Technical note | 003853

Combustion-IC

Configuring the Thermo Scientific Cindion C-IC system for a 2-in-1 operation:

Seamless switching between combustion-IC and standalone IC with an AS-AP autosampler

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Introduction

In Thermo Scientific Application Note AN003644, a method was developed to measure total organic fluorine (TOF) in food contact materials (FCM) using combustion-ion chromatography (C-IC).[1] In this method, total inorganic fluorine (TIF) was measured by directly injecting water-extracted samples through four external injection channels. This approach, while effective, required large sample volumes and manual sample changes after every four analyses.

The Thermo Scientific™ Cindion™ Combustion Ion Chromatography System integrates the Thermo Scientific™ Dionex™ Inuvion™ Ion Chromatography System, featuring reagent-free ion chromatography (RFIC), with the Thermo Scientific™ Cindion™ Combustion/Absorption Module. This integration provides versatile 2-in-1 operation capability, enabling seamless switching between combustion-IC and standalone IC with a Thermo Scientific™ Dionex™ AS-AP Autosampler. With this system, TIF analysis can now be fully automated, eliminating manual sample changes and minimizing sample volume usage, as described in Thermo Scientific Application Proof Note AP003822.[2]

Moreover, when the Cindion combustion/absorption module is not in use, the standalone IC with the Dionex AS-AP autosampler can be employed for other IC applications, thereby maximizing the utilization of the IC system. This technical note provides step-by-step instructions for configuring the Cindion C-IC system for 2-in-1 operation.

Procedure

1. Install the auxiliary valve

The Dionex Inuvion IC system should already have a 6-port injection valve installed. Install an additional 6-port auxiliary valve next to the injection valve. Connect the auxiliary valve as shown in Figure 1. The auxiliary valve has two positions.

- **Position A:** Ports 1 and 6 are connected, allowing the Dionex AS-AP autosampler to deliver the sample to the IC injection valve's sample port
- **Position B:** Ports 5 and 6 are connected, allowing the sample from the IC manual injection port (connected to the Cindion C-IC system) to be delivered to the IC injection valve's sample port

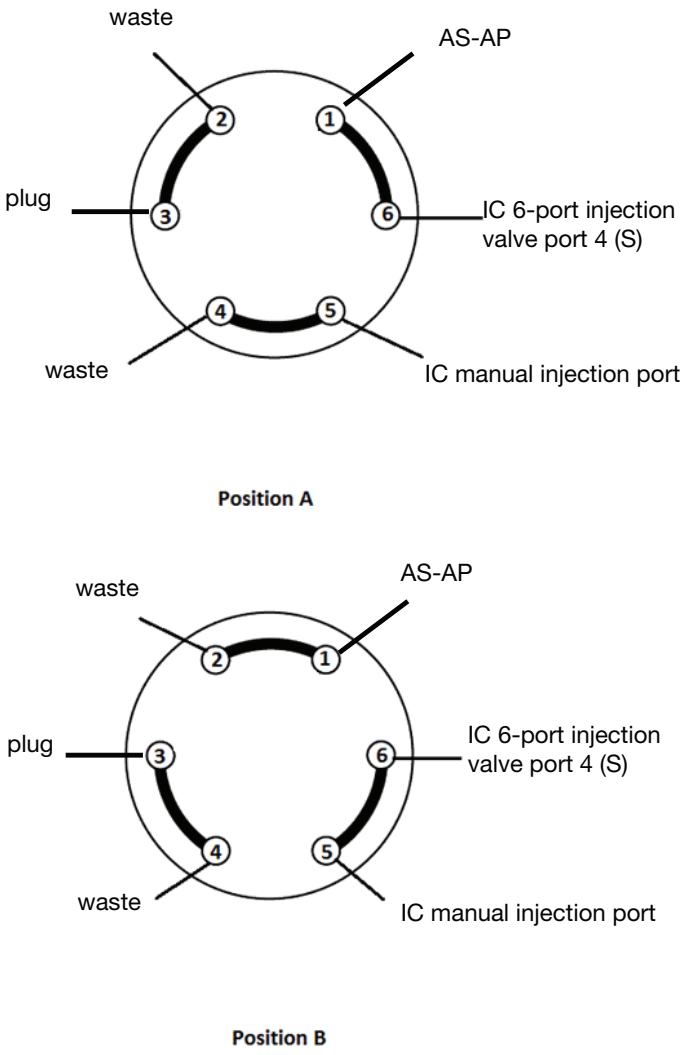

Figure 1. Auxiliary valve positions A and B

2. Add the Dionex AS-AP autosampler to the instrument configuration

In the instrument configuration, follow the setup instructions for both the Dionex Inuvion IC system and Cindion C-IC system as described in the user manuals or Thermo Scientific Technical Note TN003733.[3] With the auxiliary valve installed on the Dionex Inuvion IC system, the Dionex Inuvion IC system instrument configuration should display the HP_valve as checked, as shown in Figure 2, and the IC panel should display the HP valve with A and B positions, as shown in Figure 3. Connect the Dionex AS-AP autosampler cable to the Dionex Inuvion IC system and add it to the instrument configuration (Figure 4a). The default device name "Sampler" has been used for the Cindion C-IC system. Therefore, change the device name to a different name such as "SamplerASAP," as shown in Figure 4b. During the configuration check, you may encounter the warning: "More than one inject device installed for instrument" (Figure 4c). This warning can be ignored.

