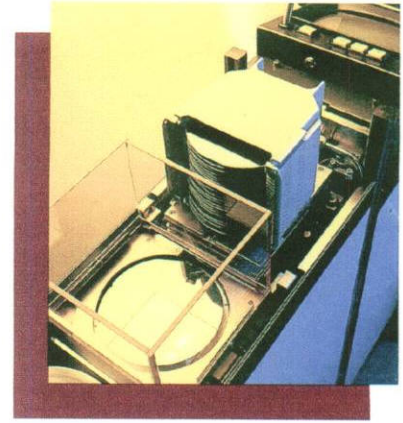


Proven process performance for  
advanced device production:

# MultiFab<sup>®</sup>



S U B S T R A T E • P R O C E S S I N G • S Y S T E M S

## The top two track requirements.

Are you replacing obsolete equipment with state-of-the-art systems, adding tracks to increase productivity, or selecting the first equipment for your new fab area? In every case, the processing equipment you select must meet two criteria: reliable performance and application of the newest processing techniques. MultiFab gives you both these benefits and many others, such as advanced contamination control, multiple configuration options, increased uptime and throughput, interface capability, and unsurpassed process uniformity.



## “MultiFab” stands for “Multiple Fabrication Options”.

To realize the full potential of the track concept, equipment design had to go beyond in-line configurations. MultiFab does just that, providing more configuration freedom, a larger menu of process controls and options, and greater compatibility with other equipment. For the fundamental functions your track performs, yesterday's details have become today's critical considerations.

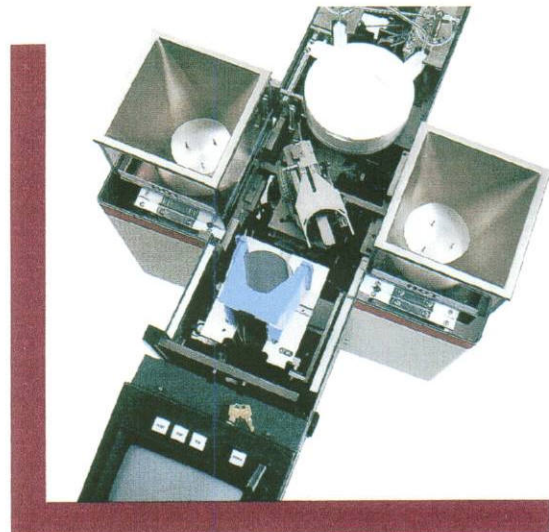
## Meeting the one-micron challenge.

The shift to one-micron devices has changed processing equipment and techniques dramatically, and MultiFab reflects those changes:

Self-contained process modules provide unsurpassed reliability, adaptability, accessibility, and performance.

Pick-and-place handling makes MultiFab processes faster, cleaner, and more precise than ever before.

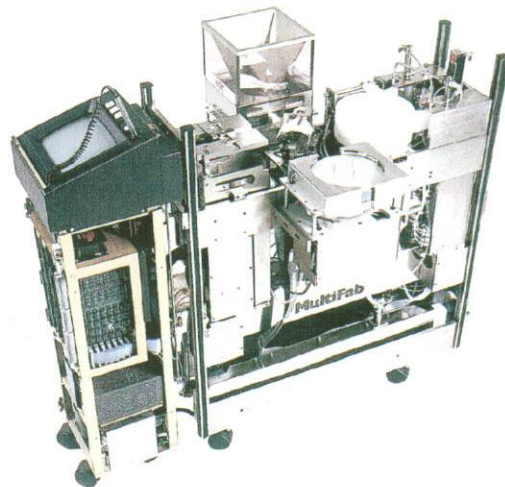
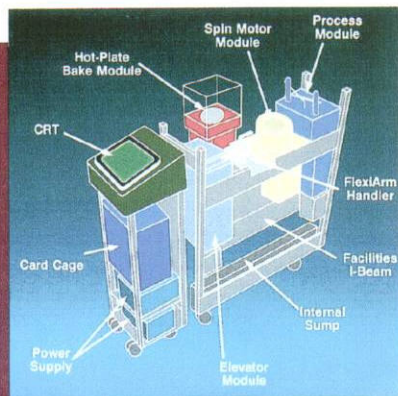
Laminar flow is augmented by a central vacuum plenum, while MultiFab's moving components are designed and positioned to minimize contaminants.



**MTI**

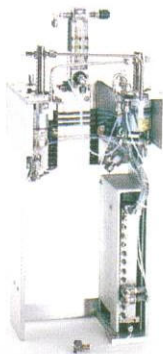
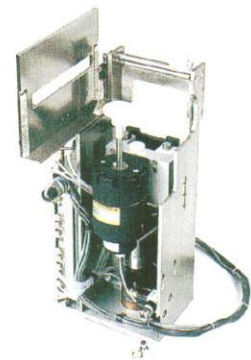
## MultiFab Modules: The inside story.

In semiconductor device production, the quality of your yields depends on the quality of your processing equipment. With MultiFab, MTI has maximized the advantages created by modular design principles: cleaner operation, reduced maintenance, and a wider range of process capabilities. All MultiFab systems are based on a common chassis, which provides mounting locations and facilities connections for drop-in process and handling modules. MultiFab's compact process modules are manufactured with state-of-the-art components, and engineered for superior process performance and control.



