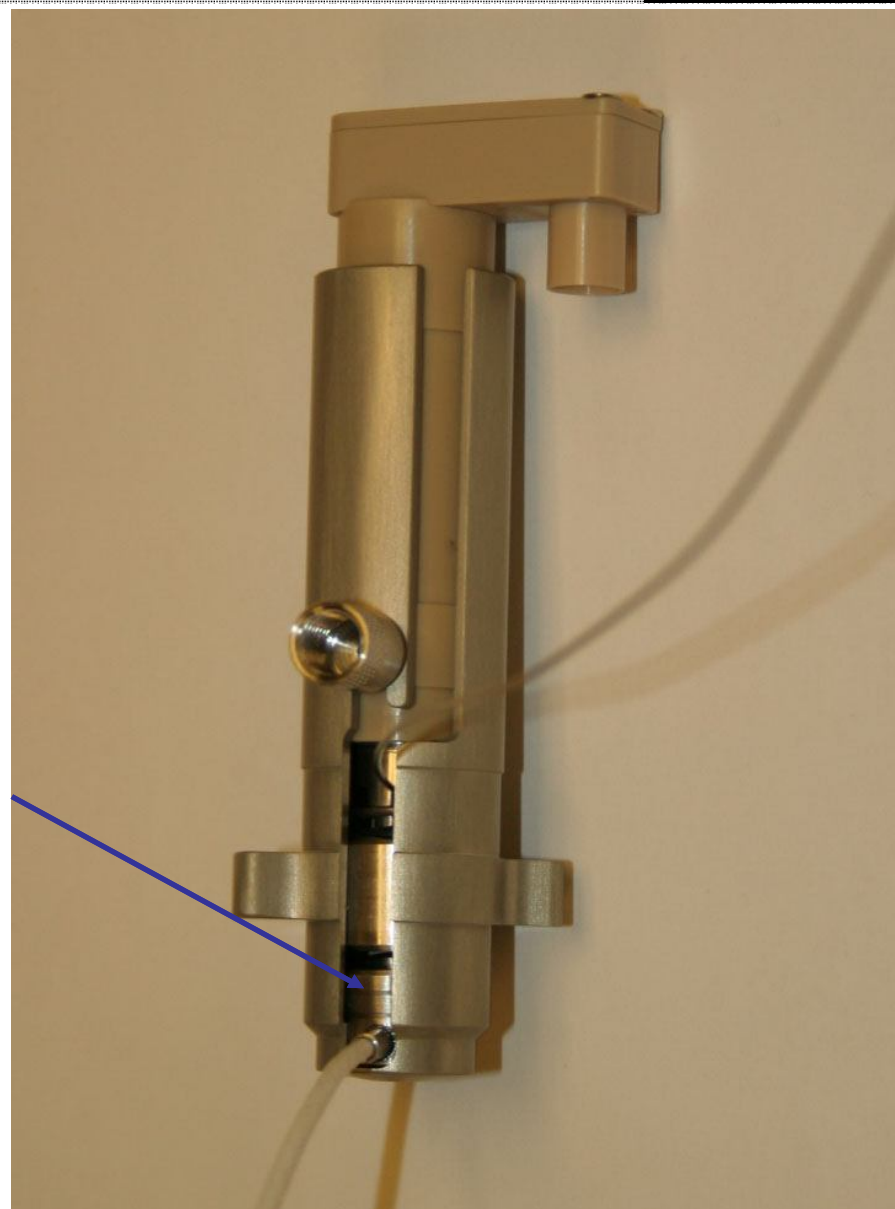
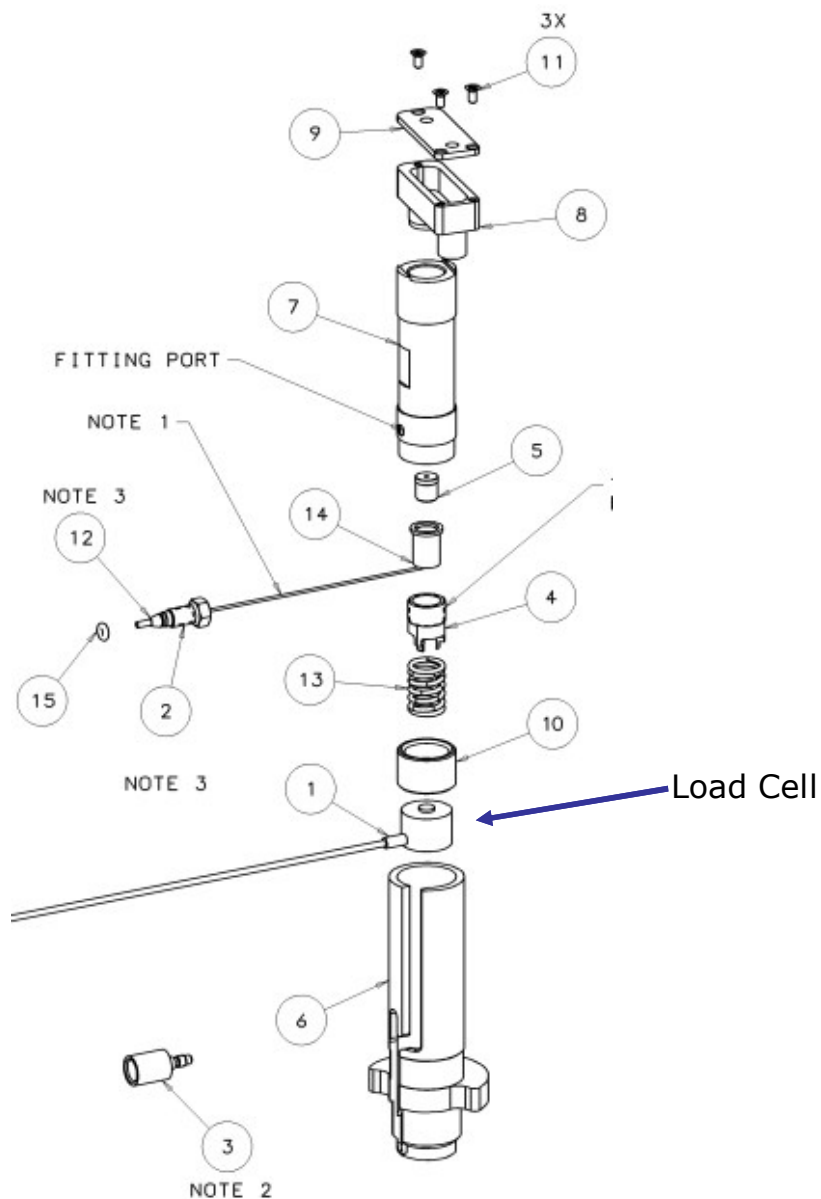
Stationary Side Seal Assembly



Needle Seal Wash Housing Assembly



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Needle, Loop and Syringe Options



Volume Configuration

Extended Loop Size: 0.0 μL

Needle size: 0.0 μL

Sample syringe size: 0.0 μL

OK Cancel

Volume Configuration

Extended Loop Size: 0.0 μL

Needle size: 15.0 μL

Sample syringe size: 15.0 μL

OK Cancel

Volume Configuration

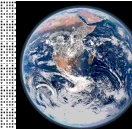
Extended Loop Size: 0.0 μL

Needle size: 15.0 μL

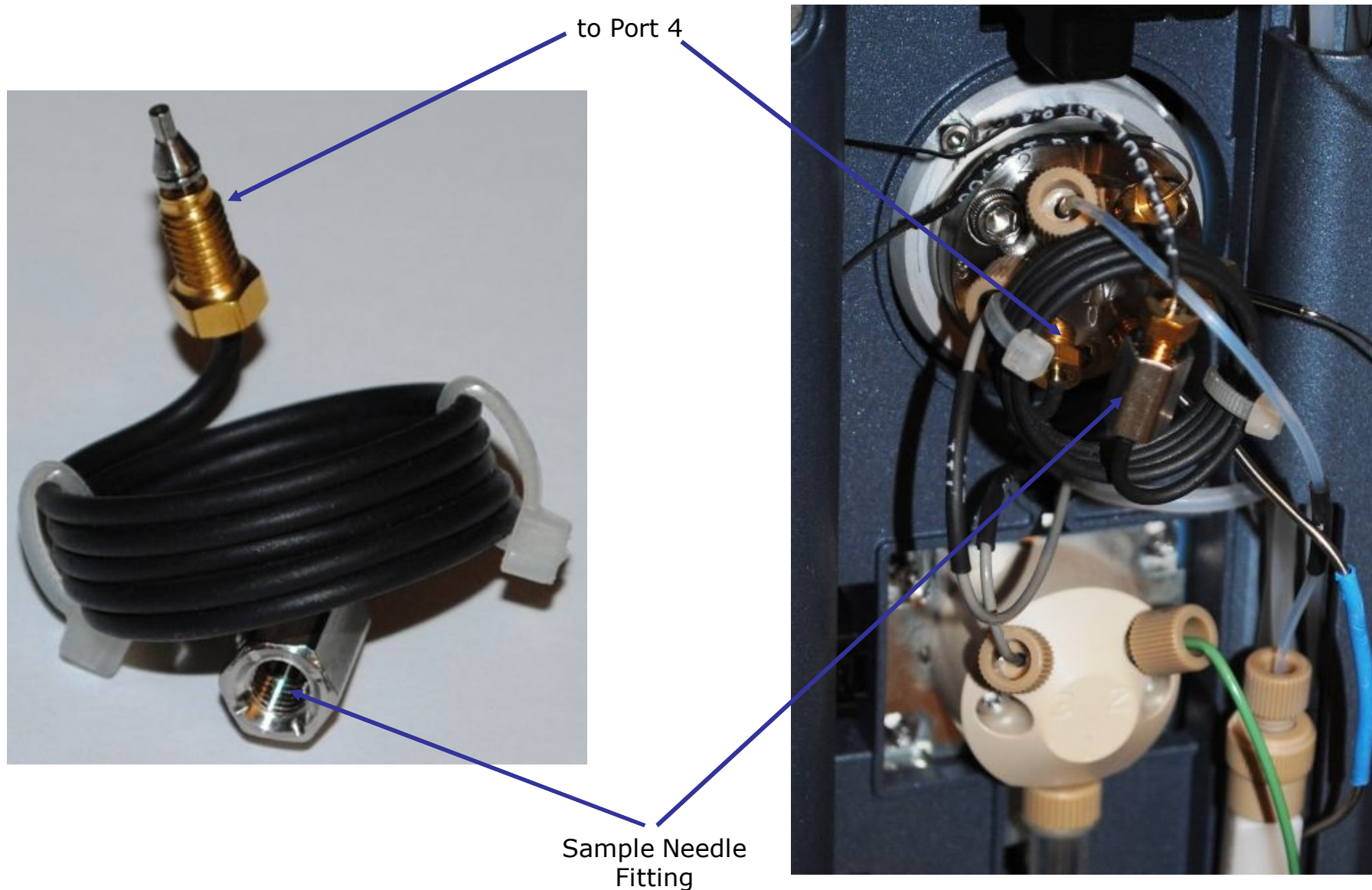
Sample syringe size: 100.0 μL

OK Cancel

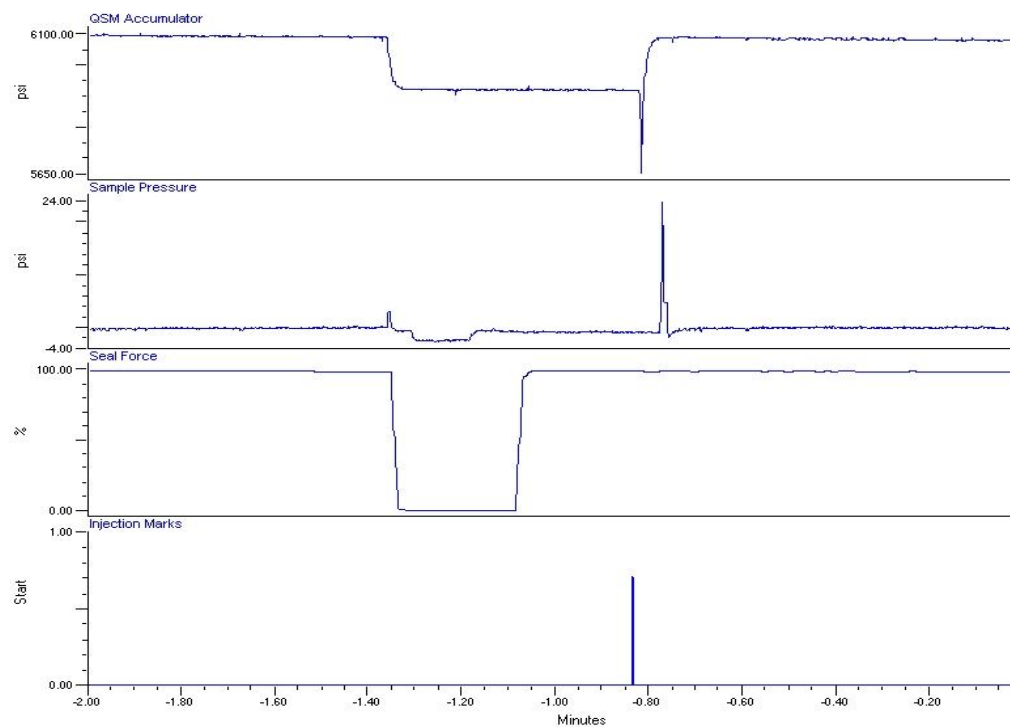
Extended Loop



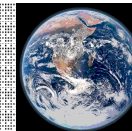
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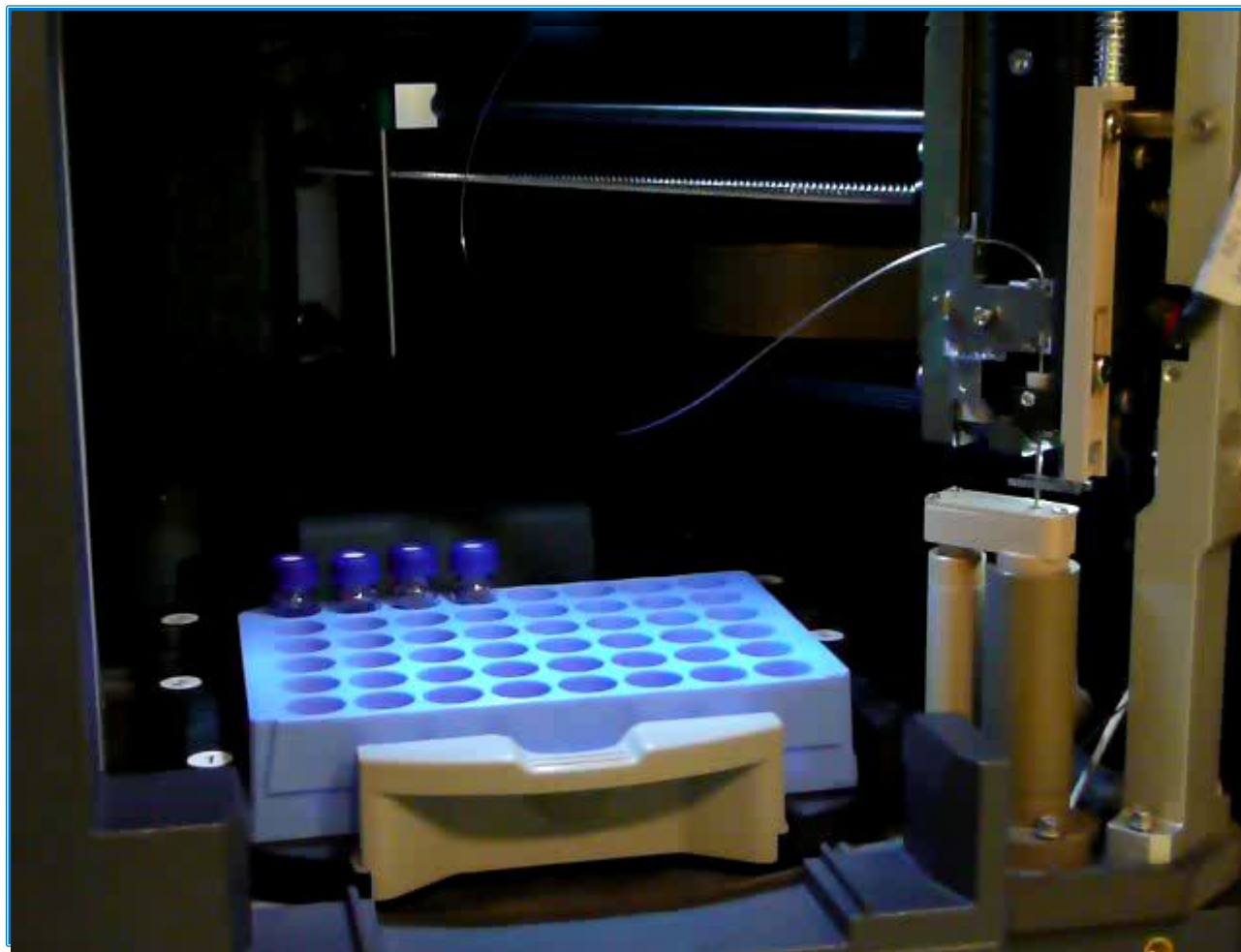
SM-FTN Injection Sequence



Sample Withdrawal Sequence



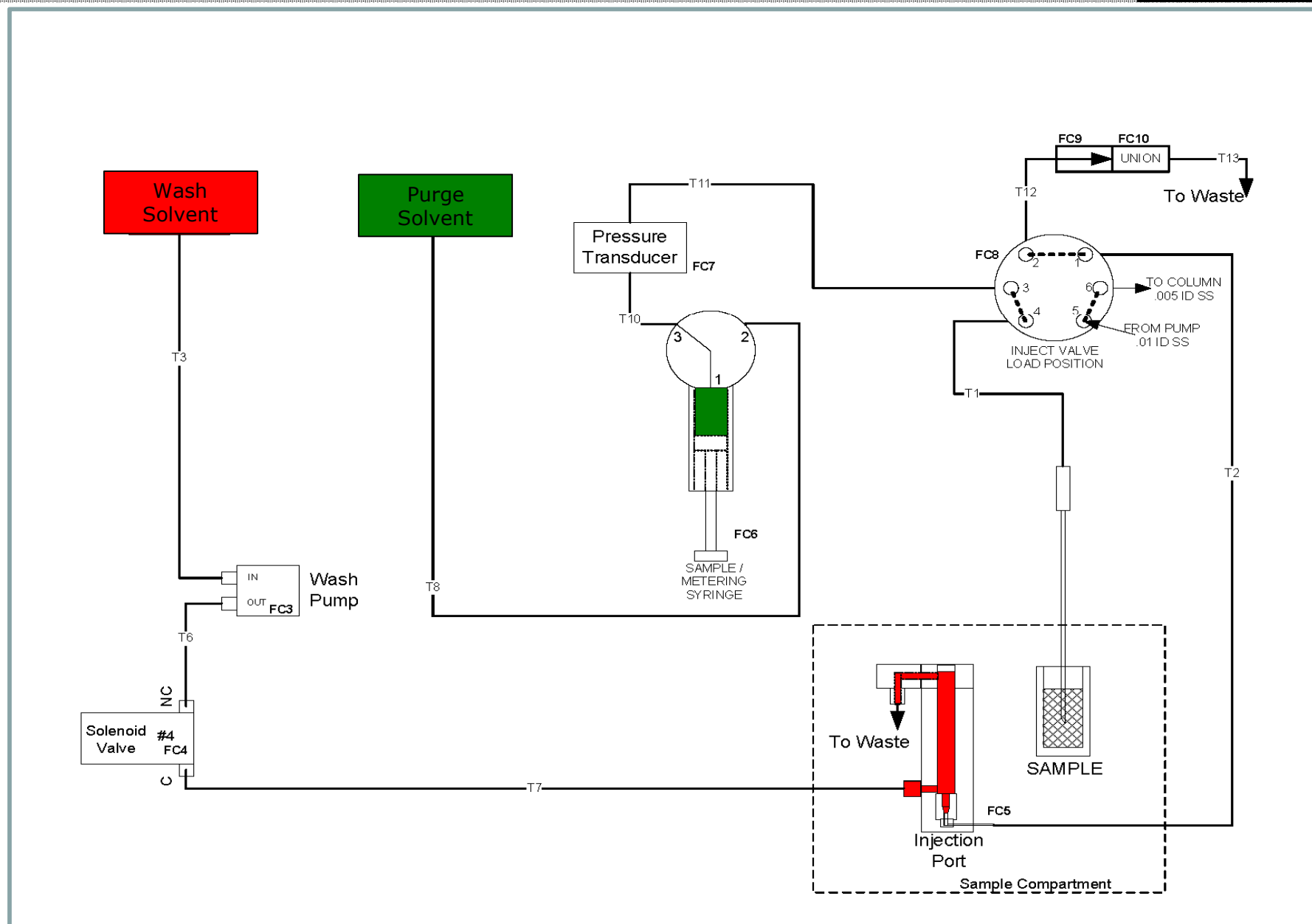
Global Training
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Flow Diagram- Sample Withdrawal



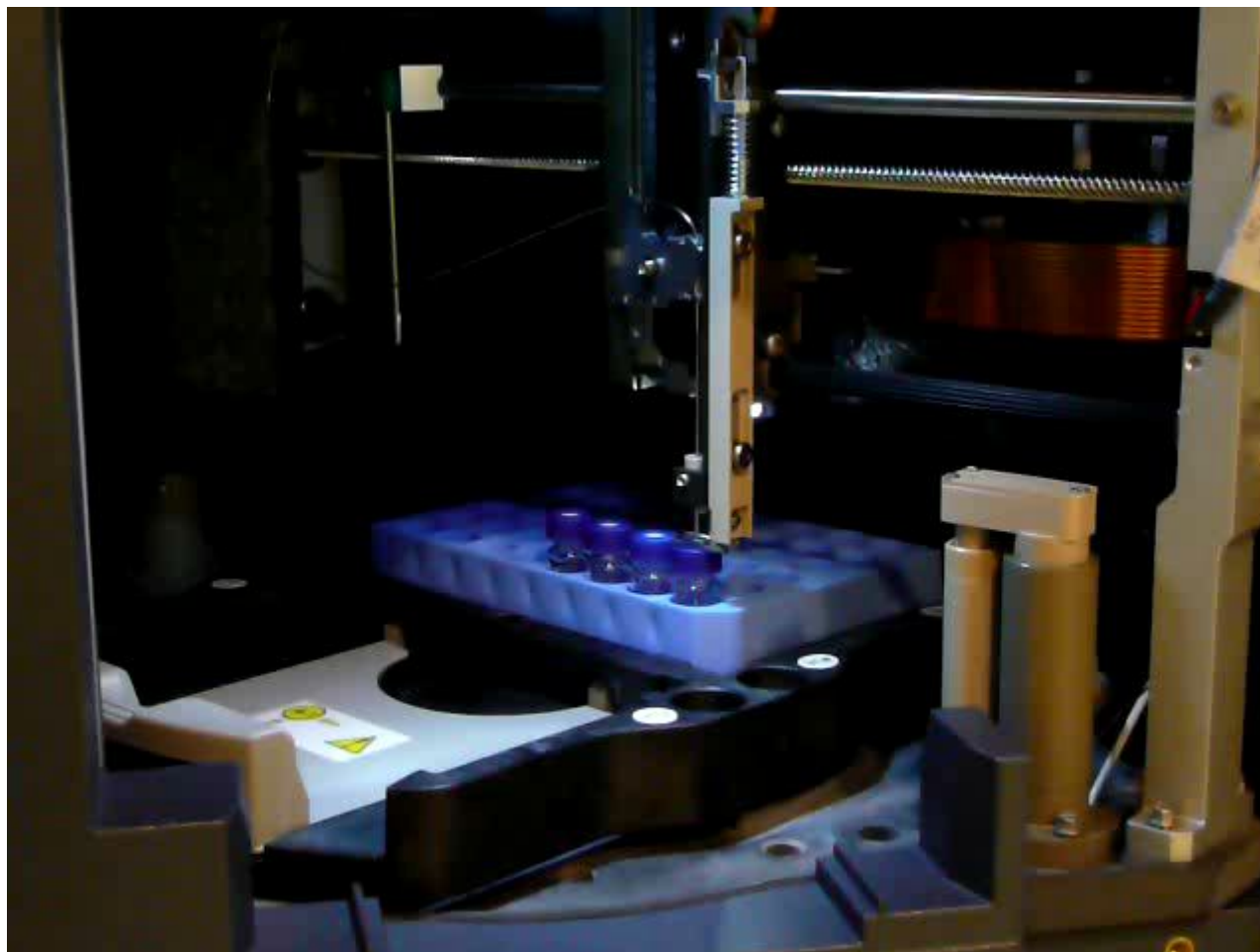
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Sample Injection Sequence