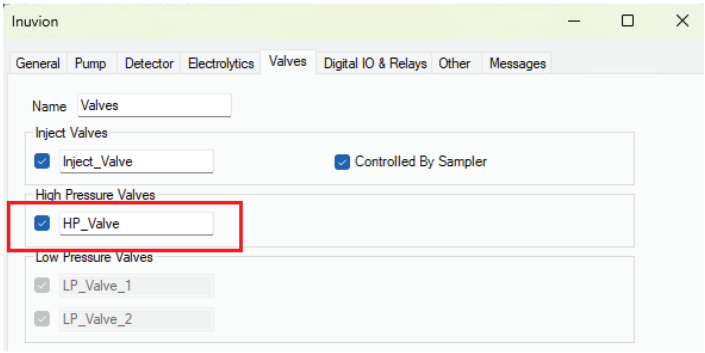

Figure 2. Dionex Inuvion IC system HP valve configuration

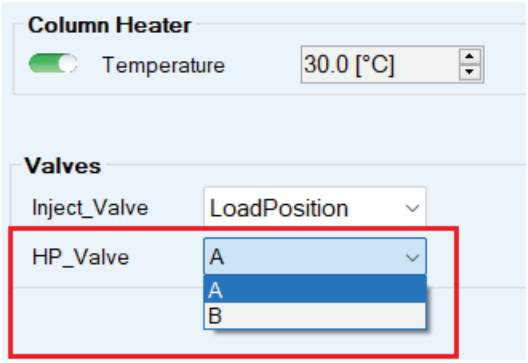

Figure 3. HP valve in Dionex Inuvion IC system panel

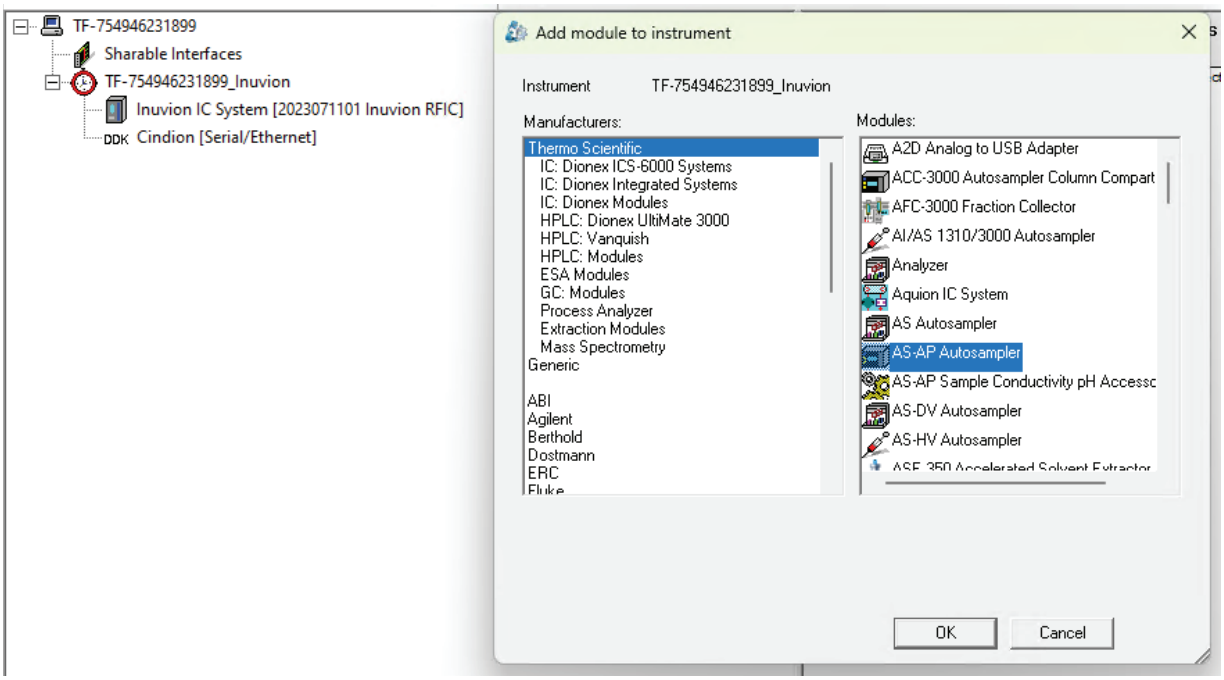

Figure 4a. Adding Dionex AS-AP autosampler to instrument configuration-step 1

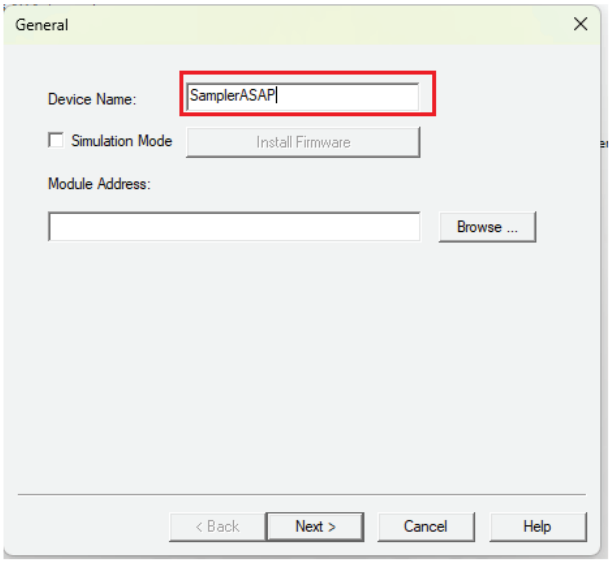

Figure 4b. Adding Dionex AS-AP autosampler to instrument configuration-step 2

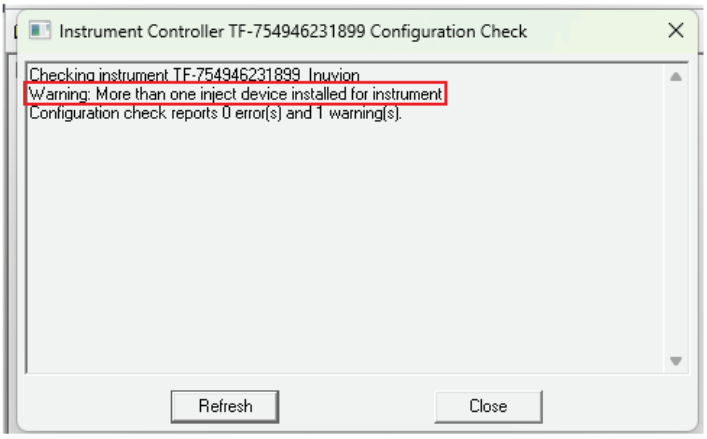

Figure 4c. Add Dionex AS-AP autosampler to instrument configuration-step 3

3. Create separate sequences for combustion-IC and standalone IC

Since the sample position information differs for combustion-IC and standalone IC sequences, it is essential to create separate sequences for each type of application. Figures 5a, 5b, and 5c illustrate the three steps for creating a sequence in combustion-IC mode. In the sequence creation wizard (Figure 5a), ensure that “Cindion.Absorber” is selected as the sampler. In sequence preview (Figure 5b), set the sample start position to SolidTray: #, where # is the first tray position containing a sample. The final combustion-IC sequence is created as shown in Figure 5c. Figures 6a, 6b, and 6c show the three steps for creating a sequence for standalone IC mode. In the sequence creation wizard (Figure 6a), make sure to select “SamplerASAP” as the sampler. In sequence preview (Figure 6b), set the sample start position to a typical Dionex AS-AP autosampler position such as RA1. The final standalone IC sequence is created as shown in Figure 6c. Sequence queues can be created to allow automatic switching between combustion-IC sequences and standalone IC sequences, providing flexibility in operation (Figure 7).

