

Cell analysis

Automation and robotics for flow cytometry

Everyday high throughput for your flow cytometry workflow

Robotic integration

What is an integrated workcell?

A workcell in flow cytometry is a multicomponent, automated work station (Figure 1) containing the instruments needed to complete a particular plate assay. Robotic integration for flow cytometry is a solution for high-volume labs and standardized operational parameters. The features and capabilities of each instrument in the work station contribute to the overall performance. In this guide, you will learn how each of these instruments from the Thermo Scientific[™] and Invitrogen[™] flow cytometry portfolio collectively deliver the walk-away reliability that automation is meant to provide.

Reliable performance for efficient flow cytometry

Our flow cytometry robotics workcell comprises five high-performance instruments that unite to provide a seamless, automated workflow for flow cytometry assays. Move your research forward with the help of our integrated, comprehensive, and automated flow cytometry station (Figure 1). Explore the suite of instruments designed to maximize operating capacity, mitigate human operator error, and enable rich, reproducible data:

- Invitrogen[™] Attune[™] Flow Cytometers—superior speed, mechanical integrity, and now with a high-speed camera option
- Invitrogen[™] CytKick[™] Autosamplers-consistent plate sampling
- Thermo Scientific[™] Orbitor[™] RS2 Microplate Mover unmatched speed and accuracy
- Thermo Scientific[™] Cytomat[™] 2 C-LiN Automated Incubator Series—dependable, environmentally controlled sample storage
- Invitrogen[™] Attune[™] External Fluid Supply (EFS) expanded fluidics and 24-hour continuous run time



Figure 1. Components of a fully integrated robotic automation workcell for cell-based flow cytometry assays.

Flow cytometer: Attune Flow Cytometers



Traditional flow cytometers face the following challenges when coupled with high throughput and automation:

- **Potential for clogging**—large, sticky, or heterogeneous cell populations can block tubing and the flow cell
- **Time-intensive assays**—certain types of samples are slow to acquire and analyze
- Data inaccuracies—imprecise concentration measurements, well-to-well carryover, inadequate mixing, and >10% coincidence rate of diminishing data quality affect overall performance

Performance overview

Reliability is central to automated operations and high-throughput experiments. Attune Flow Cytometers within a robotics workstation (Figure 2) are high-performance instruments, engineered to meet the rigid demands of a high-throughput environment.

Fluidics designed for speca

The instrument operates with a non-peristaltic, continuous flow pump. Advantages include:

- **Precise counts**—uncompromised volumetric cell counts for all samples in a known volume (gated or total events)
- **Stable flow**—low fluid pulsation offers less variation in a particle's velocity within the flow stream and increased certainty of where the particle will be after traversing a distance within the flow cell
- Engineering to actively resist clogging—a syringe-driven system pushes the sample with a force of up to 75 psi and is significantly less susceptible to clogs caused by backpressure; robotic capability is inconsequential if paired with an instrument prone to clogging and other malfunctions



Figure 2. The Invitrogen[™] Attune[™] CytPix[™] Flow Cytometer configured for robotic automation with the Orbitor RS2 Microplate Mover. The components include the (A) Attune CytPix Flow Cytometer, (B) Invitrogen[™] CytKick[™] Autosampler, and (C) Orbitor RS2 Microplate Mover.

Built-in high-speed camera

The Attune CytPix Flow Cytometer adds a high-speed camera that captures brightfield images of cells passing through the flow cell to verify that cell populations consist of single cells and to verify morphology.

- Consistent image quality is achieved even at high flow rates
- Imaging can be added without changing existing flow cytometry protocols or reducing throughput
- Morphological information from images adds to the richness of flow cytometry data over multiplexed staining alone

Optimized optics

Optical design with defined, fixed alignment of up to 4 spatially separated lasers (Figure 3) offers consistency in data over time, superior performance, and measurable reliability.

