

ing accuracy and stability as well as minimum hysteresis during adjustment. The high precision Universal Shutter Tower combines optimum laser steering with an integral beam-blocking shutter. Controlled by illuminated, color-coded relays, the Universal Shutter Tower provides high efficiency reflectance, wavelength-specific mirrors for each optical pathway. The MoFlo preserves vertical polarization of the laser light, thus ensuring optimum illumination of the sample.

All optical elements are of the highest quality and designed for laser optical research or high-resolution microscopy. Spatial and chromatic filtering, with collimating lenses on each laser collection pathway, maximize signal quality and signal-to-noise ratio and minimize inter-laser cross-talk. Only standard 25 mm (0.98 in.) optical filters and dichroic mirrors are used in the MoFlo; no costly special-order filters are required.

Hamamatsu photomultiplier tubes were chosen for use with the MoFlo because of their superior performance. Selection from the models available is based on the requirements of the application. A photomultiplier tube may be used in place of the photodiode in the forward light scatter position to facilitate experiments analyzing bacteria, algae and sperm.

Two infrared cameras view the stream. One is positioned to observe the stream emerging from the CytoNozzle™; the other camera views the stream at the last attached drop during sorting. These built-in cameras eliminate the need for tedious viewing microscopes. The second camera is also used by SortMaster™, which automates the determination of the droplet break-off measurement and controls the break-off during the sort.

FLUIDIC SUBSYSTEM

The heart of the fluidic subsystem is the CytoNozzle (Figure 1). It is designed to operate at high pressures and flow rates, with high stability and minimal resonance effects, and is engineered with attention toward minimizing cavities where contaminants could accumulate. All tubing, connectors and valves are of the type used in High Pressure Liquid Chromatography applications, where possible. These parts have extremely low dead volumes, very stable physical characteristics and a high resistance to reagents. All tubing is color coded throughout the MoFlo for ease of use and safety.

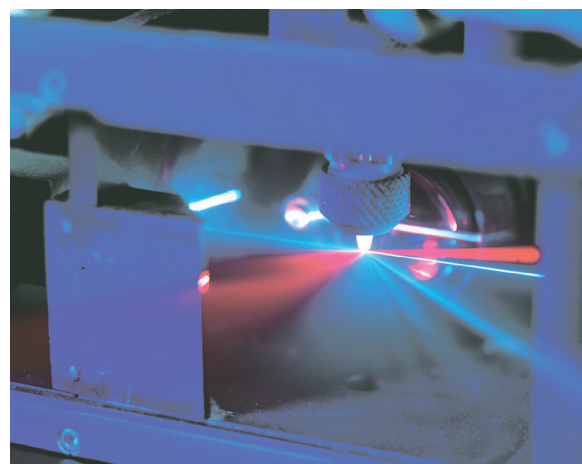


Figure 1: The MoFlo's CytoNozzle

There are two MoFlo sample injection systems available. Both have been designed to minimize carry-over contamination between samples and are easily dismantled for autoclaving and sterilization. Either system can be attached to an optional water circulator for temperature maintenance. The manual sample block offers simplicity, speed of sample exchange and a built-in kinetics reagent port. The Automated Sample Station provides a high level of operator safety by completely enclosing the sample in a pressurized chamber, thus removing the risk of tube fracture and loss of sample containment. It has built-in three-speed sample agitation to ensure long-term sample stability for extended duration sorts and analyses.

ELECTRONICS SUBSYSTEM

The patented MoFlo Data Bus provides digital signals to the modular components residing in the MoFlo electronics console. With the open architecture of the bus, any researcher can design and integrate custom interfaces and special purpose hardware into the instrument without voiding the warranty or service contract.

Eight ADC modules (16 channels) may be installed in the MoFlo bus. Each ADC channel can generate peak, log or integral signals, and each may be connected to any signal input, for maximum flexibility. Flexibility in the number of signal channels allows the investigator to start with a 5, 6, or 7 fluorescence parameter system, then add more as needed; up to 14 fluorescence channels are available.

The MoFlo cytometer's electronic subsystem incorporates a patented system that precisely measures, analyzes and makes sort decisions on each cell as it passes sequentially through multiple, spatially separated laser intercept points. The MoFlo seamlessly integrates the data collected from each of these three laser intercept points into an intuitive, user-friendly sort controller, the Cytomation Sort Unit (CSU). This capability eclipses other instrument designs, which can handle just one cell at a time in the laser intercept region and are therefore performance-limited by the number of lasers.

SUMMIT SOFTWARE SYSTEM

Summit, Cytomation's premier software product, offers full control of all MoFlo functions. Summit controls all instrument parameters in an intuitive Windows® NT-based, drag and drop software environment. It provides full input and output support for the standard FCS Version 2 file format. Summit has been designed to provide true "what you see is what you get" printing for publication-quality output. The Summit

Database has been designed to allow the researcher to manipulate the data as needed to assist in data analysis.

SUMMIT WORKSTATION

This high-end computer provides a powerful platform for the MoFlo, as well as off-line analysis, manuscript preparation and desktop publishing. The standard workstation is very powerful, and upgrades and peripherals are available to customize each workstation to meet the needs of the researcher.

OPERATOR SAFETY

Safety is a primary consideration during the MoFlo's design and can be clearly seen wherever concern is warranted. With the optical subsystem, MoFlo is the only cytometer designed to allow complete access to optical elements without the need to remove or defeat safety shields. In the fluidic subsystem, where high pressures can lead to sample tube breakage, the operator is protected by the Automated Sample Station, which totally encloses the sample tube. The Aerosol Evacuation System evacuates microdroplets and airborne particulates from the sort chamber. Wherever safety is a concern, Cytomation is continually developing better technology to protect the operator.