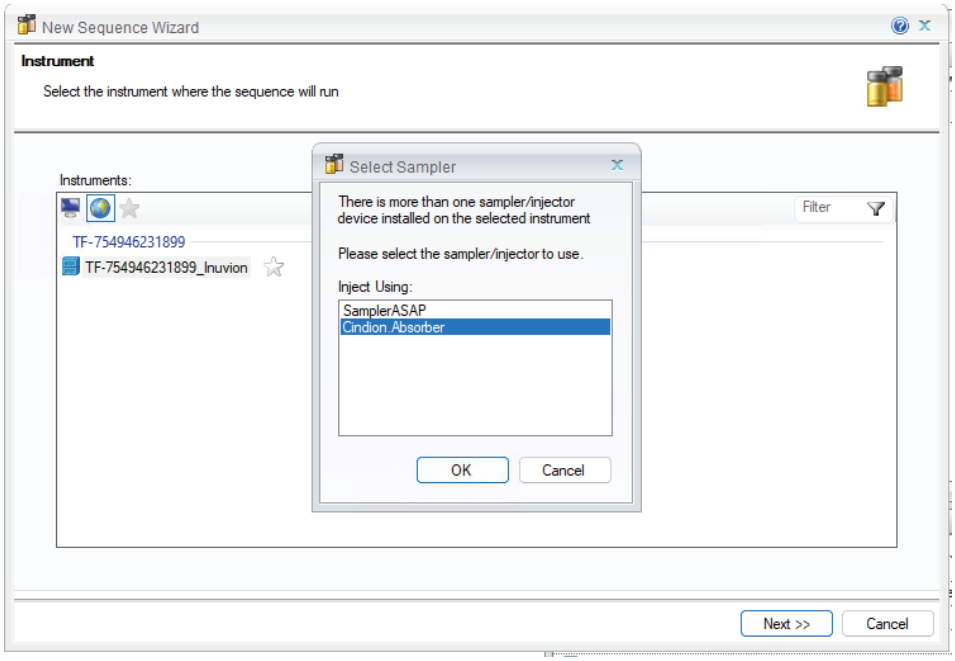

Figure 5a. Sequence creation for combustion-IC mode-step1

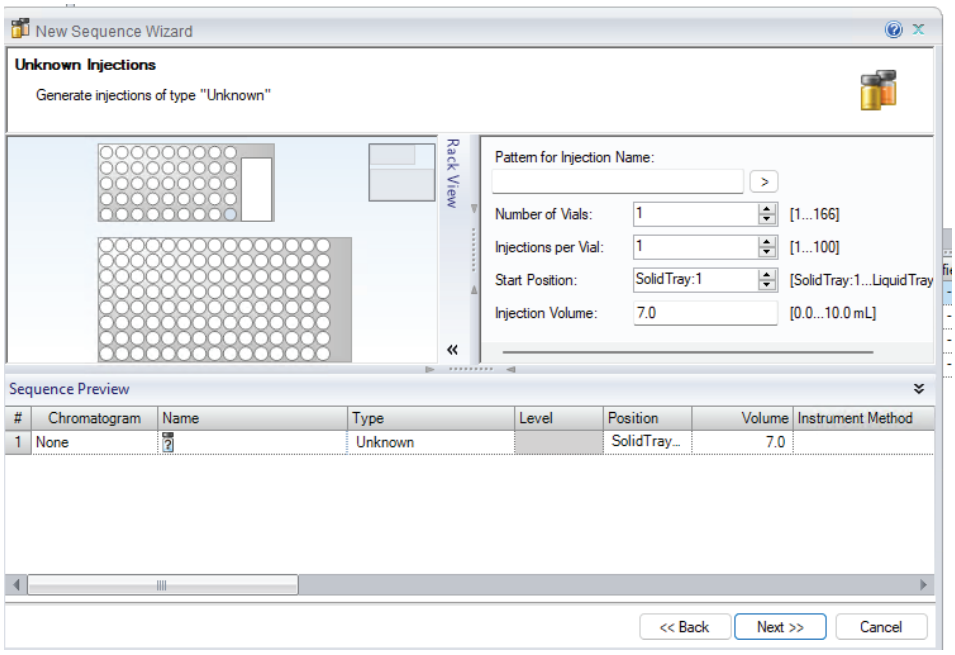

Figure 5b. Sequence creation for combustion-IC mode-step2

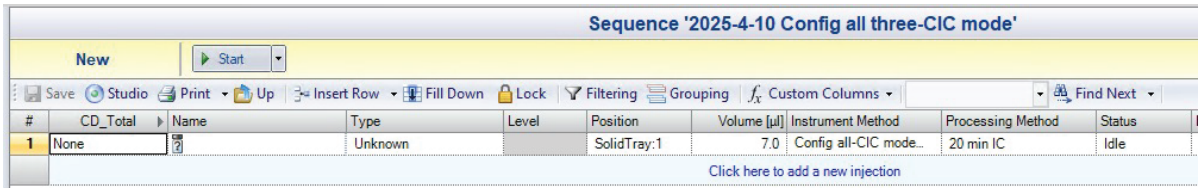

Figure 5c. Sequence creation for combustion-IC mode-step3

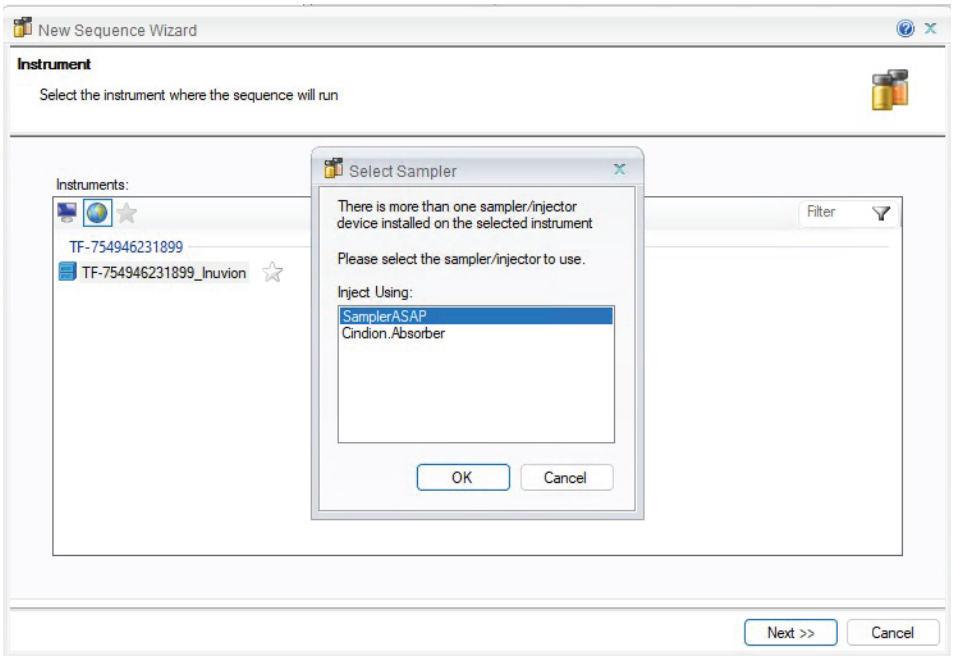

Figure 6a. Sequence creation for standalone IC mode-step1

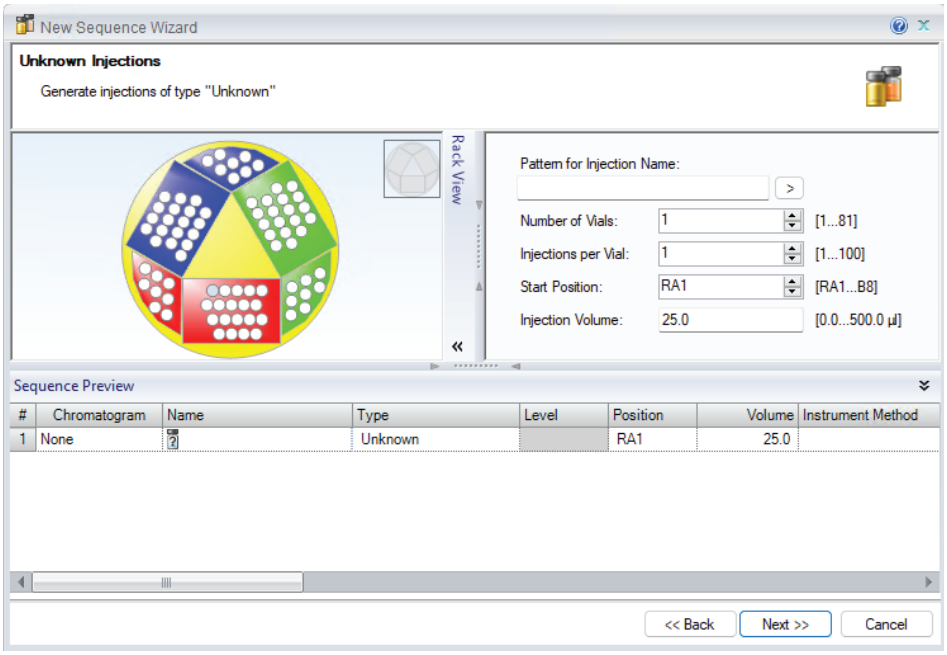

Figure 6b. Sequence creation for standalone IC mode-step2

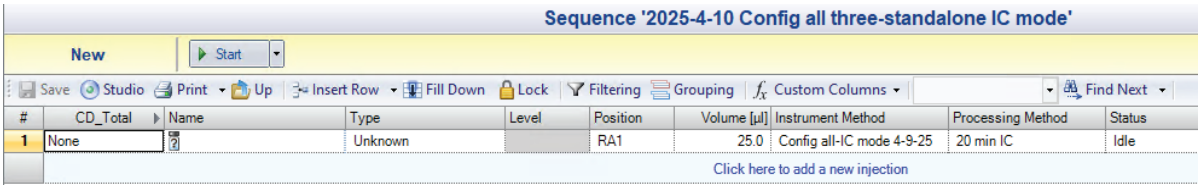

Figure 6c. Sequence creation for standalone IC mode-step3

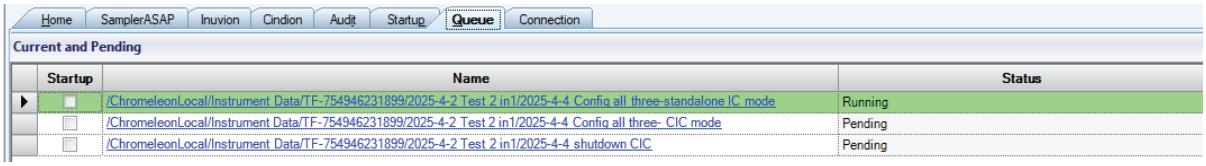

Figure 7. Sequence queue

4. Create separate instrument methods for combustion-IC and standalone IC

- Combustion-IC method:
  - Create the instrument method using the wizard (Figure 8a)
  - Manually insert the injection valve load position and HP valve_B command at the beginning of the instrument method script (Figure 8b). Here are the detailed step-by-step instructions
    - Step 1: Click on the “Script Editor” tab in the Instrument method
    - Step 2: Click the first command line in the script. The selected line will turn blue. Right-click on the selected line and choose “Insert Command”
    - Step 3: Insert the command “Inuvion.Valves.Inject_Valve.LoadPosition”
    - Step 4: Repeat the previous step to insert the command “Inuvion.Valves.HP_Valve.B”
    - Step 5: Confirm both commands have been inserted successfully
  - Manually insert the injection position duration 360 seconds command after Inuvion CD Autozero into the instrument method script (Figure 8c)
  - Delete any Dionex AS-AP autosampler-related commands from the script editor (Figure 8d):
    - Step 1: Locate the command that contains the name you chose when configuring the AS-AP. In this example, the name is “SamplerASAP”
    - Step 2: Click the commands and the selected command will turn blue
    - Step 3: Press the “delete” key on your keyboard or right-click on the selected command and choose “delete”
- Standalone IC method:
  - Create the instrument method using the wizard (Figure 9a)
  - Manually insert the HP valve_A command at the beginning of the instrument method script (Figure 9b)
  - Remove any Cindion C-IC system-related commands from the script (Figure 9c)