- Interchangeable filters minimized reagent crosstalk and maximized signal
- Laser simmer mode—ready at all times, but only changes to "on" when actively lasing; no warm-up requirement between acquisitions
- Stable alignment—prealigned and welded fiber to laser beam–shaping optics (BSO) interface

Technology

The instrument uses traditional hydrodynamic focusing for low sample rates (12.5–25 μ L/min) and acoustic-assisted hydrodynamic focusing for high sample rates (up to 1,000 μ L/min). Advantages include:

- Uniform laser illumination—a precisely aligned particle stream is maintained regardless of the sample input rate
- High speed with low coincidence rate—acquire data at up to 35,000 events/sec and 6,000 images/sec with 34 parameters, based on a 10% coincidence rate per Poisson statistics

Lasers	Laser configuration	Violet 405 nm	Blue 488 nm	Yellow 561 nm	Green 532 nm	Red 637 nm	Total detection channels*	Attune CytPix	Attune NxT
							Fluorescence + FSC + SSC		
1	Blue	**	4	**	**	**	6	N/A	A24864
	Blue/green	**	3		4	**	9	N/A	A28995
	Blue/yellow	**	3	4		**	9	A51842	A24861
2	Blue/red	**	4	**	**	3	9	A51840	A24863
	Blue/violet	4	4	**	**	**	10	A51841	A24862
	Blue/violet 6	6	3	**		**	11	A51843	A29002
	Blue/green/red	**	3		4	3	12	N/A	A28997
2	Blue/red/yellow	**	3	4		3	12	A51845	A28993
	Blue/green/violet	4	3		4	**	13	N/A	A28999
0	Blue/violet/yellow	4	3	4		**	13	A51846	A24859
	Blue/red/violet	4	4	**	**	3	13	A51844	A24860
	Blue/red/violet 6	6	3	**		3	14	A51847	A29003
	Blue/red/violet/green	4	3		4	3	16	N/A	A29001
4	Blue/red/yellow/violet	4	3	4		3	16	A51848	A24858
	Blue/red/yellow/ violet 6	6	2	3		3	16	A51849	A29004

* Number of detection channels includes all fluorescence channels as well as a forward scatter (FSC) and side scatter (SSC) channels.

** Laser upgrade available, green laser not available on Attune CytPix Flow Cytometer.

Figure 3. Optimized optics with up to 4 lasers, 14 colors, 16 channels, and brightfield imaging. Choose the instrument configuration that fits your needs. The Attune CytPix Flow Cytometer is available in 2–4 laser configurations with brightfield imaging, and the Invitrogen[™] Attune[™] NxT Flow Cytometer is available with 1–4 lasers without imaging.

