

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 reagentfree 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.

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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



AS-AP

IC 6-port injection

valve port 4 (S)

IC manual injection port

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.

Inuvion								-	\times
General	Pump	Detector	Electrolytics	Valves	Digital IO & Relays	Other	Messages		
Name Inject	Valve Valves	5							
	nject_Va	alve			Controlled By	/ Sample	F		
High	Pressure	Valves							
	HP_Valv	e							
Low I	ressure	Valves							
I	P_Valve	e_1							
	_P_Valve	e_2							





Position B

Position A

waste

waste

plug

Figure 3. HP valve in Dionex Inuvion IC system panel

Figure 1. Auxiliary valve positions A and B



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

eral		×	
Device Name: Sam	plerASAP	1	
Simulation Mode	Install Firmware	21	EIII Instrument Controller TF-754946231899 Configuration Check
Module Address:		Browse	Checking instrument TF-754946231899 Inuvion Warning: More than one inject device installed for instrument Configuration check reports 0 error(s) and 1 warning(s).
< F	ack Next > Car	ncel Help	Refresh Close

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).

Instruments: TF-754946231899 TF-754946231899_Inuvion	Select Sampler X There is more than one sampler/injector device installed on the selected instrument Please select the sampler/injector to use. Inject Using: SamplerASAP Cindion Absorber	Filter 🖓
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Figure 5a. Sequence creation for combustion-IC mode-step1

1	🗊 New Sequence Wizard 💿 🗴								
Ur	known Injections Generate injections	of type "Unknown"						1	
				Rack Vie	Pattern for Injection	on Name:	>		-
				× v	Number of Vials:	1		[1166]	
	0000	000000000000000000000000000000000000000	R		Injections per Vial	: 1	÷	[1100]	
	0000		Ž 🗌	:	Start Position:	SolidTray	:1 🔶	[SolidTray:1LiquidTr	ay
	0000		ğ		Injection Volume:	7.0		[0.010.0 mL]	
			8	«					
Sec	uence Preview		Þ		⊲			3	;
#	Chromatogram	Name	Туре		Level	Position	Volume	Instrument Method	
1	None	2	Unknown			SolidTray	7.0		
4									Þ
						<< Ba	ck Next :	>> Cancel	ן

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

					Sequence	'2025-4-10 C	onfig all three-C	IC mode'		
	New	▶ Start								
	Save 🧿 Studio	🎒 Print 👻 📩 Up 🛛 🖓 Inse	ert Row 👻 🖳 Fill Down	Lock V	Filtering 📇 Gr	ouping $\int_{\mathcal{X}} Cust$	om Columns 👻	• 🕰 F	Find Next 👻	
#	CD_Total	Name	Туре	Level	Position	Volume [µl] Ir	nstrument Method	Processing Method	Status	
1	None	2	Unknown		SolidTray:1	7.0 (Config all-CIC mode	20 min IC	ldle	
						Click here to ac	dd a new injection			

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

Instruments: TF-754946231899 TF-754946231899_Inuvion 😭	Select Sampler × There is more than one sampler/injector device installed on the selected instrument Please select the sampler/injector to use. Inject Using: SamplerASAP Cindion Absorber OK Cancel	Filter
--	--	--------

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

1	New Sequence V	Vizard						Ø x
Ur	nknown Injections Generate injections	s of type "Unknown"						1
				Rack View 🛛	Pattern for Inje Number of Via Injections per Start Position: Injection Volur	ection Name: Is: 1 Vial: 1 RA1 me: 25.0	> • •	
Sec	quence Preview							*
#	Chromatogram	Name	Туре		Level	Position	Volume	Instrument Method
1	None	2	Unknown			RA1	25.0	
		10						
								•
						<< Ba	ack Next :	>> Cancel

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

				Sequ	ence '202	25-4-10 Cor	nfig all three-standa	lone IC mode'	
	New	Start -							
	Save 💿 Studio 🧧	🚽 Print 👻 💼 Up 🛛 🖓 Inser	t Row 👻 🖳 Fill Down 🍟	Lock Y	Filtering 冒	Grouping $\int_{\mathcal{X}}$	Custom Columns -	🝷 🏯 Fir	nd Next 👻
#	CD_Total ▶	Name	Туре	Level	Position	Volume [µl]	Instrument Method	Processing Method	Status
1	None	2	Unknown		RA1	25.0	Config all-IC mode 4-9-25	20 min IC	ldle
						Click here	e to add a new injection		

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

Home SamplerASAP Inuvion Cindion Audit Startup Queue Connection Current and Pending							
Startup	Name	Status					
	/ChromeleonLocal/Instrument Data/TF-754946231899/2025-4-2 Test 2 in1/2025-4-4 Config all three-standalone IC mode	Running					
	/ChromeleonLocal/Instrument Data/TF-754946231899/2025-4-2 Test 2 in1/2025-4-4 Config all three- CIC mode	Pending					
	/ChromeleonLocal/Instrument Data/TF-754946231899/2025-4-2 Test 2 in1/2025-4-4 shutdown CIC	Pending					

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)