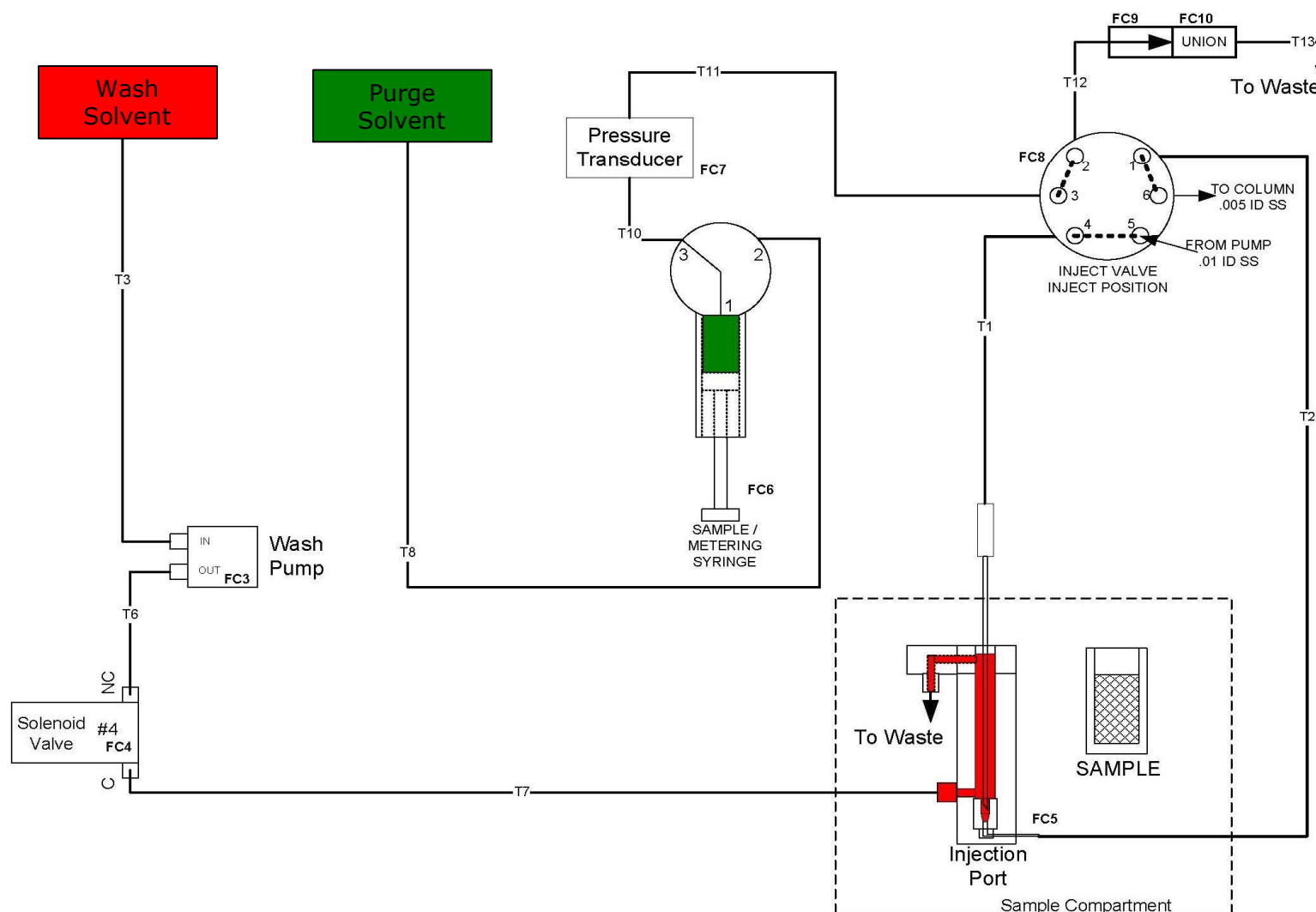
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Flow Diagram- Inject Mode



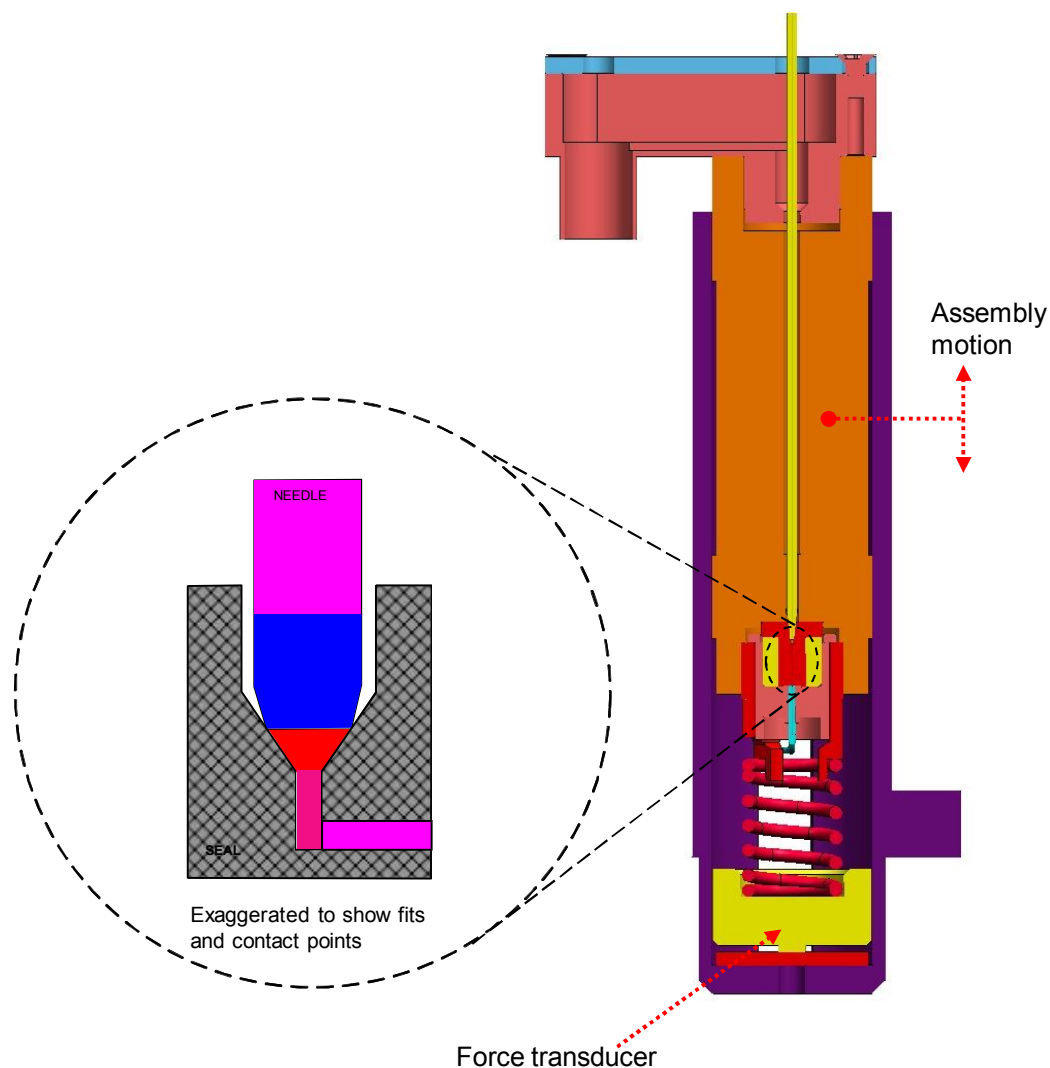
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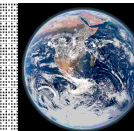
SM-FTN I-Class Enhancements



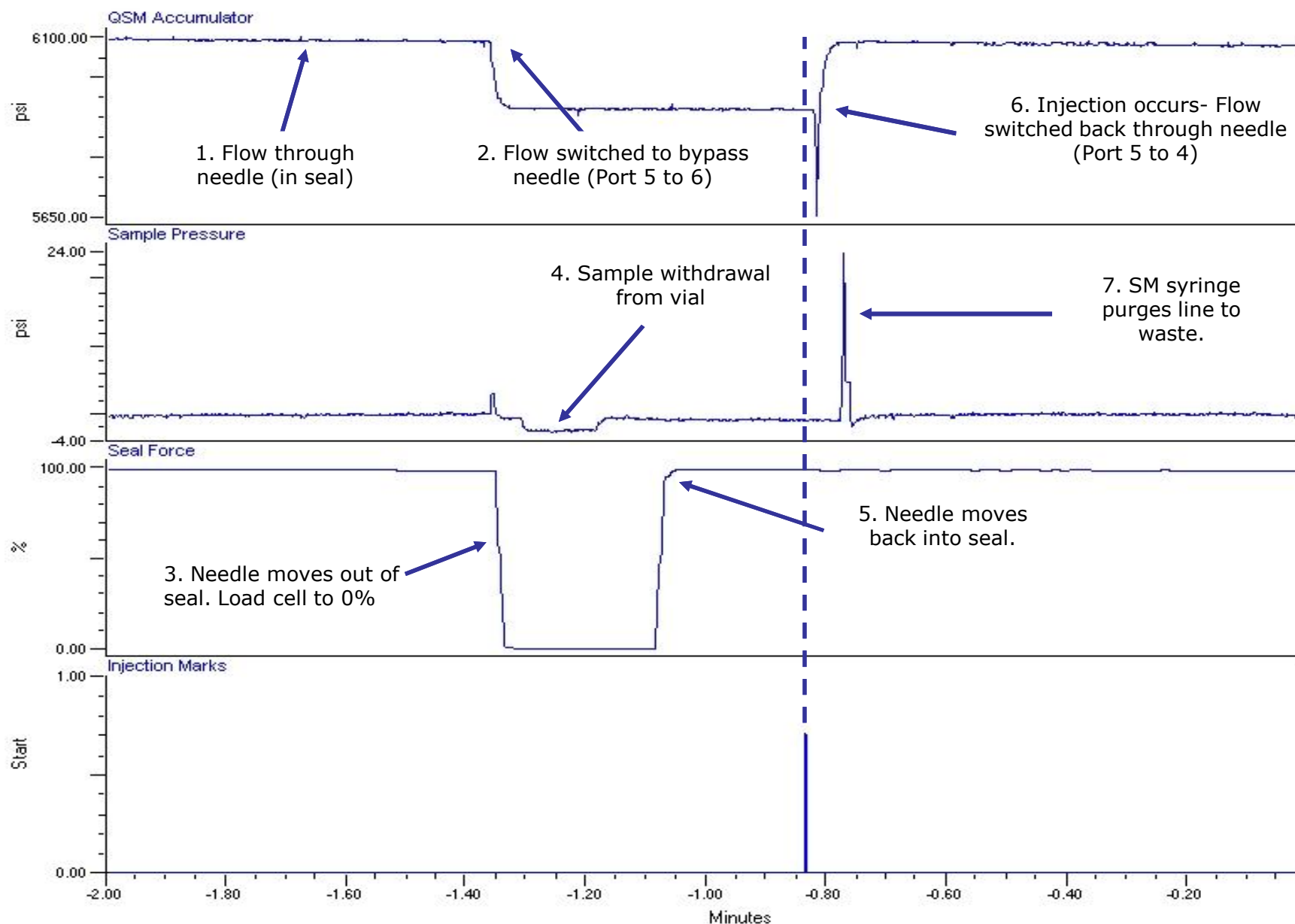
- Hardware in injection port stays the same
- Sealing force increased
- Return line reduced from 0.004" to 0.003" to reduce dispersion



Injection Sequence Pressure Trace



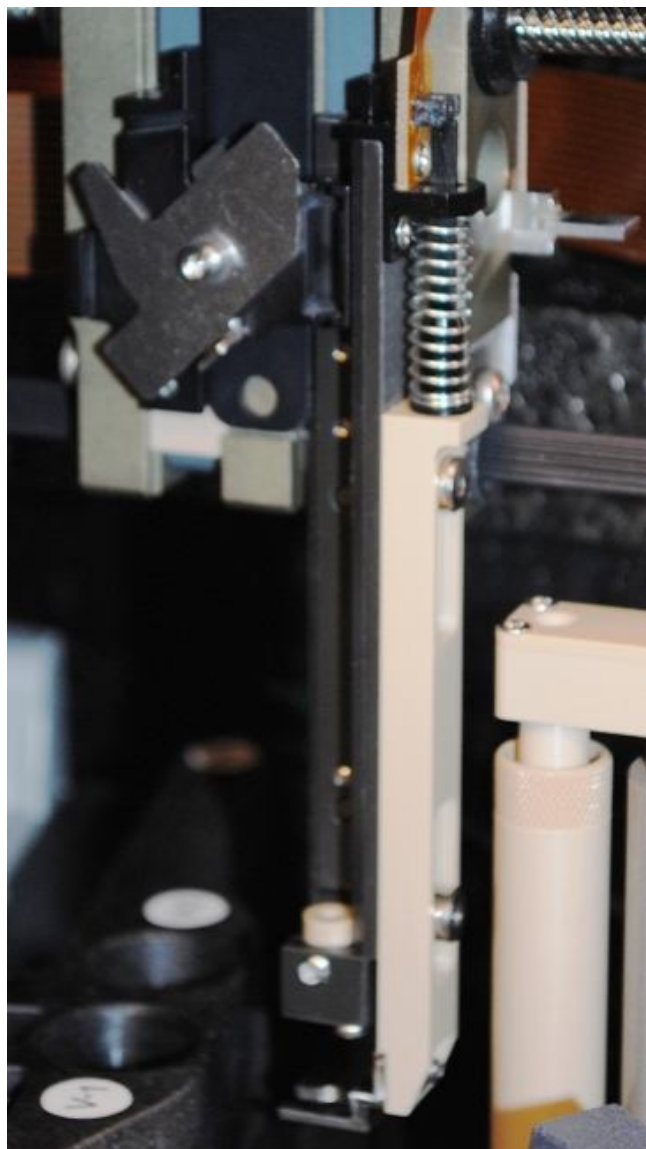
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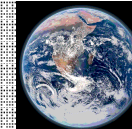
Needle Installation- Production Units



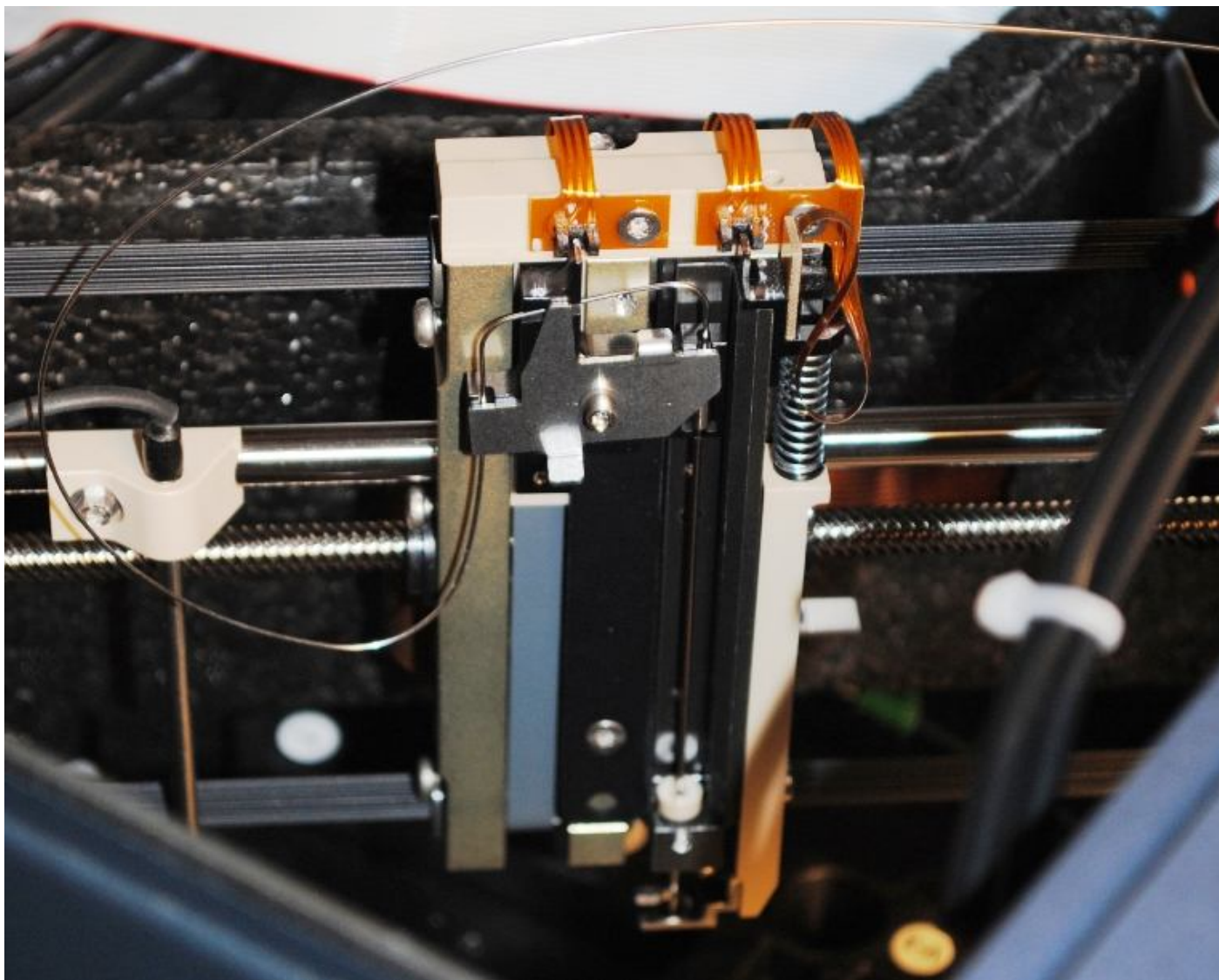
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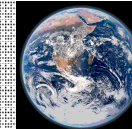
Needle Routing- Production Units



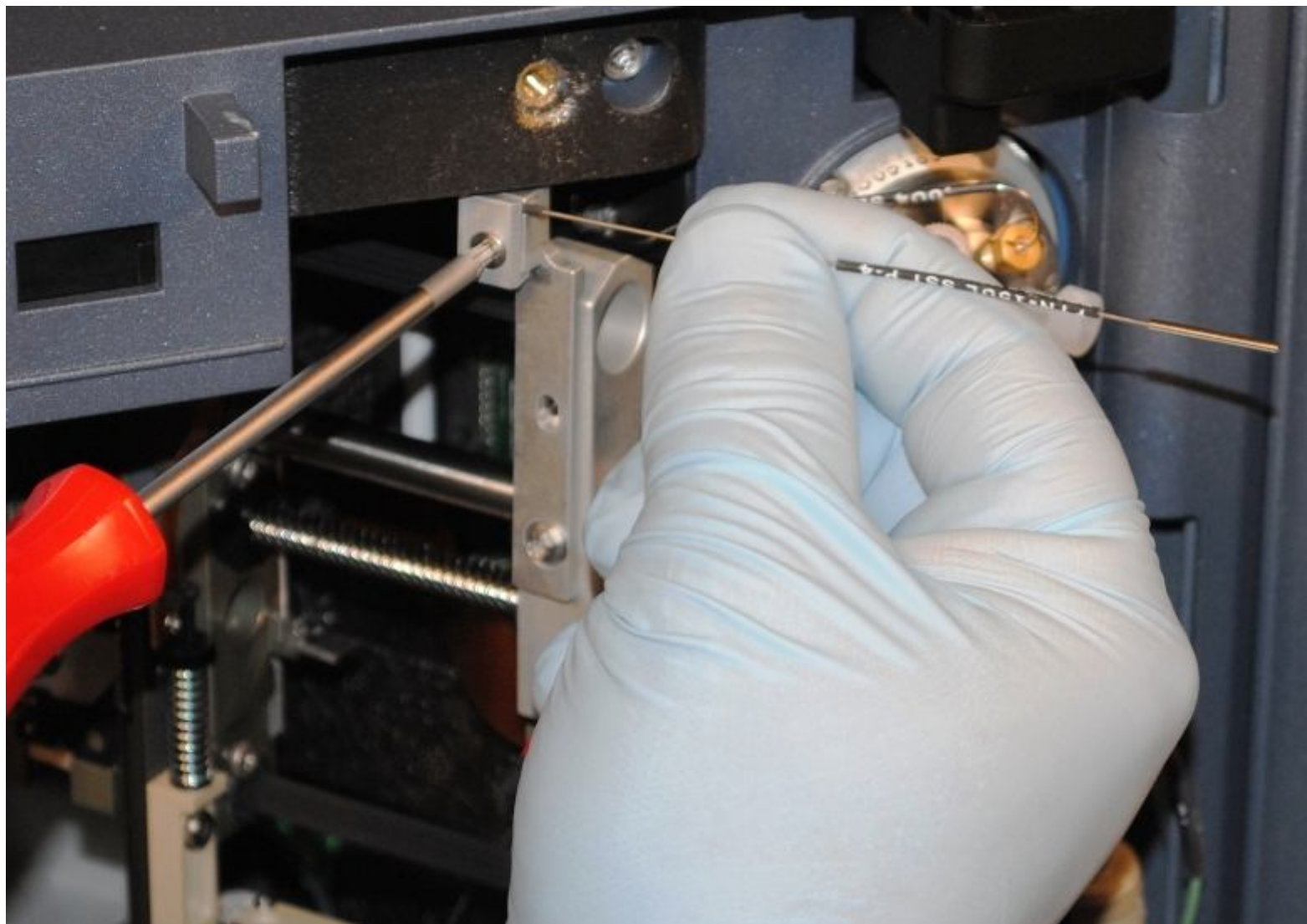
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Needle Routing- Production Units