Technical specifications: Attune Flow Cytometers

Instrument specifications		Attune CytPix		Attune NxT			
		Laser	Wavelength (nm)	BSO* (mW)	Diode power** (mW)		
		Violet	405	50	100		
		Blue	488	50	100		
		Green [†]	532	100	140		
	Laser power	Vellow	561	50	100		
		Pod	607	100	140		
		Amount of measured usable laser nower after light has none through the heam ontice and chaning filters					
		** Vendor-specified theoretical n	naximum.	ne beam optics and snaping inters.			
Optics:	Laser excitation	Optimized excitation for minimized stray laser-line noise and losses to reflection					
fluorescence	Laser profile	10 x 50 µm flat-top laser providing robust alignment					
detection	Emission filters	Up to 14 color chann	els with wavelength-tur	ned photomultiplier tul	bes (PMTs);		
		iser-changeable, keyed filters					
	Laser separation	100 μm		150 μm	e ve ev ive el		
	Optical alignment	Fixed alignment with prealigned weided liber; no user maintenance required					
	Onboard thermoelectric cooler	INO WARTH-up delay; TIDER ISN'T ATTECTED by "ON/OTT"					
	Simmer mode	instant on/on reduces usage and/or aging by TUX; only turns on when acquiring samples					
	Flat-top laser specified at the	Coofficient of variation (OV), 200, over the width of the flat ten loop					
	flow cell						
	Upgradable	Convenient field chai	nges	N1/A			
Onting	Laser excitation	405 nm	le eu teurit effe etc el	N/A			
imaging	Pulsed laser power	by "on/off"	iber isn't affected	N/A			
	Pulse width	<50 nanoseconds		N/A			
	Flow cell	Quartz cuvette gel coupled to 1.2 numerical aperture (NA) collection lens, 200 x 200 µm					
	Sample analysis volume	20 μL-4 mL					
	Custom sample flow rates	12.5–1,000 µL/min					
	Sample delivery	Positive-displacement syringe pump for volumetric analysis					
	Sample tubes	Accommodates tubes from 17 x 80 mm to 8.5 x 45 mm					
Fluidics	Fluid-level sensing						
	Standard fluid reservoirs	1.8 L focusing fluid tank, 1.8 L waste tank, 1/5 mL shutdown solution tank, and 1/5 mL wash solution tank			tion tank, and 175 mL		
	Fluid storage All fluids stored within instrument						
	Extended fluidics option Configuration for 10 L fluid						
	Nominal fluid consumption	1.8 L/day					
	Automated maintenance cycles <15 min start-up and shutdown—deep clean, sanitize, and debubble modes				ble modes		
	Fluorescence sensitivity	uivalent soluble fluoroch	nrome (MESF) for FIIC	C, ≤30 MESF for PE,			
	Fluorescence resolution	CV <3% for the singlet peak of propidium iodide-stained chicken erythrocyte nuclei					
	Data acquisition rate	Up to 35,000 events/sec, 34 parameters, based on a 10% coincidence rate per					
	Maximum electronic speed	65.000 events/sec with all parameters					
	Carryover	Single-tube format: <1%					
	Forward and side scatter sensitivity	Able to discriminate platelets from noise					
Performance:	Forward and side scatter resolution	Optimized to resolve lymphocytes, monocytes, and granulocytes in lysed whole blood					
fluorescence	Forward scatter	Photodiode detector with 488/10 nm bandpass filter					
detection	Side scatter	PMT with default 488/10 nm bandpass filter; optional 405/10 nm bandpass filter					
	Fluorescence detectors	14 individual detectors			·		
	Electronic pulse	Measured area, height, and width pulse for all detectors					
	Violet side scatter resolution	Can be configured for violet side scatter to better resolve particles from noise					
		0.2 μm on side scatter using submicron bead calibration kit from Bangs					
	Minimum particle size	NxT Flow Cytometer with standard 0.5 mm blocking configuration an Invitrogen™ Attune™					
		NxT 488/10 Filter (Cat. No. 100083194). and Attune [™] Focusing Fluid (Cat. No. 4488621					
		4449791, or A24904) that has been passed through a 0.025 um filter.					
	Pixel resolution	0.3 µm/pixel		N/A			
	Objective magnification	20x		N/A			
	Objective numerical aperture (NA)	0.45		N/A			
Dorformonoc	Theoretical resolution	0.6 µm		N/A			
imaging	Detection limit	Visually detect 800 n	m particles	N/A			
inaging	Image capture rate	3,000–6,000 images	s/second	N/A			
	Image size	96 x 96 pixels-248 x	248 pixels	N/A			
	Field of view	29 x 29 µm–74 x 74 µ	Jm	N/A			

† Green laser not available on the Attune CytPix instrument.

Comprehensive specifications available at thermofisher.com/attune

Plate sampler: CytKick Autosamplers



The CytKick and CytKick Max Autosamplers, accessory instruments for Attune Flow Cytometers, are high-throughput plate samplers that interface with the robotic Orbitor RS2 Microplate Mover.

Performance overview

These instruments enable 96-well, 384-well, and deep-well microplate capacity to Attune Flow Cytometers, increase walkaway autonomy, help improve experimental workflow, and systematize the data-gathering process.

- **Consistent data**—designed to provide minimal variation (Figure 4)
- Intelligent probe—minimizes clogging and carryover (0.5%) and helps prevent damage to the instrument (Table 1)
- Mixing by aspiration—mixes sample by aspiration instead of shaking, which helps to ensure homogeneity of the sample and cell viability (Table 2)
- Supports systematic operation—serves as the transaction interface with the Orbitor RS2 Microplate Mover

Engineering

Maximized sample integrity is achieved with the CytKick Autosamplers by minimizing carryover or contamination (Table 1).

CytKick Autosamplers have a sample-mixing feature to maintain homogenous samples between wells (Table 2).





Figure 4. Consistent results are achievable regardless of sampling method. Whole blood lysed with ammonium chloride was labeled with Invitrogen[™] mouse anti–human CD45 Pacific Orange[™] (Cat. No. MHCD4530), mouse anti–human CD4 FITC (Cat. No. MHCD0401), and mouse anti–human CD8 R-PE (Cat. No. MHCD0804) antibody conjugates. Labeled samples were analyzed on a blue/violet-configured Attune NxT Flow Cytometer equipped with a 488 nm laser for fluorescence excitation of the FITC (530 BP) and R-PE (574/24 BP) dyes and a 405 nm laser for the Pacific Orange dye (603/48 LP). Identical samples, including compensation controls, were analyzed using either (A) tube mode or (B) plate mode with a standard collection rate of 200 µL/min. Lymphocytes were gated using a CD45 vs. side scatter plot, and analyzed for expression of CD4 and CD8 antigens. Minimal variation was observed between analysis in a tube alone and on a plate running on the CytKick Autosampler.

