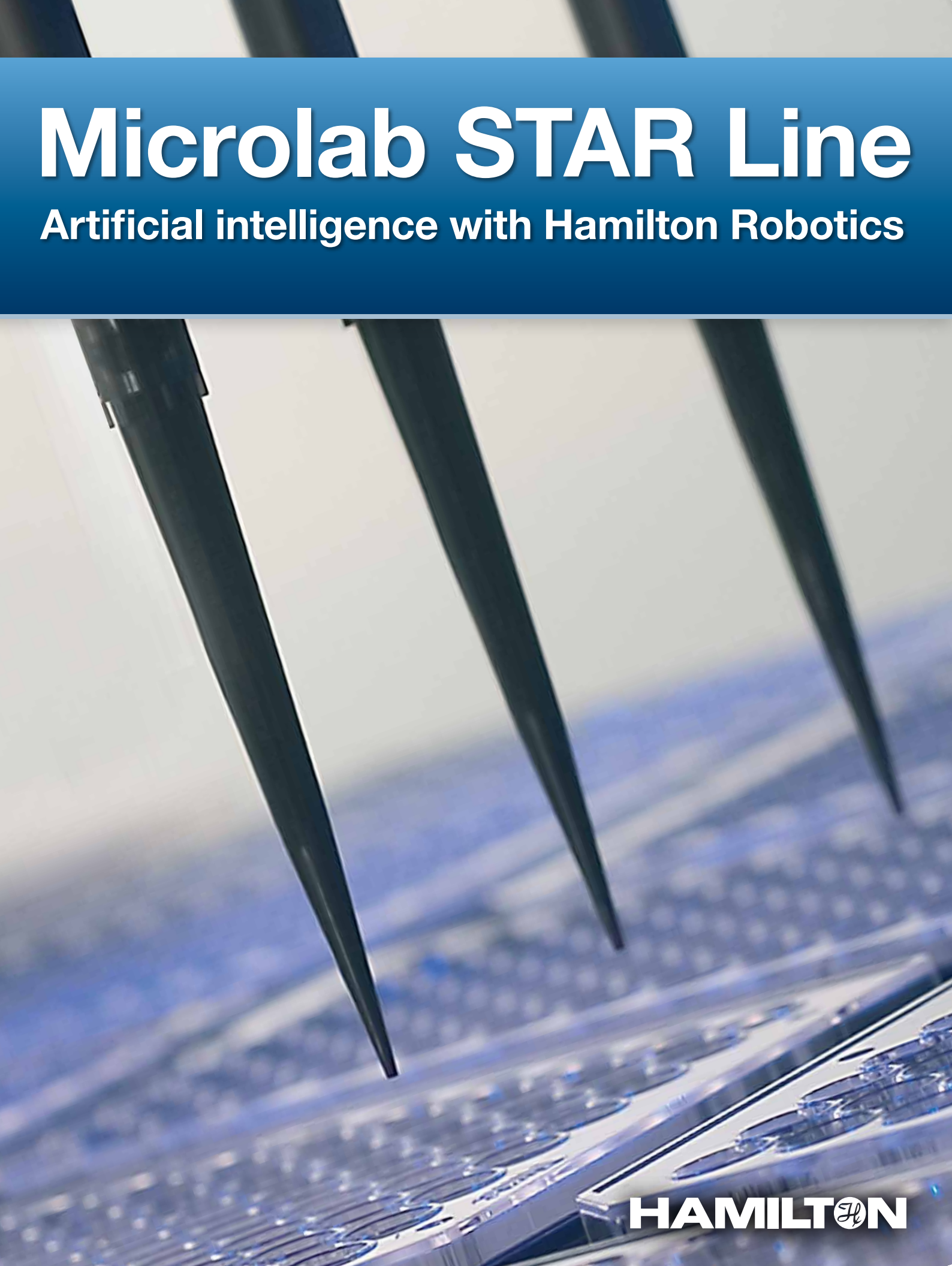
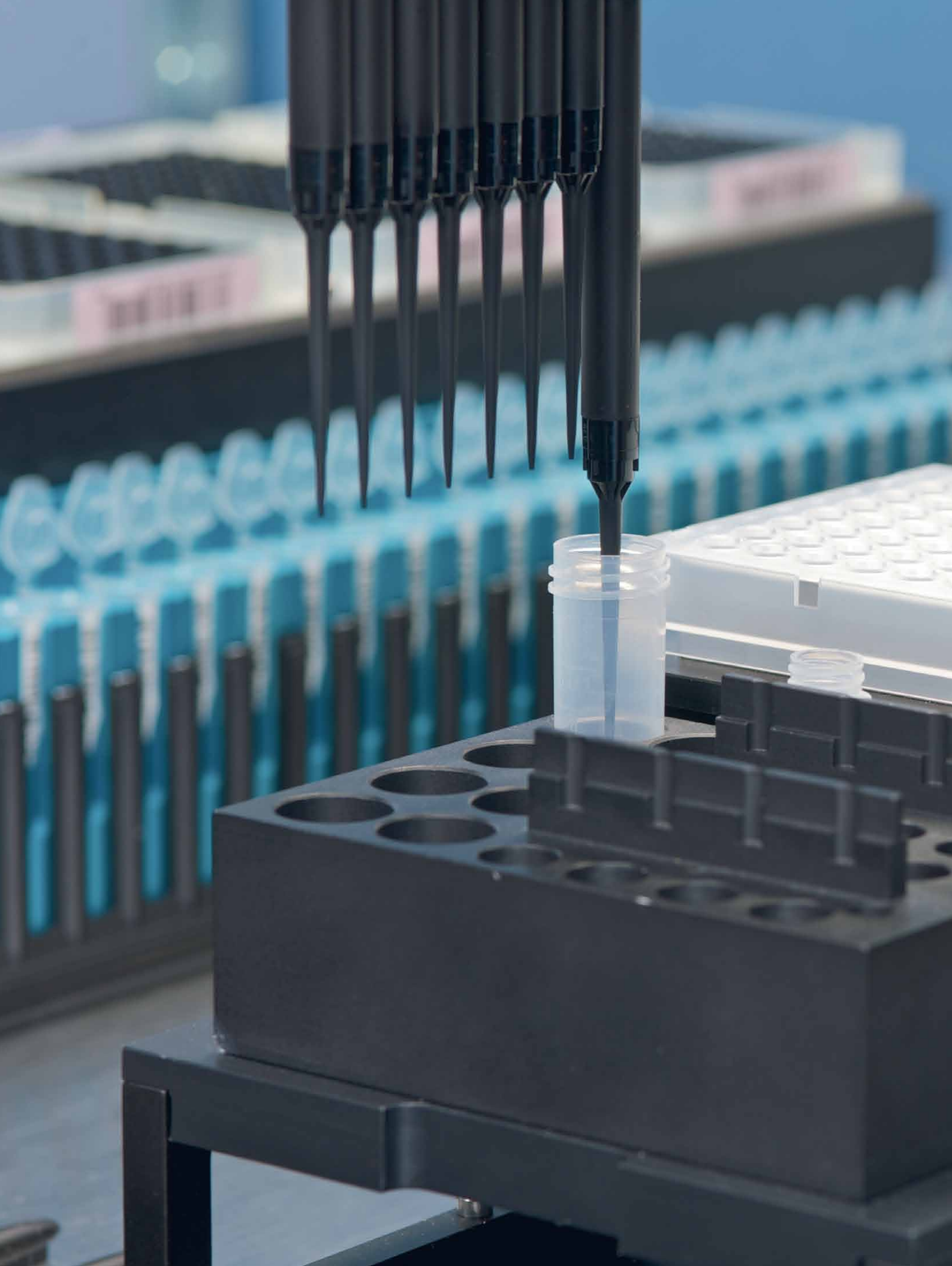
Microlab STAR Line

Artificial intelligence with Hamilton Robotics



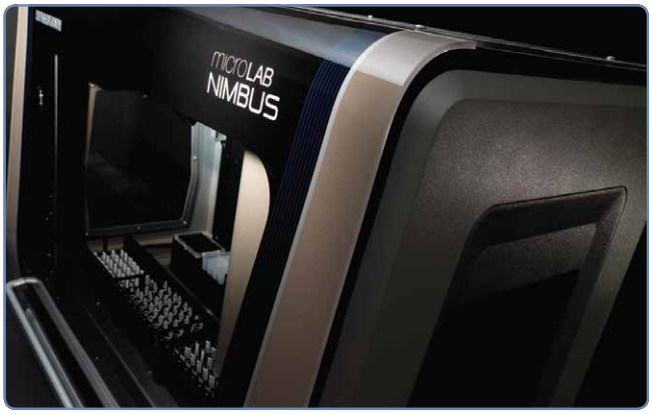


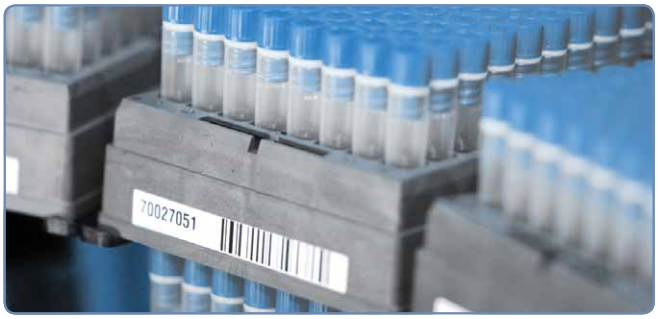
About Hamilton Company

Hamilton Company is a global enterprise with headquarters in Reno, Nevada; Franklin, Massachusetts; Bonaduz, Switzerland and subsidiary offices throughout the world.
We are an industry leader in the design and manufacture of liquid handling, process analytics, robotics and automated storage solutions. For more than 60 years, Hamilton has been satisfying customer needs by combining quality materials with skilled workmanship to ensure the highest level of performance.
Hamilton's lifelong commitment to precision and quality has earned us global ISO 9001 Certification.

Founded on the technology of analytical Microliter and Gastight syringes, Hamilton has a broad offering of laboratory products including manual and semi-automated precision fluid measuring instruments, chromatography products, process sensors, laboratory electrodes, pipettes and more. Top innovations from these lines include Arc pH, DO and Conductivity Intelligent Sensors, the BioLevitator 3D Cell Culture System, Microlab 600 Diluters/Dispensers and the Microlab 300 Guided Pipetting System.

A pioneer in liquid handling equipment and laboratory automation technology, Hamilton Robotics is known for advancing life science and biotechnology industries through reliability, performance and flexibility. Hamilton is the industry leader in design and manufacturing with patented technologies such as Compression-induced O-Ring Expansion (CO-RE), Total Aspiration and Dispensing Monitoring (TADM) and Anti-Droplet Control (ADC). Hamilton's platforms include Hamilton VANTAGE, its newest vertically-integrated liquid handler, Microlab STAR, Hamilton's highest selling automated pipetting platform, and Microlab NIMBUS, the first in its class of compact, high-speed, personalized pipetting workstations.





Hamilton Storage Technologies offers comprehensive ultra-low temperature automated sample management systems for microtube and microplate storage.
Hamilton's line of biobanking and compound storage solutions, as well as consumables, are designed for a broad array of life science processes.
Products include BiOS, SAM and ASM, designed for sample integrity, flexibility and reliability.

Hamilton Company is focused on blending invention and accuracy to deliver customers unparalleled products.

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Technology

Innovations for highest process reliability.

Air displacement pipetting

The STAR Line uses air displacement technology, which is analogous to a hand held pipette.