The modules are mechanically self-contained and require minimal external connections, simplifying maintenance access. Process upgrades are easily incorporated into individual modules without affecting MultiFab's basic design, system reliability, or user familiarity. MultiFab's controller is built as a separate unit, and provides multitask control of all track systems. The performance of each MultiFab module is enhanced by maximal laminar flow and a balanced exhaust through the system.

MultiFab spin-process tracks are equipped with a proprietary process-cup assembly and a spin-motor module. The cup assembly consists of the cup, centering device, vacuum chuck, and sealed spin motor. The process cup is solid Teflon<sup>®</sup>, and machined for specific substrate sizes. Spin-motor speed is programmable from 100 - 7,000 rpm in 100 rpm increments, with a maximum acceleration rate of 30,000 rpm/sec., programmable in 10% increments. MTI's special exhaust features include an adjustable damper and a dedicated sensor for automatic shutdown in the event of insufficient exhaust.



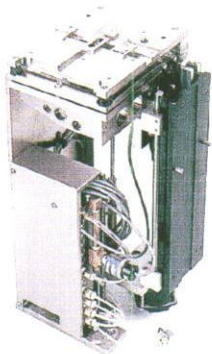
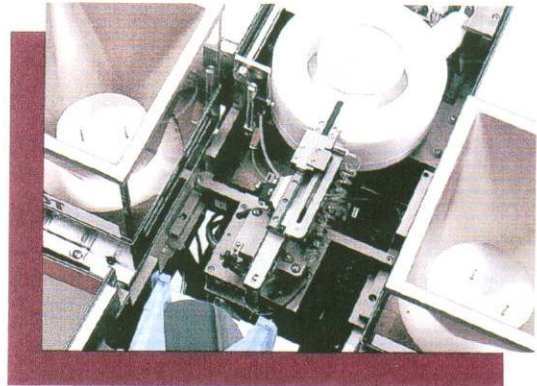
MultiFab's coat module is available with either pressurized or pump dispense systems using 1/8" O.D. or 1/4" O.D. dispense lines. Standard on all systems are one stationary 1/8" O.D. side-dispense nozzle, edge-bead resist removal, backside rinse, process-cup rinse, and predispense functions. The process-cup rinse is programmable to occur after each dispense sequence or after each cassette for total cleansing. Predispense is programmable to occur before each dispense sequence. Pneumatic or motorized dispense arms perform radial, dynamic, static, or oscillating sequences.

## Substrate transportation without contamination.

Substrate handling is a critical factor in reducing equipment-produced contamination in semiconductor processing. MTI's beltless transports eliminate this major source of contamination. Each MultiFab handling system utilizes a pick-and-place design principle to insure quick, clean, and reliable transport. MultiFab's economical process paths minimize substrate movement, and the substrate-handling plane is located above the mechanical assemblies. The range of MultiFab transport modules include two internal system handlers and two interface units. MTI's FlexiArm module and flexible-band load arm are capable of transporting wafers from 76mm to 150mm. The FlexiArm module is also capable of handling 4" x 4" rectilinear substrates. MultiFab's two interface units are WaferBot<sup>®</sup>, and a track-integration transport module.

FlexiArm's 360° handling envelope provides access to all processing stations in its base track. Its rotation is controlled by a stepper motor; and linear extension is provided by two slides, which are driven by a high-torque gearhead motor. The FlexiArm module provides full backside support, augmented by vacuum to secure the substrate during movement.

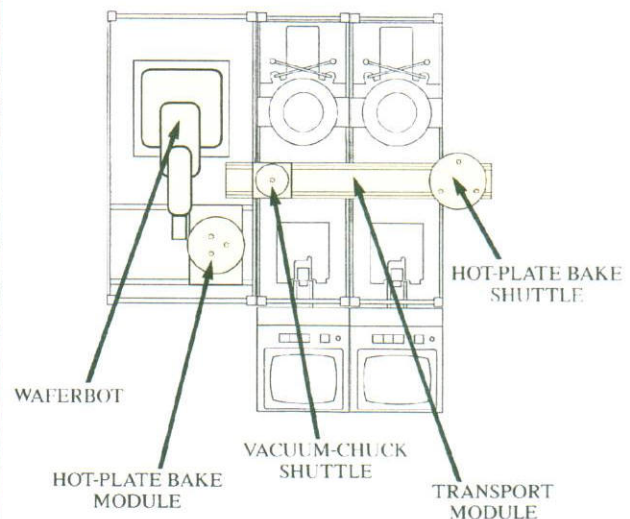
The flexible-band load arm extends 18" horizontally for substrate transport; when not in use, it retracts into a vertical position at the front of the track via a roller assembly. A vacuum tip is used to secure the substrate during movement.



MultiFab's elevator module incorporates a stepper-motor and precision lead-screw to produce regulated, vibration-free movement. The elevator module is programmable to process cassettes from the top or bottom with the FlexiArm module, and bottom-to-top with the flexible-band load arm. The elevator module's cassette-slot indexing is controlled by a vertical optical encoder to maintain the slot-to-slot integrity of the substrates. MultiFab's elevator module is common to all MultiFab track configurations and accommodates all H-bar cassettes.