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SM Performance



Injection Volume Recommendations



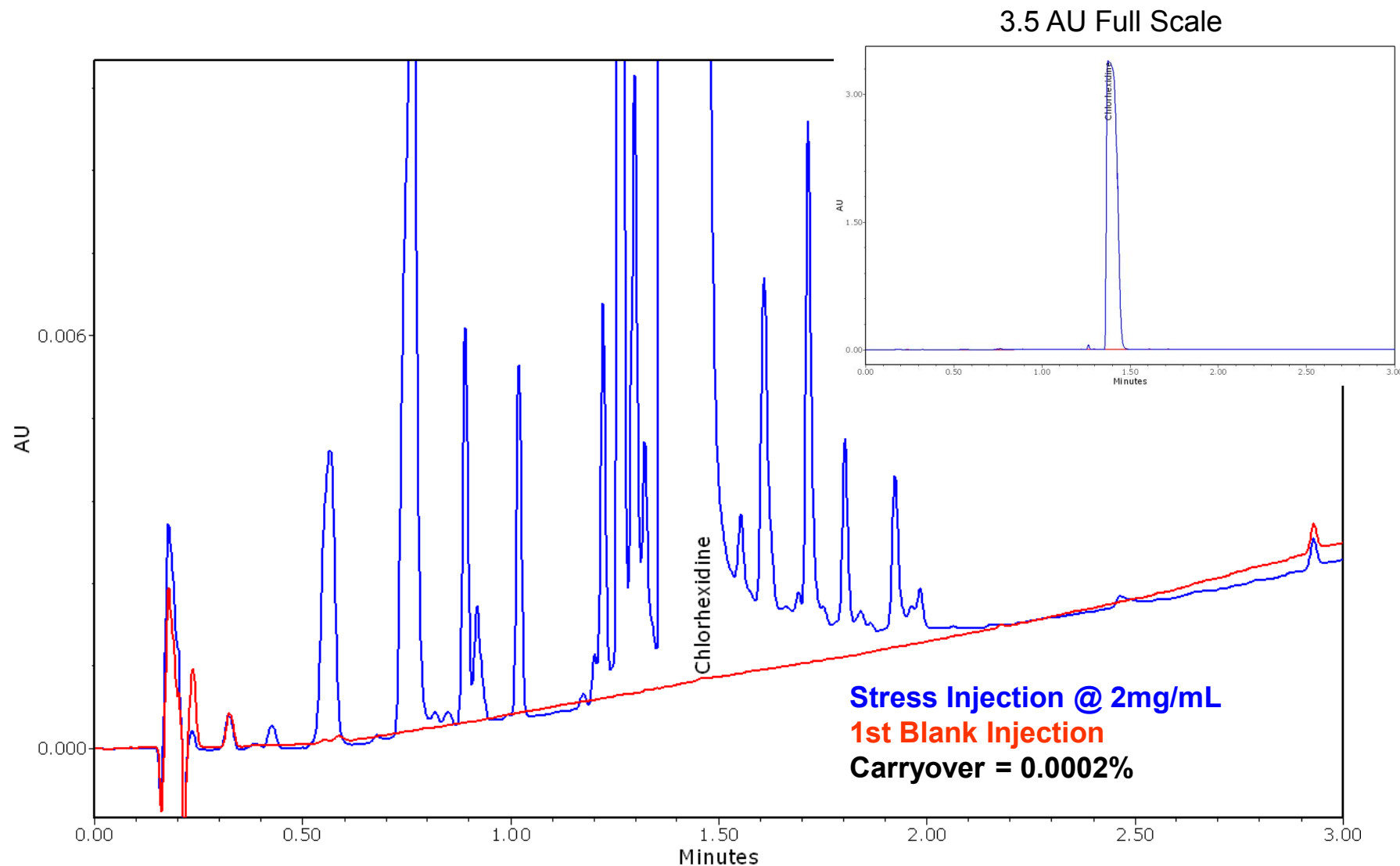
Configuration	Extension Loop	Injection Volume	R ² 0.999
15µL needle		0.1 to 10µL	0.2 to 10µL
30µL needle		0.1 to 25µL	0.2 to 25µL
Any needle	50µL	Up to 50µL	2 to 50µL
Any needle	100µL	Up to 100µL	10 to 100µL
Any needle	250µL	Up to 250µL	25 to 250µL

Carryover with UV Detection



Excellent carryover performance @ 0.0002% was achieved for chlorhexidine (a basic and difficult-to-remove compound) with the new sample manager flow-through-needle (SM-FTN) design.

Carryover with UV Detection

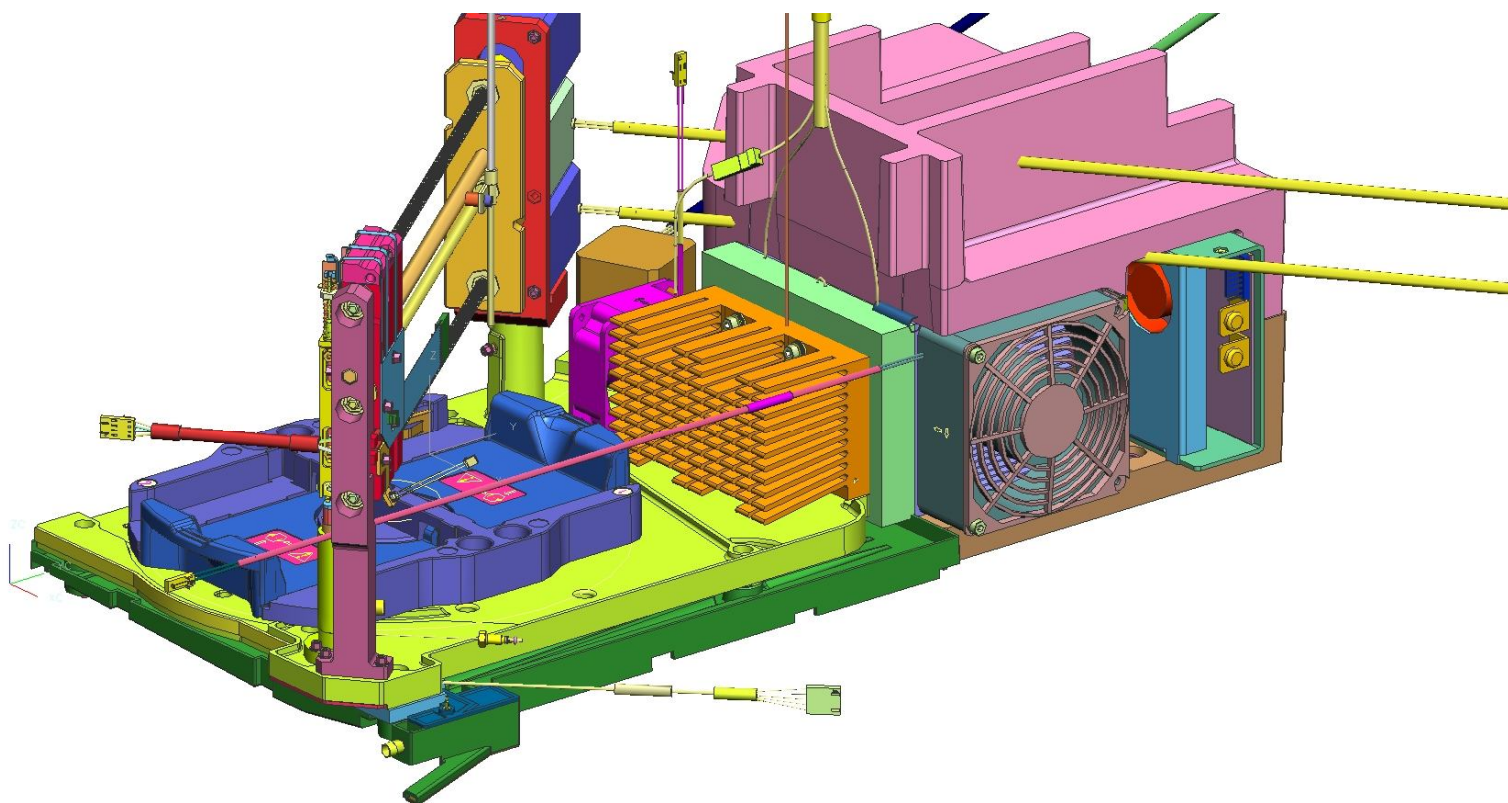


Excellent carryover performance @ 0.0002% was achieved for Chlorhexidine (a basic and difficult-to-remove compound) flow-through-needle (SM-FTN) design.

R-Theta Drive Assembly

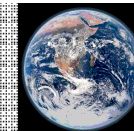


R-Theta Drive Assembly

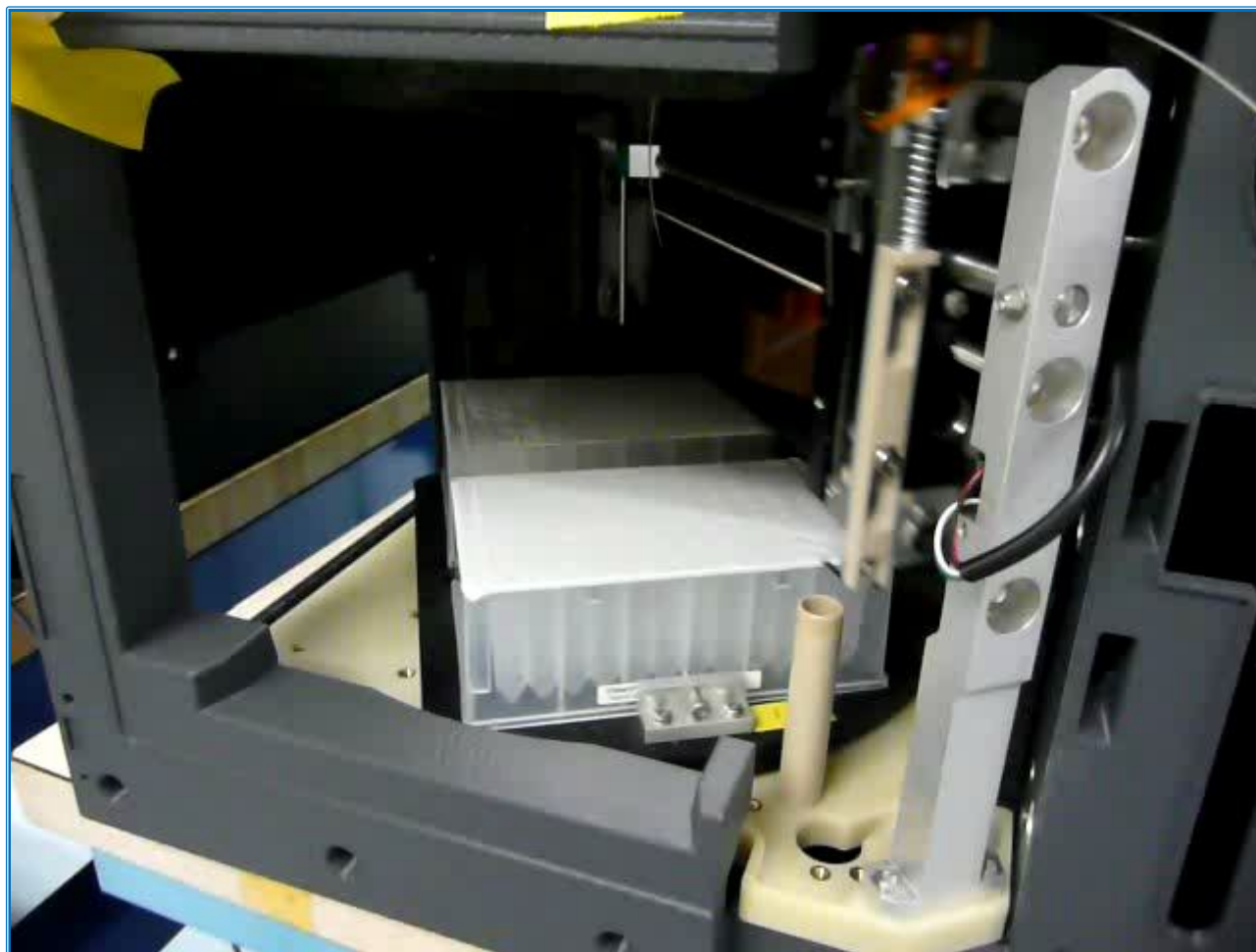


TFR-170 WORK Camera TFR-170

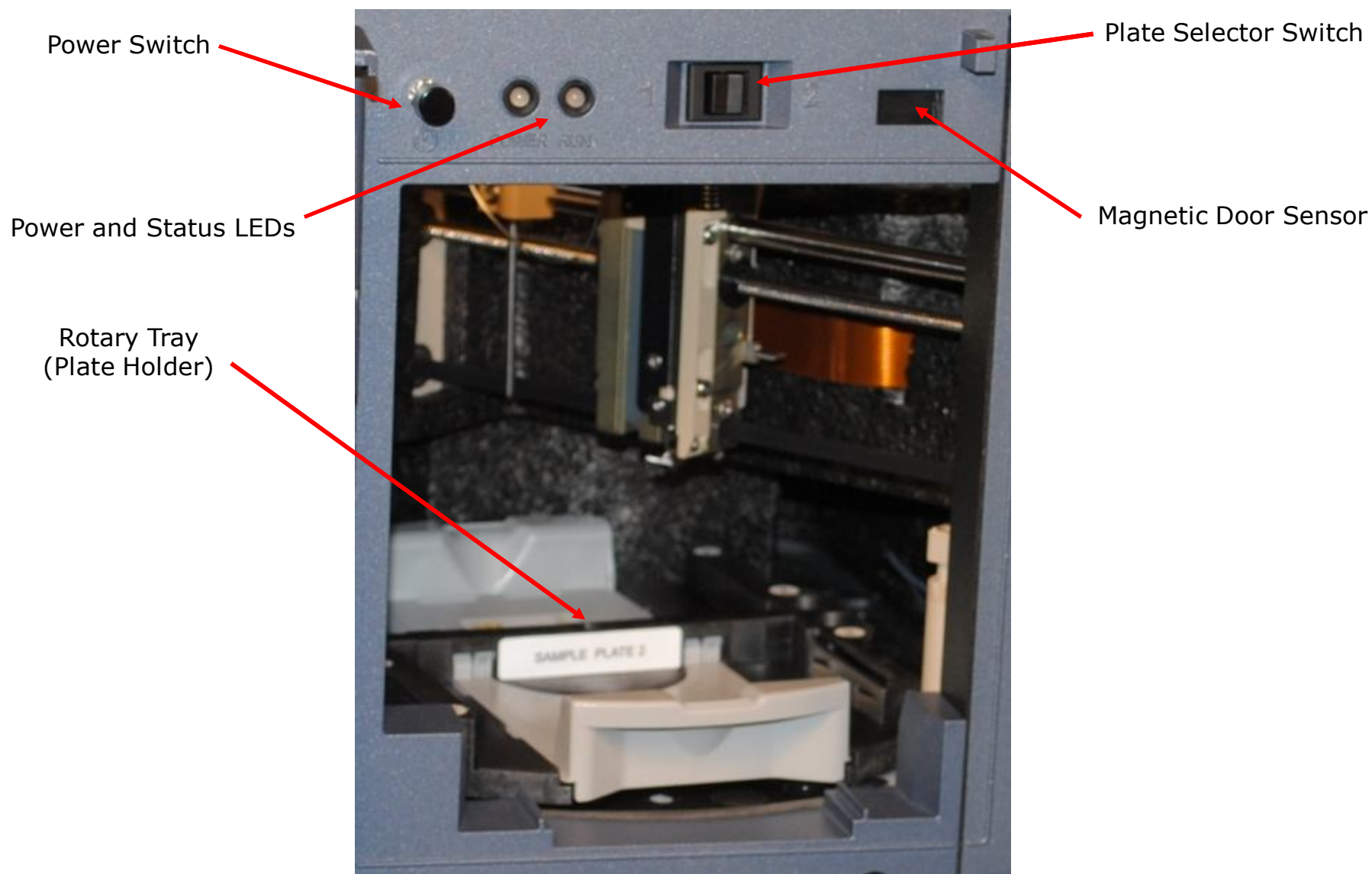
R-Theta Coordinated Movement



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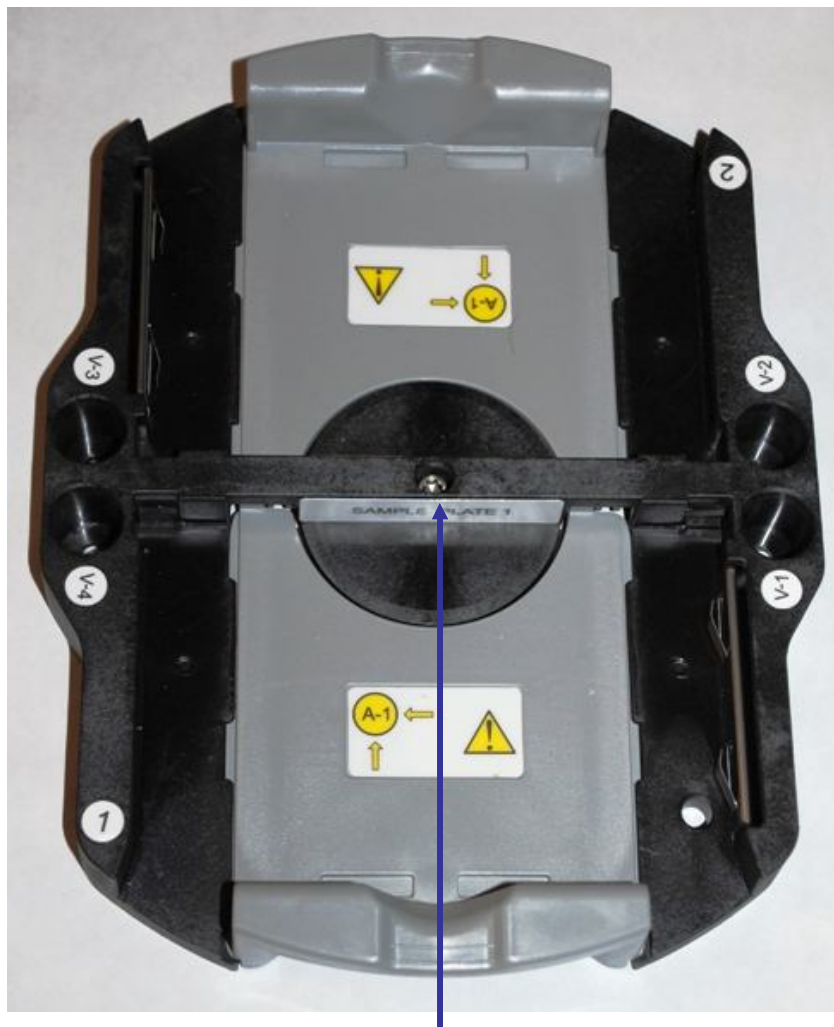
Sample Compartment



Rotary Tray

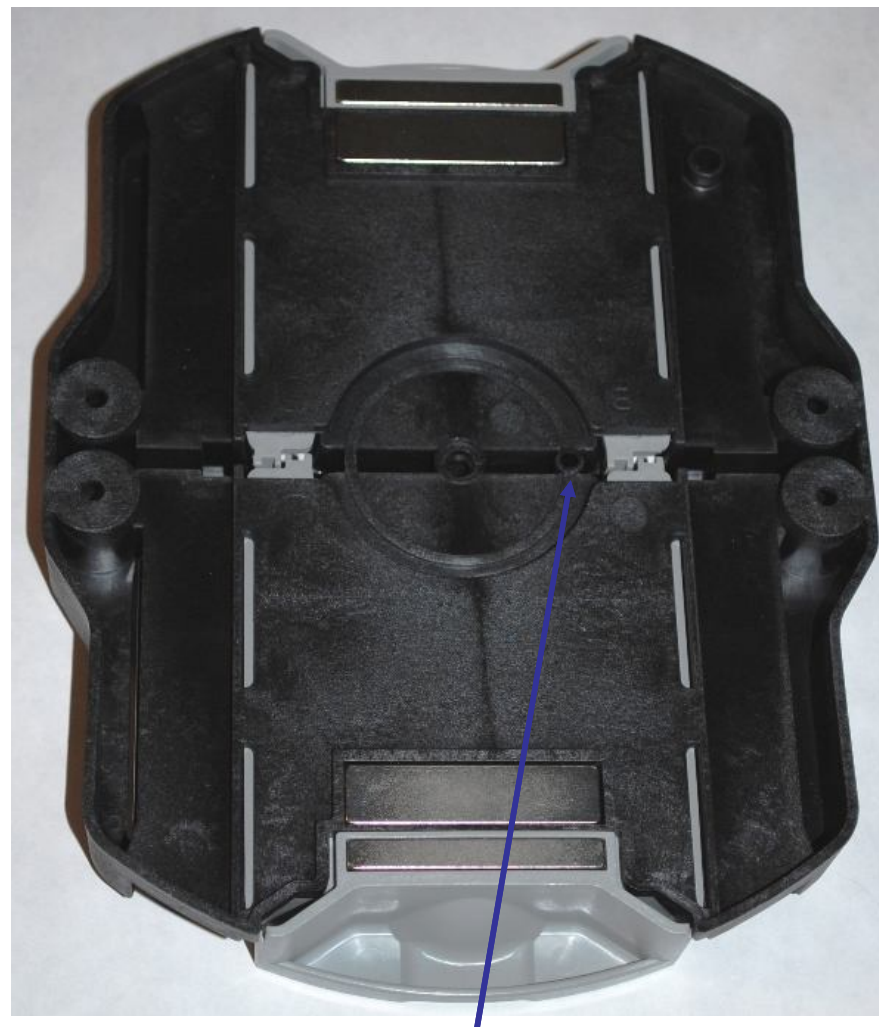


Top View



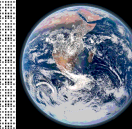
T20 Torx Screw

Bottom View

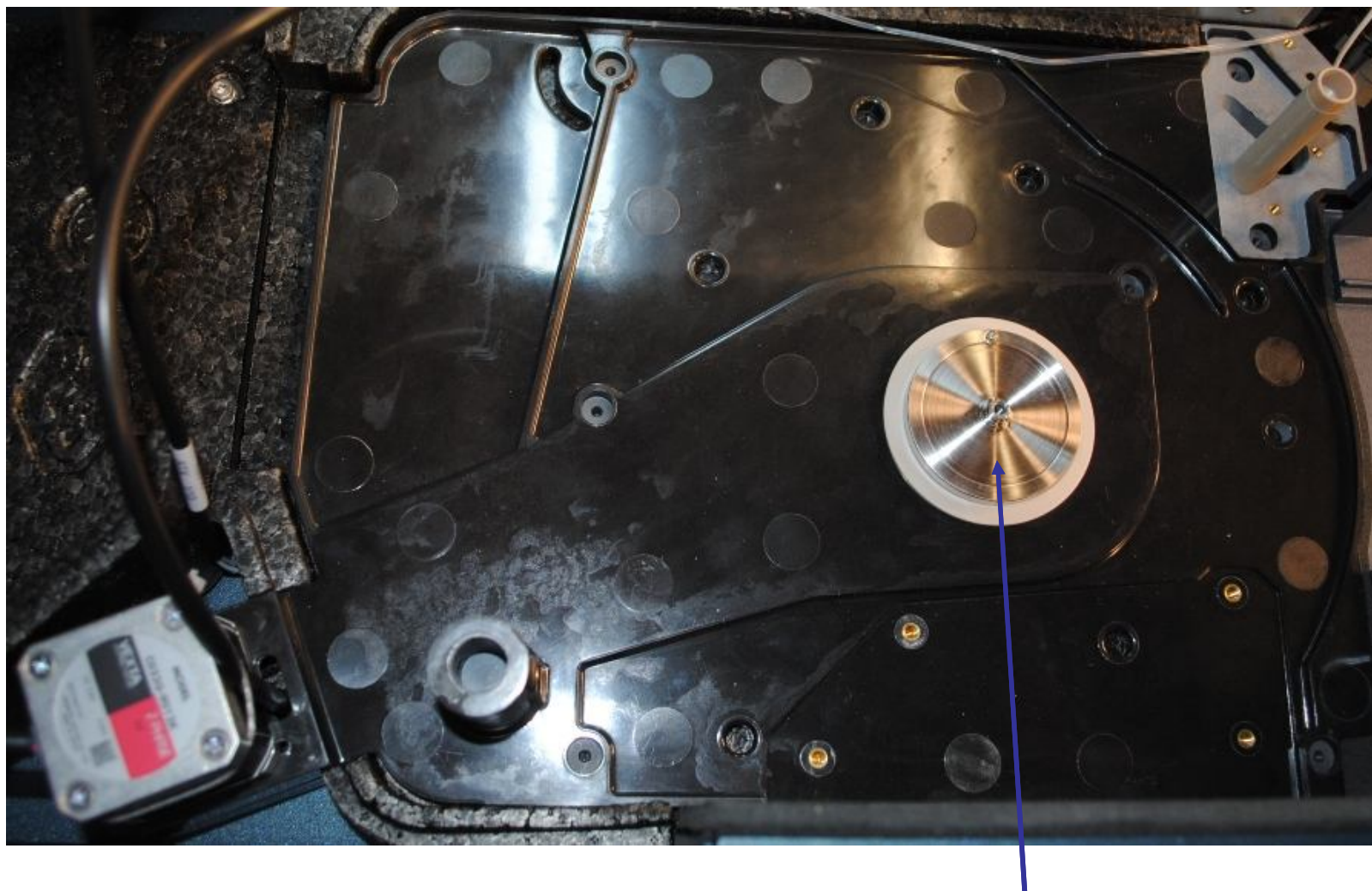


Guide Pin Hole

Theta Drive Assembly (Top View)