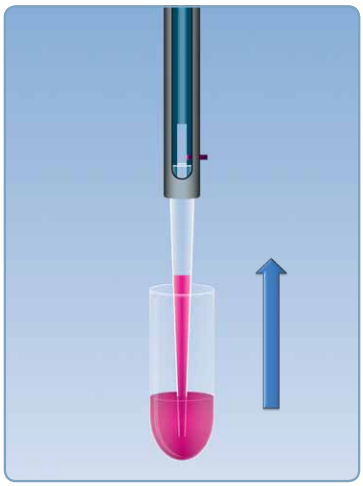


Figure 1: Aspiration from a sample tube

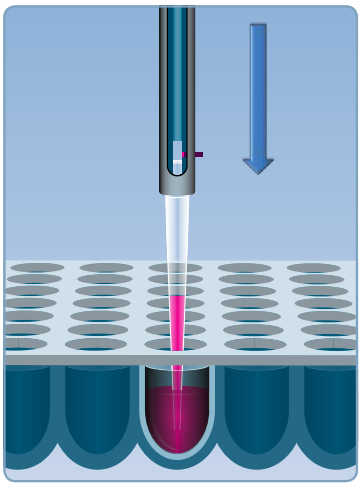


Figure 2: Dispense into a 96-well plate

Technology benefits:

- Automated intelligence with Hamilton's air based advanced pipetting features
- Reduced risk of contamination for critical assays thanks to the combination with disposable tips
- Less maintenance required due to no system liquid, valves or tubing
- No dilution effects of samples with system fluid

Technological innovations implemented on the STAR Line include individual positioning of pipetting channels, precise tip attachment, unrivalled liquid level detection, a wide volume range and quality pipetting.
Thus the STAR Line meets the strictest requirements regarding positional accuracy, precision and flexibility.
With MAD, TADM, ADC, DLC and CO-RE (explained in the following pages), you can be assured that your application will be automated with the best process security, reliability and throughput available.

Monitored Air Displacement: MAD

With MAD your STAR Line pipetting robot gives you a feedback on the real-time tracking of the aspiration performance. Therefore MAD delivers a confirmation of the successful aspiration.
Monitored Air Displacement eliminates uncertainty in automated assays by providing reliable, consistent walk-away automation.

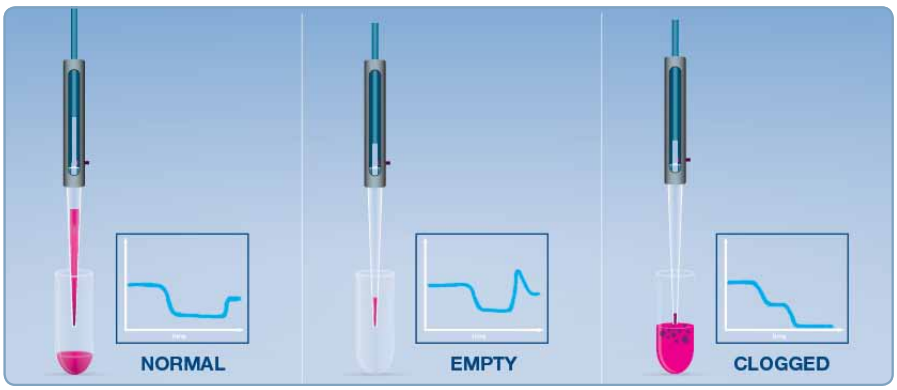


Figure 3: MAD monitors the aspiration pressure curves

Total Aspiration and Dispense Monitoring: TADM

During crucial sample transfers, such as in “in vitro diagnostic” (IVD) laboratories, parameters may be set up by the operator to monitor in real time the aspiration and dispensing steps. TADM verifies the sample transfer with a traceable digital audit trail.

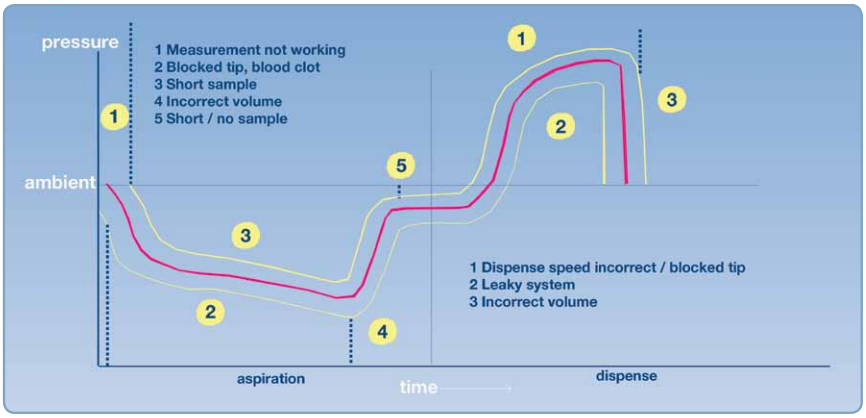


Figure 4: TADM bands and possible pipetting cases

Liquid Level Detection: pLLD and cLLD

Hamilton’s single pipetting channels (1000µl and 5ml) offer two modes of Liquid Level Detection (LLD): capacitance- and pressure-based. The capacitive LLD (cLLD) detects conductive liquids. The pressure-based LLD (pLLD) detects all liquids including non-conductive solvents. If required for the application, capacitance and pressure based LLD may be combined as Dual LLD (e.g. foamy samples). Multiprobe heads (96, 384) allow cLLD in reagent troughs by using capacitance Liquid Level Detection, eliminating the need to program specific pipetting heights.

Anti-Droplet Control: ADC

In general, pipetting of highly volatile organic solvents is nearly impossible on an automated system.
With Hamilton’s ADC there is a solution. The intended use is a secure and drop-free pipetting of these highly volatile solvents. ADC detects and reacts on pressure changes in the channels that are caused by the high vapor pressure of volatile solvents in real time. This feature is available with single pipetting channels.

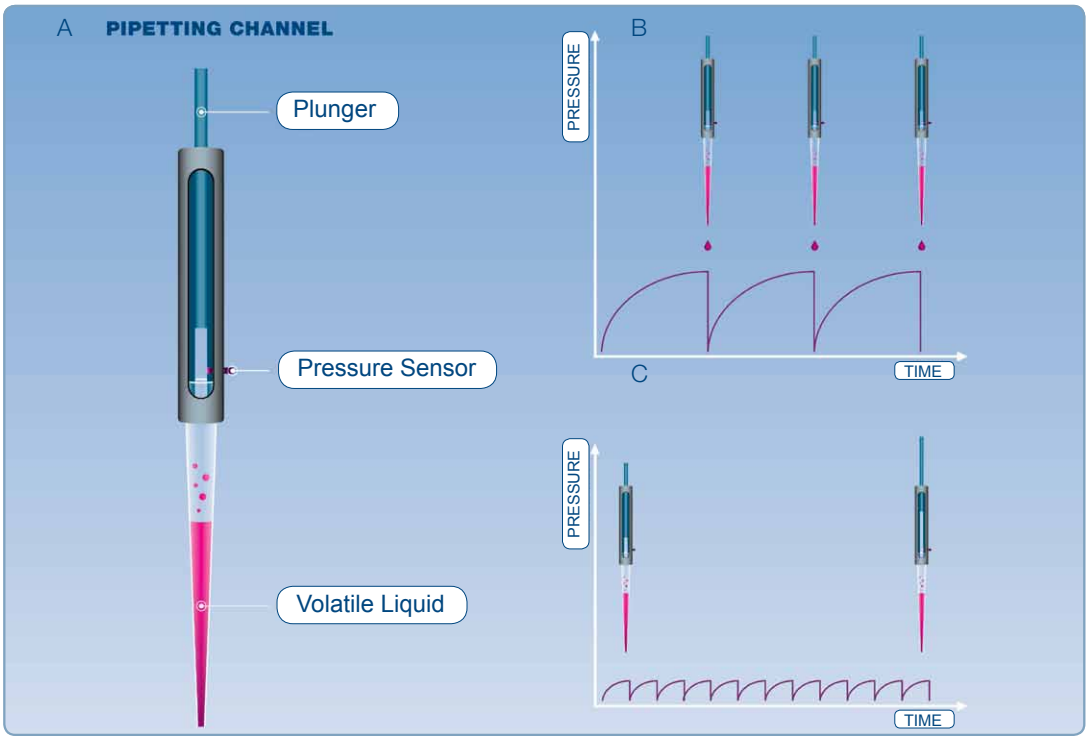


Figure 5: Pipetting with ADC

A) Schematic sketch showing a pipetting channel with its pressure sensor. The volatile liquid contained in the tip evaporates into the air space.

B) Pipetting without ADC, as the pressure in the tip increases, a droplet forms at the end of the tip, reducing the pressure in the tip when it falls off.

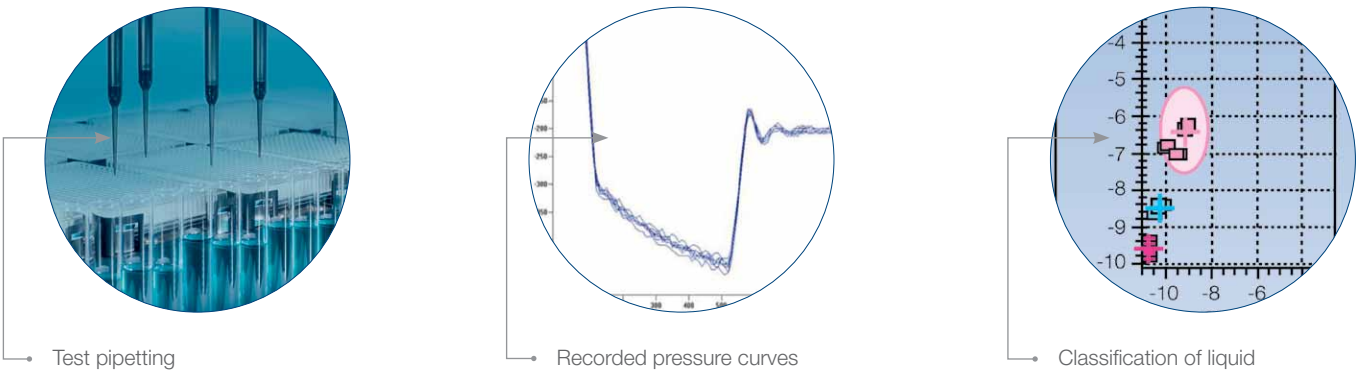
C) Pipetting with ADC, pressure differences are detected by the pressure sensor and will be compensated in real time by plunger movements: droplet formation is prevented.

Dynamic Liquid Classification: DLC

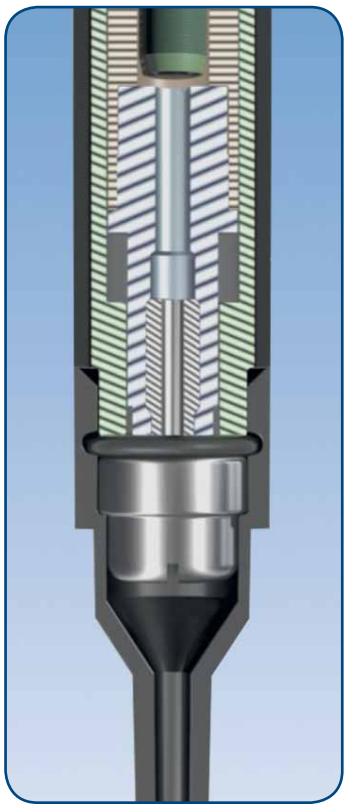
Dynamic liquid classification is a tool to enable your Microlab STAR Line instrument to classify liquids by comparing pipetting pressure curves generated during a test pipetting with a data base.

Based on this classification, it allows the system to make dynamic decisions during the run of the method.

The decision can be reached from dynamic selection of the right pipetting parameters for pipetting to individual downstream treatments of different liquids based on their classification.



- Increases reliability and reduces variability: Enables adaptation of pipetting parameters according to liquid used.
- Increases throughput: Allows reliable and reproduceable automated handling of unknown liquids.
- Enables new functionalities: Screening of liquids according to pipetting parameters is possible.



CO-RE technology

Many of today's applications require precision in tip attachment and positioning. To ensure such precision, Hamilton uses quality engineered components and the CO-RE tip attachment technology.

The CO-RE system attaches disposable tips or steel needles to the pipetting channels with a stable lock-and-key fit.

The system requires no vertical force for tip attachment or tip ejection, thus eliminating mechanical stress and improving the overall system reliability along with pipetting speed, positional accuracy and dexterity.