Individual MultiFab tracks may be integrated using a transport module. The transport module links the intermediate process zones of the MultiFab units in the system, and uses vacuum-chuck or hot-plate bake shuttles to transport substrates between them.

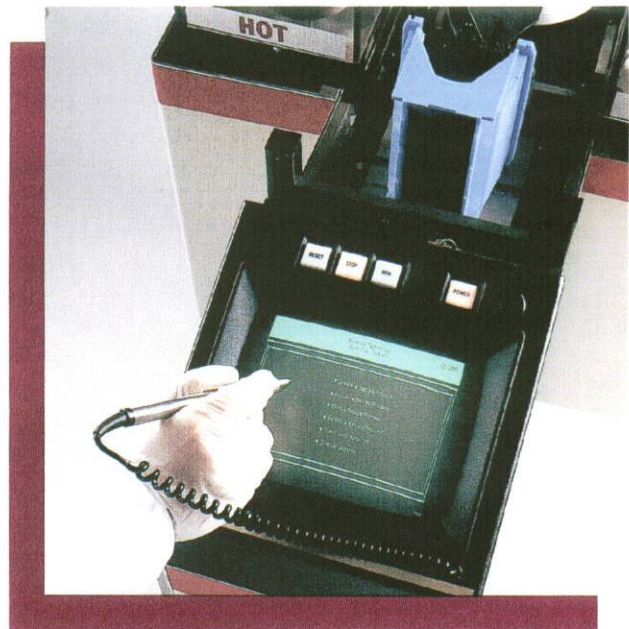
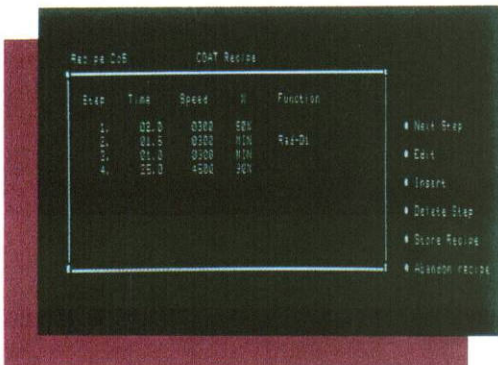
WaferBot provides a simple, versatile method of interfacing all MultiFab equipment versions to outside equipment such as aligners or inspection stations. WaferBot's 5-axis robotic arm features a 30" diameter handling envelope and a Teflon-coated vacuum hand for substrate transfer. A WaferBot unit may be equipped with hot-plate or chill-plate modules to increase the process capability of the system. The interface transfer is created by stepping the robot through the desired handling sequences using its programming controller. The complete program is stored in E<sup>2</sup> PROM memory, and substrate flow during processing is coordinated by the master controller of the system.



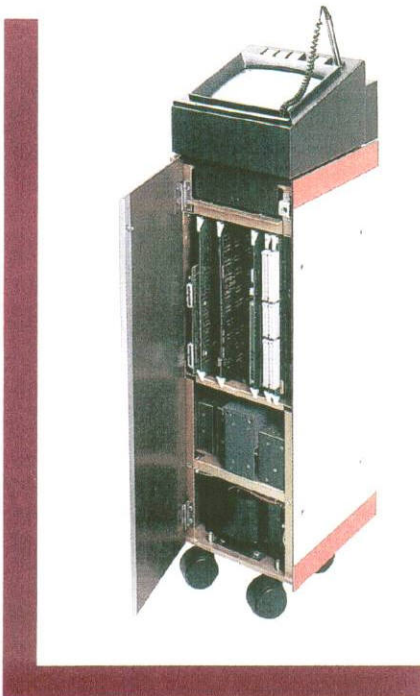
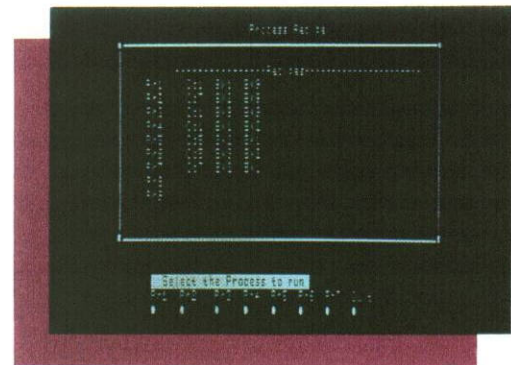
*Integrated MultiFab system with WaferBot for automated coat/bake/aligner interface/develop/bake process*

## Point, press, and process.

MultiFab's controller is the core of MultiFab's processing performance and substrate-handling coordination. The user-friendly design eliminates complex process programming inherent to keyboards. Interaction between the system operator and the controller is accomplished by using a menu-driven CRT screen and hand-held light pen. All of the controller's electronics and software designs are created and updated by MTI. The controller monitors all functions of the track modules, performs self-diagnostics, and presents all information in plain English.