Table 1. Minimal carryover using the CytKick Autosamplers. Jurkat cells at a concentration of 1 x 10⁶ cells/mL were dispensed into a 96-well V-bottom plate and sampled using the CytKick Autosampler. Samples were analyzed on the Attune NxT Flow Cytometer using collection rates in standard mode (200 μ L/min) and high-throughput mode (500 μ L/min). Each sample was mixed once, and the CytKick Autosampler was washed 1–3 times prior to sampling the next well. Percent sample carryover was calculated.

Number of washes and percent carryover			
Mode	1	2	3
Standard	0.01	0.01	0.01
High-throughput	0.02	0.02	0.02

Table 2. Gentle sample mixing using the CytKick Autosamplers. Increasing the number of mixing cycles does not adversely affect cell viability. Ammonium chloride–lysed whole blood (LWB) and NIH 3T3 (live and heat-treated) cells were stained with 2 µg/mL propidium iodide and loaded in triplicate into a 96-well V-bottom plate. Prior to acquisition, samples were mixed 0–5 times by the CytKick Autosampler, and then samples were analyzed using standard-mode collection rates (100 µL/min for NIH 3T3 cells, 200 µL/min for LWB) on the Attune NxT Flow Cytometer. Propidium iodide was excited using a 488 nm laser, and fluorescence emission was collected using a 640 nm longpass filter. Minimal variation was observed within each cell type, regardless of the number of mixing cycles used prior to acquisition.

	Percentage of dead cells		
Number of mix cycles	LWB	NIH 3T3	
0	0.75	34.10	
1	0.78	32.83	
2	0.74	33.52	
3	0.74	32.75	
4	0.74	33.26	
5	0.75	31.58	

Technical specifications: CytKick Autosamplers

Specifications	CytKick Autosampler	CytKick Max Autosampler			
	<42 min per 96-well plate in high-throughput mode	• 22 min per 96-well plate in Boost mode; one rinse, one mix, and full			
Acquisition time	<70 min per 96-well plate in standard mode with wash cycles	analysis for each 20 µL sample at 1,000 µL/min			
	$\bullet~<\!\!\!145$ min per 384-well plate in standard mode; one mix, one rinse, and full analysis for each 20 μL sample at 500 $\mu L/min$	 88 min per 384-well plate in Boost mode; one rinse, one mix, and full analysis for each 20 μL sample at 1,000 μL/min 			
	• <0.5% carryover for 100 $\mu L,$ 200 $\mu L,$ 500 $\mu L,$ and 1,000 μL samples with one mix and one rinse in standard mode	• <0.5% carryover for 100 $\mu L,$ 200 $\mu L,$ 500 $\mu L,$ and 1,000 μL samples with one mix and one rinse in standard mode			
Carryover	 <1.0% carryover for 12.5 μL and 25 μL samples 	 <1.0% carryover for 12.5 μL and 25 μL samples 			
		$\bullet~<$ 1.0% carryover for 500 μL and 1,000 μL samples in Boost mode with one mix and one rinse			
Mixing optimization	Mixing optimized to preserve cell viability; number of m	ixing cycles optimized to match sample analysis volume			
Mixing method	Each well mixed via aspiration and	Each well mixed via aspiration and dispensation of sample (no shaking)			
No. of wash cycles	Up to 10 wash cy	cles (user-defined)			
Minimum dead volume (single draw)	30 μL for 12.5–200 μL/m	in; 50 μL for 1,000 μL/min			
Sample window	Window allows viewing of well progress; protective coat	ing prevents exposure to ambient light during acquisition			
Autocalibration	Regular 30-day intervals w	ith system-initiated function			
Plate and tube compatibility	One-click transition from tubes to plates and vice	versa; no disassembly, no additional QC, no reboot			
	• 96 deep-well (flat, U-bottom, and V-bottom)	 96 deep-well (flat, U-bottom, and V-bottom) 			
	• 96-well standard depth (flat, U-bottom, and V-bottom)	• 96-well standard depth (flat, U-bottom, and V-bottom)			
	• 384-well standard depth (flat, U-bottom, and V-bottom)	• 384-well standard depth (flat, U-bottom, and V-bottom)			
Compatible plate types	• 384 deep-well (flat, U-bottom, and V-bottom)	• 384 deep-well (flat, U-bottom, and V-bottom)			
companie plate types		Customizable to accept other plate types			
		 1.5 mL and 2 mL microcentrifuge tube rack (up to 24 tube racks per vessel) 			
		 Foil-covered 96-well (U-bottom) and 384-well (U-bottom and V-bottom) 			
Fluidics requirements	Fluid storage: external Total fluid volume: two 2 L tanks				
Extended fluidics	Available with Invitrogen [™] Attune [™] External Fluid Supply (EFS); optional external fluid tank with 10 L fluid capacity				
Size (W x D x H)	~43 x 33 x 41 cn	n (17 x 13 x 16 in.)			
	• Minimum width: 43 cm (17 in.); total width is 99 cm (39 in.) when attached to an Attune Flow Cytometer				
Space requirements	• Minimum depth: 39.5 cm (15.6 in.); allow 33 cm (13 in.) for the cytometer unit and 6.5 cm (2.6 in.) behind the unit for ventilation				
	Minimum clearance height: 74 cm (29.1 in.) above the mounting				
Mounting	Mounted on side	or placed behind			
Martala A	 16.9 kg (37.2 lb) with empty focus and waste bottles 				
weight	 20.9 kg (46 lb) with focus and waste bottles at full capacity 				
Operating range (environmental conditions)	15–30°C (59–86°F)				
Operating humidity	<80%, noncondensing				
Electrical requirements	quirements 100-240 VAC, 50/60 Hz, <300 W				
Sample cooling	N/A Passive cooling available for 96-well U-bottom plates and microcontube racks				
Evaporation protection (foil cover)	N/A	Yes			
Service	Field service or rap	pid exchange option			
Warranty 1-year standard warranty; extended warranty options available					