- **Great flexibility with Hamilton's CO-RE technology**
- **Use disposable tips and washable needles within the same run**
- **Pick up different on-deck labware transportation tools with pipetting channels**
- **Eliminate aerosol production utilizing super-soft tip ejection**

Figure 6: Cross section of a pipetting head with disposable tip attached

Configure your pipetting platform

Deck space and instrument dimensions

	STARlet	STAR	STARplus
			
Width	1124 mm	1664 mm	2160 mm
Heigh	903 mm	903 mm	903 mm
Depth Manual load	795 mm	795 mm	795 mm
Depth Autoload	*1006 mm*	*1006 mm*	*1006 mm*
Deck Area	675 x 145 x 497 mm	1215 x 145 x 497 mm	675-1215 x 145 x 497 mm
Tracks	30	54	30 up to 71 *
Plates **	25	45	25 up to 55+

** Depending on deck configuration.*
*** Plate dimensions according to SBS (Society for Biomolecular Sciences), not stacked. Plates may also be stacked up to 10 high, increasing the deck capacity.*

Pipetting channels and multiprobe heads

For your configuration you can select from different options:

- Up to 16 independent 1000µl pipetting channels
- Up to 8 independent 5ml pipetting channels
- CO-RE 96 Probe Head 1000µl (with or w/o TADM)
- CO-RE 384 Probe Head 50µl

Additional tools

In addition to pipetting channels and/or multiprobe heads, you can select from these tools:

- Platehandler iSWAP and CO-RE Gripper
- Tubehandler
- DeCapper
- Imaging system (camera channel)

Pipetting volume range

Head	Volume range	Tip sizes *
1000µl channels	0.5µl-1000µl	10µl, 50µl, 300µl & 1000µl
5ml channels	50µl-5000µl	4000µl, 5000µl
CO-RE 96 Probe Head (with or w/o TADM)	1µl-1000µl	10µl, 50µl, 300µl & 1000µl
CO-RE 384 Probe Head	0.1µl-50µl	50µl
CO-RE 384 Probe Head using Rocket tips**	2µl-300µl	300µl

** Please obtain detailed information from our consumables catalogue*
*** Rocket tips turn the 384-well format into a 96-well format by forming one out of four channels*

Depending on the complexity of the labware handling involved in the application, you can select the tools that can be picked up with the regular pipetting channels:

- CO-RE Gripper can be picked up by two single channels during a run. With this tool the channels can transfer plates on the deck – without the need for a robotic hand. Available with 1000µl and 5ml channels.
- CO-RE Lid suction tool to transport lids (e.g., petri dishes)

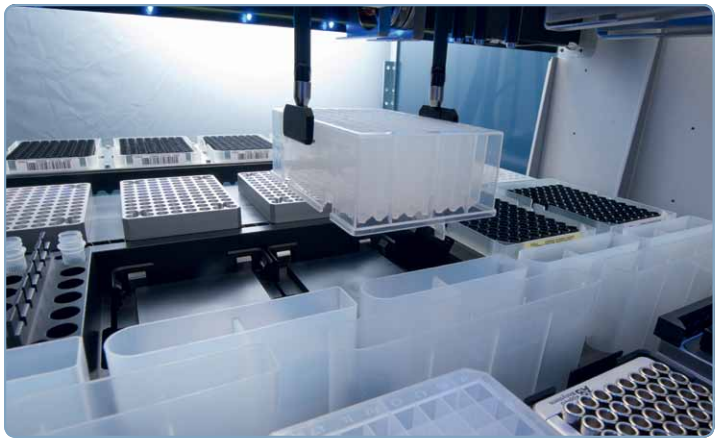


Figure 7: CO-RE Gripper: on-deck transport of a deep-well plate

Modularity and scalability

Invest in a safe future: due to the modular design, changes and upgrades to existing configurations are easy with STAR Line instruments. As your projects change, your STAR Line workstation can also evolve to meet new challenges. Most upgrades can be performed in your lab within 1-2 days to minimize the instrument's downtime. Would you like to get started in automation with a benchtop workstation, with the option to expand your system if needed?
The STARlet can be extended to a STARplus with an extension module, thereby more than doubling deck capacity.

The scalability of STAR Line instruments means that the widest possible range of throughputs and budgets can be accommodated: additional pipetting channels, a CO-RE 96, 384 Probe Head or an iSWAP can be fitted to existing configurations.

Upgrade your robot

Would you like to automate additional assays on your STAR Line system? Has your throughput changed, requiring additional pipetting tools? Or do you wish to start on a small scale and upgrade instrument size and accessories later on? In addition to the wide range of functional deck equipment such as the vacuum station, heaters, coolers and shakers, the STAR Line systems can be upgraded with:

Key Features:

- **Up to 16 x 1000µl channels**
- **Up to 8 x 5ml channels**
- **Multiprobe heads**
- **Labware handling tools**
- **Imaging channel**
- **Platform upgrade**
- ***... and much more ...***

Figure 8: STAR with 2 arms equipped with 8 x 1000µl, 2 x 5ml channels and iSWAP

Application engineering: APE

STAR Line instruments excel in automating multiple applications from biological to analytical sciences. Thousands of STAR Line workstations have been installed around the world to automate a wide range of applications. They offer the flexibility and modularity you need to create the perfect automated solution for your laboratory. For specific demands, the Hamilton application engineering group is available to design everything from custom racks to complex system integrations.

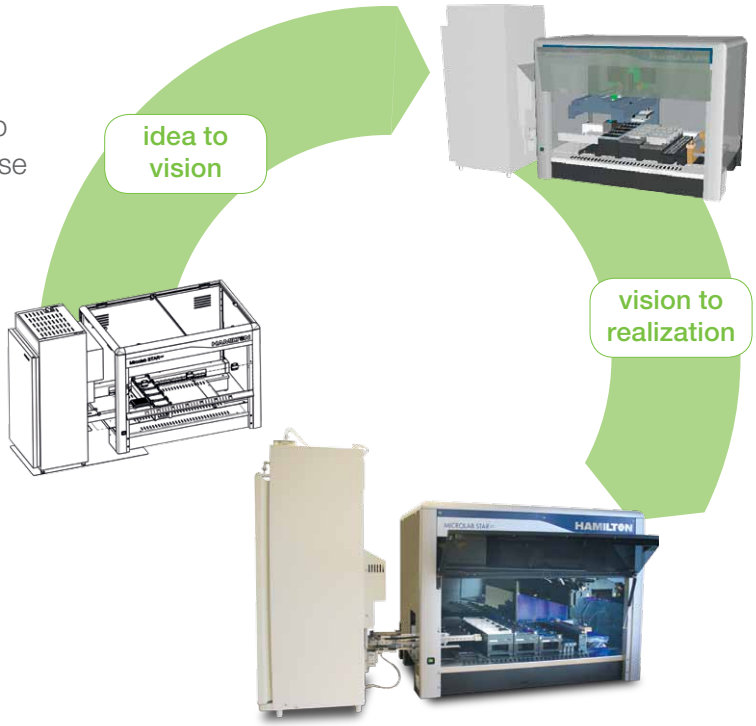
Figure 9: Microlab STAR with touch screen

System planning

Thanks to the unparalleled modularity of the STAR Line instruments, you can choose from more than 10,000 possible configurations that can be built from the standard components. Hamilton's application specialists come to your lab and work together with you on the best automation solution of your assay. You can rely on their expertise and experience to select from 3 different deck sizes, one or two arms, up to 16 individual channels and your choice of multiprobe heads to match your STAR Line system to your application requirements. The latest technology is used to configure and visualize your system, making sure that you get exactly what you need. Already at this stage, hardware and software concepts for your application are created. Typically, a draft specification is also prepared for the system. For larger systems (with 3rd party integration), this is done with assistance from the Hamilton application engineering (APE) group.

System setup

Once your system is specified and defined, the project enters the realization and implementation phase at one of our headquarters. A project leader from the APE group takes the lead to realize your project. This realization phase ends with the Factory Acceptance Test (FAT), which is conducted to validate the design of the system.
Once the system passes this test, it is shipped to your site, where the local team takes over the responsibility and supports you to get your system up and running by providing training and support. This phase ends with the Site Acceptance Test (SAT).



Integrated approach

This tightly connected process management between the production site in one of our headquarters, the local application specialist and the sales team ensures that you have a competent contact person at all times.
You can be sure that you get help with any questions that may arise during and after the realization phase of your project.

Tools

Expertise. Quality. Commitment.

Pipetting channels

Years of experience and development in liquid handling created a highly precise and robust tool: the 1000µl pipetting channel. This channel can pipette volumes as low as 0.5µl and as high as 1000µl.
Supported by different disposable tip sizes that are specifically shaped, highest pipetting accuracy and precision can be reached. Due to the possibility of unique asymmetric spreading random access* is provided and complex pipetting patterns are supported, thus enabling quicker pipetting.

	Disposable tip size	Pipetted volume	Trueness IRI (%)	Precision CV (%)
	10µl	0.5µl	10%	6%
	10µl	1µl	5%	4%
	10µl	5µl	2.5%	1.5%
	10µl	10µl	1.5%	1%
	50µl	0.5µl	10%	6%
	50µl	1µl	5%	4%
	50µl	5µl	2.5%	1.5%
	50µl	50µl	2%	0.75%
	300µl	10µl	5%	2%
	300µl	50µl	2%	0.75%
1	300µl	200µl	1%	0.75%
	1000µl	10µl	7.5%	3.5%
	1000µl	100µl	2%	0.75%
	1000µl	1000µl	1%	0.75%

Test criteria available upon request

Figure 10: 1000µl channels aspirating from sample tubes

Figure 11: 5ml channels aspirating with 5ml tips from sample tubes

The 5ml channel for higher volumes uses the same precise technology to pipette volumes from 50µl to 5ml. These high-volume pipetting channels also allow random access*.

Disposable tip size	Pipetted volume	Trueness IRI (%)	Precision CV (%)
5000µl	50µl	5%	2.5%
5000µl	500µl	2%	1.5%
5000µl	1000µl	1.5%	1%
5000µl	5000µl	1%	0.5%

Test criteria available upon request

*depending on configuration

Multiprobe heads

To speed up pipetting processes where highly parallel liquid handling is required, Hamilton has developed the CO-RE 96 Probe Head (1µl to 1000µl) with and without TADM feature and the CO-RE 384 Probe Head (0.1µl to 50µl). They can be added to all Microlab STAR Line instruments with multiprobe capability and combined with other tools on the flexible STAR platform.

Multiprobe heads support pipetting processes such as:

- plate replication:
  e.g. 96-well to 96-well, 384-well to 384-well
- reformatting of plates:
  e.g. 96-well to 384-well or vs.
- pipetting from/to single wells
  and row or column wise pipetting

In addition, the CO-RE 96 Probe Head with our TADM feature is intended for applications requiring real-time monitoring of pipetting processes.

By using Rocket tips and/or prestacked tipracks, the CO-RE 384 Probe Head turns into a 96 Probe Head.
Small-footprint wash stations for multiprobe heads are available for tip washing.

Figure 12: CO-RE 384 Probe Head

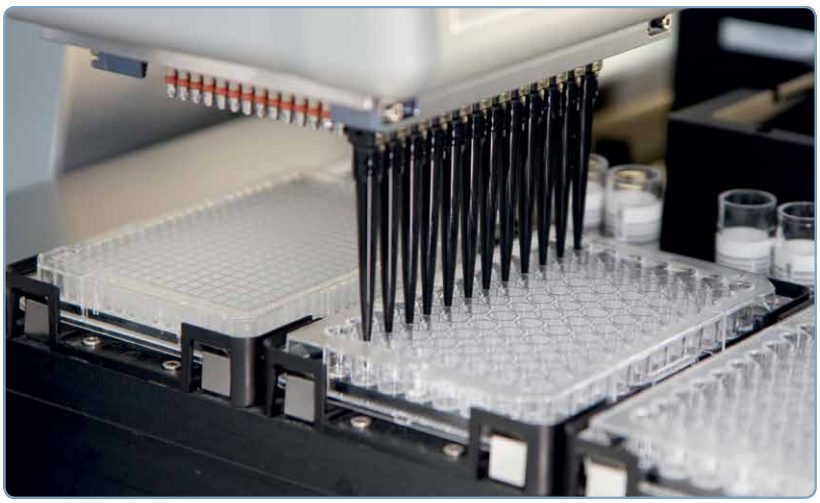


Figure 13: CO-RE 384 Probe Head with one row of Rocket tips

CO-RE 96 Probe Head w+w/o TADM:

Disposable tip size	Pipetted volume	Trueness IRI (%)	Precision CV (%)
10µl	1µl	5%	5%
10µl	5µl	2.5%	2%
10µl	10µl	1.5%	1.5%
50µl	1µl	5%	5%
50µl	5µl	2.5%	2%
50µl	50µl	1.5%	1%
300µl	10µl	3%	2%
300µl	50µl	1.5%	1%
2 300µl	300µl	1%	1%
1000µl	10µl	7.5%	3.5%
1000µl	100µl	2%	1%
1000µl	1000µl	1%	1%

Test criteria available upon request

CO-RE 384 Probe Head:

Disposable tip size	Pipetted volume	Precision CV (%)
50µl	0.1µl	8%
50µl	0.5µl	6%
50µl	1µl	3.5%
50µl	5µl	3%
50µl	10µl	2%
50µl	50µl	2%
Rocket tips		
300µl	2µl	4%
300µl	5µl	2%
300µl	10µl	2%
300µl	100µl	2%
300µl	300µl	2%

Test criteria available upon request

Labware transportation tools

By using two pipetting channels in parallel, the Microlab STAR Line instruments can transport plates or tip racks on deck with the CO-RE Gripper. 1000µl as well as 5ml channels can be used for this task. A selection of gripper braces enables transport of labware with a square footprint. For custom labware the Hamilton APE (Application Engineering group) designs and manufactures customized gripper braces. The gripper braces' parking position is at the waste station of your STAR Line instrument (can vary with integration of third-party devices), and thus does not occupy any deck space. Another convenient labware handling tool is the unique CO-RE Lid Tool that carries a little suction cup. This tool uses the CO-RE technology in combination with the air displacement technology for transportation. Therefore holds on to any kind of lid with a glossy surface (e.g., petri dish lids).
Typical handling tasks like loading/unloading of plates outside the instrument becomes very simple with the iSWAP, a robotic arm that transports plates on the instrument deck available as an additional tool.