MultiFab's processes, which are formulated by touching the desired function listing on the CRT screen with the light pen, are quickly programmed and easily stored. Processes are based on step-and-recipe construction; the system operator creates recipes step-by-step, then combines them to produce desired working processes. Storage of nine complete processes is standard; additional process storage is available.

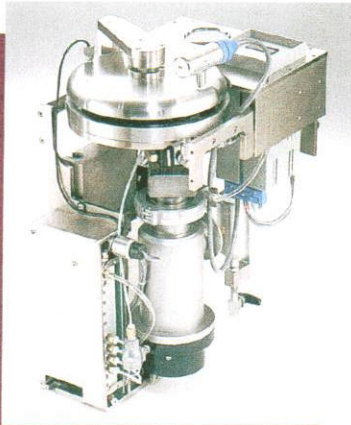
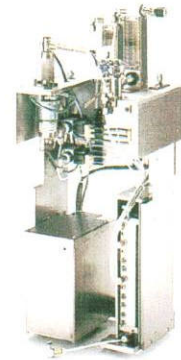


A security lock and access code protect user-created processes by preventing undesired modifications to the system. Data storage is maintained in non-volatile E<sup>2</sup> PROM memory, eliminating the need for battery backup.

Central to system control is an 8086 16-bit microprocessor. Temperature and spin-motor control is performed by two dedicated 8741 microprocessors.

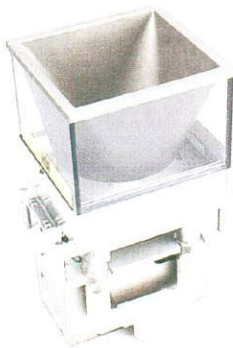
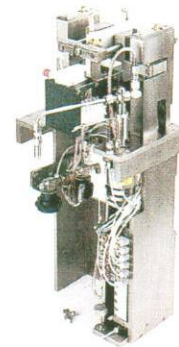
The controller's electrical power ranges from the 5VDC required to run the logic sensors to the 220VAC needed to operate the hot plate. The current is maintained by a power-supply transformer, which is augmented by a sequencer. The sequencer regulates current and prevents accidental operation of solenoids during power-up and power-down sequences.

MultiFab's develop systems provide dispense styles for positive or negative develop processes, including stream, aspirated, spray, or VaporJet® II. VaporJet II, MTI's ultrasonic nozzle, delivers a low-velocity vapor of develop fluid, increasing uniformity significantly over the substrate. VaporJet II doesn't require special temperature control equipment, and reduces developer consumption from traditional systems by 40% or more. Dispense options include those featured in the coat module, as well as a mist enclosure and dispense/rinse functions programmable sequentially or simultaneously.



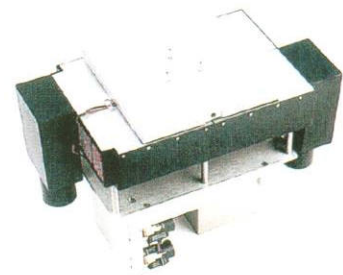
VacuPryme® is MTI's unique vacuum vapor-prime module. It combines the benefits of a high-vacuum environment, dehydration hot-plate bake, and single-substrate processing to provide optimal priming results. VacuPryme's features include vacuum capability of 10 millitorr, a process time of under 60 seconds, and a 150°C hot plate. Prime dispense amounts are programmable as a function of either time, in 0.1 second increments; or as a change in chamber pressure, in 10 millitorr increments.

The MultiFab scrub module combines precise brush-head movement with a high-pressure stream system to create an efficient substrate-scrubbing process. Features include an oscillating high-pressure dispense arm; brush-head oscillation; micrometer-calibrated brush-head pressure; and detergent, rinse, and blow-off dispense functions. The high-pressure system is adjustable over a wide pressure range: 450-3,000 psi. The scrub module's anti-mist features include a nozzle skirt and enhanced process-cup exhaust capabilities.