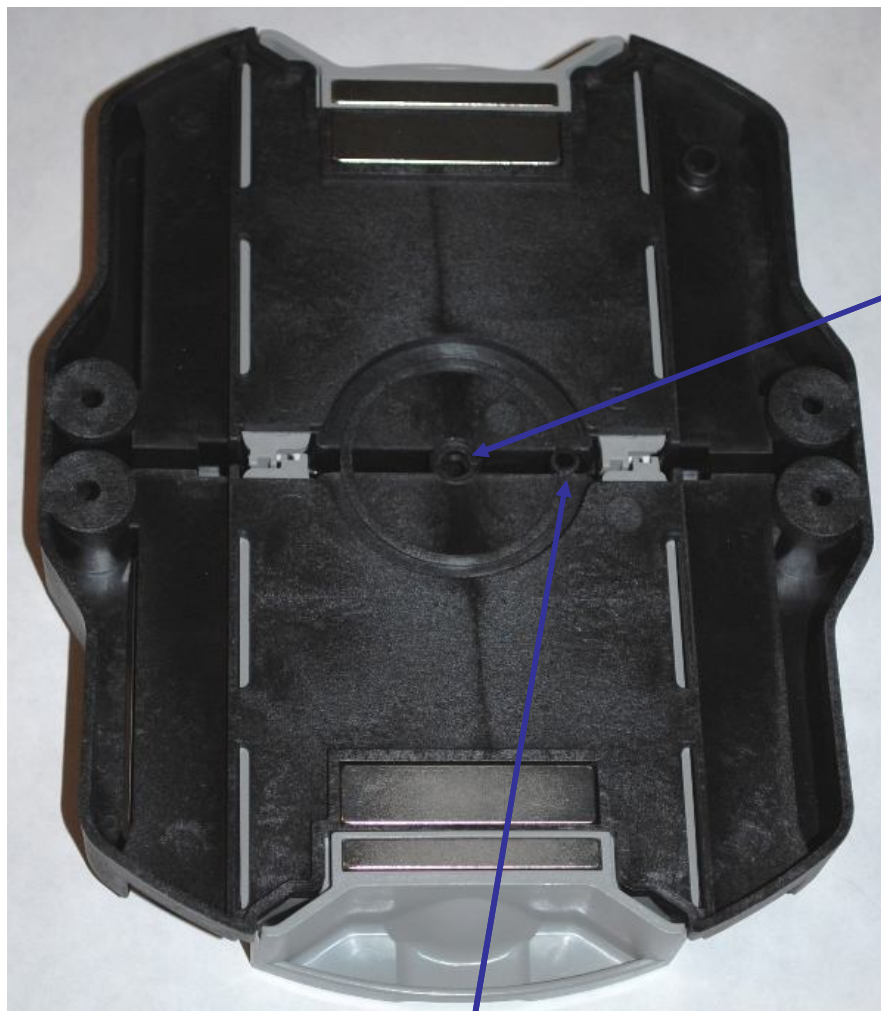


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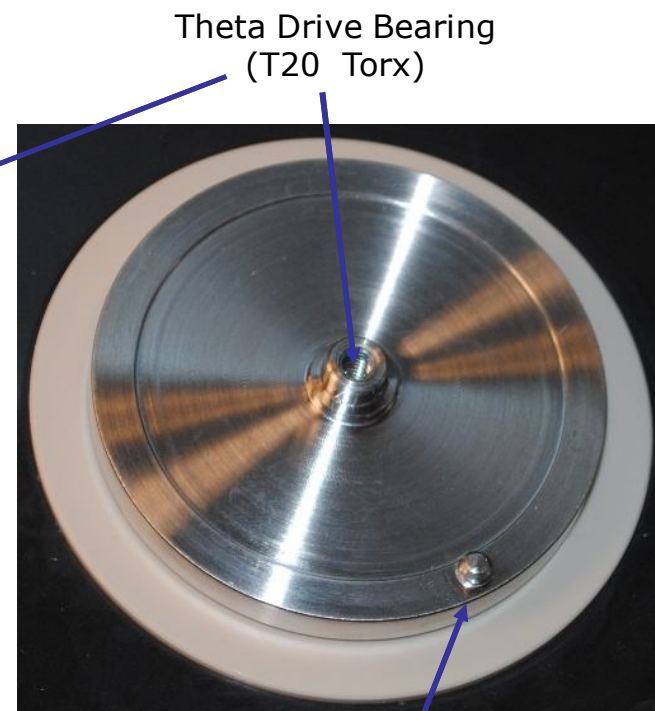


Rotary Tray Drive Bearing

Rotary Tray and Theta Drive Bearing

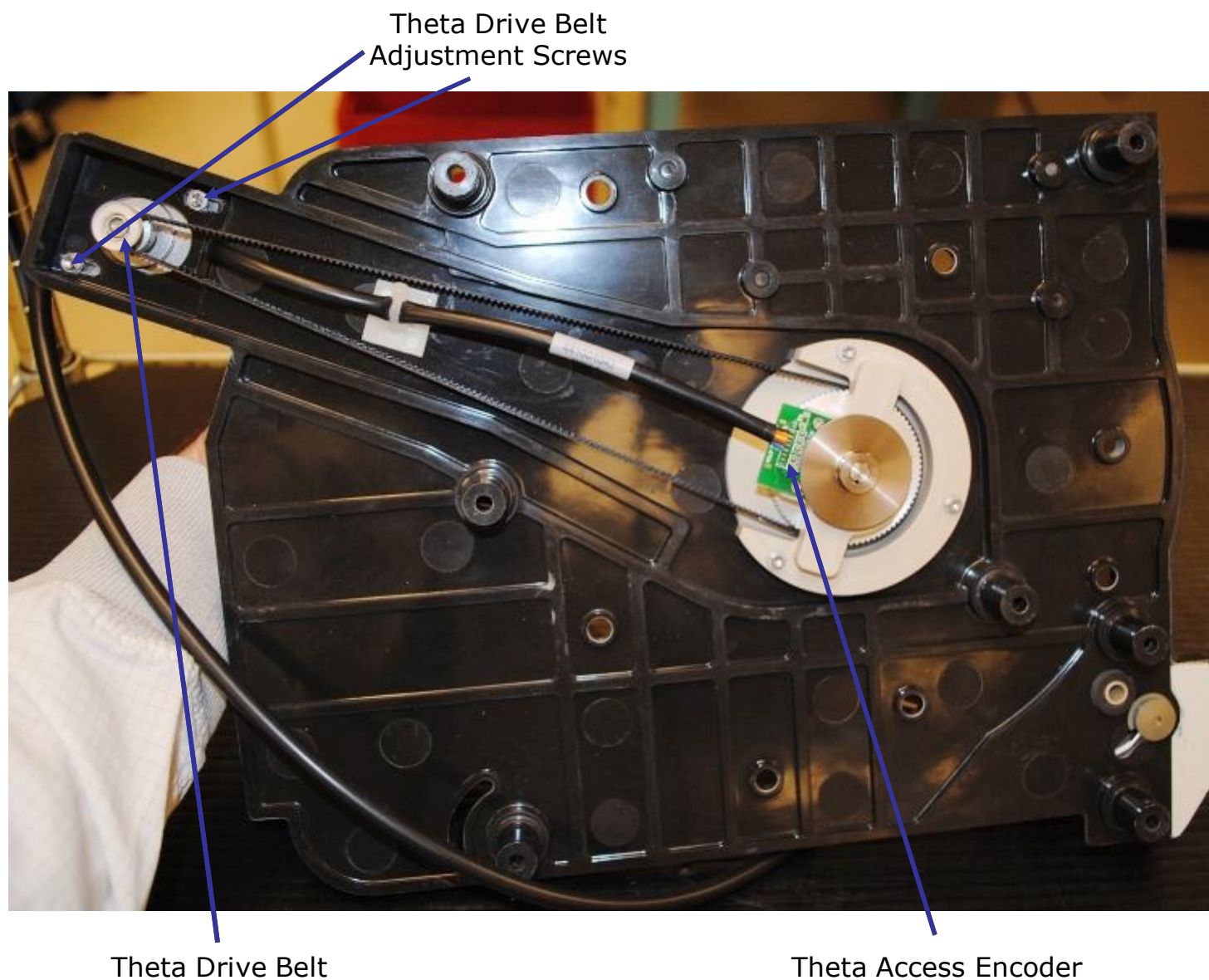


Guide Pin Hole



Guide Pin

Theta Drive Assembly (Bottom View)



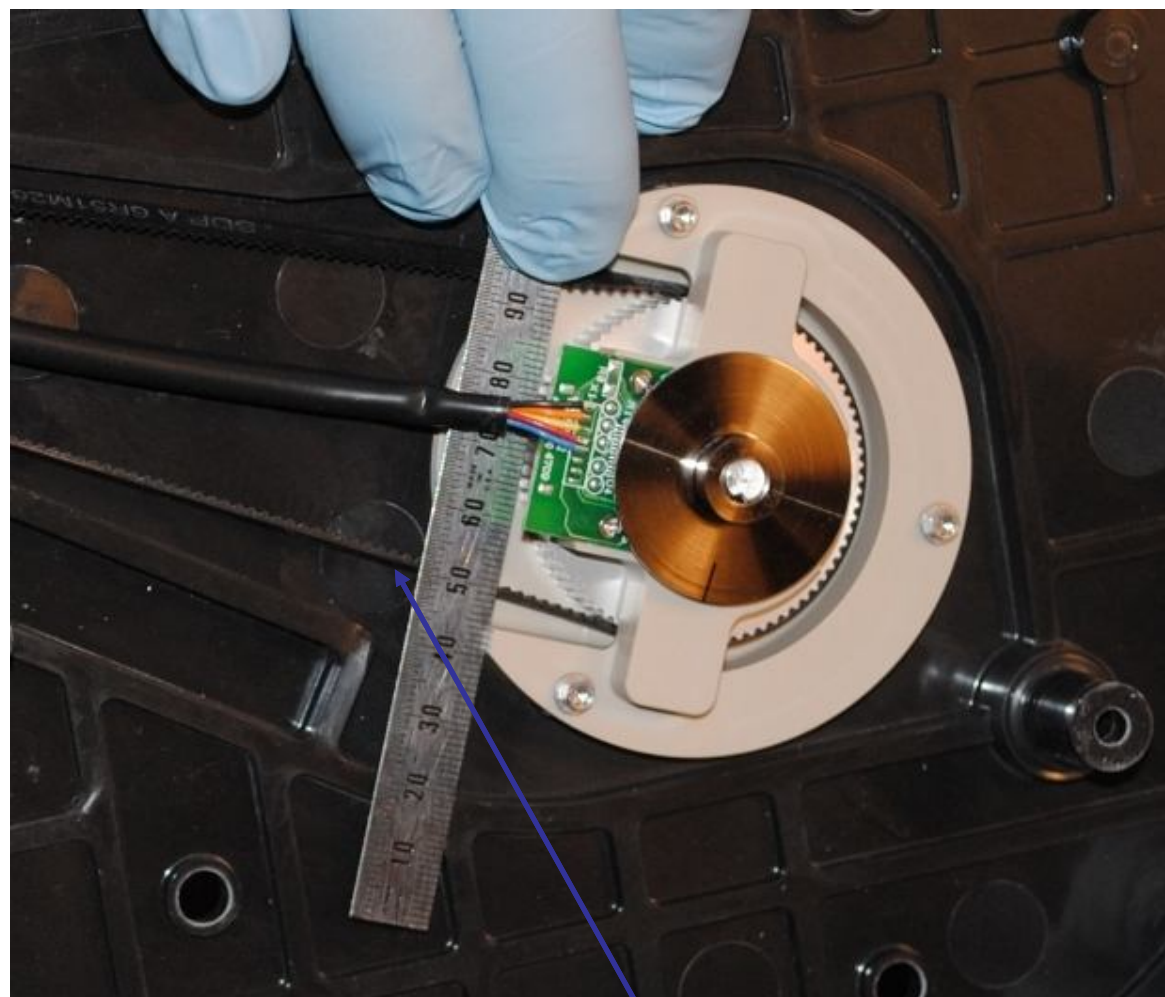
Theta Drive Belt

Theta Access Encoder

Theta Drive Belt Adjustment

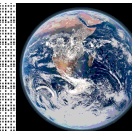


Adjust Theta Drive Belt
tension to 7 lbs force.

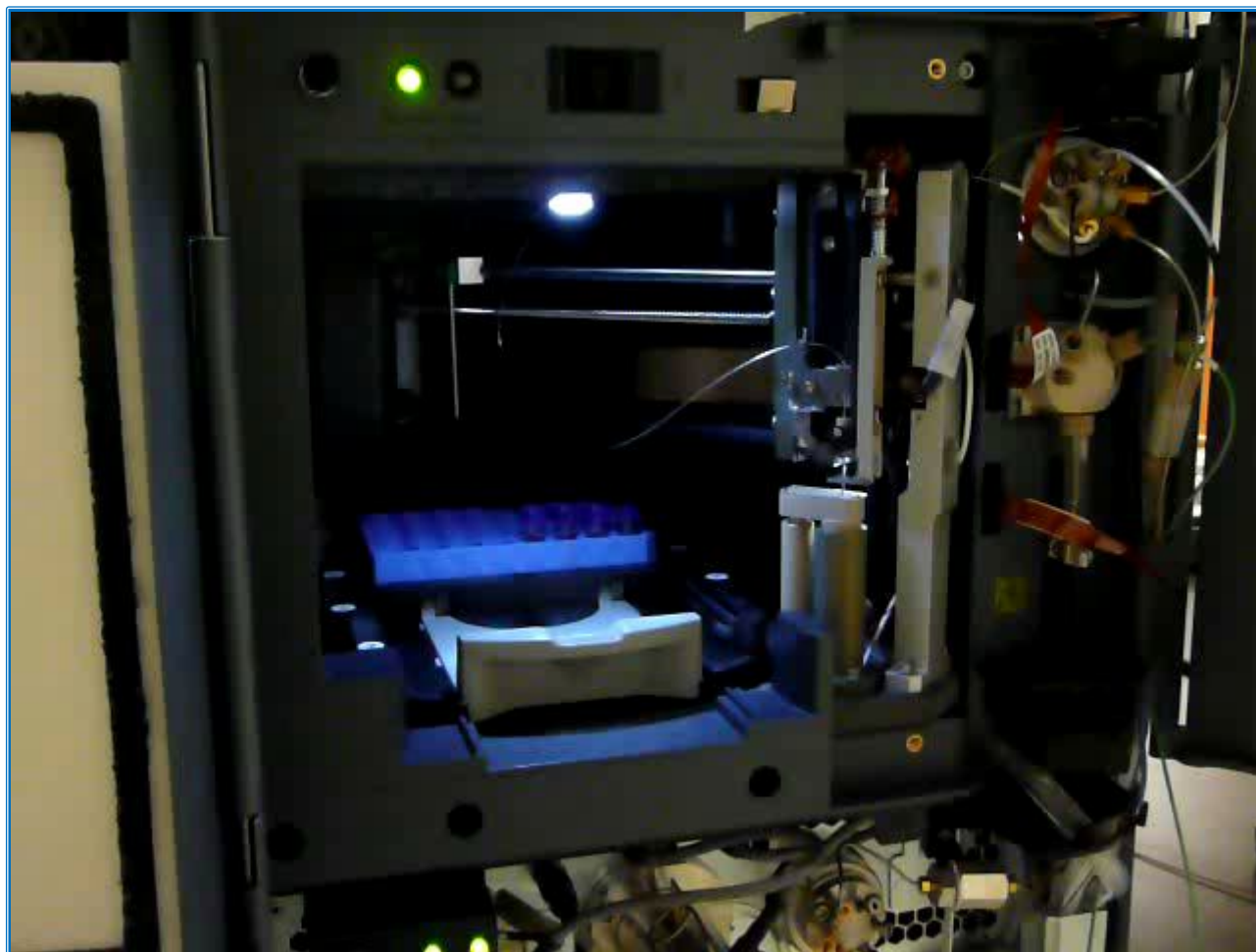


Alternate adjustment is 3mm displacement with
finger tension here.

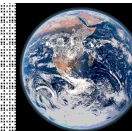
Removing Sample Plates



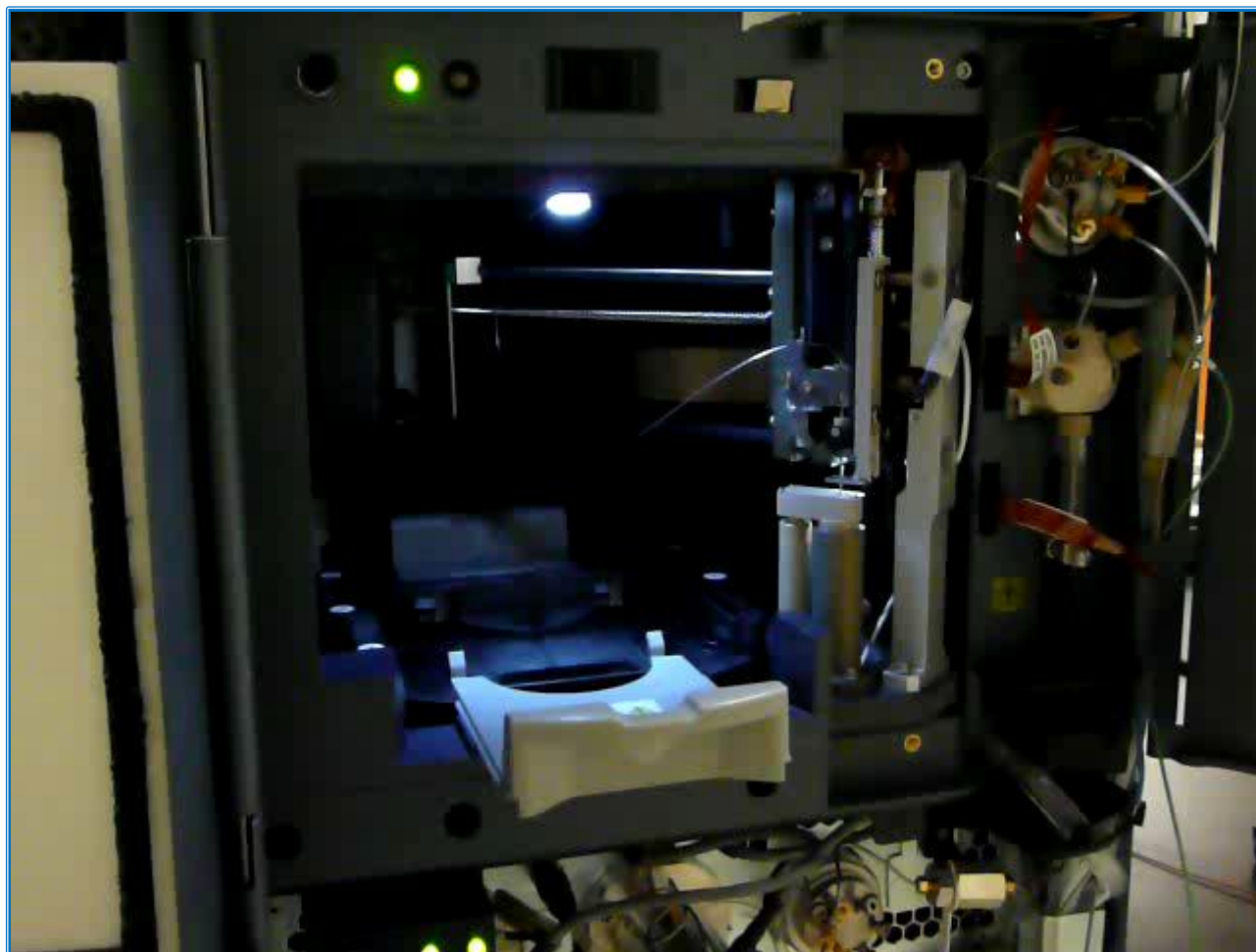
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Loading Sample Plates



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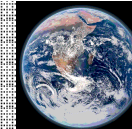
Sample Compartment Top Foam Cover



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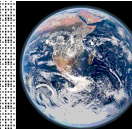
Sample Compartment Top View