Figure 14: CO-RE Lid Tool

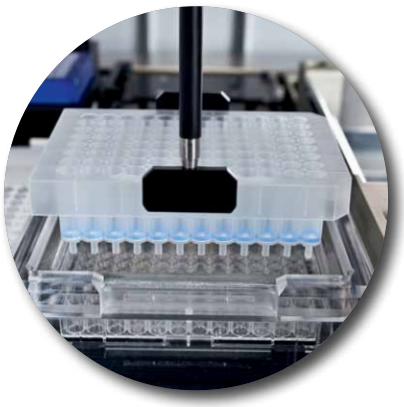


Figure 15: CO-RE Gripper 1000µl

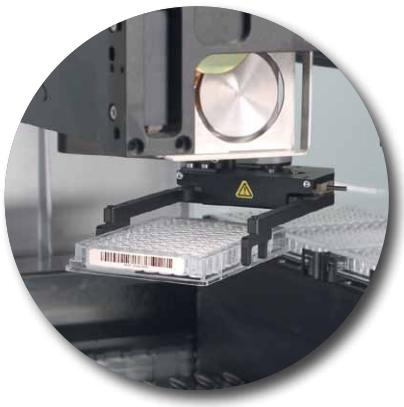


Figure 16: iSWAP

Identify your labware

▶ Automated labware identification: The Autoload function consists of an automatic loading option for the labware located on carriers and a 1D barcode reader. The Autoload moves to the loading position and reads 1D barcodes from sample tubes, microplates and carriers while being automatically loaded into the system. It verifies correct labware positions for greater method security.

Figure 17: Autoload 1D barcode reading of sample tubes while loading the STAR deck

▶ Automated tube decoding: The easyCode carrier saves space on deck with a small footprint and is easy to integrate onto the STAR Line deck. With a high performance industrial camera and superior decoding software, tube codes are identified in a very short time. Furthermore the easyCode Carrier PLUS also offers in addition reading of the rack code. The easyCode Carrier as well as the easyCode Carrier PLUS set the new standard in terms of speed and reliability.

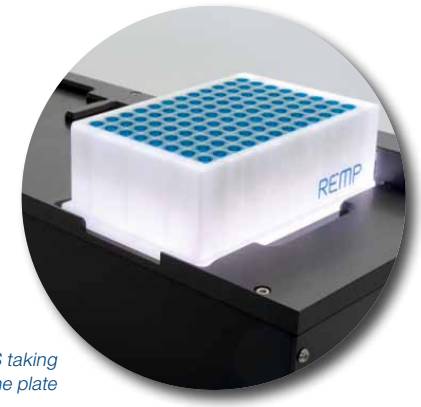


Figure 18: easyCode carrier PLUS taking picture of the bottom 2D barcodes of the plate

Imaging and analysis

Hamilton's advanced imaging technology is based on a channel that carries a high-resolution industrial camera that can be moved over the whole deck area.
The camera takes pictures, analyzed by software. Our analyzing methods are facilitated by machine-vision algorithms from the industry providing the highest standard in technology. Several applications benefit from this advanced and robust imaging technology.

Figure 19: Camera channel

Check the status of your sample

▶ easySolveCheck: Smart and very efficient solubility check which is done directly in the storage tubes. A clever and simple optical test that detects particles and turbidity and leads to astonishing results.
▶ easyColour: The software provides an easy-to-use, intuitive interface and is used to detect any color change in your assays or cell culture. It processes pictures taken by the camera channel or the imaging carrier.

Figure 20: Colony picking - petri dish placed on a light table for contrast

Locate your sample

▶ easyPick: Our image analysis of a bacterial culture plate allows precise measurement of the colony positions and turns every Hamilton STAR into a powerful and reliable colony picker. In the proprietary easyPick software, the user defines parameters and determines the weighting for the typical criteria to identify colonies.

▶ easyBlood: Fully automated fraction separation of a centrifuged blood sample. With its reliable and accurate fraction detection and pipetting, it provides the perfect tool to isolate the DNA-rich buffy coat, which is an especially labor-intensive and tedious task for most operators.

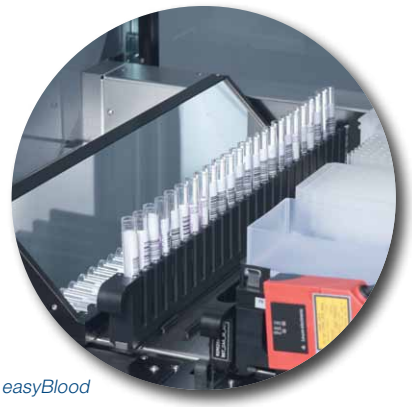


Figure 21: easyBlood

▶ easyPunch: Card imaging and analysis enable robust and specific FTA card handling and punching. An image of the card is taken by an internal camera. The image is used to identify the card by its barcode and to determine the exact position of the sampling area and the sample spot. This technique allows for exact calculation of the optimal punching position. The application provides online monitoring and reporting of the punch delivery to the destination well.

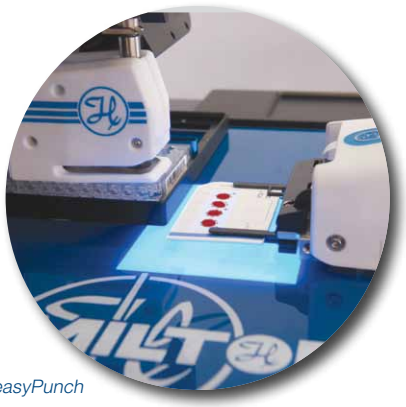


Figure 22: easyPunch

Accessories

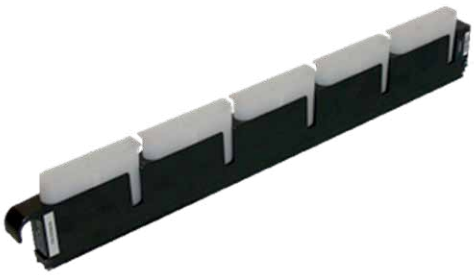
Unlimited flexibility

Carrier concept

For flexible placing of your labware Hamilton has developed carriers for the STAR Line instruments.
These carriers hold your labware in place on the deck.
The carriers can be loaded manually or automatically.
These are examples of the carriers that we offer; there are more carriers available.

- **Unlimited flexibility**
- **Easy loading**
- **Free choice of desired labware**
- **Quick and simple customization to high end customization**
- **High process safety**

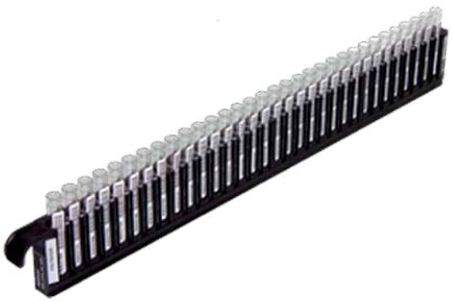
Carrier for plates



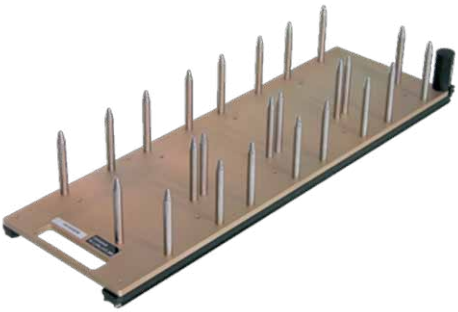
Reagent carrier

Carrier for 24 tubes

Carrier for Nestable Tip Racks



Carrier for 32 tubes



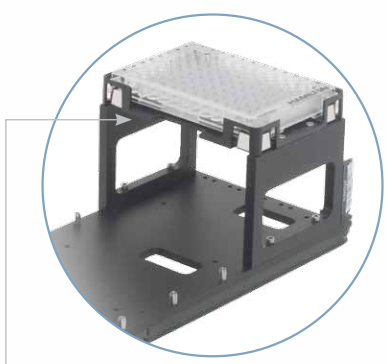
Stacker carrier

Tip carrier

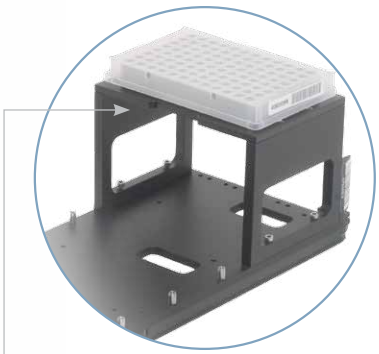
Multiflex concept

If not all positions of one carrier are needed for the same type of labware, Multiflex carriers can host multiple kinds of labware. Select from a broad range of Multiflex modules to configure your desired carrier and deck layout.
A base carrier plate enables flexible placing of these modules for all common labware: Microtiter plates, deep-well plates, 96-or 384-well PCR plates, plate-, petri dish- or tip-stackers, tube holders, reagent troughs, tilt modules, heating and cooling modules and many more options.
The layout of Multiflex carriers can be changed according to your needs.

- From shakers to heating or cooling modules, tube or plate modules, Multiflex carriers can be designed to exactly fit the application.
- For specific customization that cannot be covered with the Multiflex carriers, Hamilton's APE (application engineering) group creates the right solution to turn your vision of an automated application to reality.



Microtiter plate module



96-well PCR plate module

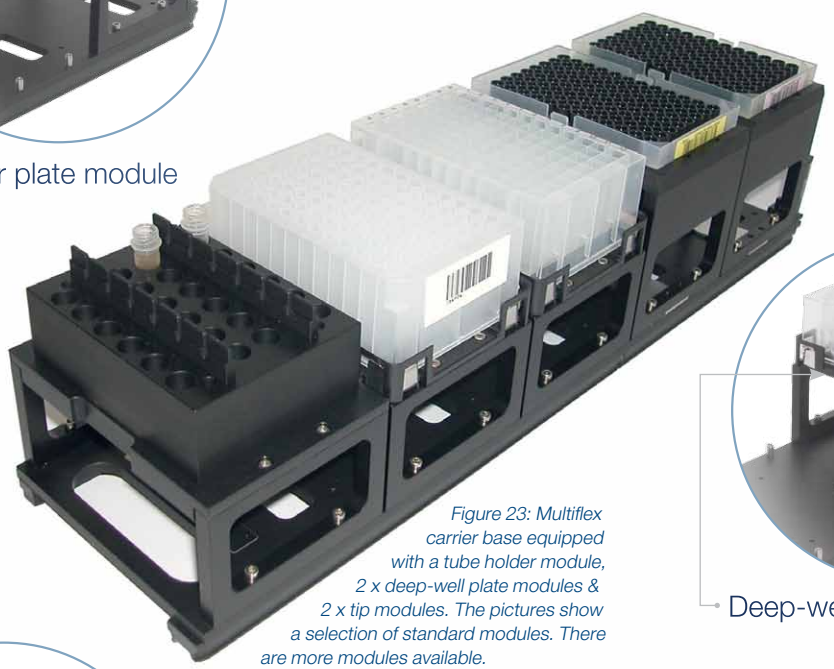
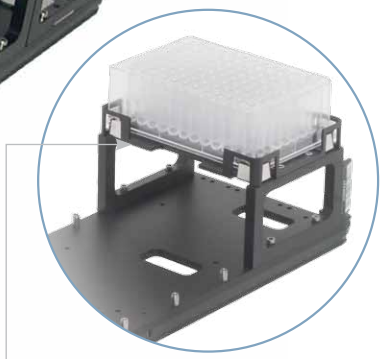
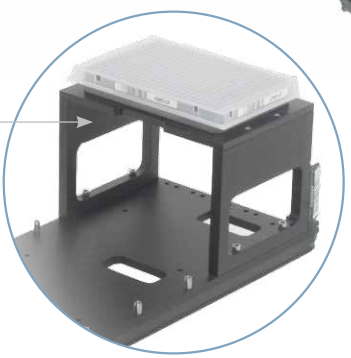


Figure 23: Multiflex carrier base equipped with a tube holder module, 2 x deep-well plate modules & 2 x tip modules. The pictures show a selection of standard modules. There are more modules available.