Comprehensive specifications available at thermofisher.com/attune

Robotic arm: Orbitor RS2 Microplate Mover

With superior speed and accuracy, the Orbitor RS2 Microplate Mover (Figure 5) is the perfect solution to automate a variety of workflows. When paired with an Attune Flow Cytometer, scientists can benefit from the performance, software design, and safety features of the Orbitor RS2 mover.

Performance overview

Incorporating the Orbitor RS2 mover into the Attune Flow Cytometer automation workflow helps increase efficiency and flexibility.

• Rapid nest-to-instrument speed—keeps pace with Attune Flow Cytometers, instruments that are already 10x faster than conventional flow cytometers, with a high-speed transfer from storage to instrument

- Extended continuous runtime—the mover can run unattended and without fluid resupply for up to 19 hours when configured with an Attune Flow Cytometer; external fluids can be refilled without interrupting operation for extended runtime
- Collision detection and recovery—the overhead gripper design is inherently safe and built-in control stops all movement at the slightest unexpected contact
- Onboard barcode reader integrated, in-grip scanner enables sample tracking and inventory management, and reduces the risk of lost samples



Robotic arm

Orbitor RS2 Microplate Mover

Figure 5. The Orbitor RS2 Microplate Mover.

Plates

The Orbitor RS2 mover is compatible with a wide variety of plate types, enabling automated plate moving for a broad range of applications. The mover can de-lid plates, re-lid plates, and move lidded plates to and from storage.

Plate storage

Plate storage is managed by combinations of random access (hotels) and sequential access (stacks) storage options (Figure 6). Both hotels and stacks support landscape or portrait plate orientation.

The random access option enables the mover to retrieve and return a plate to and from the same nest. The sequential access option enables "run-until-empty mode," processing all of the plates from the top down.

The robot comes standard with a baseplate for mounting storage configurations of up to 3 hotels or stacks. Expandable options are available with a capacity of up to 9 hotels or stacks.



Figure 6. Storage options. (A) Hotel plate storage for random access. (B) Stack plate storage for sequential access.

Find out more at thermofisher.com/orbitorrs2

Straightforward, feature-rich software

Invitrogen[™] Attune[™] Software (Figure 7A) is designed for compatibility with Thermo Scientific[™] Momentum[™] Workflow Scheduling Software. The buttons on the ribbon in Attune Software control the automation settings within the software (Figure 7B). When automation is enabled, the Momentum software connects the Orbitor RS2 Microplate Mover to the Attune Flow Cytometer and manages the operations between the instruments.