FUTURE AUTOMATION

Cytomation is in the process of developing a fully automated sorting process. Modules recently designed for MoFlo employ microprocessor-control, which means that these modules are programmable and will be able to communicate with each other to coordinate the sort process. Microprocessor-controlled modules already available include the Automated Sample Station, 4Way™ Sorting, Aerosol Containment, CyCLONE® and SortMaster. Cytomation is unique in the industry in adding microprocessor-control to its flow cytometer. Cytomation is designing in the power and flexibility necessary for a fully integrated, automated sort.

MOFLO CYTOMETER SPECIFICATIONS

Sorting Method:	Jet-in-air
Sorting Rate:	70,000 events/second
Sorting Purity:	> 99% for 70,000 events/second
Sorting Modes:	15 modes (3 x 5 matrix of purity, enrich, single vs. 0.5, 1, 1-2, 2, 3 drops) plus mixed mode
Compensation:	8 x 8 matrix, ratios and time
Acquisition Speed:	150,000 events/second
Fluorescence Sensitivity:	< 200 with Spherotech Rainbow calibration particles
Fluorescence Resolution (CV):	< 2% DAPI stained trout erythrocytes
Optical Parameters:	2 scatter and 10 fluorescence standard, 16 fluorescence available
Beam Geometry:	Spherical and elliptical
Number of Lasers:	1-3
Accepted Lasers:	Argon, Krypton, mixed gas ion, dye heads, HeNe, multi-line UV, Cytomation's 635 nm solid-state diode laser
Fluidic System Rating:	up to 100 psi (689 kPa)
CytoNozzle Orifice:	50, 70, 100, 150, 200, 400 µm diameter
Sample Flow Rate:	30 µl/min at 0.5 psi (3.5 kPa) differential
Optical Bench Sizes (feet):	4 x 6, 4 x 5, 4 x 4, 3 x 4, 3 x 2.5, 2.5 x 2.5
Optical Bench Grid:	1 inch center, 1/4"-20 holes
Benchtop System Dimensions:	125.0 cm wide x 76.25 cm deep x 74.0 cm tall

SUMMIT WORKSTATION SPECIFICATIONS

Platform:	Windows NT operating system
Motherboard:	Dual Intel 400 MHz Pentium® II with 128 MB RAM expandable to 1 GB
Storage Space:	Two 8.4 GB hard disks, CD-ROM drive, optional DVD, CD-RW
Monitor:	Single or dual-monitor 16 MB video card, one or two 21-inch or larger traditional tube-type or LCD flat screen monitors
Miscellaneous:	Ethernet LAN card, 3.5" disk drive, sound card and speakers

Ask your Cytomation sales representative for these product specification sheets:**ACCESSORIES**

- 4Way Sorting
- CyCLONE® Automated Cloning
- Aerosol Evacuation System
- SortMaster™

OPTIONS

- Elliptical Beam Shaping Optics
- 635 nm Diode Laser
- Automated Sample Station

FEATURES

- Summit Software
- Safety

Cytomation, Inc. is a privately held bio-technical instrumentation corporation specializing in high-performance, high-speed flow cytometer analyzers, sorters and upgrades. Our mission is to design, produce, and service the finest flow cytometers and cell sorters in the world — unparalleled in performance, accuracy, versatility, reliability and speed. MoFlo, our premier flow cytometer, is a modular system that is easily upgraded whenever requirements change or new modules become available.

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CYTOMATION

Better Tools. Good Science.

**HIGH SPEED SORTING**

The MoFlo (modular flow) cytometer was designed, first and foremost, as a high-speed sorter. It offers the sorting precision required for the isolation of rare cell populations, with high purity and yield. The MoFlo is designed to sort at up to 70,000 events per second, approximately 5 to 10 times faster than existing instruments. Sorted cells must be viable, purity must be greater than 99 percent at any speed, and yield must be solely determined by Poisson statistics. To illustrate this with an example, the MoFlo can sort 5x10⁶ cells from a 0.5 % population in 5.6 hours. Other instruments may take as long as 10 or more hours to complete this same sort. The high sort speed of the MoFlo provides the user with unparalleled performance.

MODULARITY

The MoFlo embodies the modular design philosophy that originated at Lawrence Livermore National Laboratory (LLNL). Cytomation has kept this philosophy while expanding the original LLNL design into a viable, versatile flow cytometer that meets today's challenging research needs. The MoFlo comprises four basic subsystems: optical, fluidic, electronic and com-

The MoFlo cytometer's performance surpasses that of all other instruments, no matter how performance is measured. Its modularity makes additions and upgrades easy, so MoFlo will never be outgrown and never become obsolete.

puter; each of these is modular by design. This innovative approach to design means that each subsystem is composed of individual, interchangeable modules, so that each MoFlo can be custom configured to meet the researcher's needs. As needs change in the future, individual modules can be upgraded or reconfigured, ensuring that a MoFlo purchased today will continue to maintain its state-of-the-art technology for years to come.

OPTICAL SUBSYSTEM

The foundation of the MoFlo is the industry standard optical bench, which is designed to eliminate vibration. This bench provides an extremely rigid, heavy surface on which the optical and fluidic subsystems are mounted. Each laser path consists of a laser, a Universal Shutter Tower, filters, lenses and dynamic range detectors.

Each laser is independently steered and focused for easy, stable alignment. Laser focusing is accomplished using either spherical or elliptical illumination optics. High-precision Newport translation stages are used on all optical elements. They deliver sub-micron position-