Deep-well plate module



384-well PCR plate module

Tube holder module

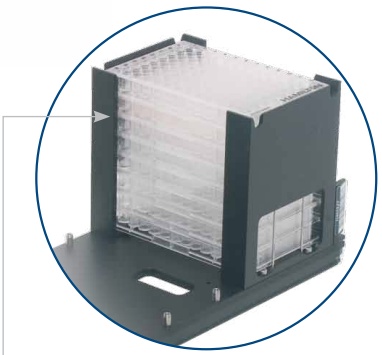


Plate stacker module

On Deck Thermal Cycler (ODTC)

The ODTC is for “on deck” integration, a superior quality product from INHECO adapted for the Hamilton liquid handling instrument line. Any molecular biological workflow that needs repeated heating or cooling steps can be realized.

Figure 24: The On Deck Thermal Cycler is SiLA compliant

- Easy integration without any deck modification
- Ideal for genomics workflows like PCR & NGS
- Up to 2x ODTC per carrier
- Up to 4 ODTC per instrument
- Runtime < 40 min for 40 cycles

The Hamilton Heater Shaker

The Hamilton Heater Shaker (HHS) is specifically designed for integration into the Microlab STAR. It allows heating and shaking of a large variety of SBS plates, from microtiter to deep well plates, as well as tubes.

Figure 25: Hamilton Heater Shaker with universal flat bottom adapter

- Orbit: 1.5, 2.0 & 3.0 mm
- Adapter: Standard and Customized
- Temperature: 5ºC above ambient up to 105ºC
- Shaking up to 2500rpm
- 2 sided plate lock

Vacuum system

The Crystal Vacuum System (CVS) allows automation of vacuum based kits for SPE, LC-MS, genomics and proteomics. The CVS consists of a 7-track-wide carrier base equipped with a vaccum chamber and its manifold top, the park position for the manifold top and two microtiter plate positions or one microtitier plate position and one Hamilton Heater Shaker.

- The manifold top can be handled either by the iSWAP or by the CO-RE Gripper
- Easy integration
- Available for all kits with SBS format
- Intelligent vacuum technology

The CVS accommodates a wide variety of 96-well and 384-well filter plates. With the height adjustable inserts inside the vacuum chamber, almost any kind of plates can be used for the elution.

The CVS carrier is mounted on the instrument deck. It is possible to place up to four CVS carriers on one instrument.

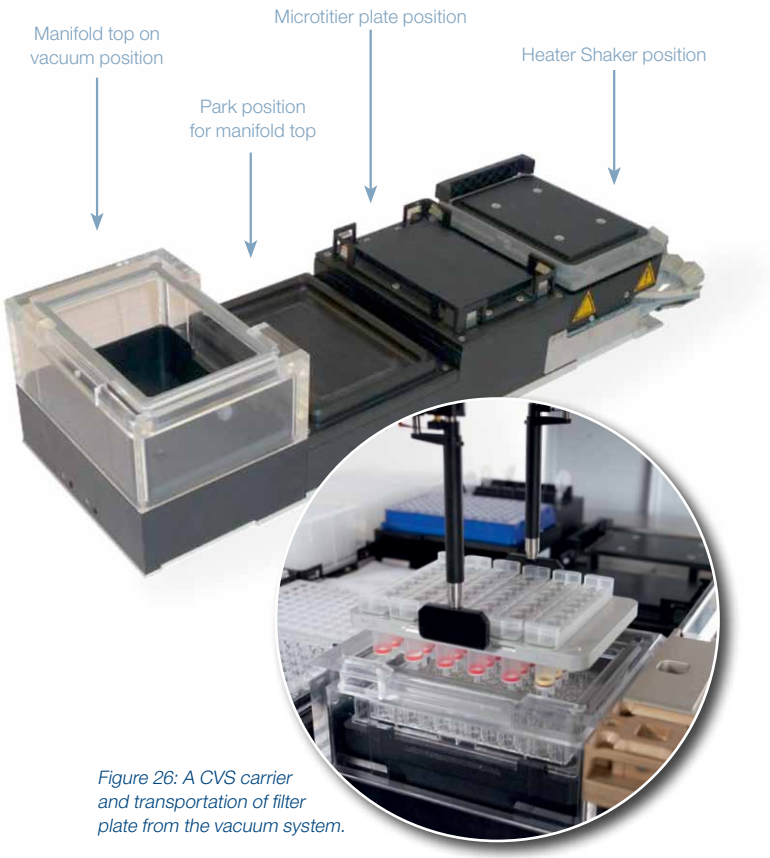


Figure 26: A CVS carrier and transportation of filter plate from the vacuum system.

Needles and washing

The Hamilton CO-RE system not only allows picking up of disposable tips, but also washable steel needles with 1000µl channels. The needle wash station for 1000µl channels instruments is designed for parallel washing.

Software

Powerful software for a powerful workstation

VENUS software

The system's flexible hardware is reflected by the VENUS software, which provides several programming levels to efficiently define your applications. VENUS offers simple to complex programming, without limiting your imagination or compromising your requirements. Additional software packages, such as the Dynamic Scheduler (for optimized resource use), the TADM feature (for full traceability of the pipetting workflow), the DataBasePlus option (to use remote tracking servers) and the Dynamic Liquid Classification plugin (for automatic liquid class selection), make VENUS even more powerful.

Intuitive method creation

VENUS's intuitive editors give you full control in every aspect of your method. It comes with standard definitions for simple method creation and offers custom definitions for ultimate flexibility. Customize your labware, dynamic pipetting patterns, individual volumes, error handling options, data handling, walk-away routines and many more. For example, almost every programming step offers an individual treatment of every possible error case, in which automatic, semi-automatic or manual recovery is selectable. It is an intuitive user interface to control the Microlab STAR Line and any third-party component that allows remote access. While programming, the intuitive and modular concept reduces programming time and lets you achieve results faster with less training. At runtime, intelligent dialogs (created with the Customized Dialog step) reduce error-prone user inputs and provide clear visualization of method parameters.

Operate everything from one control center

Today's automation solutions often require demanding integration of third-party equipment. Hamilton has responded to these needs with seamless integration through library drivers. Remote controllable third-party components can be integrated into VENUS at any time, making your system integration friendly, flexible and future-proof. Thanks to the open design, VENUS software can control most third-party hardware. This concept allows you to benefit from Hamilton's outstanding error-handling concept, which provides multi-level error recoveries even for non-Hamilton components. This intelligent setup guarantees worry-free operation in which all resources work seamlessly in one, integrated system.

Figure 27: VENUS step icons can be simply dragged and dropped to create your assay skeleton within minutes

Figure 28: VENUS Graphical Editor.

Figure 29: Hamilton VENUS's 3D view of a STAR deck layout.

- **Action Editor**: the Action Editor is the fast way to create a method skeleton. It holds all possible actions (loading, pipetting, transportation, incubation, etc.) in a toolbox for simple drag-and-drop programming. The Action Editor allows quick throughput calculations and is the base for further customization.
- **Drag & Drop**: this innovative module allows you to execute the most common lab routines (copy plates, add buffer, serial dilution, etc.) with least possible user interaction: a wizard guides you through a few dialogs (e.g., to enter number of plates, volume or liquid type) and guides you through deck loading. You no longer have to care about labware names or deck layout creation – it is all done automatically.
- **Step templates**: step templates offer a skeleton of commonly used assay steps such as serial dilution, vacuum steps, stacked tip handling, etc. Simply drag the template into your method and adapt it to your needs: change the pipetting volume, specify source and target plates on the 3D deck and run the method.

Application software engineering: ASW

The Application software group (ASW) at headquarters and local specialists prepare re-usable software modules to integrate third-party components, customize graphical user interfaces, handle database accesses and much more. These modules and methods were tested on the original hardware in the relative environment and only released after meeting Hamilton's strict quality standards.

21 CFR Part 11 regulatory tools

meets the regulatory requirements specified in 21 CFR Part 11, including controlled system access, human readable and printable files, electronic record creation, protection and maintenance as well as documentation and training requirements.

Consumables

Tailor-made consumables for automation

PerfectTouch tip attachment technology

Hamilton uses the PerfectTouch system with revolutionary CO-RE technology to softly pick up and eject original Hamilton disposable tips with pipetting channels and multiprobe heads.
The CO-RE PerfectTouch system attaches disposable tips to the pipetting channels with a unique stable lock-and-key fit. The system requires no vertical force for tip attachment or tip ejection, thus eliminating mechanical stress and improving the overall system reliability along with pipetting speed, positional accuracy and dexterity.

The PerfectTouch Tip technology provides unrivalled benefits in an automated workflow:

- **Improved system reliability**
- **Minimizes the risk of cross-contamination**
- **Increase the pipetting performance**
- **Ensure reproducible results**

Tip production

Hamilton CO-RE tips are produced in an ISO Class 8 Clean Room, based on ISO 14644 standards. Each tip is checked for concentricity of its orifice and absence of flash from the molding process. You can be assured that Hamilton is shipping 100% performing products for accurate pipetting with each tip.

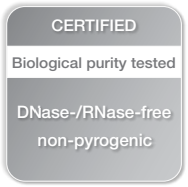
Tip precision and reliability

Hamilton tips are designed for optimal liquid handling with single pipetting channels and multiprobe heads. Tip geometry is adapted to a wide range of applications for better access in a variety of tubes and plates.
Each dimension of the tip has been analyzed and optimized using numerical grid simulations and empirical testing to produce accurate and repeatable results in the widest range of pipetting modes.
Hamilton's CO-RE tips have been invented to work in perfect combination with our revolutionary CO-RE technology. The special CO-RE tip cone ensures a seamless fit with our automated systems and aerosol-free tip ejection on all workstations.

Purity concept

The superior biological purity of the CO-RE tips, tubes and reagent containers is guaranteed by a controlled production process. Skilled personnel and automated clean room production enable contamination-free manufacturing. At regular intervals, the production batch is forwarded to a highly sensitive PCR method to secure compliance with the defined purity criteria:

- DNase-/RNase-free
- Pyrogen-free (endotoxin-free)
- PCR inhibitor-free

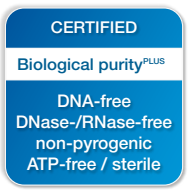


Especially for forensic applications, Hamilton has introduced a new purity grade to eliminate the residual risk of contamination of already clean products. Just one contamination from extraneous DNA on disposable products used at a crime scene or forensic laboratory, could result in incorrect DNA profiles, which can make evidence worthless.

Along with the strictest purity requirements during the production process, an additional treatment step of manufactured and packed disposables is performed. This treatment ensures the effective removal of contaminants by physically destroying any DNA molecule. In accordance with Forensic Science International (FSI) Hamilton has validated the treatment process to prove the effectiveness of eliminating amplifiable DNA.

All products awarded with the **Biological purity^{PLUS}** meet the following requirements, like the unique AutoLys tubes (see box below):

- Human-DNA-free
- DNase-/RNase-free
- PCR inhibitor-free
- Pyrogen-free (endotoxin-free)
- ATP-free
- Sterile, according to ISO 11135



AutoLys tube: revolutionary automated lysis system

Hamilton's **AutoLys tube** is a novel, automation friendly consumable designed explicitly for forensic DNA sample lysis and extraction on the AutoLys STAR.