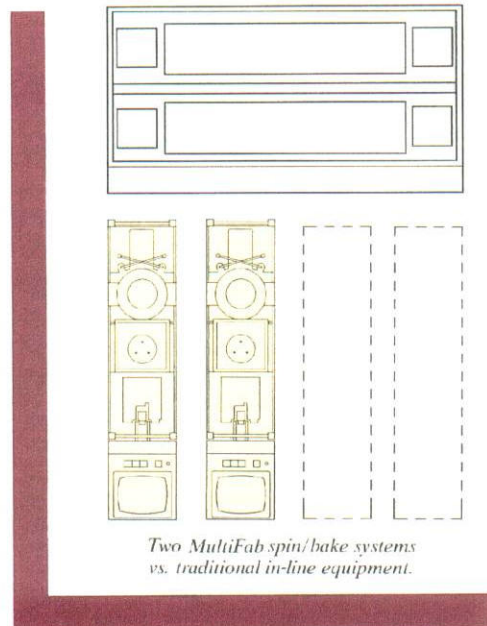
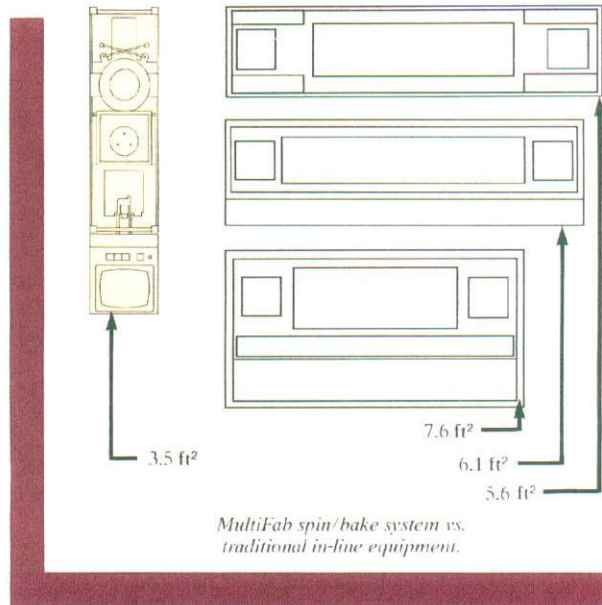
MultiFab is available with hot plates for both soft and hard-bake processes. The hard-bake module achieves a maximum temperature of 275°C and features stepper-motor-driven transfer pins, programmable for contact or proximity-bake modes in 0.001" increments. The hard-bake module also features a fume-exhaust system, which utilizes a funnel to create uniform air flow over the hot plate. The soft-bake module (150°C maximum) is equipped with pneumatically-operated transfer pins, which are manually adjustable for contact or proximity-bake modes. Both hot-plate modules are programmable in 1°C increments, and offer vacuum pull-down capability. A dedicated microprocessor and thermocouple sensor guarantee flat heating profiles across the substrate.

The MultiFab chill plate increases throughput by cooling heated substrates to preselected temperatures rapidly. The chill-plate module is equipped with four thermoelectric junctions and a heat sink, which efficiently draw heat out of soft or hard-baked substrates. Chill-plate features include a thermocouple sensor, vacuum pull-down, and pneumatically-operated transfer pins. The chill-plate temperature is programmable from 15°C-25°C in 1°C increments.



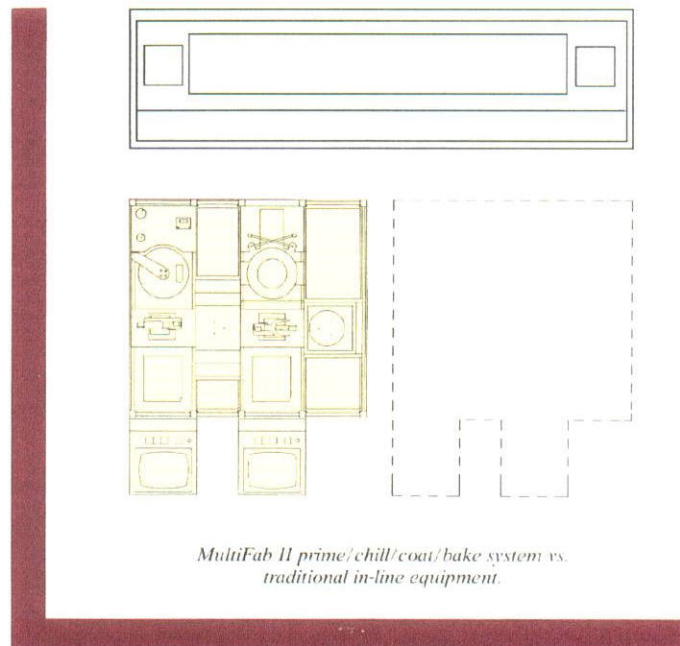
## Process Performance/Ft<sup>2</sup>: No other system comes close.

All of MultiFab's configurations have real production advantages over in-line track equipment, including smaller footprints, easier maintenance access, and superior contamination control. And MultiFab's design format always puts the cassette and controller where they logically belong: on the aisle. Replacing the cassette requires no operator reachover—and no contamination—of the process areas.



MultiFab stand-alone systems have the smallest footprint, and orient the process front-to-rear instead of side-to-side. In an area where two in-line tracks can be stacked front-to-back, four or five MultiFab systems can be located side-to-side. And each MultiFab system is easily removed for maintenance without interrupting production on the other systems.

MultiFab II systems make the most efficient use of clean room space, providing the same four-process capability in half the length of in-line systems. And two MultiFab II systems provide more uptime than any two-track in-line system; because each MultiFab II system operates independently, one off-line system doesn't affect the other.