The Momentum software utilizes event-driven scheduling for optimal performance. With unrivaled logic for on-the-fly decisions and adaptability to current situations, you can have confidence in your system's performance. The Momentum scheduling software uses a straightforward and intuitive dashboard from which you can add plates, choose prevalidated automated workflows, and monitor the progress of ongoing work units (Figure 8).

- Worklist import—matches barcode value to specific templates
- **Progress visualization**—records plate traceability and project status relative to others in priority on the Momentum software dashboard
- Multiuser, multiprocess scheduling—actively prioritizes and reprioritizes runs in high-volume labs with dynamic scheduling
- **Customizable settings**—establishes user-determined variables to align with lab operations (for example, monitoring a specific fluid, modifying a default setting, or creating a batch scope that is most relevant)
- Admin settings—assigns tiered user roles: "Admin,"
 "Operator," and "Expert"



Figure 7. Attune Software features. (A) The home screen and user interface of the Attune Software. (B) Automation icons on the ribbon of the Attune Software.



Figure 8. The dashboard screen and user interface of the Momentum Workflow Scheduling Software.

Technical specifications: Orbitor RS2 Microplate Mover

Instrument specifica	ations			
Axis	• Z (height): 575 mm (range); 750 mm/sec (velocity); 2,250 mm/sec ² (acceleration)			
	• Radius (reach): ±406 mm (range); 200 mm/sec (velocity); 3,600 mm/sec ² (acceleration)			
	• Theta (rotation): Infinite (range); 225 deg/sec (velocity); 675 deg/sec ² (acceleration)			
Storage options	Random access: 8 plates per hotel			
	Sequential access: 40 plates per stack			
	Maximum standard hotel capacity: 72 plates			
	Maximum standard stack capacity: 360 plates			
	Temperature control: Storage device available			
Physical	Power requirements: 110–230 V auto switching			
characteristics	• Operating environment: 4-40°C, noncondensing			
	Safety compliances: CE, CSA			
	• Weight: 25 kg (55 lb)			
	Motion control: Closed-loop servo, brushless AC motor			
	• Operator control: Directly from PC, requires Microsoft™ Windows™ 7 or 10 operating system			
Grip	Plate type: Handles most SBS-conforming plates			
	Orientation: Landscape or portrait mode			
	Lids: Lids and un-lids			
	Plate detection: Enabled			
	Force and speed: User adjustable			
	Fingers: Variable plate and container designs			
Safety	Collision detection and recovery: Self-homing mover			
	Manual override: Hardwired emergency stop button			
Software	Interface format: Dashboard			
	Runtime views: Detailed			
	Mid-run sample loading and unloading: Available			
	Worklist: Automatic execution enabled			
	Process flow: User-set time and logical constraints			
	Shared lab: Multiuser login management			
	Process validation and version control: Built-in			
	Compliance: 21 CFR Part 11 and CLIA compliant; full audit logs in XML format			
	Distributed motion: Multimover systems supported			
	Workflow designer: Drag and drop			
	Sample tracking: By barcodes and sample ID			
	Container definition: Built-in library			
	Simulation mode: Real time, accelerated			

Comprehensive specifications available at thermofisher.com/flowautomation

Temperature control: Cytomat 2 C-LiN Automated Inclubator Series

Temperature control Cytomat 2 C-LiN Automated Incubator Series

The Cytomat 2 C-LiN Automated Incubator Series bring the latest incubation technology to a compact solution with a wide temperature range and CO_2 control—the perfect temperature storage option for a robotic automation system (Figure 9).

Performance overview

- **Complete control**—achieve ideal conditions for your cells with precise temperature, humidity, and CO₂ control, plus a variety of other options
- **Proven protection**—keep your cells safe from contamination using the ContraCon decontamination routine, which simplifies cleaning and eliminates variability in disinfection
- Superior speed—with an average access time of 12 sec and a dedicated plate shuttle system, your automation system won't have to wait around



Figure 9. The Cytomat 2 C-LiN Automated Incubator.