Secure, easy & fast workflow

Lysis process: incubation and shacking

Lift & Lock: lift up inner tube in locking position

Lysate is filtered by centrifugaiton

Clear lysate is ready for DNA purification

The AutoLys tube is also available in a **manual version** with special cap for convenient lift and lock procedure by hand, and AutoLys Starter Kit for lysis steps and preparation of clear lysates.

Dedicated tips and consumables

Supporting our advanced pipetting technology, we have an ongoing development of functional tips & other consumables:

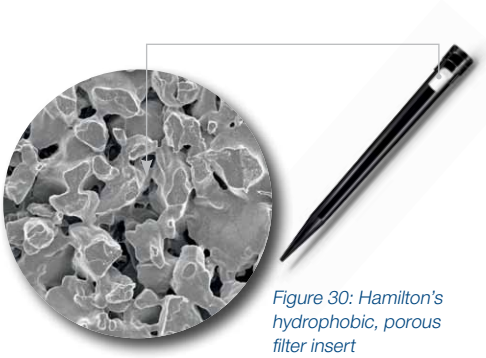


Figure 30: Hamilton's hydrophobic, porous filter insert

- Prevention against carry-over by using a porous protection barrier in tips: especially when working with infectious samples, Hamilton filter tips safely prevent from aerosols entering the pipetting channels.
- Enlarged process safety with cLLD: due to the **graphite inclusion** in the black CO-RE tips, capacitance Liquid Level Detection can be performed when pipetting conductive liquids.

- Increased tip capacity on the workstation deck for longer walk-away times: Hamilton's **Nested Tip Rack (NTR)** reload system with stackable tip racks. This system is available with black and clear CO-RE tips for 10, 50 or 300µl for single pipetting channels and multiprobe heads.

Figure 31: Hamilton reload system with stacked and nested tips NTR

Figure 32: Unique Rocket tip - 4 in 1 tip for the CO-RE 384 Probe Head

- Flexible format changes with the CO-RE 384 Probe Head: Hamilton's unique **Rocket tips** enable easy format changes from 384 to 96 wells. These specific tips combine 4 channels into one. An additional option for quick format change is the pre-stacked NTR system with 96 tips in a 384 SBS rack.

- Slim tips mimize risk of liquid overflow in cluster tubes, deep-well blocks and two phased liquid applications: Hamilton **Slim tips** are recommended for aspirating liquid in "fixed height mode" down to the base of thin tubes.

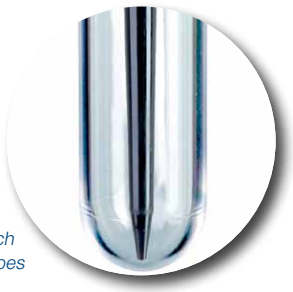


Figure 33: Slim tips can reach down to the very bottom of tall tubes

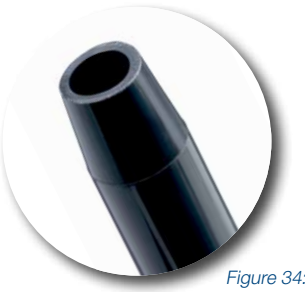


Figure 34: Wide Bore tip

- Optimized pipetting of high viscosity liquids or liquids with unsolved particles: Hamilton **Wide bore tips** enable easy handling of genomic DNA, fragile cell lines or blood fractions.

- Hamilton **Piercing tips,** with carbon fiber reinforcement, enable you to pierce various sealing materials. Safely aspirate from and dispense into sealed labware.

Figure 35: Carbon fiber reinforcement in the Piercing tips

FlipTube® A 1.5 mL: the first automatable microcentrifuge tube

The new Hamilton FlipTube A 1.5 mL is the perfect tool for contamination-free sample handling, which has been design for your hand and developed for automation. Sample integrity first!

- ***Contamination-free:*** *Manual opening, by applying a gentle pressure on rear lid*
- ***Unique lid design:*** *Automated opening/closing processes by FlipTube® Tool*
- ***Precise lid sealing:*** *Minimizing sample evaporation*
- ***Easy marking:*** *Large frosted lid and surface on the side*
- ***Optical control:*** *Graduated lines for 0.1, 0.5, 1.0 and 1.5 mL*

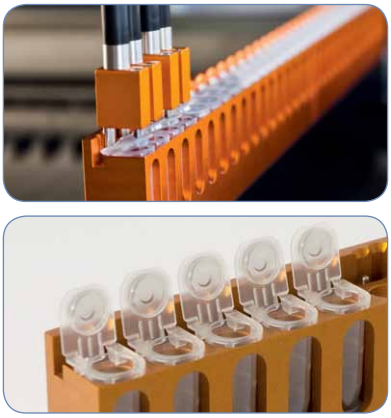


Figure 36: Contamination-free sample handling by FlipTube tool set

Reagent containers

Reagent reservoirs are available for the STAR Line instruments.
They can be placed in suitable reagent carriers on deck.

- Sizes available: 60ml, 120ml, 200ml
- Most container types are manufactured under clean room conditions and certified: CE and IVD-compliant
- Self-standing (60ml, 120ml, 200ml)
- Autoclavable (60ml, 120ml, 200ml)
- Additional wave breakers (60ml, 120ml, 200ml)
- Additional volume markings at 60ml

All reagent containers are presented on the STAR Line platform in specific deck-space-saving carriers:

- 5 x 60ml reagent container (1 track wide)
- 3 x 120ml reagent container (1 track wide)
- 4 x 200ml reagent container (2 track wide)

Figure 37: Hamilton 60ml reagent containers black (for light sensitive liquids) and transparent with lid

Figure 38: Hamilton 120ml reagent containers transparent self-standing and non-self-standing

Figure 39: 200ml reagent container transparent & black (for light sensitive liquids) w/o lid

Applications

Automate your assay

Your solution: from start to finish

Thousands of STAR Line workstations have been installed around the world to automate a wide range of applications. They offer the flexibility and modularity you need to create the perfect automated solution for your laboratory. For specific demands, the Hamilton application engineering group (APE) is available to design everything from custom racks to complex system integrations. Therefore, you can get everything from a benchtop system to a fully customized solution with integration demands from one supplier. With the modularity and flexibility of the STAR Line instruments, almost any configuration is possible. Select from a wide variety of platforms, modules and accessories to create the perfect configuration for your specific application based on:

- **Desired degree of automation**
- **Throughput, number of samples, walk-away time & precision**
- **Requirements for data handling, sample tracking & LIMS integration**

- **Design the best automation of your assay together with our application specialists**
- **Benefit from the unparalleled modularity and integration capabilities of the STAR Line systems**
- **Choose from more than 10,000 configurations that can be built from standard components**
- **Get a fully customized solution that fits to the specific needs of your assay**

Customization according to Good Laboratory Practice (GLP)

	DQ	IQ	OQ	PQ
RESPONSIBLE	Hamilton: system Customer: assay	Hamilton	Hamilton / Customer	Customer
TEST TYPE	Factory Acceptance Test (FAT)	IQ tests onsite as part of Site Acceptance Test (SAT)	Site Acceptance Test (SAT)	PQ tests
SCOPE OF TEST	Specification according to system requirements (applicative tests, water runs, data handling, etc.)	IQ report of manufacturers, including Hamilton's instrument general functionality	Subset of FAT re-testing onsite biological feasibility	Real sample runs
DOCUMENTS	Hamilton: Specifications, FAT	IQ reports	SAT document	Customers documents
RELEASE	Hamilton Quality Control	Hamilton Service Engineer	Customer / Hamilton	Customer

The chart describes the path from development to validation of customized projects

Applications from A to Z

We cover a great range of applications, which vary from genomic, cellomic, drug discovery applications to complex workflow solutions in biobanking. STAR Line-based customized automated applications vary from simple benchtop solutions to complex, large-scale workflow automations with different third-party device integrations.

Some examples:

Genomics benchtop workstation

- Nucleic acid purification
- Vacuum or magnetic bead technology
- PCR setup and purification
- Clog check for monitoring of vacuum steps
- RNA isolation from cells and tissue

Drug discovery platform

- Compound screening
- SPE
- ADME assays
- Two-arm configuration for parallel processing of two tasks
- Integration of readers, centrifuges, FACS, sealers, etc.

Cell culture system

- Compound screening
- Cell harvesting (post trypsin)
- Cell plating to create new cultures
- Addition of pharmacologically active substances to cell cultures
- Handling of fragile cell types such as embryonic stem cells
- Integration of incubators

Genomics
DNA/RNA extraction
PCR setup
Colony picking
NGS
Sample normalization

Drug discovery
ADME Tox
Solubility assays
PAMPA
Cytotoxicity assays

Diagnostics
ELISA processing
Blood grouping
Pooling

Cellomics
Cell culture maintenance
3D cell cultures
Colony picking

Proteomics
Protein crystallization
In-gel digestion
MALDI TOF spotting
Protein precipitation
Protein purification

Forensics
Sample lysis
DNA/RNA extraction
Quantification
Normalization
STR profiling

Biobanking
Sample preparation
Blood fraction separation
DNA/RNA purification
Sample storage

Standard Solutions: Acquire a ready-to-use-solution

Fig. 40: Pipetting on the STAR platform

With our Standard Solutions, Hamilton offers pre-configured workstations for a variety of applications: from automated PCR setup to blood fractionation, from sample preparation to LC-MS, Hamilton delivers a Standard Solution for almost any routine workflow in your laboratory, providing a maximum of user friendliness and process safety. Strong cooperation with renowned biotechnology companies and the Hamilton advanced automation technology yield in best solutions.

The Hamilton Standard Solutions product portfolio ranges from simple flexible hardware solutions with dedicated software to systems for applications that automate the workflows of specific biological kits. These systems comprise dedicated hardware, software and methods verified by the particular kit manufacturer.

We are continuously developing new ready-to-use solutions.

Diagnostics - Pharma

Bioanalytical STARlet: automate your LC-MS workflow

The Bioanalytical STARlet workstation offers fully automated sample preparation for pre-analytical and analytical LC-MS workflows including direct injection into the HPLC. Fully automated sample processing for therapeutic drug monitoring offers traceability and reproducibility. Minimizing human interaction with blood, serum, or plasma samples, the Bioanalytical STARlet includes barcode reading to reduce human errors and provide sample traceability whilst completing just-in-time sample processing during the HPLC runtime. An ingenious tools to automate your LC-MS workflow!

- **Save time and labor with automated QC and calibration curve preparation**
- **Single sample processing avoids sample degradation**
- **Direct LC-MS integration for increased walk away time**
- **Ensure data integrity with complete sample tracking**

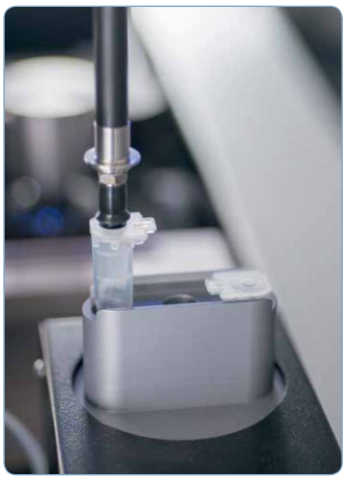


Fig. 41: CO-RE Lid Tool loading the Bioanalytical STARlet Vortexer

Diagnostics - Pharma

MassSTAR: your workhorse for sample preparation

Therapeutic drug monitoring requires solutions that comply with IVD guidelines, enable a full audit trail and are easy to use. Chromsystems together with Hamilton has developed MassSTAR as a solution that meets these requirements.

There are two methods available, one for immunosuppressant analysis based on Chromsystems' MassTox immunosuppressant kit, and the second one for vitamin D analysis based on Chromsystems' MassChrom Vitamin D2/D3 kit. Both methods have been verified according to CE-IVD standards. *(not available in the U.S.)*

- **Integrated centrifuge for increased process control**
- **Automated report file generation for LIMS and LC-MS/MS**
- **Capacity up to 288 samples incl. controls and calibrators fit on deck**
- **Throughput ~90 min for 96 immun. samples, ~50 min for 96 vit. D samples**

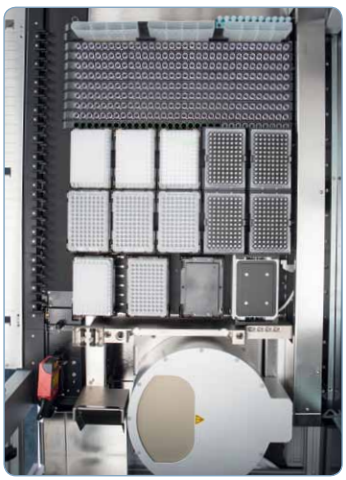


Fig. 42: The MassSTAR deck layout from the top with the centrifuge on the bottom

Genomics

chemagicSTAR: flexible nucleic acid workstation

Automating nucleic acid purification is often a trade-off between quality and throughput: good stand-alone purification systems lack liquid handling support for walk-away operation. In addition, liquid handling workstations often require lenghty adaptation of manual protocols.