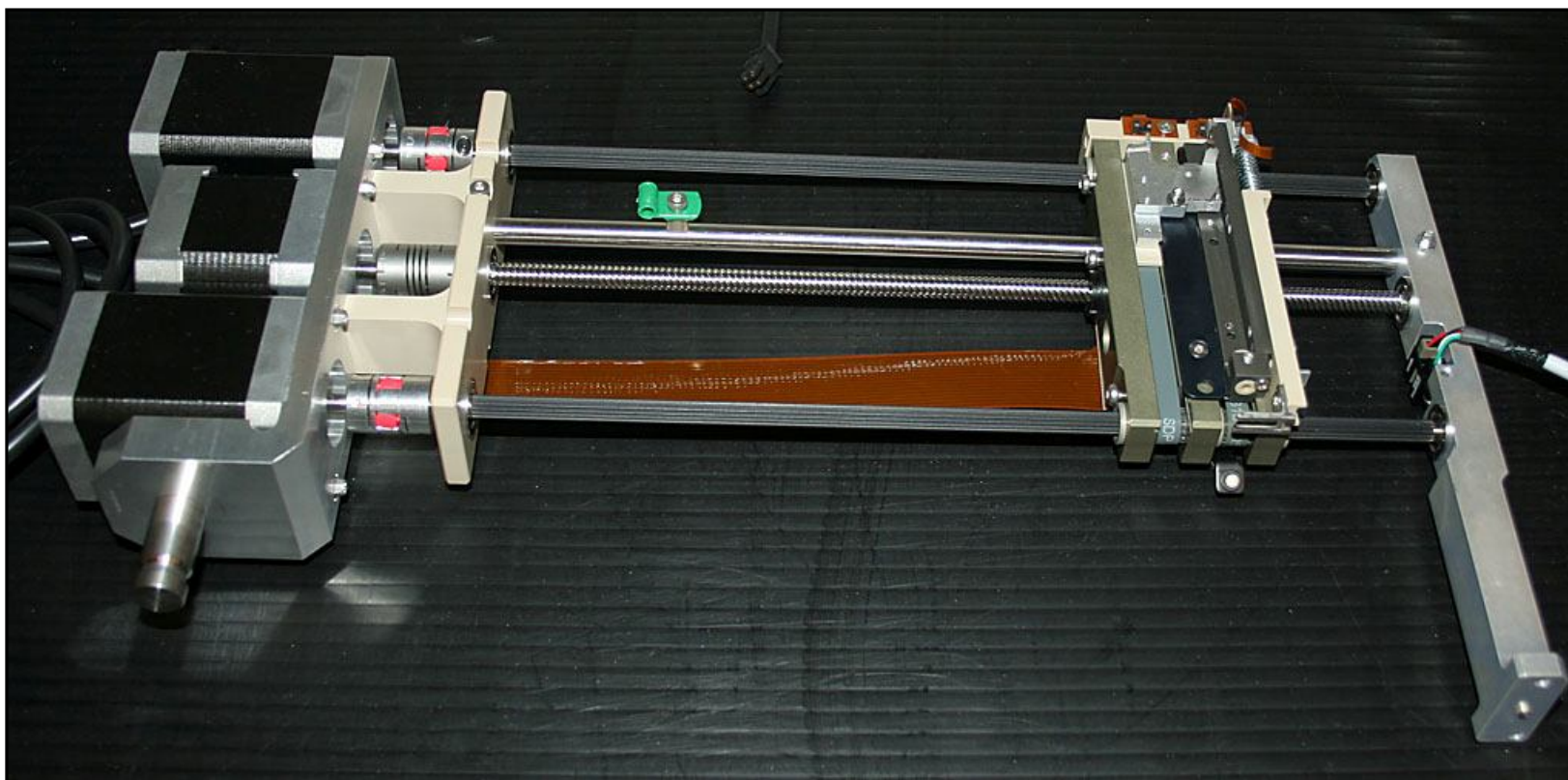
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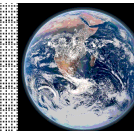
R-Carriage Assembly



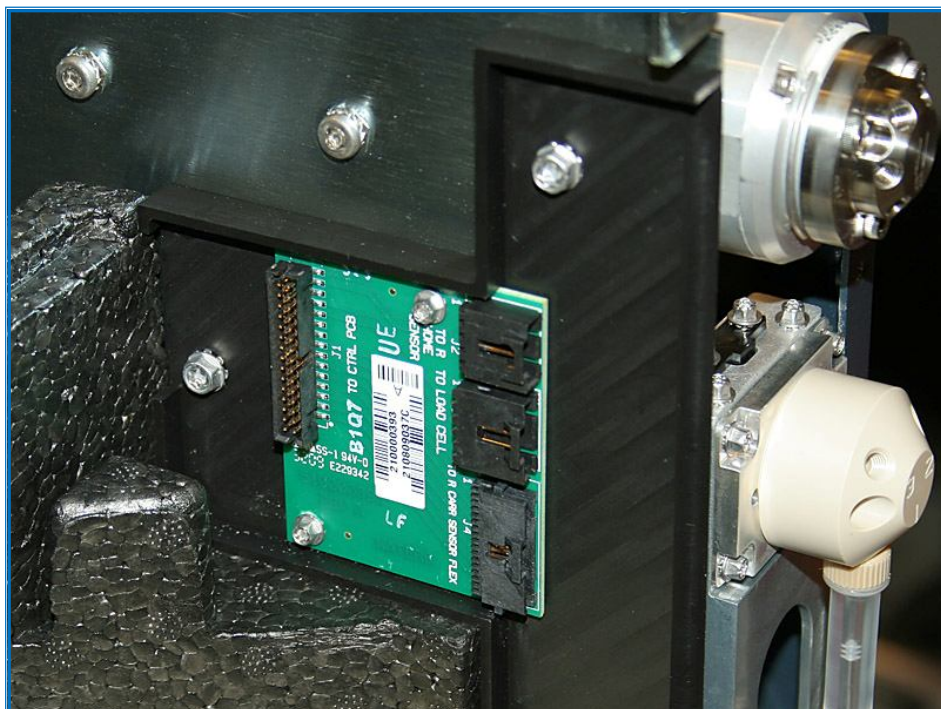
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Interface PCB



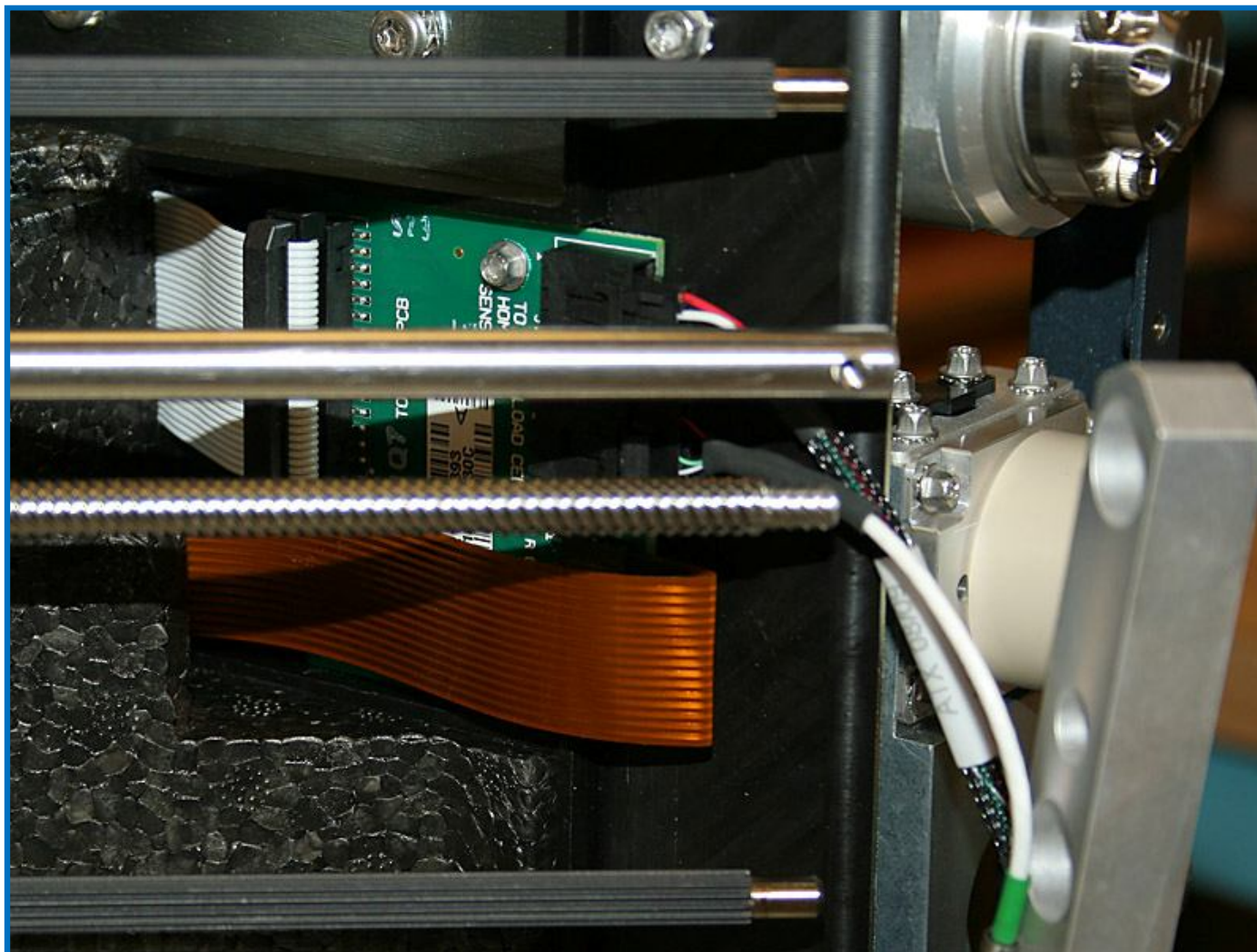
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Interface PCB with Cable Connections



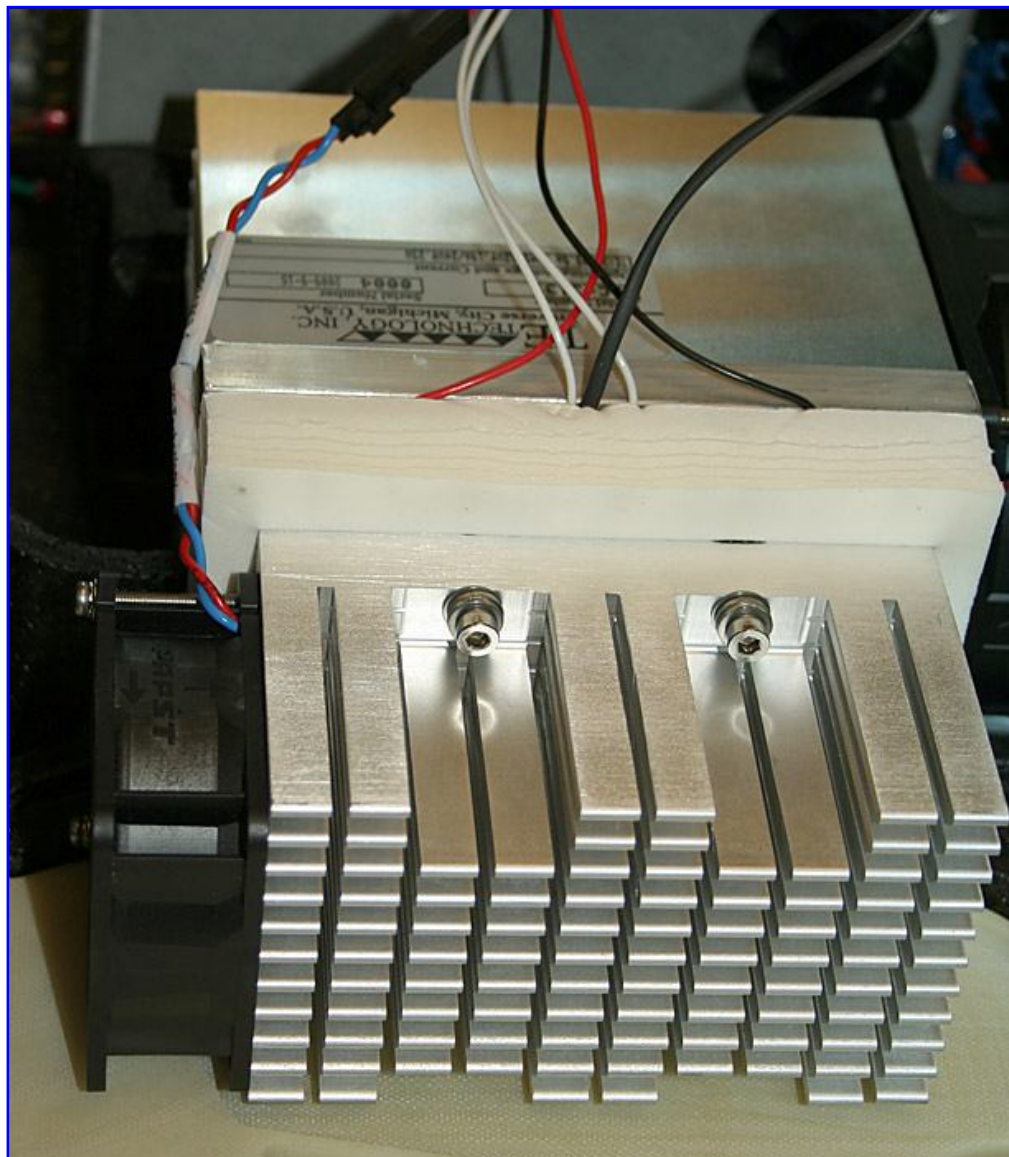
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Sample Heater/Cooler Assembly



Heater/Cooler Engine



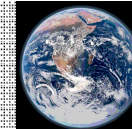
Heater/Cooler Engine in Foam Support



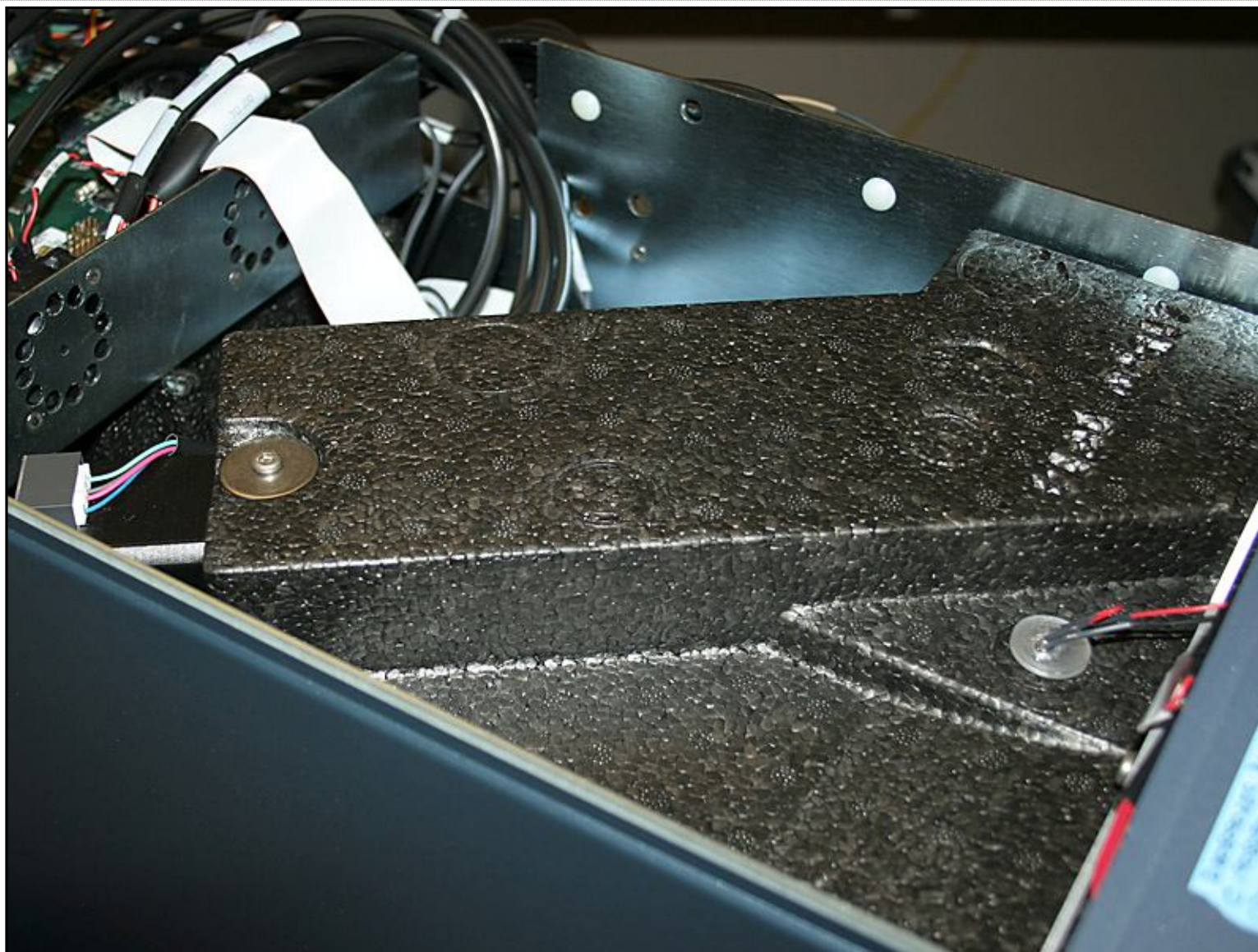
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Sample Compartment Foam Cover



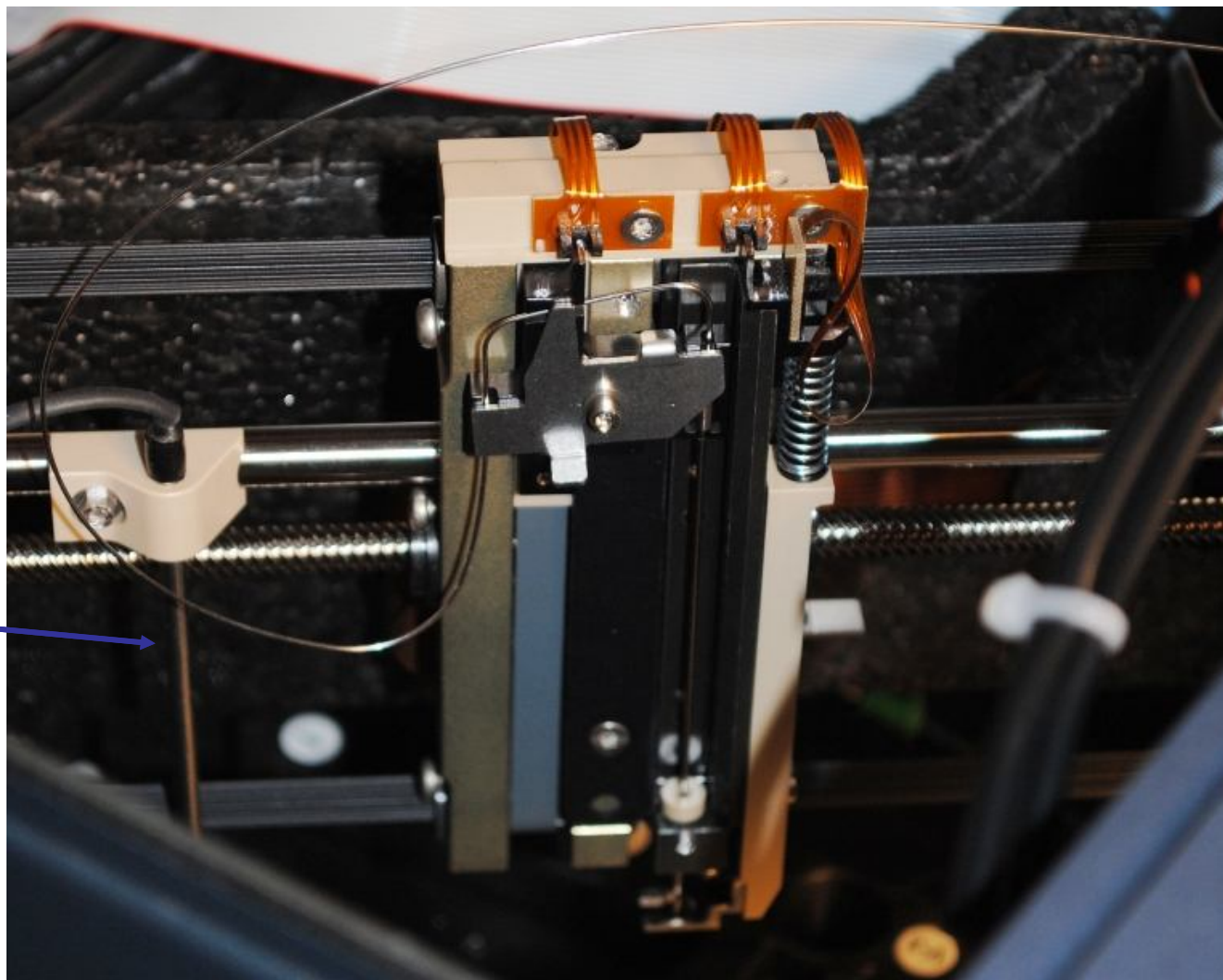
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Sample Compartment Temperature Probe