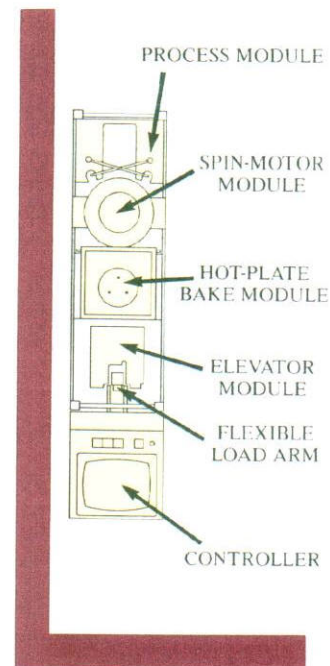
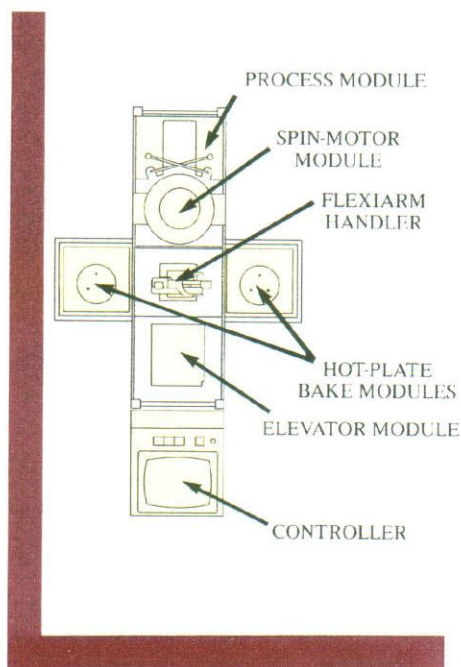


## MultiFab Configurations: A path for every process.

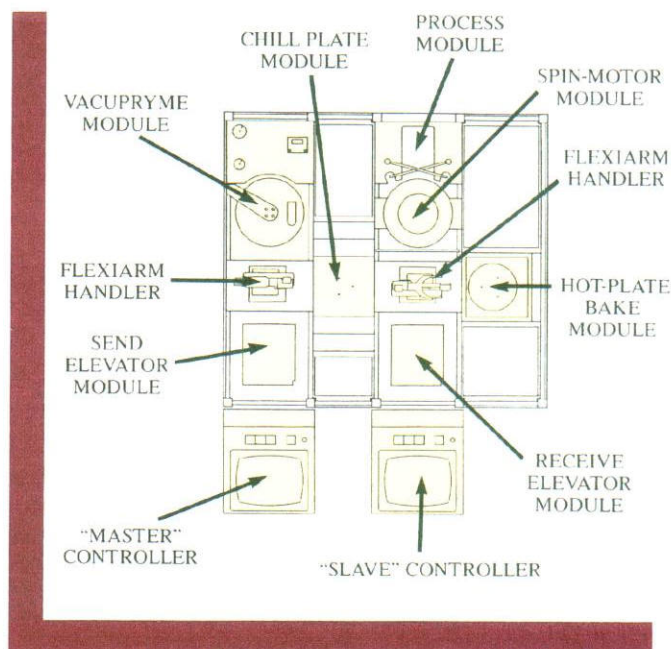
MultiFab's basic design concept provides as many format options as it does process possibilities. Stand-alone versions may be equipped with a single process module (i.e. spin, bake, or VacuPryme), or combine one spin process module with bake or chill process modules. MultiFab II systems may perform either a four-process, cassette-to-cassette process, or operate as individual two-process systems. Individual MultiFab units can be combined to form multiple-track systems; both tracks and systems can be interfaced to outside equipment. MultiFab's variety of configurations meets the full range of specific fabrication format requirements.

The most compact MultiFab configuration occupies less than four square feet—the smallest spin-bake system in the industry. A flexible load arm is used to transport substrates between the cassette and the process zones.

When equipped with MTI's FlexiArm pick-and-place handling system, MultiFab's process capability and flexibility are both increased. FlexiArm's 360° handling radius allows the addition of a second hot-plate bake or chill-plate module, and its programmable handling path may access the three process zones in any sequence. This allows user programming of stepped-bake processes (by using two hot plates sequentially), increased throughput of extended-bake processes (by using two hot plates simultaneously), or, for develop-configured MultiFabs, post-expose bake/develop/hard-bake sequences.



MultiFab II provides extended process capability (i.e. prime/chill/coat/bake) by integrating two MultiFab stand-alone systems with FlexiArm handlers and specialized software. One MultiFab controller is designated the master, and controls the substrate flow through the cassette-to-cassette path. Individual diagnostics and process control of each track is retained by its controller, maintaining system reliability and performance.



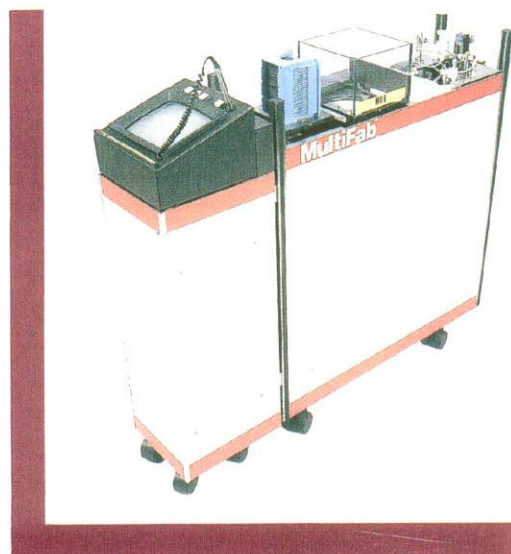
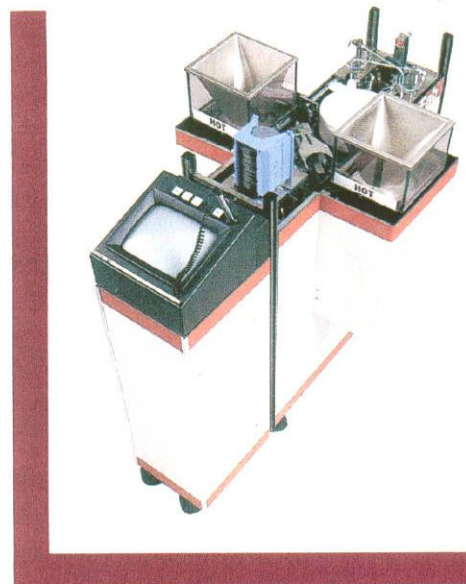
## Proven process performance...