The chemagic STAR combines chemagen's leading nucleic acid (NA) purification system with the best automated liquid handling technology to offer you stress-free operation in one benchtop system.

- **Integrated system for DNA and RNA isolation, pipetting and further processing**
- **Broad sample and volume range (20µl-10ml)**
- **Full sample traceability**
- **"Ready to start" automation protocols for 34 chemagen kits**

Fig. 43: the 24 rod CHEMAGEN head in action on the chemagicSTAR

Genomics

Genomic STARlet: high quality nucleic acids

High quality nucleic acids are a key for downstream applications like genotyping, sequencing and real-time PCR analysis. Together with MACHEREY-NAGEL, we have verified extraction processes to reach minimal variation and maximal standardization. Features like Monitored Air Displacement technology and clot detection offer a high process safety. An intuitive graphical user interface and a real-time status window provide a comprehensive control over all processes. With the user-friendly software you can easily choose your kit and sample type. Each run is summarized in a report file, giving full traceability.

- **8 in 1 system: up to 8 preinstalled and verified protocols on the same instrument**
- **Easy to run software with intuitive user interface**
- **Proven silica based filter plate technology from MACHEREY-NAGEL**

Fig. 44: performing a transport with the CO-RE Gripper onto the vacuum station

Genomics

PCR setup Workstation

Automated PCR assay setup for e.g. endpoint, real-time, RT or multiplex PCR and a wide range of applications such as cloning, gene expression, mutagenesis, gene sequencing, disease/mutation testing, etc. Equipped with a user friendly software, the new Hamilton PCR setup Workstation combines the intuitive approach of a manually created PCR with the benefits of automation.

- **Highly flexible and user friendly system for a wide range of PCR types and applications**
- **Full reagent and labware flexibility, no supplier limitation**
- **Time saving due to reusable protocols and optional on deck PCR cycler (ODTC) integration**
- **T raceability of all input parameters through the whole setup process**

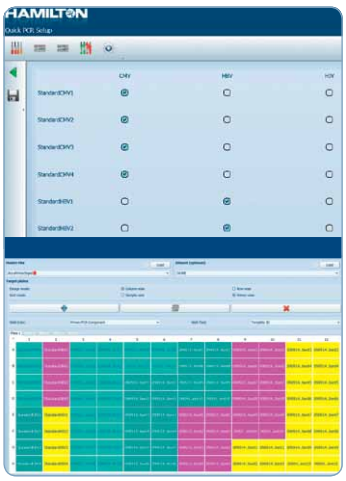


Fig. 45: two screenshots of the PCR software in action

Genomics - NGS

NGS STAR for Illumina Library Preparation

Hamilton has partnered with Illumina, Inc. to automate a variety of Illumina library preparation kits. It is a medium- to high-throughput system that can be configured to run Illumina-qualified protocols. Illumina-qualified means the analysis has shown the libraries prepared on the automated system perform comparably to those prepared manually. Through an interactive run settings dialog, the user has the option of customizing each run, by selecting desired starting and stopping points for the major processes in the Illumina protocols.

- **Compatibility with both the Illumina low-throughput & high-throughput kits**
- **Barcode verification of original Illumina-supplied reagent vials**
- **qPCR preparation, normalization, and pooling included**
- **Single hardware configuration to run multiple protocols**

Fig. 46: Autoload feature for barcode reading providing error proof deck setup

Genomics - NGS

NGS Workstation: automated NGS library preparation

The NGS Workstation is a compact, flexible and future-proof workstation for library preparation for all common sequencing platforms. It is excellently suited for any throughput from 8 to 48 samples and reduces time consuming manual pipetting steps and sample-to-sample variability.

It is an open workstation for any library preparation chemistry and includes validated methods for the NEBNext® Ultra™ DNA library prep kit for Illumina sequencers, from New England Biolabs (NEB®).

- **High quality reagents with simplified workflow incorporating magnetic bead-based size selection for superior ease of use**
- **Automated master mix preparation on deck**
- **True walkaway solution through incubations on deck**

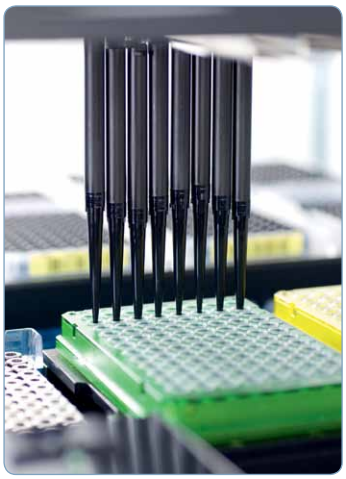


Fig. 47: single use filter tips to minimize contamination risk

Genomics - Sample Preparation - Biobanking

easyBlood: fully automated blood fractionation

Before a biobanking blood sample is sent to storage for many years, the sample must be split into different fractions.

Especially the isolation of the DNA-rich buffy coat is a labor intensive and tedious task. The easyBlood system automates the fraction separation process and increases the reliability and accuracy of both fraction detection and pipetting.

- **Camera based fraction identification**
- **Automated buffy coat isolation**
- **Dedicated specific liquid classes**
- **Automates tedious and error-prone buffy coat pipetting process**
- **Operator independent pipetting of precious biobanking samples**
- **Free-up laboratory resources**

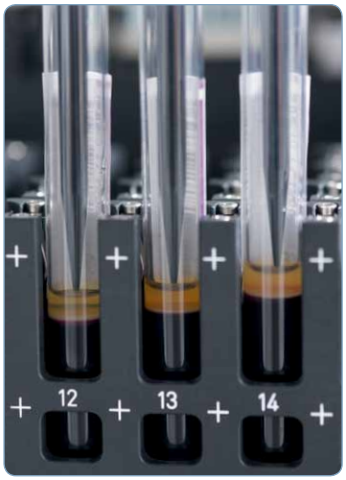


Fig. 48: easyBlood STARlet separating blood fractions

Forensics - Diagnostics

easyPunch: integrated system for punching & pipetting

easyPunch is a system integrating FTA™ sample collection card punching and liquid handling capability all in one instrument. Its flexible modular nature makes tailoring of the workflow exactly to your needs easy. Additional functionalities such as inventory of cards and cherry picking add even more value to the system. Removal of tedious work during punching and pipetting decreases health risks of personnel.

- **Supports GE Whatman® EasiCollect™, DMPK, large cassette HID & similar cards**
- **Superior card imaging and analysis**
- **Full traceability of samples**
- **Seamless integration of different workflows by using predefined methods**

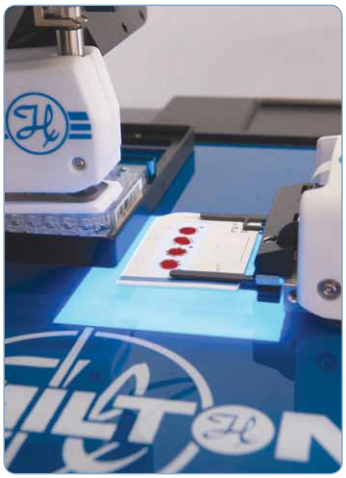


Fig. 49: easyPunch integrated system for punching with card and plate gripper

Forensics

AutoLys STAR: automated Lysis & DNA extraction

The AutoLys STAR liquid handling workstation provides a fully automated solution for lysis and DNA extraction from dried blood and saliva stains, swabs, paper punches, cigarette butts, hard tissues and other forensic specimen residing on solid surfaces.

The AutoLys Tube is a novel, tube-in-tube device. To automate all the AutoLys tube functions a special channel has been developed which is compatible with all STAR Line instruments.

- **Automated sample lysis**
- **DNA extraction**
- **Unique AutoLys tubes - no spin baskets needed anymore**
- **Integrated centrifuge and heater shakers**

Fig. 50: The AutoLys STAR transport of outer AutoLys tubes

Forensics

ID STARlet: for every need of Human ID laboratories

It's solution developed collaboratively with Life Technologies designed for the unique needs of forensic laboratories. The ID STARlet workstation streamlines the entire DNA purification and analysis process using Life Technologies Human Identification (HID) kits. This includes: DNA isolation using the PrepFiler® Forensic DNA Extraction Kit, Quantification using the Quantifiler® and Quantifiler® Duo DNA Quantification Kits, Normalization and STR reaction setup to achieve reliable profiling using any of a number of high quality Life Technologies AmpFℓSTR® typing kits.

- **Integrated system for DNA isolation, quantification, normalization & STR profiling**
- **Optional on-site verification by Life Technologies**
- **Full sample traceability**
- **Optimized automated protocols**

Fig. 51: ID STARlet for DNA isolation, quantification, normalizaiton & STR profiling

Sample Preparation - Other Applications

Replicators: enhancing walk-away times

Replicators can optimize the daily work schedule in your laboratory and enable worry-free and stress-free working. To increase the flexibility of building your perfect automation solution, smart accessories and innovative consumables are available.

Depending on your application needs, you can chose between platforms equipped with single pipetting channels or Replicator platforms with multiprobe heads that handle 96-, 384- or 1536- plate formats. A combination of multiprobe heads and single channels allow for plate handling on the deck.

Replicators cover a big range of applications: DNA extraction, PCR/qPCR setup and cleanup, dye terminator removal, sample and reagent transfers, serial dilutions, hit picking, solid phase extraction, cell plating, cell based assays, compound handling, reformatting, and more.

Fig. 52: Tip washing with the CO-RE 96 Probe Head

Upgrade Kit - Colony Picking

easyPick II: revolutionising colony picking

The Colony picking is a very labor-intensive task that is generally performed during cloning protocols. Manual colony picking is both slow and tedious. Automation makes the process more consistent and reliable, as well as considerably faster.

The introduction of integrated colony pickers on liquid-handling platforms has revolutionized gene cloning and colony picking workflows, allowing time-efficient and error-free cloning processes together with automation of additional upstream and downstream processes.

easyPick II allows the selection by size, shape, distance to next neighbor and color settings and guarantees secure picking of colonies even if they are as small as 1mm with a speed of up to 300 colonies/h.

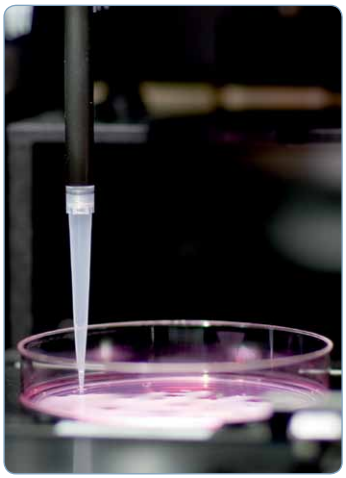


Fig. 53: Colony picking process

Watch all the Standard Solutions VIDEOS on our website!

Microlab STAR and Storage Integration

The Microlab STAR Line integrates seamlessly with our automated storage systems creating a comprehensive sample processing center with a broad range of applications in the fields of drug discovery, biobanking and forensics.

The systems are integrated using a hand-off arm, which is a fast and reliable robot used to integrate our automated storage systems to several devices, including Microlab STAR Line workstations, additional storage systems, LabElite DeCappers, or third-party equipment such as hotels, incubators and plate readers.

Features such as automated barcode reading on the storage systems and on the STAR Line instruments, along with a fully monitored pipetting process on the STAR Line instruments provide full chain-of-custody, sample tracking and documentation.