Temperature
Probe



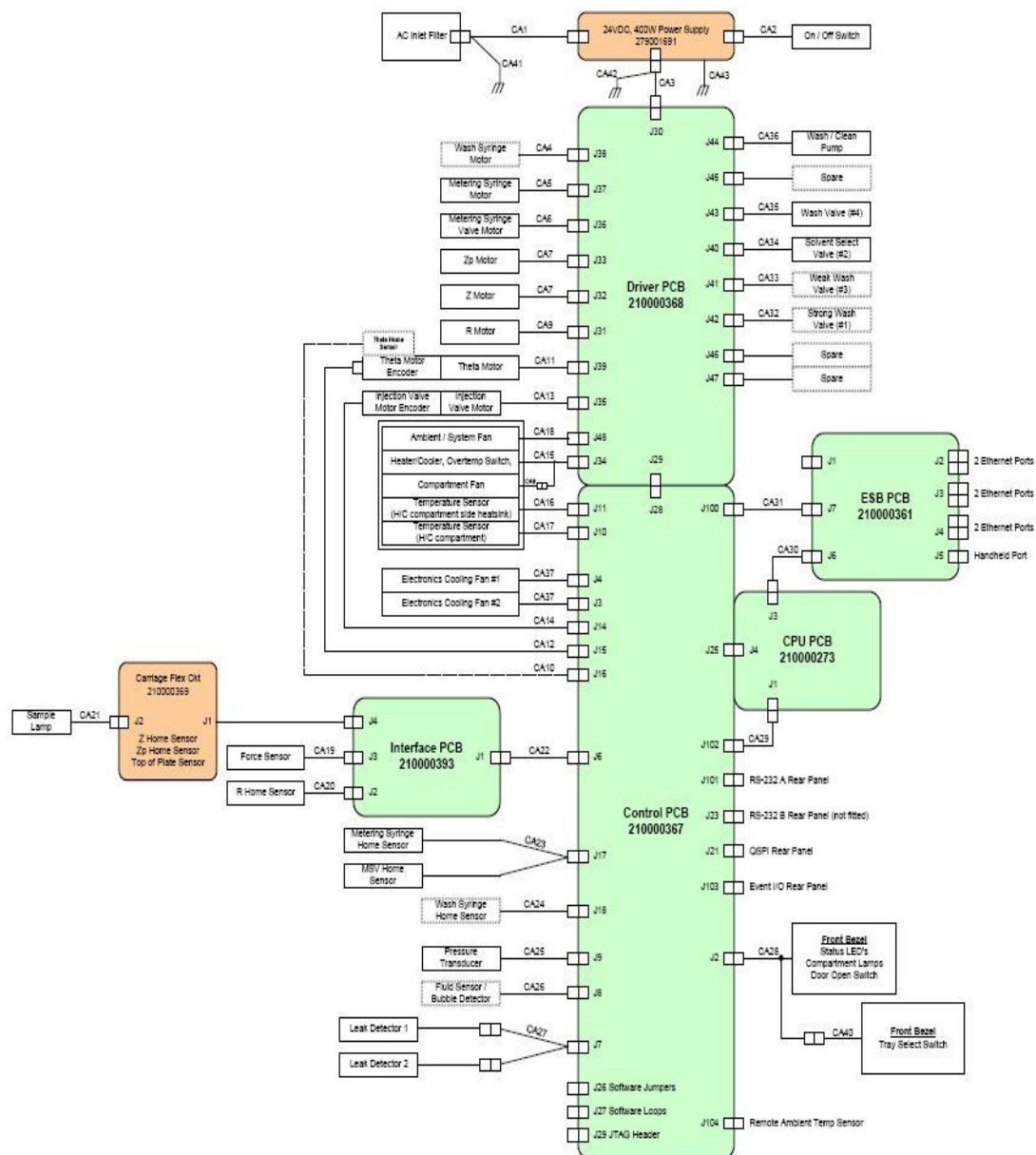
Electronics



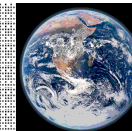
Electrical Interconnect Diagram



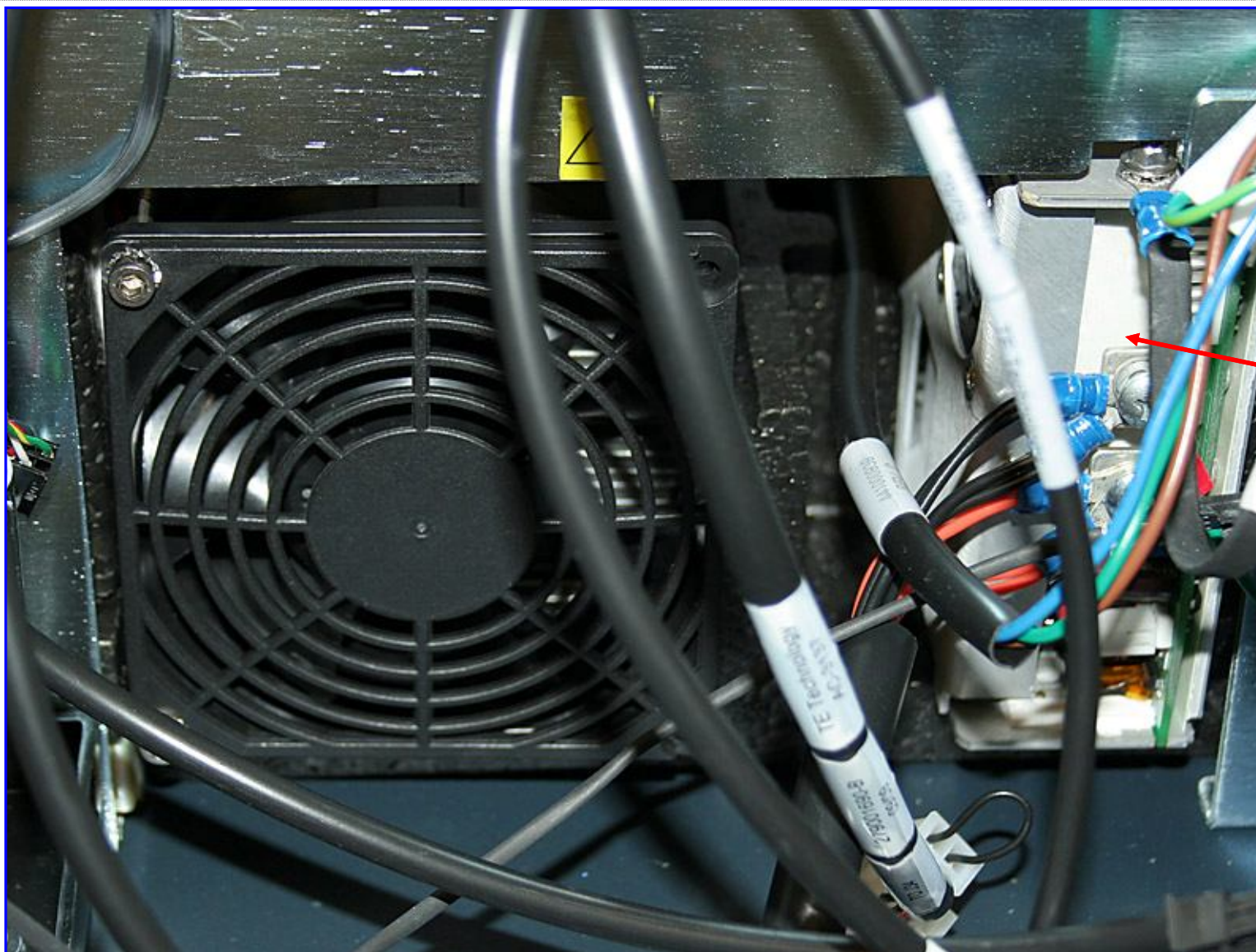
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Power Supply



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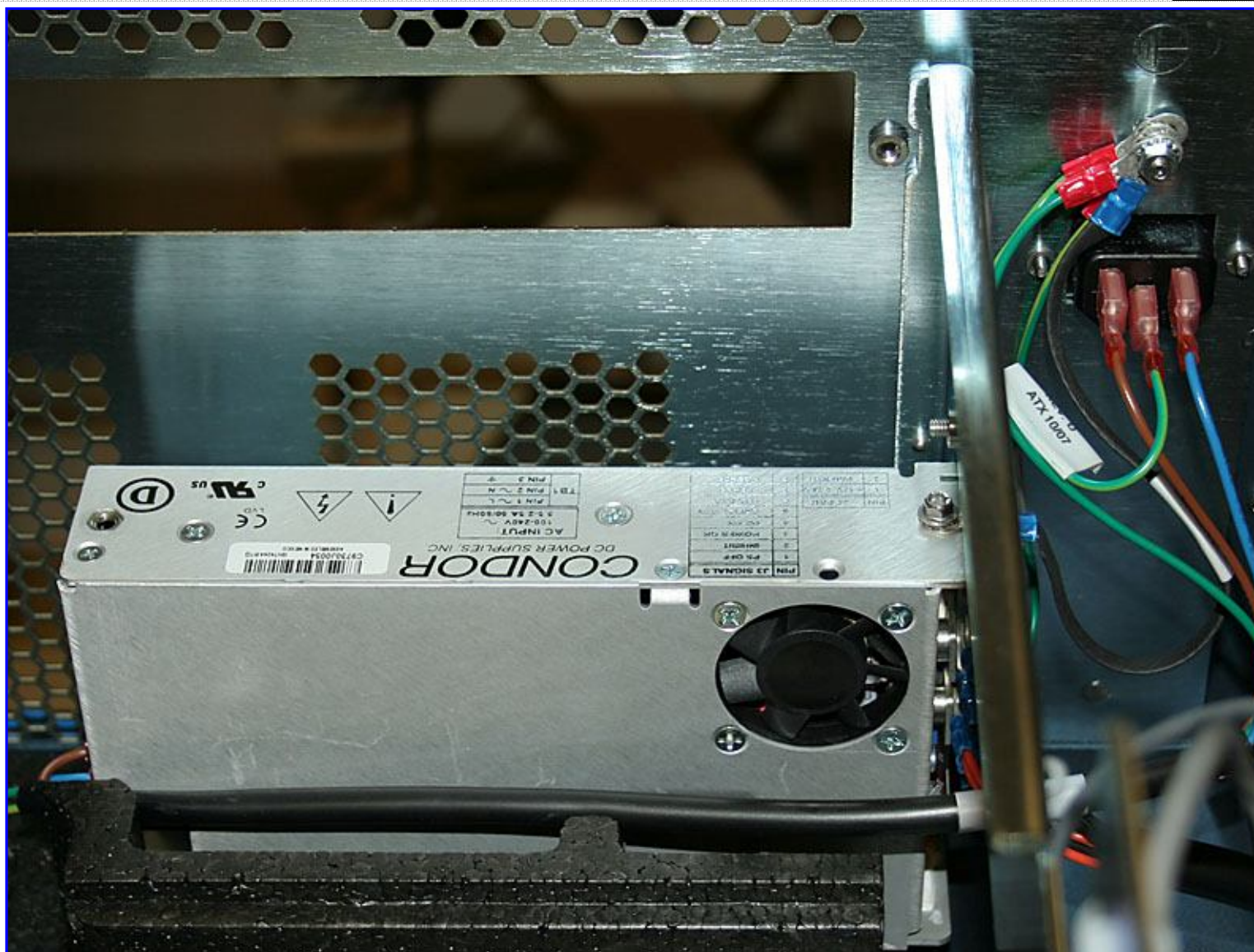


Power Supply

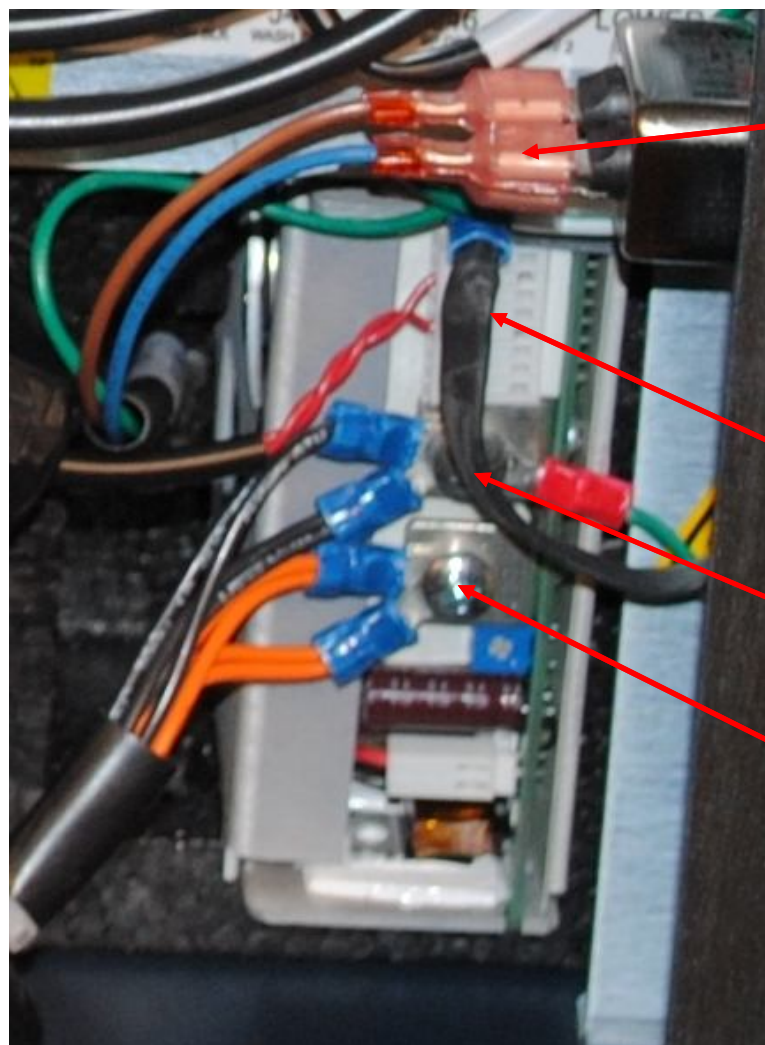
Power Supply



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Power Supply



AC Line Input

Front Panel Power
Switch
(contact closure)

Ground

+24 volts



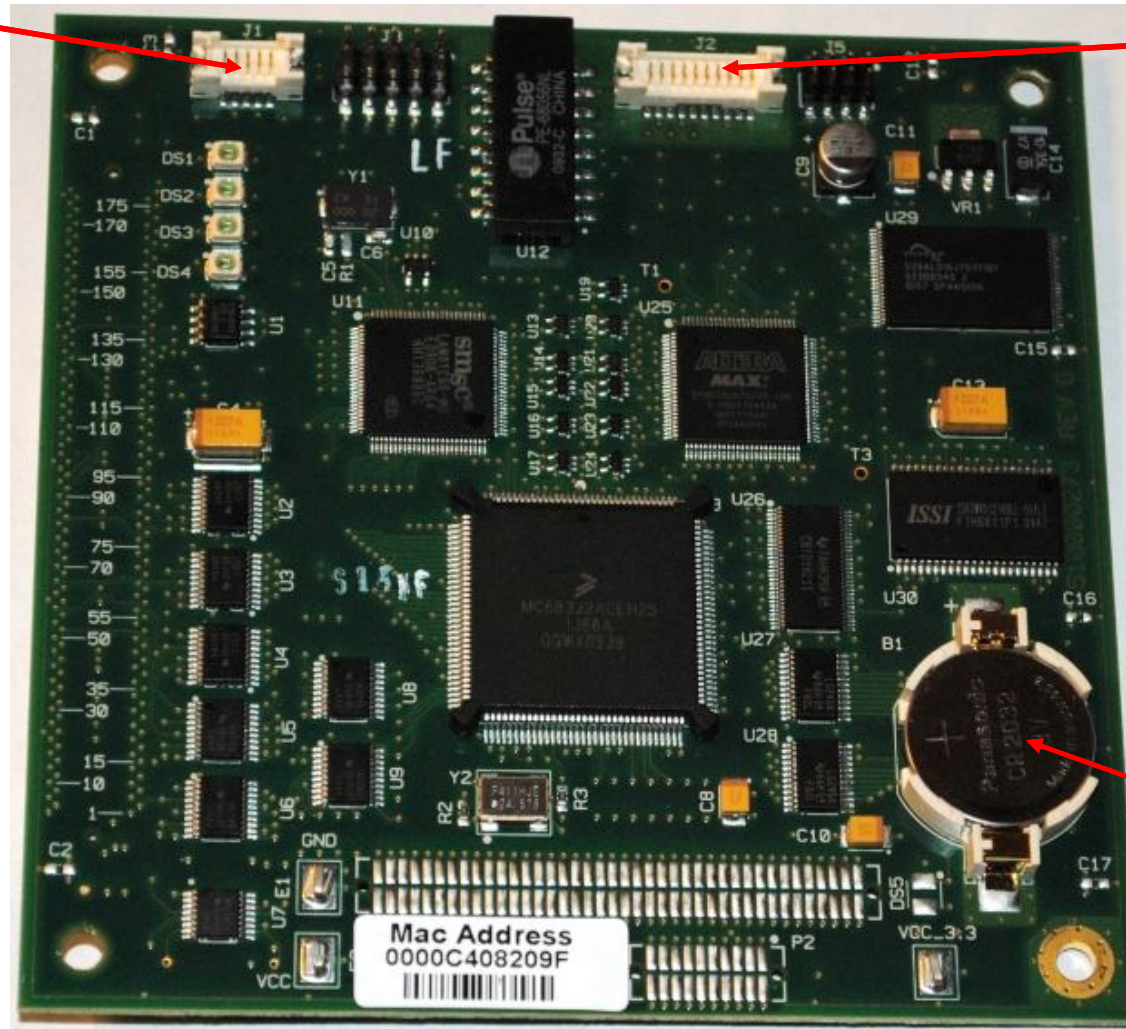
SM-FTN PCB Module Assembly



CPU2000 3V



J1
Cable to J102 on
Control PCB



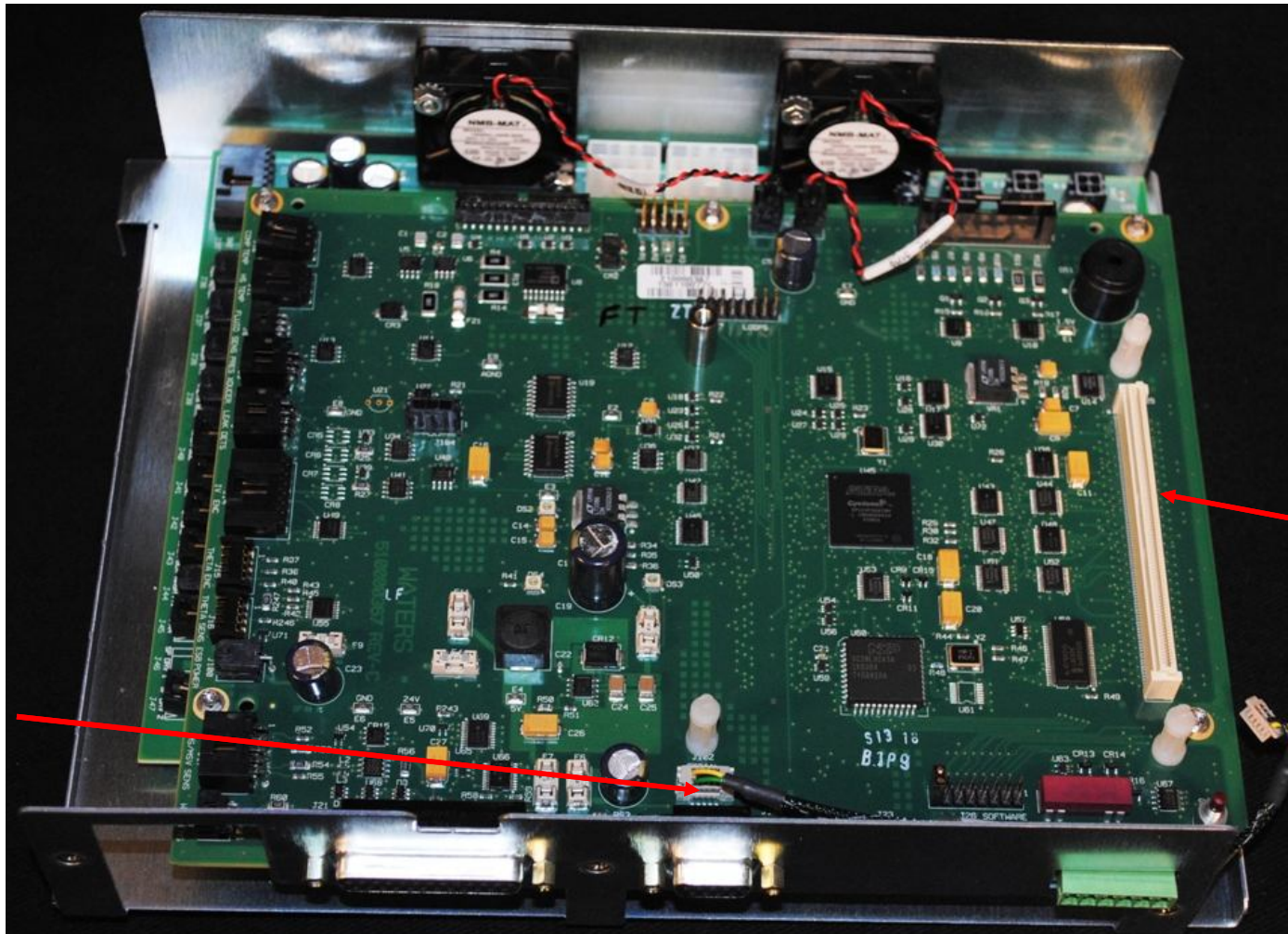
J3
To Ethernet
Switch PCB J6

Panasonic
CR2032
3V Battery

Control PCB



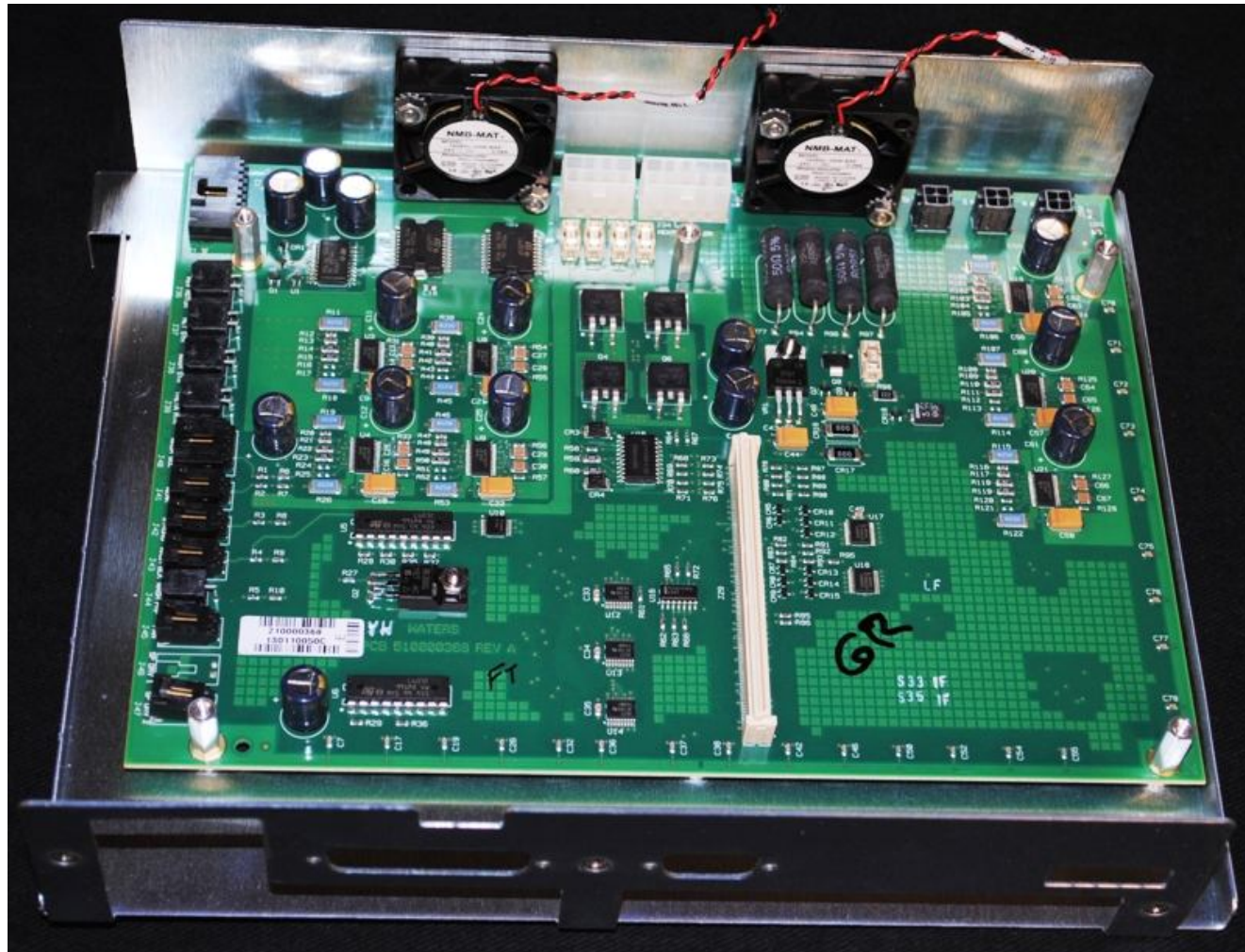
J102
Cable to J1 on
CPU2000 3V



J25
CPU2000 3V
Connector

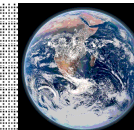
The function of the Control PCB is to Monitor the sensors and encoders in the SM-FTN. The Control PCB also drives the CHA via the QSPI connector as well as providing event and RS232 support.

Driver PCB



The function of the Driver PCB is to drive most of the motors in the SM-FTN. Examples of some of the motors are: the Wash Syringe, Metering Syringe, Metering Syringe Valve Zp, Z and Theta drive motors.