Instrument specifica	itions			
Temperature range	 Wide temperature ranges available, from 4°C to 70°C 			
Inventory	• 56 x 1,536-well plates, 42 x 96-well plates, 30 x transwell or insert plates, 20 x deep-well plates			
Physical	• W x D x H: 57.2 x 51.1 x 90.4 cm (22.5 x 20.1 x 35.6 in.)			
characteristics	• Weight: 80 kg (~176 lb)			
Features	12 sec access time			
	 Precise temperature and CO₂ 			
	Controlled humidity up to 90% relative humidity			
	Fully automated decontamination routine—ContraCon tool			
	Easy-to-use glove-friendly display with intuitive operation			
Certifications	CE marked			
Available options	 Integrated barcode reader (1D/2D) enables sample tracking, barcode transmission, and inventory management 			
	Plate park positioning sensor in stacker helps to eliminate labware handling errors			
	 HydraSmart technology for precise humidity control without heat extraction and external water tank to avoid contamination 			
	Adjustable speed settings for the right plate and right application			
	6 possible gate positions available for maximum flexibility			
	Solid copper inner chamber for natural contamination prevention			
	 Tower shaker for true orbital shaking available for applications requiring sample agitation and cells that need to be kept in suspension 			

Technical specifications: Cytomat 2 C-LiN Automated Incubator Series

Expanded fluidics: Attune External Fluid Supply



One significant advantage of robotic automation is the reduction of operator contact points. Configuring a workflow that includes the Attune External Fluid Supply (EFS) reduces the frequency of replenishing and emptying fluids, and increases continuous runtime.

Performance overview

When an Attune Flow Cytometer is equipped with an Attune EFS, the instrument becomes capable of running for up to 19 hours continuously, which is supported effortlessly by the continuous plate handling of the Orbitor RS2 Microplate Mover. The Attune EFS uses a cubetainer of Invitrogen[™] Attune[™] Focusing Fluid and a Thermo Scientific[™] Nalgene[™] waste bottle (Figure 10).

The Attune EFS is ideal for use with the CytKick Autosamplers and enables the collection of approximately twenty-eight 96-well or seven 384-well plates without changing the fluid tanks.

This device was designed to facilitate the use of a larger buffer and waste container. The Attune EFS connects to an Attune Flow Cytometer via umbilical cords (Figure 11). The system works by monitoring and supplying the internal fluid tanks on the Attune Flow Cytometer so that the instrument can run without the need to change fluid or empty waste.



Figure 10. The Attune EFS device, an optional accessory to an Attune Flow Cytometer, is equipped with a 10 L cubetainer of focusing fluid and a Nalgene waste bottle.



Figure 11. Umbilical cords connect an Attune Flow Cytometer and Attune EFS.

Technical specifications: Attune EFS

Instrument specific	ations		
Focusing fluid	Focusing fluid container: 10 L cubetainer, single use		
	Focusing fluid connection: Cap with sensor and fluid intake		
	• Umbilical 1: For focusing fluid cubetainer		
Waste	Umbilical 2: 6 ft connection		
	• Maximum waste volume: Up to 18 L (including 2 L of bleach for biosafety requirements)		
	Containment: 20 L reusable Nalgene standard container (non-autoclavable) with modified lid containing vent and sensor		
	• Full notification: Yes, alarm		
Physical	• Counter footprint (H x D x W): 25.4 x 41.9 x 63.5 cm (10 x 16.5 x 25 in.)		
characteristics	• Footprint with containers (H x D x W): 55.9 x 41.9 x 63.5 cm (22 x 16.5 x 25 in.)		
	• Dry weight: Approximately 13.6 kg (30 lb)		
	Weight with 10 L fluid: Approximately 28.1 kg (62 lb)		
	Electrical input: From Attune Flow Cytometer		
Operating range	• Operating range: 15-32°C		
	• Humidity range: 10-90% noncondensing		



Figure 12. Multicomponent workcell including the Attune NxT Flow Cytometer and the Orbitor RS2 Microplate Mover configured with 3 hotels.

Integrated workcell-summary

Anchor your automation with proven reliability in operation and innovative mechanical integrity.

Leverage the integrated workstation with robotic automation and a suite of instruments offered by the Thermo Scientific[™] and Invitrogen[™] portfolios for outstanding performance, walk-away reliability, accurate monitoring, and productive uptime (Figure 12). Optimize for particular specifications, workload, and objectives of multi-instrument, high-volume labs with custom upgrades.

Rich data

This degree of automation enables significantly more consistency in data than traditional methods by eliminating manual steps that can lead to variable results, increased processing costs, and impoverished data integrity.