Previous examples of integrated systems include:

- Fully automated DNA extraction and storage systems in biobanking applications
- Fully automated delivery system providing sealed plates of selected si-RNA or DNA samples stored in 1.4 mL tubes
- Fully automated production system to generate sealed serial dilutions plates or plate replicates in compound applications

Figure 54: Integration of two STAR Line systems with a -20°C ASM sample storage system

Enhanced sample storage capacity with several SAM systems linked with a hand-off arm

The hand-off arm can transport racks between the ASM or SAM to a DeCapper or STAR Line system

A LabElite Integrated I.D. Capper can be integrated for automated decapping and capping

Third-party instruments can also be integrated, such as plate spins, centrifuges, shakers and sealers

Applications for integrated systems

Compound Management

Hamilton Storage's compound management systems, ASM and Verso, can be integrated to the Microlab STAR Line to realize applications in compound management such as creation and management of assays, serial dilutions and replication. ASM and Verso are high-throughput sample management systems for sample collections ranging from 2'000 to more than 30'000 plates and/or 100'000 to millions of tubes at temperatures from ambient to -20°C.

Forensics

SAM is an automated storage platform available in +4°C, -20°C, -40°C and -80°C platforms. The system can be integrated to the Microlab STAR Line for applications such as realizing fully automated DNA extraction and subsequent automated sample storage. SAM provides a full audit trail and access control for active sample collections. This compact, localized storage system is used for secure sample management of up to 803 plates or 60,000 tubes. For mid- to large-capacities, Verso and BiOS systems can be used to automate archiving systems, and for storage of trace and second opinion samples.

Biobanking

For large sample collections of 100'000 to more than 10 million tubes, Hamilton BiOS® provides storage of sensitive biological samples at -80°C. The system is used in medium to large-size clinical biobanks or in population-based biobanking applications. For smaller sample collections, the compact footprint of the SAM allows samples to be stored directly in a lab at temperatures down to -80°C. For DNA biobanks, ASM or Verso systems can be utilized for automated storage of DNA samples at temperatures down to -20°C.

Example Workflow

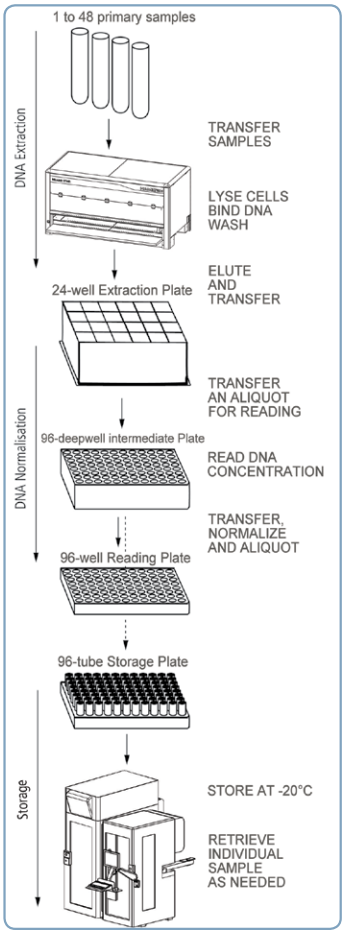


Figure 55: The workflow of a DNA biobank that automates all the steps of DNA extraction, DNA normalization, and storage/retrieval at -20°C

Figure 56: Verso for medium to large-scale sample storage at temperatures from ambient to -20°C

Figure 57: Hamilton BiOS for large-scale sample storage at -80°C

Services

Outstanding, reliable, everywhere

Service organization

All across the world Hamilton is able to supply highly qualified support by local service engineers. These engineers are trained by Hamilton certified trainers and supported by local service headquarters.

Our commitment

When customers invest in a high-performance pipetting system, they have high expectations of quality, reliability and precision. In-house manufacturing of many components, combined with a remarkable depth of production at our facility in Switzerland, means that we use only top-quality system components in our pipetting robots. State-of-the-art quality control systems and a final inspection further guarantee high quality standards in the manufacturing process.

Figure 58: Hamilton European headquarter in Bonaduz, Switzerland

At Hamilton, quality thinking is a part of product development right from the start. The most up-to-date technologies are used in our robotic systems to ensure a high degree of reliability and system stability for long-term use in laboratory routines. Features such as user friendliness and low maintenance requirements are also a factor at the product design stage.

Quality at service time – a promise customers can rely on

Customer satisfaction has the highest value at Hamilton. That goes for after-sales customer care as well. A service network linking our headquarters with our subsidiaries all over the world ensures short response times for maintenance or service work, thus minimizing downtime.

Hamilton's commitment to high quality standards is evident not only in our ISO-9001 certification, but also in the ongoing training we provide to the qualified service engineers in our subsidiaries and distribution partners. They bring their competence and skill to bear wherever Hamilton instruments are operating.

System installation

All Hamilton instruments are installed according to strict procedures in conformity with ISO-9001. They come with a comprehensive Installation Qualification (IQ) and detailed documentation.

Service contracts

With a Hamilton maintenance or service agreement, you can be sure that your robotic system is regularly monitored by qualified specialists and yields top performance over the long haul. Therefore, service costs are budgeted in advance and unnecessary risks can be avoided. When it comes to your robotic system, Hamilton guarantees satisfaction. To match the various needs of our customers, we offer three levels of service and support contracts.

Application training courses

Hamilton application training courses can follow an established generic structure suitable for a variety of users, or they can be tailor-made to meet particular needs. They combine theoretical knowledge with practical application to give a comprehensive understanding of the course content to the trainee. All participants receive a certificate or course confirmation letter from Hamilton upon successful completion of their course. Training courses take place at our headquarters and can be provided in your local subsidiary or on-site when needed.

Condition monitoring with STARwatch

STARwatch is a service that significantly increases uptime of an instrument. This service is exclusively available for Hamilton STAR Line instruments. In combination with a service contract, STARwatch continuously monitors the condition of the dedicated instrument. The captured data is automatically analyzed and when a critical pattern is recognized, the service organization is immediately informed to provide a pro-active intervention.

Every part of an instrument has a certain lifespan. External influences, improper use or the end of lifespan also can reduce the reliability and system availability of a STAR Line instrument. The aim of STARwatch is to detect this on parts of a STAR Line instrument. Once detected, the service organization is informed, and the part gets exchanged before it actually fails. This allows you to best fit service interventions into your application schedule.

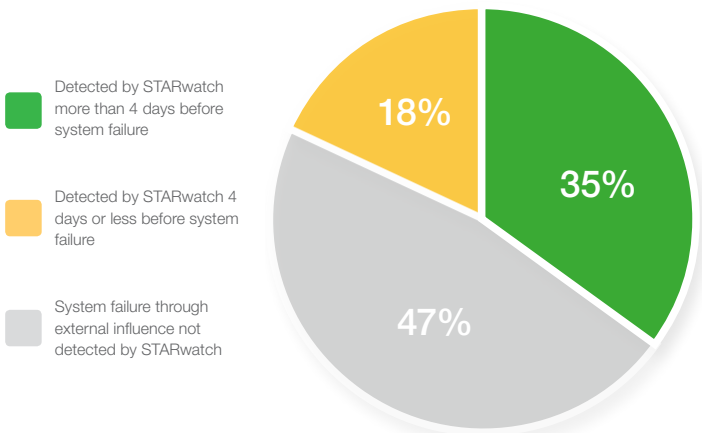
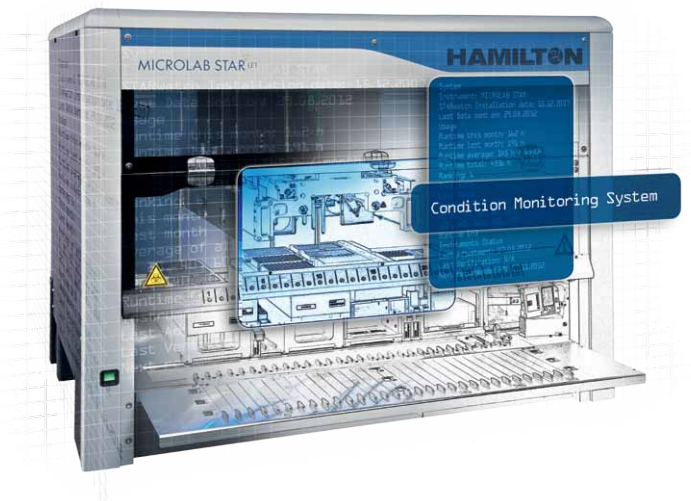


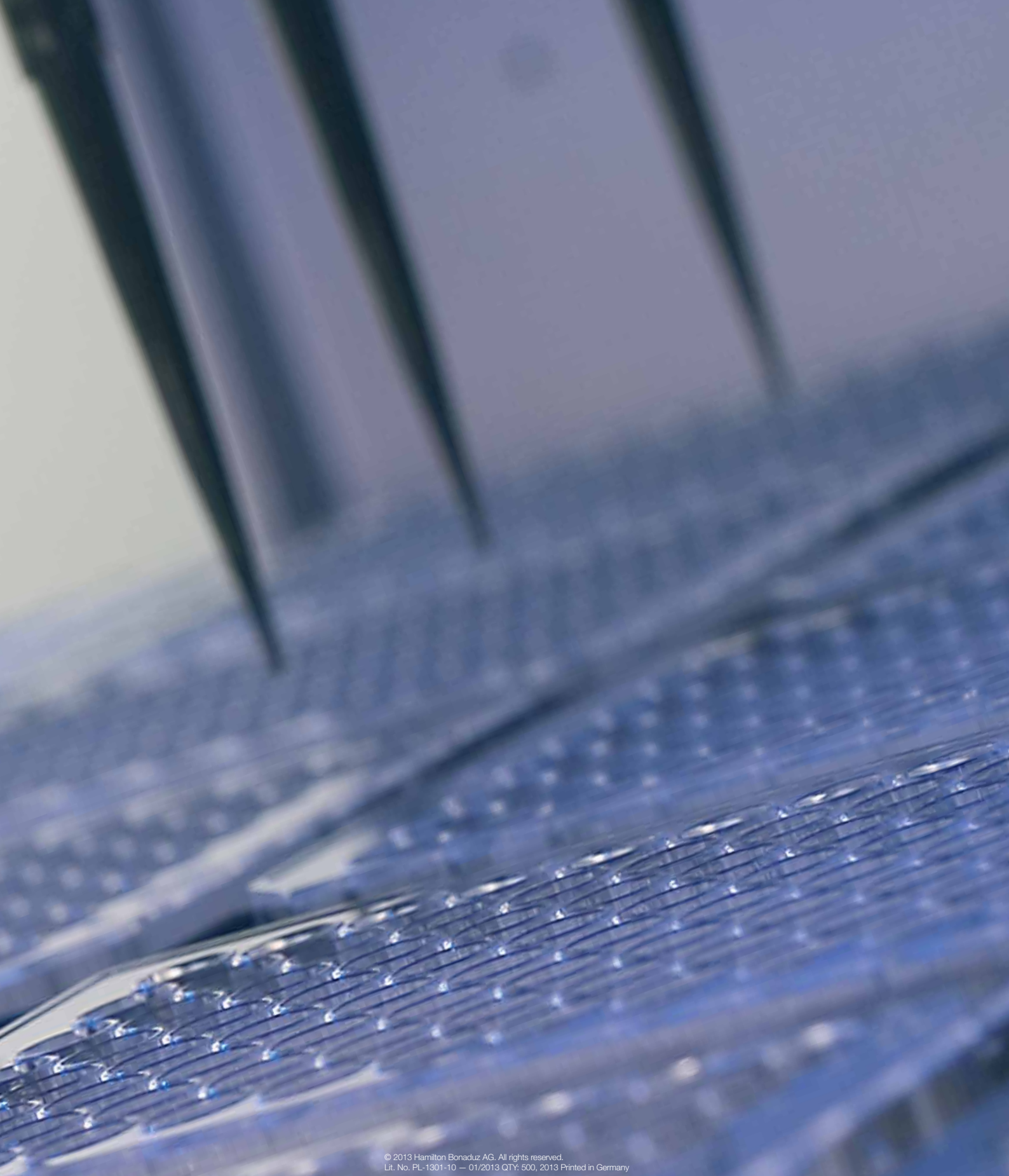
Figure 59: The statistics of the effectiveness of STARwatch software



- **Increased system availability through pro-active intervention**
- **No workflow interruption**
- **Pre-planned service visits**
- **Faster service reaction time**

STARwatch test results

During tests, STARwatch monitors all steps of the installed STAR Line systems.
Over one year, STARwatch detected most system issues more than four days (35%) or within four days (18%) in advance of a part failure. Undetected errors were generated through external influences and not by the system itself.



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