Cable Connections



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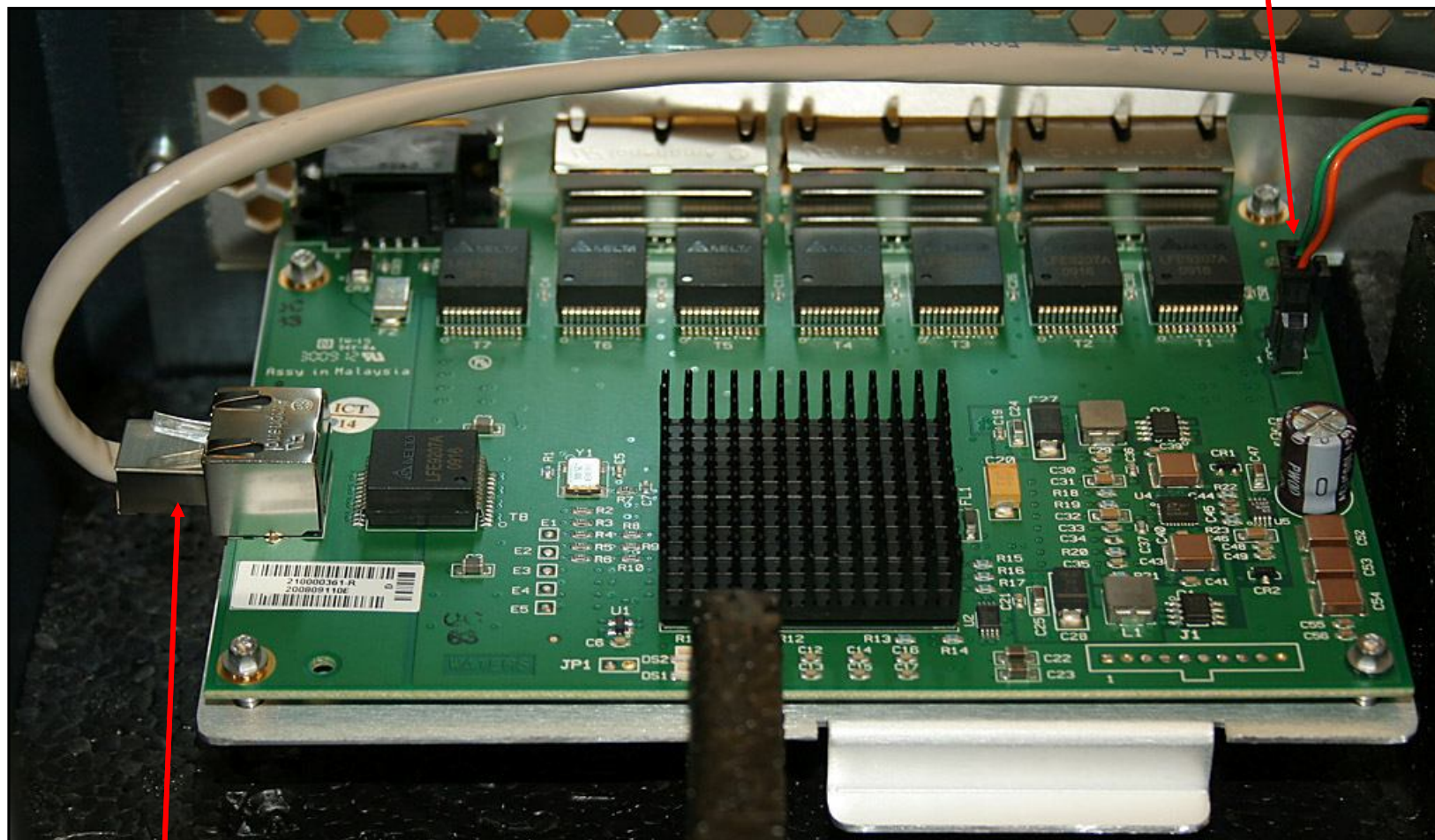
UPPER PCB		J10 COMP TEMP	J11 HS TEMP	J8 FLUID SENS	J9 XDUCER	J7 LEAK DETS	J14 IV ENC	J15 THETA ENC	J16 THETA SENS	J100 ESB POWER	J17 MS/MSV SENS	J18 WS SENS	
J35 INJ VLV MTR	J36 MSV MTR	J37 MET SYR MTR	J38 WASH SYR MTR	J39 THETA MTR	J40 WASH SEL	J41 WEAK	J42 STRONG	J43 WASH BLK	J44 WASH PMP	J45 FAN	J46 SP DRV 1	J47 SP DRV 2	LOWER PCB

Cable Connections Key
Located below PCB
connectors

Ethernet Switch PCB

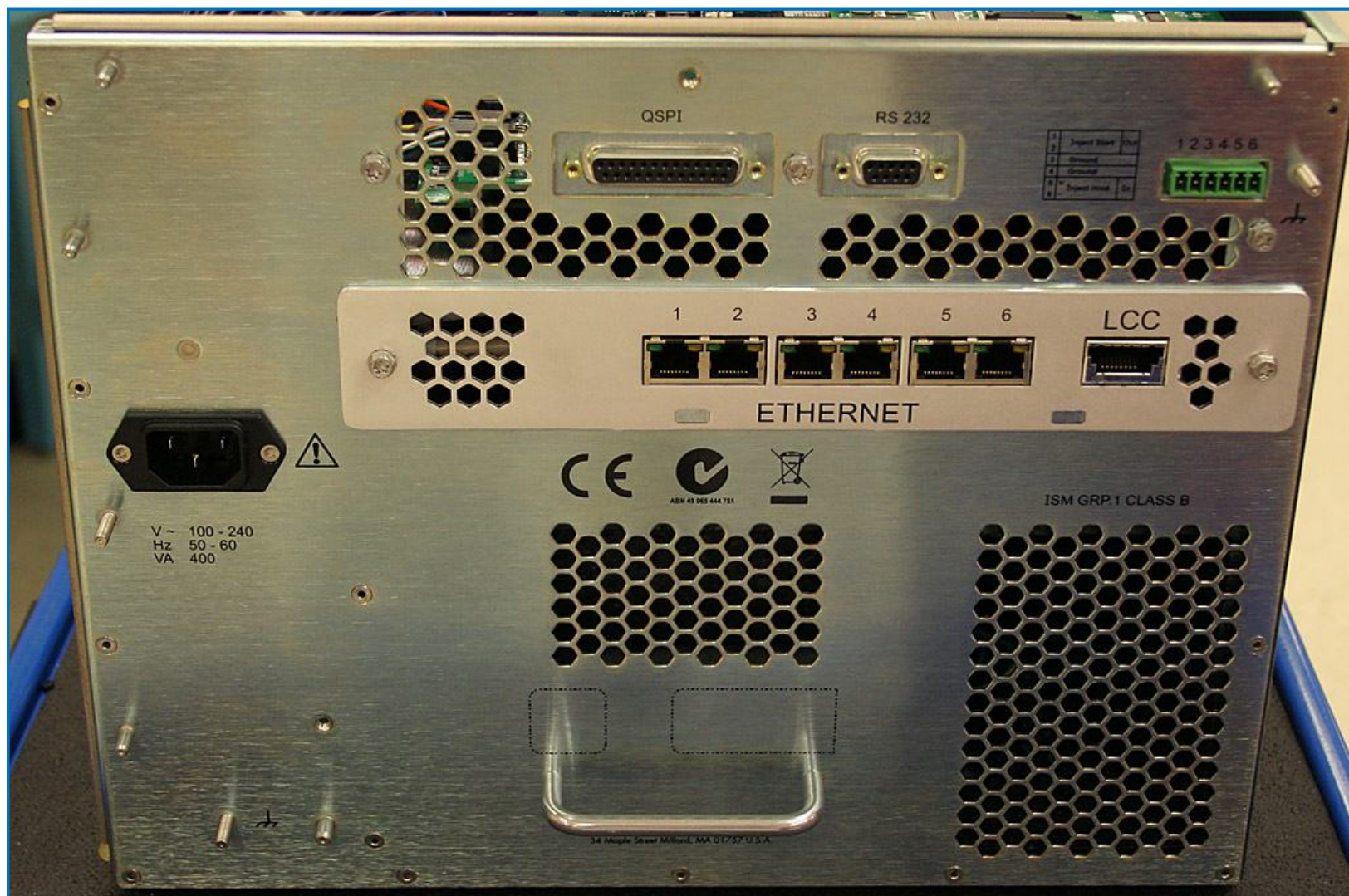


J7- +24 volt supply from
J100 on Control PCB



J6- Ethernet Connector
to J3 on CPU 2000

Ethernet Switch PCB



Removing the Ethernet Switch

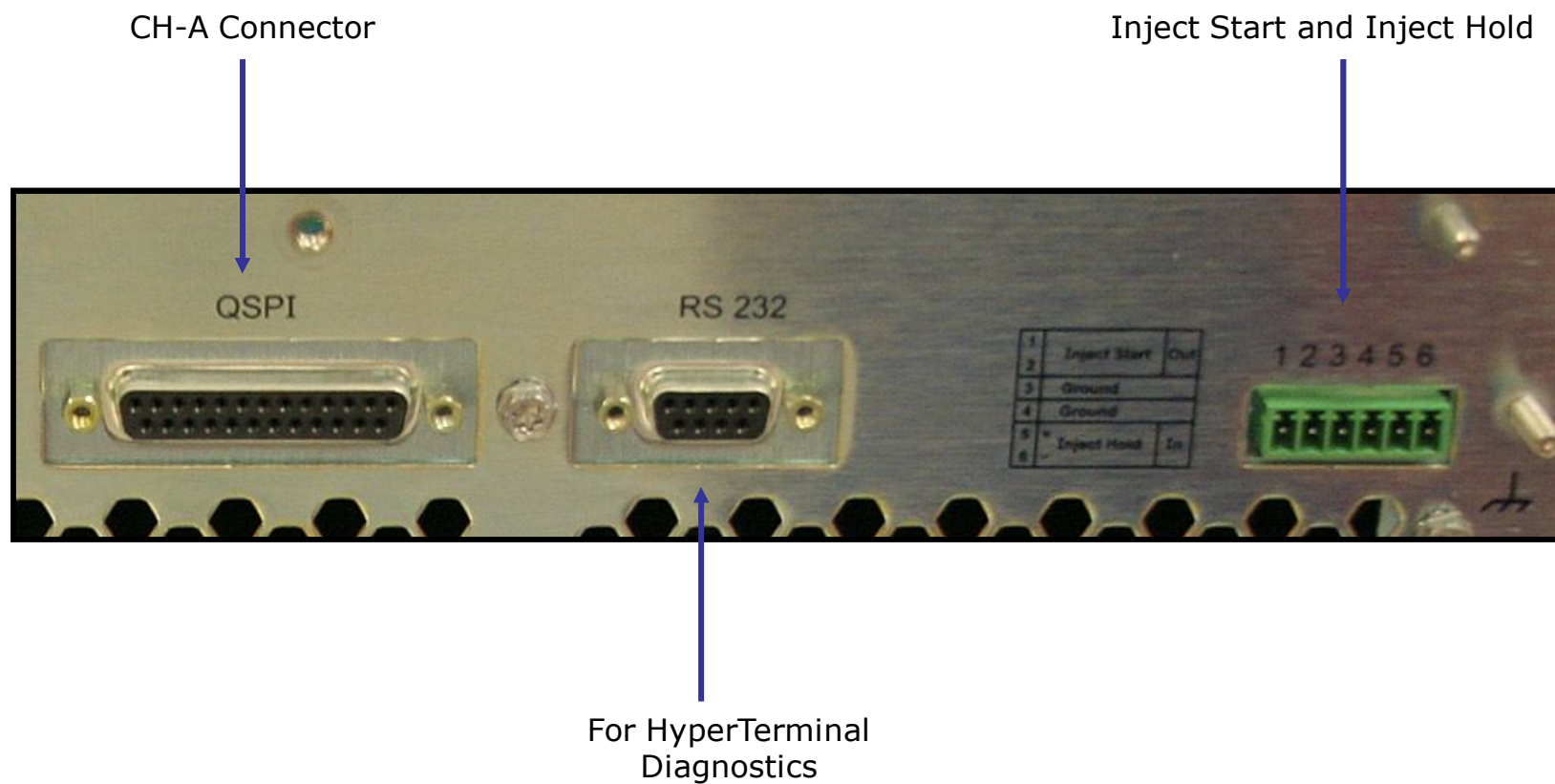


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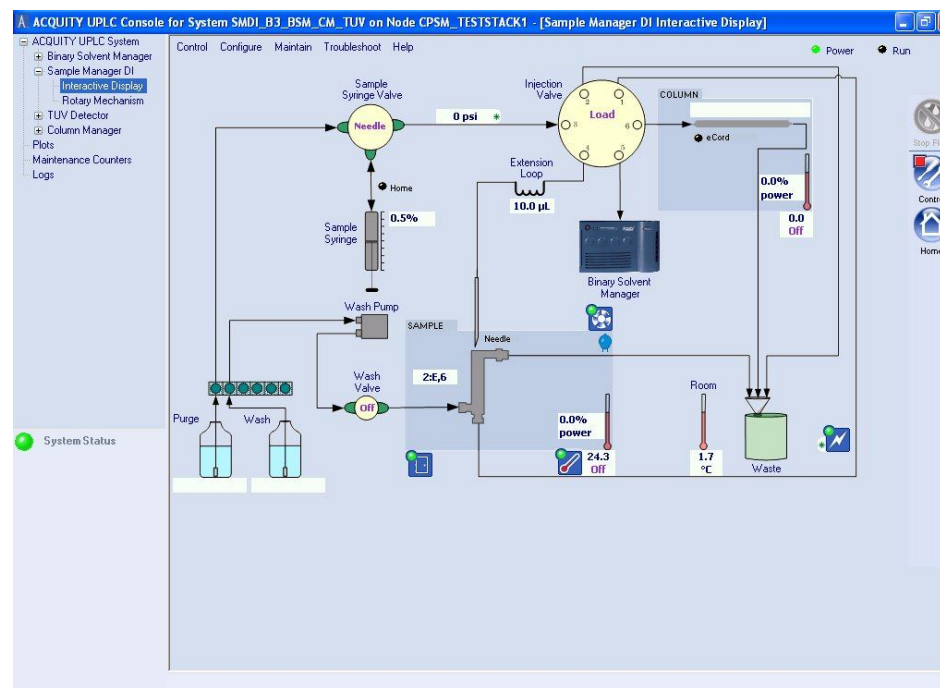


The PCB Ethernet Switch PCB can easily be removed and replaced from the rear of the SM-FTN by removing the two T20 Torx screws.

SM-FTN Rear Connections



SM-FTN Software Components



Software Components



- Instrument Method Menus
- ACQUITY Console Diagnostics and Control

SM Instrument Method- General Tab



System Precision IM in GP_Beta_QSM013_SMDI08_TUV as System/Administrator - Instrument Me...

File Edit View Help

Acquity Sample Manager ACQ-SMDI Acquity Quaternary Solvent Manager ACQ-QSM Acquity TUV Detector ACQ-TUV

Acquity Sample Manager DI

General | Data | Dilution | Events

Wash Solvent: Water

Pre-Inject: 0 sec

Post-Inject: 6 sec

Purge Solvent: Water

Comment:

Advanced...

Load Ahead: ☐

Loop Offline: Automatic min

Temperature

Column: 40.0 °C Alarm Band: ± 5.0 °C

Sample: Off °C ± 5.0 °C

Ready

Advanced Settings

Enable any of the following options to override the automatic behavior.

Syringe Draw Rate: Automatic

Needle Placement (from bottom): Automatic

Air Gaps: pre-aspirate Automatic, post-aspirate Automatic

Injection Valve Wash: Automatic

OK Cancel

SM Instrument Method- Dilution Tab



Untitled in SMDI_B3_BSM_CM_TUV as System/Administrator - Instrument Method Editor

File Edit View Help

Acquity UPLC Sample Manager ACQ-SMDI
Acquity UPLC Column Manager ACQ-CM
Acquity UPLC TUV Detector ACQ-TUV
Acquity UPLC Binary Solvent Manager ACQ-BSM

Acquity Sample Manager DI
Ultra Performance LC

General | Data | Dilution | Events

?

☒ Enable

Needle placement (from bottom)

0.3 mm

Dispensed Purge Solvent

0 uL

Post Dilution Delay

0 sec

Ready

SM Instrument Method- Data Tab



Plot Properties

Time Range | All SM

- ☒ Column Temp
- ☒ Debug Channel
- ☒ Injection Marks
- ☒ Room Temp
- ☒ Sample Chamber Heat Sink Temp
- ☒ Sample Organizer Temp
- ☒ Sample Pressure
- ☒ Sample Temp
- ☒ Seal Force

Color
lineColor Blue

Data Processing
dataProcessing **Sampled**

Description
(name) ACQ-SMDI#BETA19.ColumnTemperature

Misc
LocalName **Column Temp**

Scaling
autoscale **True**
manualMinScale **-5**

OK Cancel

SM Instrument Method- Events Tab



Untitled in SMDI_B3_BSM_CM_TUV as System/Administrator - Instrument Method Editor

File Edit View Help

Acquity UPLC Sample Manager ACQ-SMDI
Acquity UPLC Column Manager ACQ-CM
Acquity UPLC TUV Detector ACQ-TUV
Acquity UPLC Binary Solvent Manager ACQ-BSM

Acquity Sample Manager DI
Ultra Performance LC

General | Data | Dilution | Events

☒ Run Events

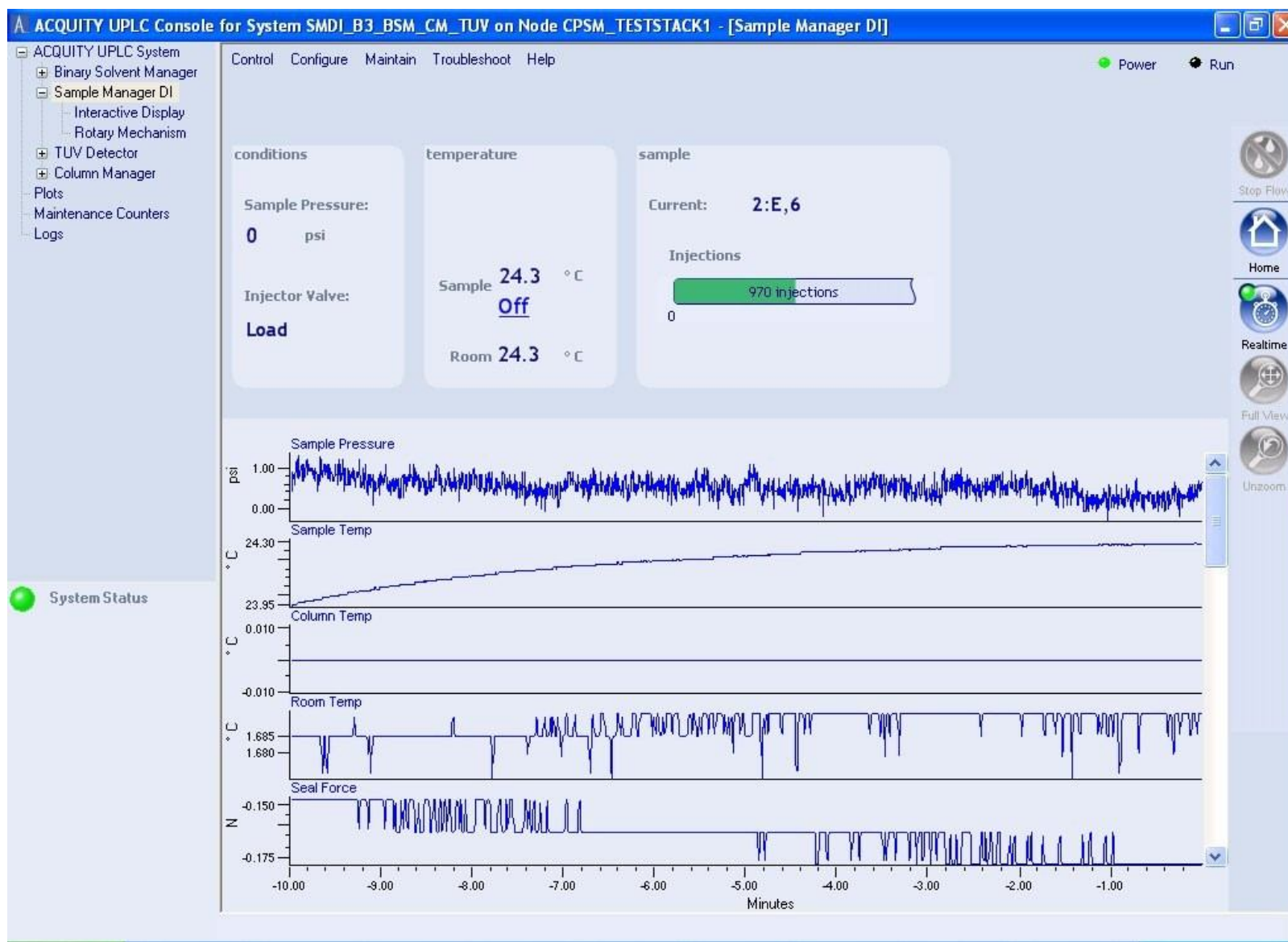
	Time (min)	Event	Action
1			
2		Sample Temperature	
3		Column Temperature	
4		Sample Temperature Off	
5		Column Temperature Off	
6			
7			
8			
9			
10			

Ready

SM-FTN Interactive Display Menu



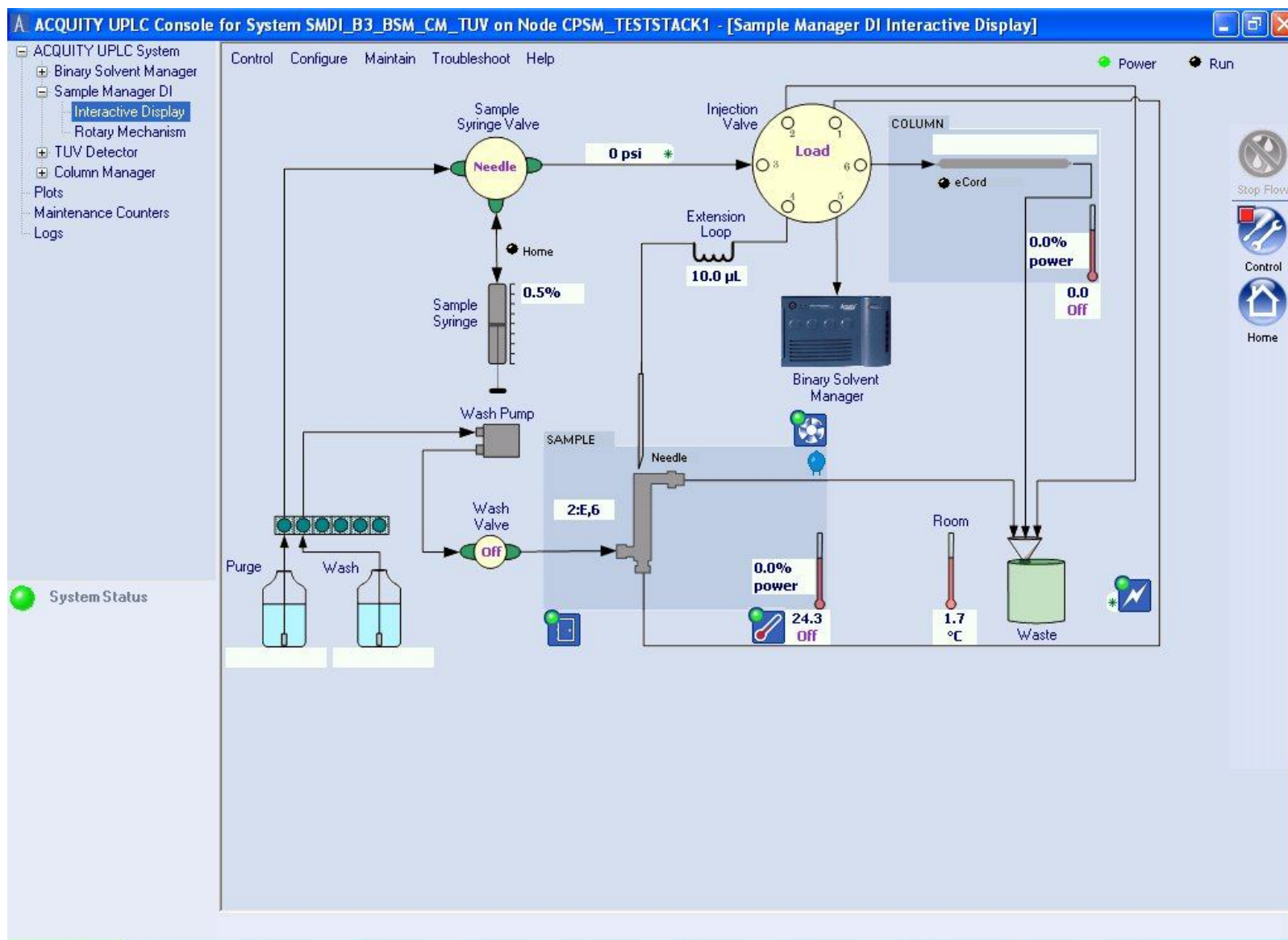
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SM-FTN Interactive Display Menu