To meet the demands of today's device production runs, you need track equipment with superior process capability that you can depend on. As you'll see below by our guaranteed specifications, MultiFab more than meets your fundamental performance requirements for reliability, contamination control, and handling.

**Reliability:** The first specification for any process is performing it without interruptions for repair, maintenance, or adjustment. MultiFab meets this specification with simple design, solid engineering, and a 98% uptime guarantee.

**Cleanliness:** Less than 0.03 particles greater than one micron per  $\text{cm}^2$  are added during a substrate pass through MultiFab. We insure that level of contamination control on MultiFab tracks, MultiFab II, and interfaced systems.

**Handling:** We guarantee less than 0.01% substrate breakage (one wafer in 10,000) on all MultiFab equipment. MultiFab's transport systems use pick-and-place technology and minimal substrate transfer paths for the cleanest, fastest, and most efficient handling available today.



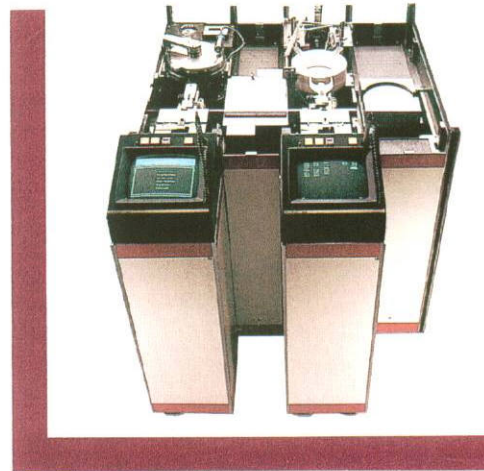
## ...for advanced device production.

Having MultiFab on your line gives you much more than the best track basics: transport, contamination control, and reliability. MultiFab also provides you with process performance and options that no other track can touch. MultiFab is continually upgraded with state-of-the-art techniques and components. Only MultiFab provides a new level of flexibility, in terms of configuration, process options, interface capability, and adaptability.

**Processing:** MultiFab's outstanding performance is based on the attention to detail we give each individual process module. MultiFab offers something extra for every process: whether it's MTI's VaporJet II develop-dispense nozzle, a 275°C hot plate, or the VacuPryme vacuum vapor-prime module.

**Modularity:** MultiFab's modular design provides you with more than easy maintenance and repair—it also gives more process per square foot than any other track equipment. The modular design allows MultiFab to adapt to process changes with simple upgrade installations.

**Flexibility:** Your MultiFab track, MultiFab II, or interfaced system offers a wide range of formats to fit your fab area and application. Whether you need replacement tracks, additional process capability, or new equipment, MultiFab is your best choice for the long run.