Coordinated operations

Whether you handle thousands of samples for complicated multiparametric analysis or hundreds of thousands of samples in drug discovery, a high-performance multicomponent flow cytometry workcell will mean the difference between a reliable, fine-tuned operation and a process rife with downtime and sample waste.

Sustained reliability

The integrated workcell with Attune Flow Cytometers is mechanically engineered to provide long-lasting high performance. True walk-away automation is not achieved solely with the integration of robotics and defined points of user intervention, but in combination with the sustained reliability that each component of this system provides. The fastest systems in the world will do no one any good if they are frequently breaking down.



Protein and cell analysis *thermofisher.com/flowautomation*

Customer support

The Thermo Scientific and Invitrogen portfolios are supported by an extensive global team of experienced scientists and engineers, who all adhere to a tenet of unrelenting reliability.

Engineering

Field service engineers dispatch to service calls and manage all instrument installs. An extended service option is also available.

Technical support

A technical support line is available for your convenience. Speak with an engineer or technician on the phone to get answers to your questions or troubleshoot a problem.

Application specialists

Globally, PhD-level and experienced scientists build the ranks of our teams to support, develop, and partner with you to expand the complexity of your cell-based assays, determine the best instrumentation configuration for your applications, and help you just get to the science.

Training workshops

After installation, labs receive a familiarization workshop to learn how to operate Attune Flow Cytometers in tandem with the Orbitor RS2 Microplate Mover, the Cytomat 2 C-LiN Automated Incubator Series, and the Attune External Fluid Supply. Supplementary sessions are available to expand operations and optimize applications.



Resources

Reference guides

The Molecular Probes[™] Handbook, 11th Edition

The most complete reference on fluorescence labeling and detection available, this resource features extensive references and technical notes, and contains over 3,000 technology solutions representing a wide range of biomolecular labeling and detection reagents. See the online version of *The Molecular Probes Handbook* at thermofisher.com/handbook

Immune cell guide

An extensive portfolio of human and mouse cell markers for immunological phenotyping of cells using flow cytometry, this 84-page guide includes a comprehensive overview of immune cell type markers, their distributions, and functions. Download at thermofisher.com/flowantibodies

Online tools

Flow cytometry antibody selection tool

Explore our extensive portfolio of high-quality primary and secondary antibody conjugates with an easy-to-use selection tool at <u>thermofisher.com/flowantibodies</u>

Fluorescence SpectraViewer

Plot up to 14 fluorophores on a single graph, then print or save for later. To find out more, go to **thermofisher.com/spectraviewer**

Flow Cytometry Panel Design Tool

Choose fluorescent antibody conjugates: pick an antibody species reactivity, select up to 14 targets of interest (choices include viability dyes), and choose the lasers or fluorophores you want to view. Then print or email your list. Access the tool at thermofisher.com/flowpanel

Interactive instrument 3D explorer demo

Explore instrument capabilities with this virtual demo. Spin the unit around and interact with the key features. To find out more, go to **thermofisher.com/attune3ddemo**

Education

Flow cytometry learning center

Search for protocols, tutorials, application notes, fluorophore and product selection guides, literature, and many other technical resources in a single place at **thermofisher.com/flowlearning**

Flow cytometry educational videos and webinars

These videos, tutorials, and webinars are designed to provide technical and educational information regarding flow cytometers, as well as flow cytometry research applications and techniques. Watch now at <u>thermofisher.com/attunevideos</u>

Publications

BioProbes[™] Journal

Our award-winning print and digital magazine highlights the latest breakthroughs in cell biology applications, featuring new technologies and products. Read the latest issue at **thermofisher.com/bioprobes**

Subscribe to receive the *BioProbes Journal* at thermofisher.com/subscribeprobes

Services and support

We offer free online tutorials, answers to frequently asked questions, and extensive troubleshooting guides for flow cytometry experiments. To browse recommendations from our experienced professionals or to contact a technical support representative, go to <u>thermofisher.com/flow-support</u>

Connect with Invitrogen flow cytometry



@facebook.com/thermofisher @facebook.com/invitrogen @facebook.com/molecularprobes



@twitter.com/invitrogen



@linkedin.com/thermo-fisher-scientific

Find out more at thermofisher.com/flowautomation

For Research Use Only. Not for use in diagnostic procedures. © 2017–2021 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries unless otherwise specified. Microsoft and Windows are trademarks of Microsoft Corporation. BROC-9359155 1224