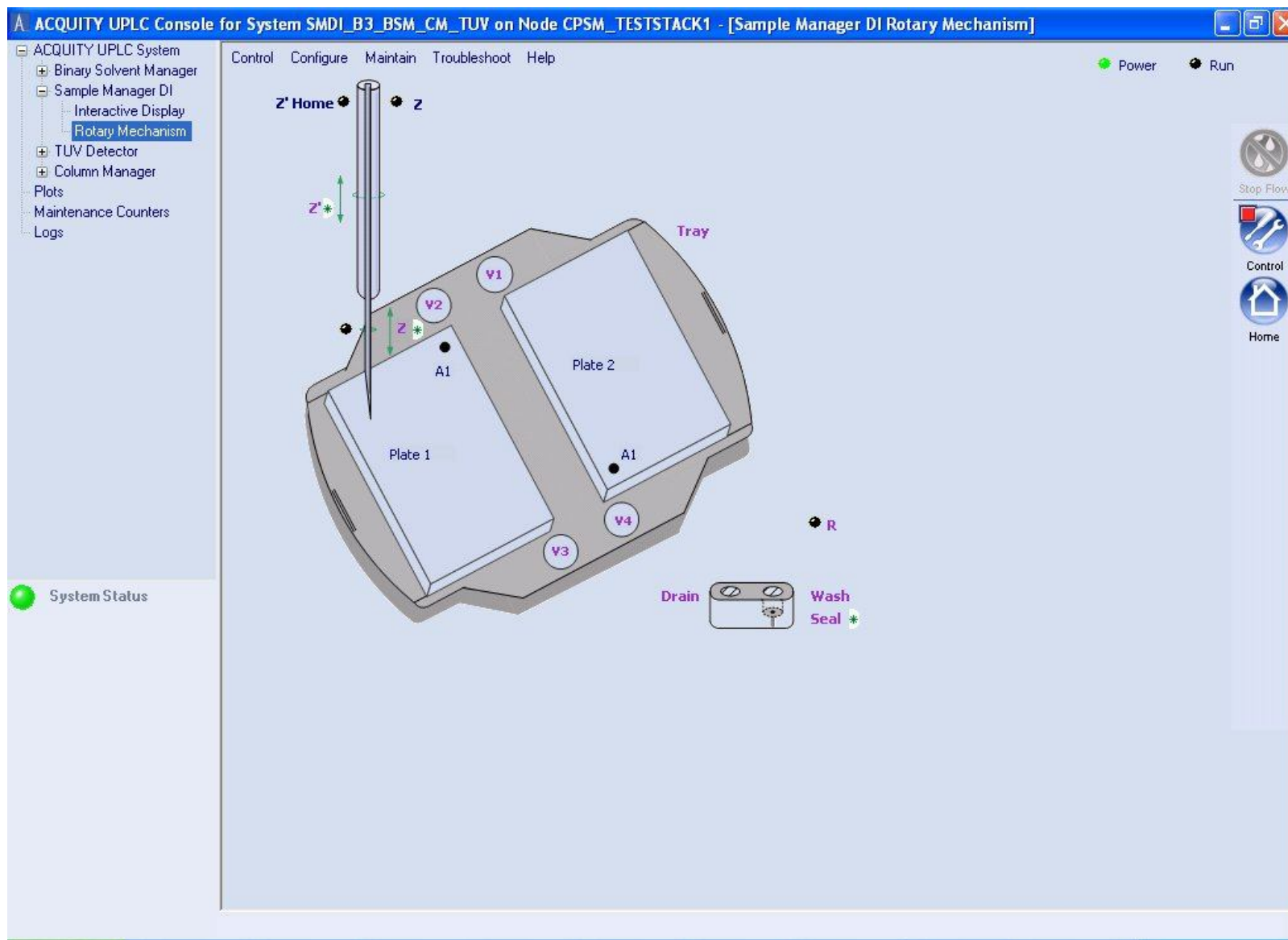
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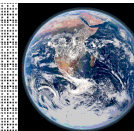
SM-FTN Interactive Display Menu



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Z-Needle Calibration



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Calibrate Needle Z Axis

Keypad

-Z

+Z

Displacement per keystroke:

☒ 0.1 mm ☐ 1.0 mm

Start

Save

Close

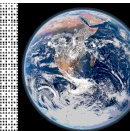
Results

Z offset: mm

Print...



Characterize Needle Seal



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Characterize Needle Seal

Run time:
0.0 Min
0.0

Start

Results >> Close

Characterize Needle Seal

Run time:
0.0 Min
0.0

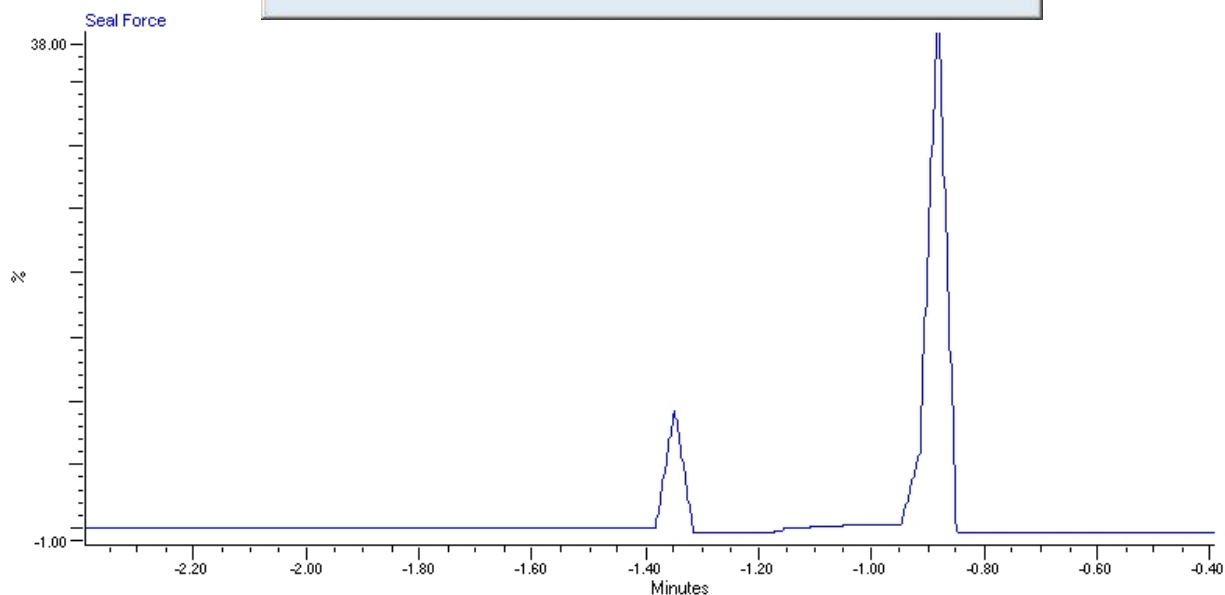
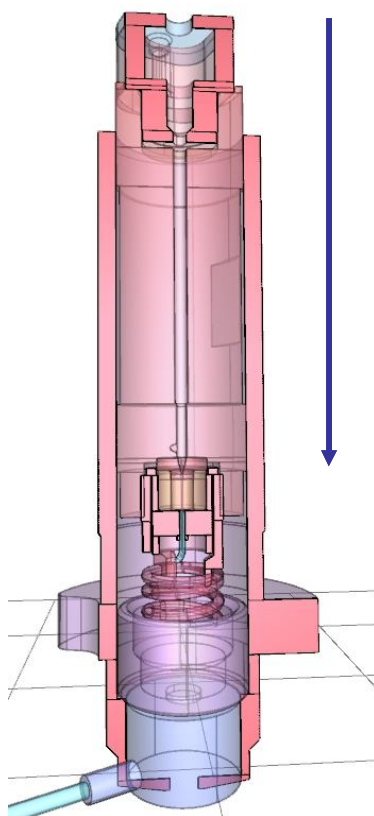
Start

<< Results Close

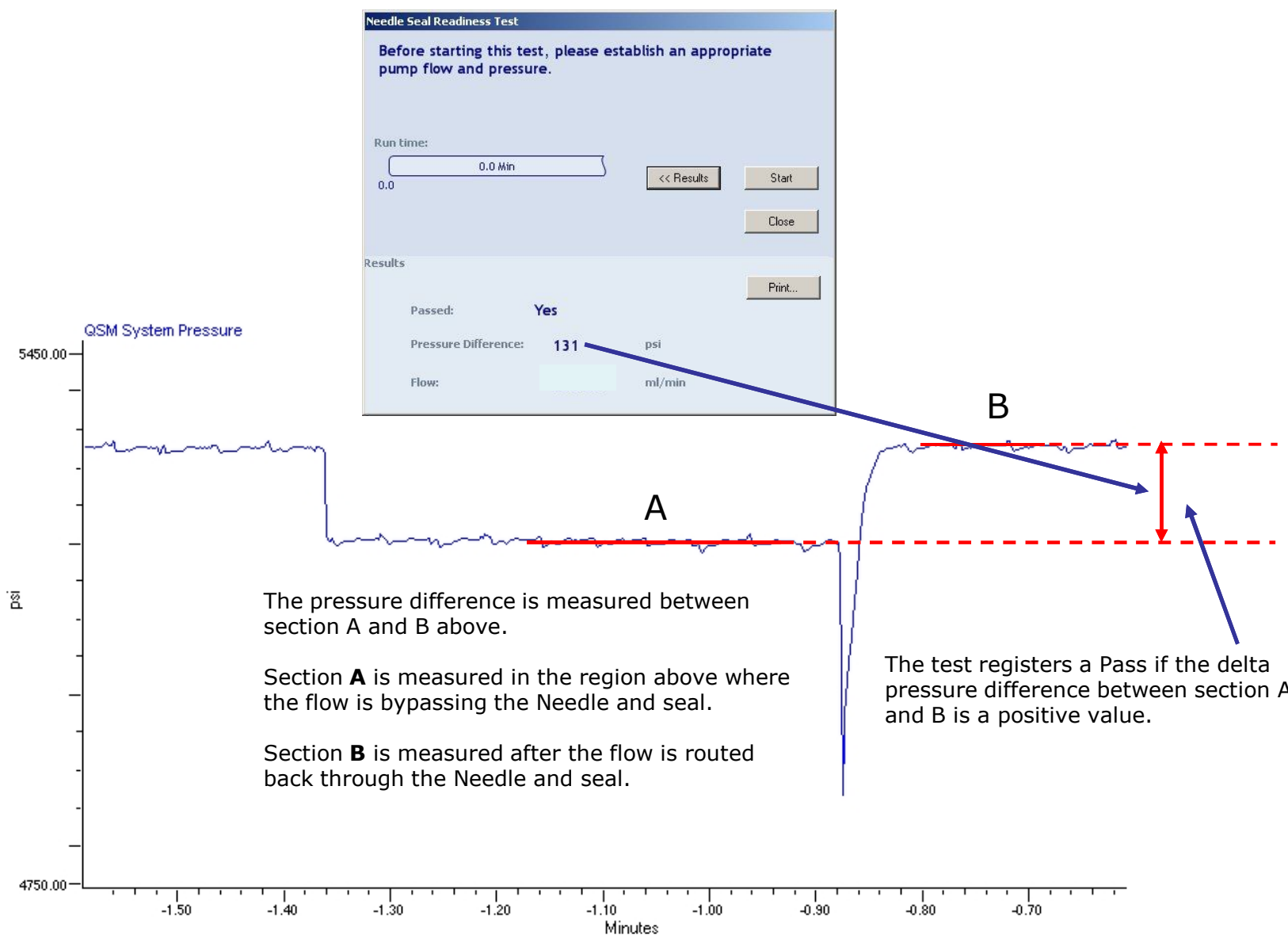
Results

Print...

Passed:	Yes	
Seal Constant:	10.33	N/mm
Distance To Seal:	56.9	mm
Foot Offset:	-0.6	mm



Needle Seal Readiness Test



Running the System Leak Test



Leak Test

Parameters | Status | Results

Pressure: Accumulator: 9000 psi, Primary: 7000 psi

Solvent: A ☒, B ☐, C ☐, D ☐, Prime ☐

End Point: Vent Valve ☐, Column (Active Pre-heater Outlet) ☒, Include Sample Manager Needle and Seal ☒

Retry the test if it fails, up to a maximum of 0 additional attempts.

Attention
Please plug the outlet of the active pre-heater, then press OK.

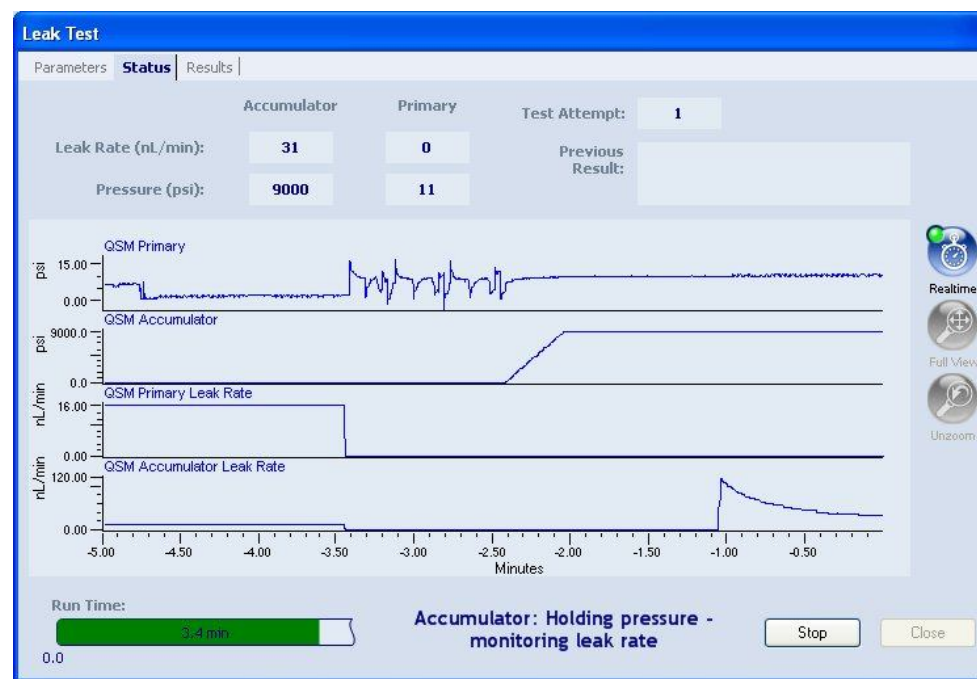
OK Cancel Start Close

Leak Test

Parameters | Status | Results

	Accumulator	Primary
Result:	Passed	Passed
Leak Rate:	15 nL/min	18 nL/min
Maximum Pressure:	9017 psi	7022 psi
Percent of Stroke:	12 %	8 %
Compressed Volume:	7 uL	4 uL
Compression Attempts:	1	1
Test Attempts:	1	

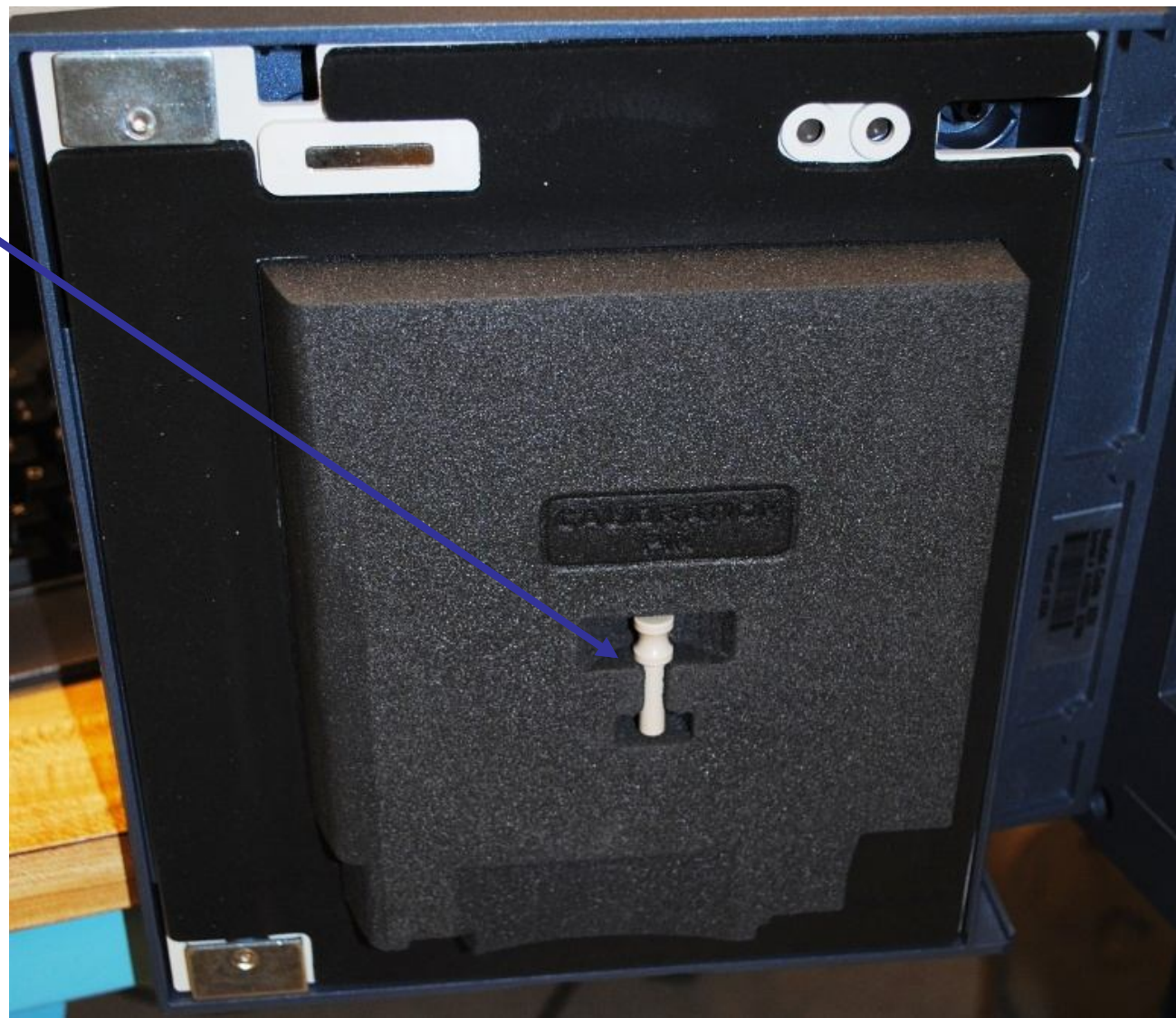
Print Start Close



Rotary Tray Calibration Pin



Calibration Pin
is located in
SM door foam



Calibrate Rotary Tray



Calibrate Rotary Tray

Step 1 of 3

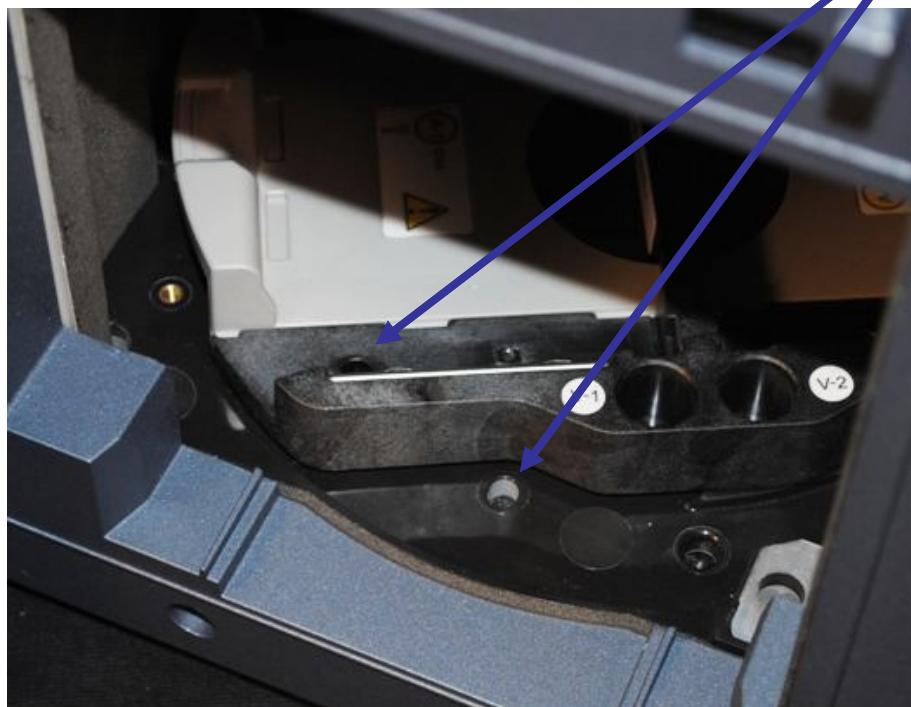
Remove Plate 1.

WARNING: Keep clear. Mechanism will begin moving when you press Continue.

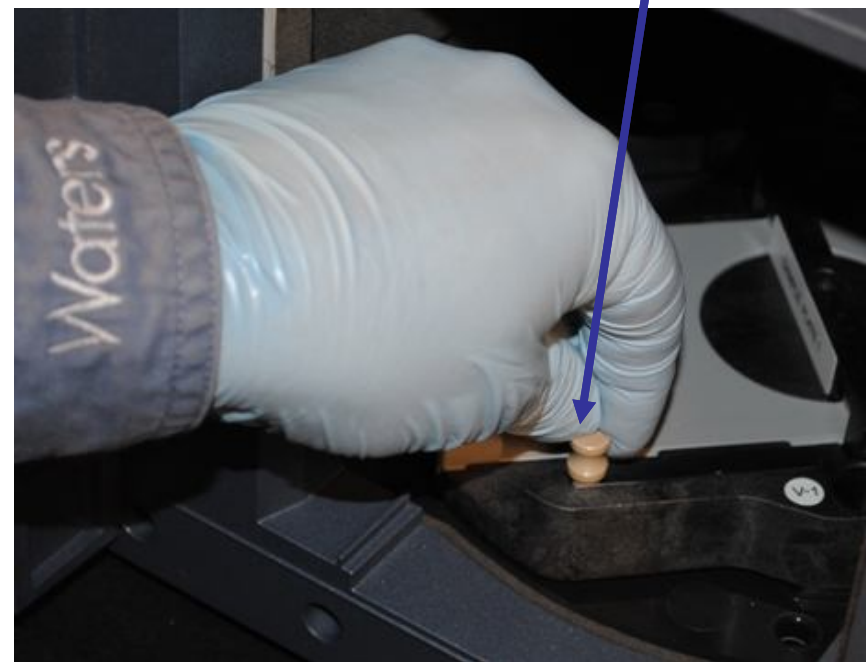
Continue

Results >> Close

Tray is moved manually until these holes line up.



Calibration Pin is inserted into the lined up holes to lock the location.



Implementation of R-Calibration



- Compensated for accurate needle positioning with 384 wellplates
- R-Calibration
 - Analogous to the X-Y calibration of the ACQUITY Sample Manager
 - But only one axis
- Calibration in user diagnostics
- Basic description of routine:
 - Insert calibration pin in calibration hole on platter as shown
 - The calibration pin has a small hole in the tip
 - Using diagnostics controls, move the needle back and forth until it lines up with the hole
 - Save calibration