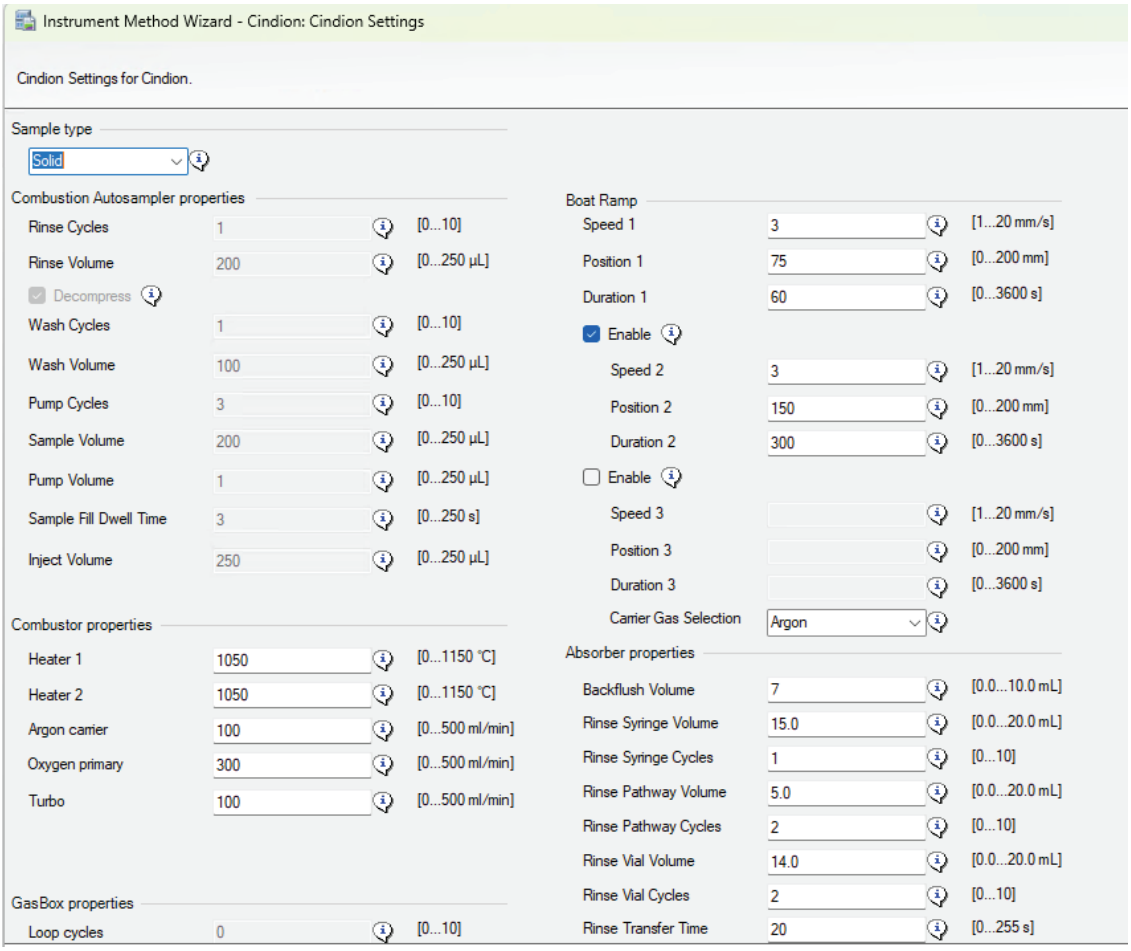

Figure 8a. Instrument method creation for combustion-IC-step1 (create method using instrument method wizard)

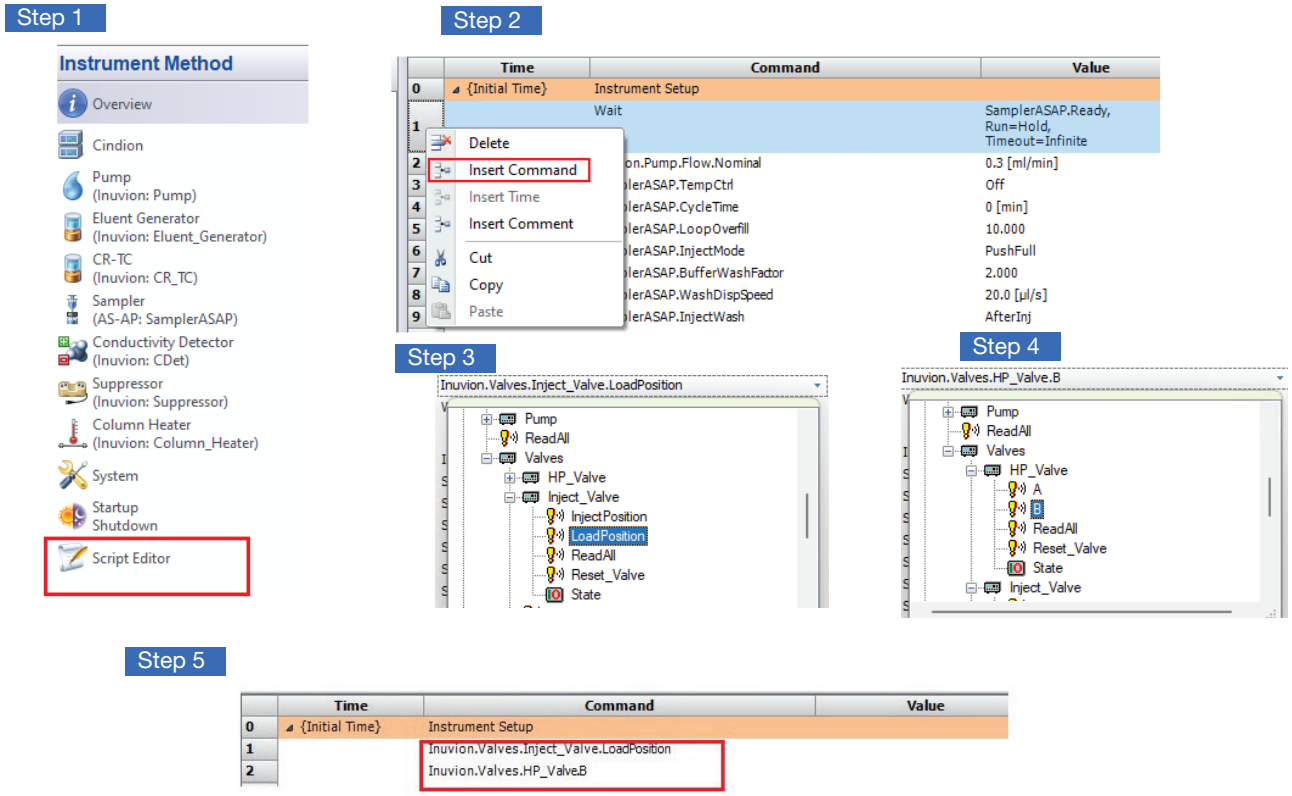

Figure 8b. Instrument method creation for combustion-IC-step2 (Add injection valve load position and HP-valve B into script)