Sample type						
Solid ~	i)					
Combustion Autosampler pr	roperties			Boat Ramp		(1 00 (1
Rinse Cycles	1	٩	[010]	Speed 1	3) [120 mm/s]
Rinse Volume	200	(ب	[0250 µL]	Position 1	75) [0200 mm]
Decompress 😲				Duration 1	60) [03600 s]
Wash Cycles	1	4	[010]	🗹 Enable 🌖		
Wash Volume	100	٩	[0250 µL]	Speed 2	3) [120 mm/s]
Pump Cycles	3	٩	[010]	Position 2	150) [0200 mm]
Sample Volume	200	٩	[0250 µL]	Duration 2	300) [03600 s]
Pump Volume	1	4	[0250 µL]	🗌 Enable 🔇		
Sample Fill Dwell Time	3	4	[0250 s]	Speed 3	(i) [120 mm/s]
Inject Volume	250	١	[0250 μL]	Position 3	4) [0200 mm]
				Duration 3	4) [03600 s]
Combustor properties				Carrier Gas Selection	Argon v)
Heater 1	1050	٩	[01150 °C]	Absorber properties		
Heater 2	1050	•	[01150 °C]	Backflush Volume	7) [0.010.0 mL]
Argon carrier	100		[0500 ml/min]	Rinse Syringe Volume	15.0) [0.020.0 mL]
Oxygen primary	300		[0500 ml/min]	Rinse Syringe Cycles	1) [010]
Turbo	100		[0500 ml/min]	Rinse Pathway Volume	5.0) [0.020.0 mL
				Rinse Pathway Cycles	2) [010]
				Rinse Vial Volume	14.0) [0.020.0 mL
GasBox properties				Rinse Vial Cycles	2) [010]
Loop cycles	0	(i)	[010]	Rinse Transfer Time	20 (i) [0255 s]

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)

		Inuvion.Pump.Pump_Pressure.AcqOn	
2		Inuvion.CDet.CD.AcqOn	
73		Inuvion.CDet.CD_Total.AcqOn	
4		Inuvion.CDet.Autozero	
75		Inuvion.Valves.Inject_Valve.InjectPosition	Duration=360
	. 0.000	Inuvion.Valves.Inject_Valve.InjectPosition	Duration=360
	a 0.000	E Pump	Duration = 20.000 [min]
B		ReadAll	8.00 [mM]
	⊿ 6.000	HP Valve	
D		I Inject_Valve	8.00 [mM]
1	⊿ 9.000		
2		I LoadPosition	75.00 [mM]
3	⊿ 12.000		
		I State	75.00 [mM]
•		Jane U Jane	8.00 [mM]
		1 · · · · · · · · · · · · · · · · · · ·	0.00 [1114]

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

3	Wait	SamplerASAP.Ready, Run=Hold, Timeout=Infinite
5	SamplerASAP.TempCtrl	Off
6	SamplerASAP.CycleTime	0 [min]
7	SamplerASAP.LoopOverfill	10.000
8	SamplerASAP.InjectMode	PushFull
9	SamplerASAP.BufferWashFactor	2.000
10	SamplerASAP.WashDispSpeed	20.0 [µl/s]
11	SamplerASAP.InjectWash	AfterInj
12	SamplerASAP.WashSpeed	20.0 [µl/s]
13	SamplerASAP.WashVolume	250.0 [µl]
14	SamplerASAP.SampleHeight	2.000 [mm]
15	SamplerASAP.WasteSpeed	20.0 [µl/s]
16	SamplerASAP.DispenseDelay	2.0 [s]
17	SamplerASAP.DispSpeed	5.0 [µl/s]
18	SamplerASAP.DrawSpeed	10.0 [µl/s]
19	SamplerASAP.DrawDelay	2.0 [s]
20	SamplerASAP.DilutionMixDispenseSpeed	60.0 [µl/s]
21	SamplerASAP.DilutionMixIterations	3
22	SamplerASAP.DilutionMixSpeed	30.0 [µl/s]
81	SamplerASAP.PunctureOffset	0 [mm]
89	SamplerASAP.Inject	

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

Instrument Method	Wizard - S	Sampler (AS-AP: Samp	olerASAP): Injection	Mode
ction Mode				
Inject Mode:	PushFull	\$ v		
Flush Volume: Flush Volume 2: Loop Overfil: Capillary Overfil: Partial Cut Volume:	Actual 10.000 50.000 10.0	Recommended N/A N/A \$ 5.000 \$ N/A N/A	[1.00010.000] [20.000200.000] [2.0100.0 µ]	Diverter Valve Position Position 1 Position 2
		Accept recon	nmended values	
Cycle Time:	0	(i) [0999 min]		
Sample Prep Over	lap			
Temperature Cont	rol 🚯		Reagent Flus	h
Temperature: 4.	0	[4.060.0 °C]	Source Vial:	Current Vial V
Ueviation: 1.	0 verature	Q [None10.0 ℃]	Source Volun	ne: 220.0 Q [1.01

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.carrierGasSelectionO2EnableProperty	Argon			
23	Cindion.Absorber.rinseTransferTimeProperty	20 [s]	83	Cindion.startPrepCommand	
24	Cindion.Furnace.duration1Property	60 [s]	84	Wait	Cindion.Absorber.Ready
25	Cindion.Furnace.boatRamp3EnableProperty	0			
26	Cindion.Furnace.boatRamp2EnableProperty	1	86	Cindion.Absorber.Inject	
27	Cindion.Gasbox.nextLoopDelayGasProperty	2 [s]			
28	Cindion.Gasbox.loopDwellTimeProperty	3 [s]	95	Cindion.startCleanCommand	
29	Cindion.Gasbox.nextLoopDelayLPGProperty	15 [s]			
30	Cindion.Gasbox.loopInjectTimeProperty	15 [s]	106	Wait	Cindion.Absorber.m_ReadyCleanPro
31	Cindion.Gasbox.loopCydesProperty	0			perty
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.speed 1Property	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]			

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

- 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
- Christison T, Rumachik N (2025) Technical Note TN003733: Configuring a combustionion chromatography system using a complete workflow, Thermo Fisher Scientific, Sunnyvale, CA, USA.

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