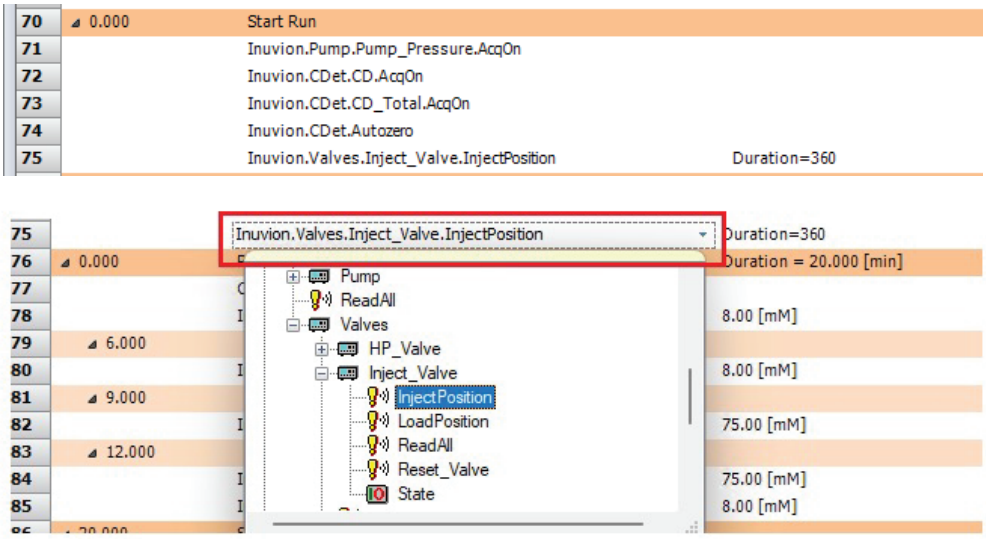

Figure 8c. Instrument method creation for combustion-IC-step3 (add 360 second injection duration to script)

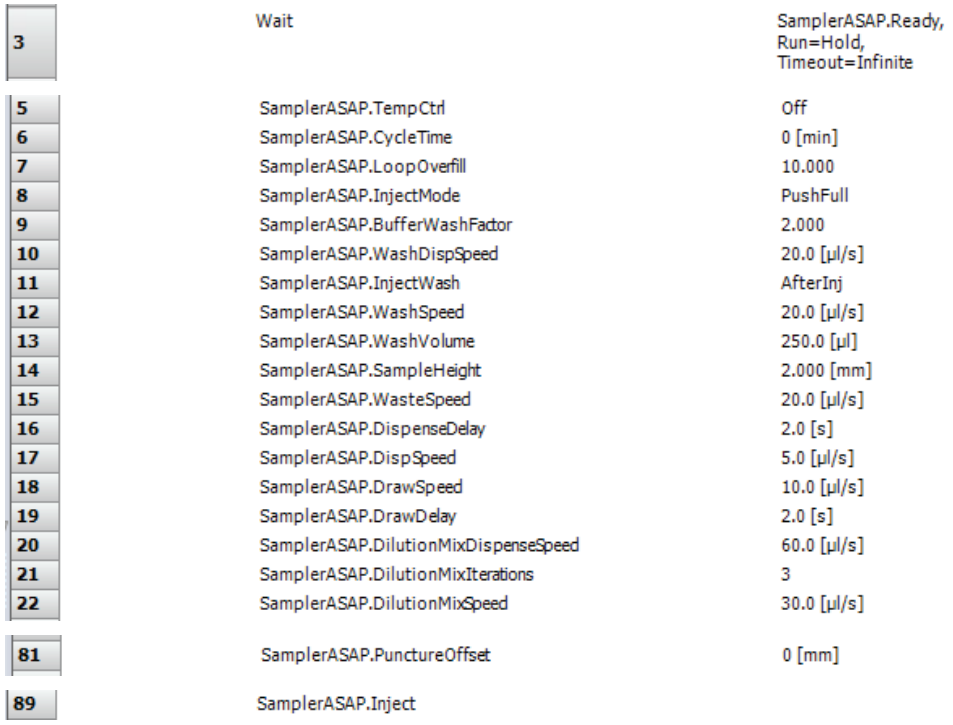

Figure 8d. Instrument method creation for combustion-IC-step4 (delete all ASAP related command from script editor)

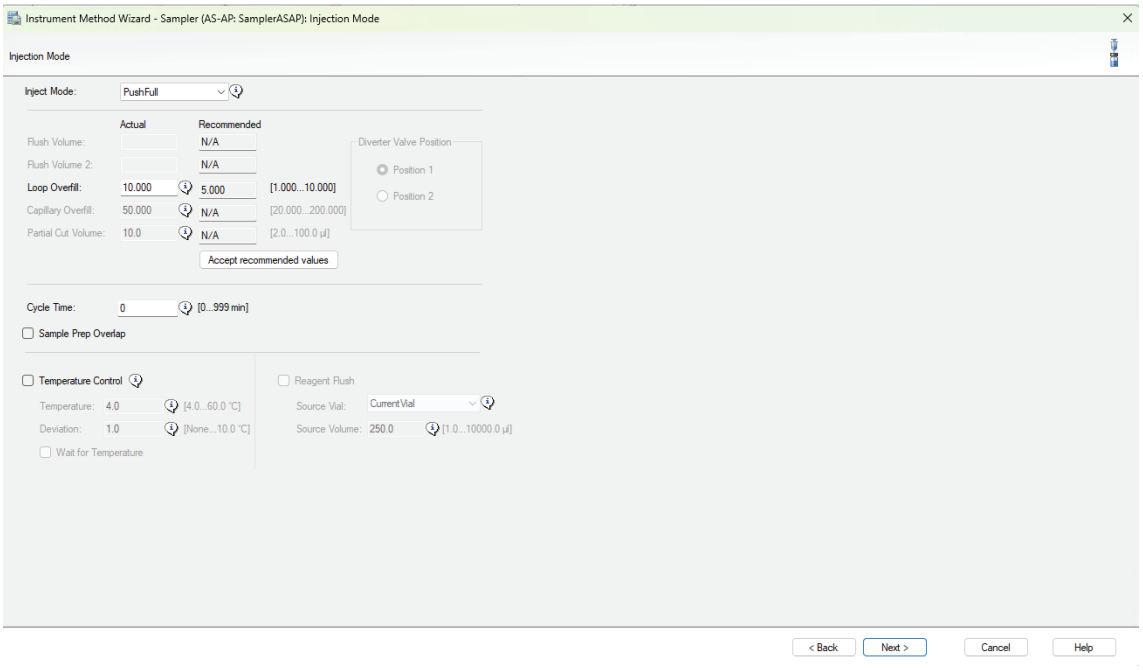

Figure 9a. Instrument method creation for standalone IC-step1 (create method using instrument method wizard)

	Time	Command	Value
0	{Initial Time}	Instrument Setup	
1		Inuvion.Valves.HP_ValveA	
2		Wait	SamplerASAP.Ready, Run=Hold, Timeout=Infinite

Figure 9b. Instrument method creation for standalone IC-step2 (Add HP-valve A into script)

22	Cindion.Absorber.carrierGasSelection02EnableProperty	Argon
23	Cindion.Absorber.rinseTransferTimeProperty	20 [s]
24	Cindion.Furnace.duration1Property	60 [s]
25	Cindion.Furnace.boatRamp3EnableProperty	0
26	Cindion.Furnace.boatRamp2EnableProperty	1
27	Cindion.Gasbox.nextLoopDelayGasProperty	2 [s]
28	Cindion.Gasbox.loopDwellTimeProperty	3 [s]
29	Cindion.Gasbox.nextLoopDelayLPGProperty	15 [s]
30	Cindion.Gasbox.loopInjectTimeProperty	15 [s]
31	Cindion.Gasbox.loopCydesProperty	0
32	Cindion.Gasbox.loopFillTimeProperty	5 [s]
33	Cindion.Sampler.methodSampleTypeProperty	Solid
34	Cindion.Sampler.InjectionVolumeProperty	250 [µL]
35	Cindion.Sampler.WashVolumeProperty	100 [µL]
36	Cindion.Sampler.SampleDwellTimeProperty	3 [s]
37	Cindion.Sampler.PumpVolumeProperty	1 [µL]
38	Cindion.Sampler.SampleVolumeProperty	200 [µL]
39	Cindion.Sampler.configurationPumpCydesProperty	3
40	Cindion.Sampler.configurationWashCydesProperty	1
41	Cindion.Sampler.configurationDecompressSampleVialProperty	1
42	Cindion.Sampler.RinseVolumeProperty	200 [µL]
43	Cindion.Sampler.configurationRinseCountProperty	1
44	Cindion.Absorber.rinsePathwayCydesProperty	2
45	Cindion.Absorber.rinseSyringeCydesProperty	1
46	Cindion.Absorber.rinseVialCydesProperty	2
47	Cindion.Absorber.rinseVialVolumeProperty	14.0 [mL]
48	Cindion.Absorber.rinsePathwayVolumeProperty	5.0 [mL]
49	Cindion.Furnace.duration2Property	300 [s]
50	Cindion.Furnace.position2Property	150 [mm]
51	Cindion.Furnace.speed2Property	3 [mm/s]
52	Cindion.Furnace.position1Property	75 [mm]
53	Cindion.Furnace.speed1Property	3 [mm/s]
54	Cindion.Furnace.mfc3SetProperty	100 [ml/min]
55	Cindion.Absorber.backflushVolumeProperty	3.0 [mL]
56	Cindion.Absorber.rinseSyringeVolumeProperty	15.0 [mL]
57	Cindion.Furnace.mfc2SetProperty	300 [ml/min]
58	Cindion.Furnace.mfc1SetProperty	100 [ml/min]
59	Cindion.Furnace.heater2SetProperty	1050 [°C]
60	Cindion.Furnace.heater1SetProperty	1050 [°C]

83	Cindion.startPrepCommand	
84	Wait	Cindion.Absorber.Ready
86	Cindion.Absorber.Inject	
95	Cindion.startCleanCommand	
106	Wait	Cindion.Absorber.m_ReadyCleanProperty

Figure 9c. Instrument method creation for standalone IC-step3 (Delete all Cindion related commands from script editor)

Conclusion

The integration of the Dionex Inuvion IC system with the Cindion combustion/absorption module enables a flexible and efficient 2-in-1 operation, seamlessly switching between C-IC and standalone IC with the Dionex AS-AP autosampler. This configuration simplifies the total inorganic fluorine (TIF) analysis process, eliminating the need for manual sample changes while minimizing sample volume usage. The added flexibility in operation not only enhances the system's utility for TIF analysis but also allows for other ion chromatography applications when the combustion/absorption module is not in use. By following the provided step-by-step instructions for configuring the system, users can ensure a smooth transition between applications, thus maximizing both efficiency and productivity.

References

1. Hu, J, Cochran R, Grim C, Rumachik N (2025) Application Note AN003644: Comprehensive screening of per- and polyfluoroalkyl substances (PFAS) in food contact materials: Utilizing a combustion ion chromatography for total organic fluorine (TOF) analysis, Thermo Fisher Scientific, Sunnyvale, CA, USA. [Online] Comprehensive screening of per- and polyfluoroalkyl substances (PFAS) in food contact materials: Utilizing a combustion ion chromatography for total organic fluorine (TOF) analysis
2. Hu J, Rumachik N (2025) Application Proof Note AP003822: Comprehensive screening of per- and polyfluoroalkyl substances (PFAS) in food contact materials: Utilizing a new combustion ion chromatography for total organic fluorine (TOF) analysis, Thermo Fisher Scientific, Sunnyvale, CA, USA. [Online] Comprehensive screening of per- and polyfluoroalkyl substances (PFAS) in food contact materials: Utilizing a new combustion ion chromatography for total organic fluorine (TOF) analysis
3. Christison T, Rumachik N (2025) Technical Note TN003733: Configuring a combustion-ion chromatography system using a complete workflow, Thermo Fisher Scientific, Sunnyvale, CA, USA.

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