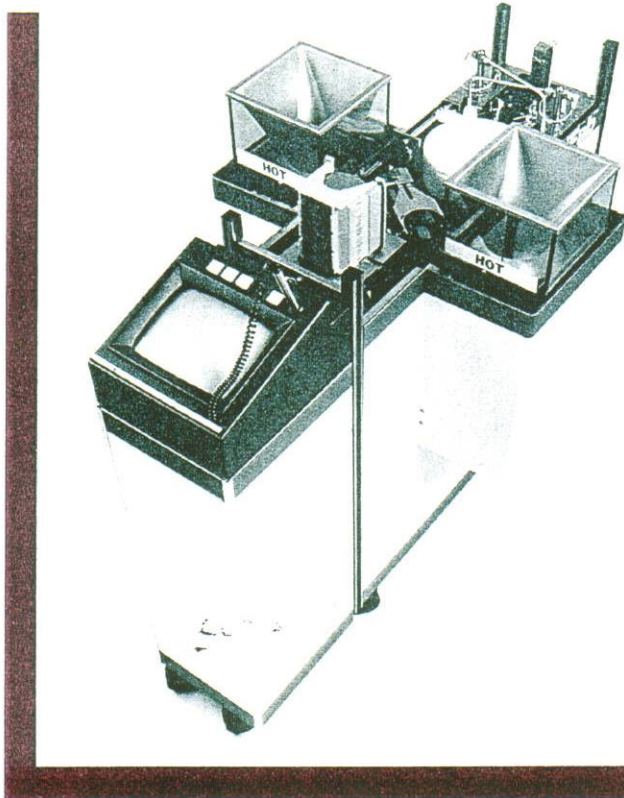
# MTI



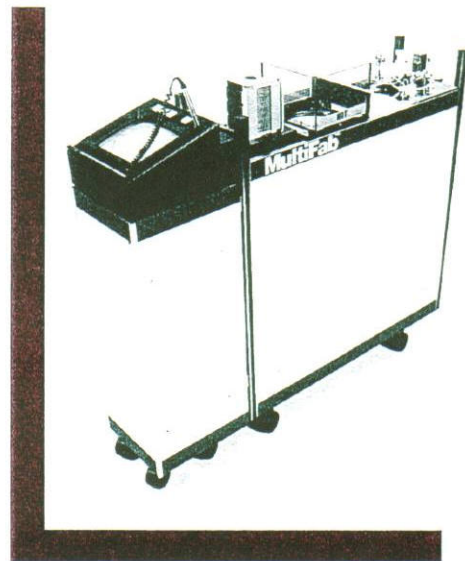
# MultiFab<sup>®</sup>

SUBSTRATE PROCESSING SYSTEM

S P E C I F I C A T I O N S



Coat/Bake  
Configurations



**MTI**

# MultiFab System Specifications

---

## CONFIGURATION

---

SYSTEM DESIGN:	Base chassis provides mounting locations and facilities connections for drop-in process and handling modules
PROCESS FORMATS:	Coat/single-bake and coat/dual-bake versions; dual-bake systems programmable for sequential or parallel bake processes
TRANSPORT FORMAT:	Automated single-cassette with slot-to-slot integrity
TRANSPORT METHOD:	FlexiArm pick-and-place system available on single and dual-bake systems <ul style="list-style-type: none"><li>- full backside-support vacuum hand</li><li>- programmable to process cassettes from top-to-bottom or bottom-to-top</li></ul> Flexible-band load arm available only on single-bake systems <ul style="list-style-type: none"><li>- vacuum tip secures substrate</li><li>- processes cassettes from bottom-to-top</li></ul>
MATERIAL SIZES:	76mm - 150mm diameter wafers; rectilinear materials to 100mm x 100mm
CASSETTE TYPES:	All H-Bar cassettes, 3/16" or 1/4" pitch
CHASSIS FEATURES:	Removable Alucobond® side covers Four leveling casters on track and controller Pneumatic floor brake Exhaust plenum at bottom of track maintains clean air flow through system

## ELECTRONICS

---

CONTROLLER:	8086 microprocessor
USER COMMUNICATIONS:	Power On/Off, Run, Reset and Stop switches Light-pen selection of CRT-displayed programming options/parameters Key switch and access code for security lockout of process creation/edit and diagnostics functions Real-time display of hot plate temperature, spin speed and process step Error message display SECS I and II capability
PROGRAM CAPACITY:	9 processes composed of 9 recipes, each recipe composed of 9 steps each; 45-process storage optional
PROGRAM STORAGE:	Non-volatile E <sup>2</sup> PROM
DIAGNOSTICS:	Manual activation of all outputs, singly or in combination Real-time display of sensor status LED display of I/O line status

## SPIN MODULE

---

MOTOR FEATURES:	115 VDC direct-drive motor with double-sealed bearings; N <sub>2</sub> purge optional Optical digital encoder for spin-speed control Mechanical indexing device for rectilinear substrates optional
PROCESS CUP FEATURES:	All-Teflon® cup matched to substrate size Design prevents splashback and creates symmetric exhaust pattern Programmable cup rinse Dispense nozzle fluid catches Single drain with fluid/exhaust separator Adjustable exhaust damper and flow-level sensor One-gallon internal sump with liquid-level sensor; external sump with liquid-level sensor or direct drain optional

# Coat/Bake Configurations

## COAT MODULE

PROCESS FEATURES:	Two radial-sweep dispense arms: one pneumatic and one motorized 1/8" or 1/4" O.D. dispense lines Nozzle tips less than 1/2" from wafer surface Millipore or Tritec pumps, or pressurized systems controlled by air-operated valves with fluid drawback Backside rinse/edgebead resist removal system; topside edgebead resist removal system optional One 1/8" O.D. stationary side dispense
PROCESS CONTROLS:	Adjustable dispense arm extend/retract speed Dispense arms programmable for static, dynamic, radial, and oscillating dispense actions Programmable predispense

## BAKE MODULE

PROCESS FEATURES:	Soft-bake (52°C - 150°C) and hard-bake (52°C - 275°C) versions 200 watt, 220 VAC heater plate; element compensated for edge-effects Thermocouple temperature sensor Hard-bake fume-exhaust system contains fumes, concentrates air flow over hot plate and creates symmetric exhaust pattern
PROCESS CONTROLS:	Temperature programmable in 1°C increments Vacuum pull-down in contact bake mode standard Transfer pins pneumatically controlled in soft-bake module and manually adjusted for proximity bake height Transfer pins stepper-motor controlled in hard-bake module and programmable in 0.001" increments for proximity bake height

## PERFORMANCE

SPIN-MOTOR CONTROL:	
Speed:	100 - 7500 rpm, programmable in 100 rpm increments
Acceleration:	30,000 rpm/sec. maximum, programmable in 10% increments
Control:	±40 rpm
RESIST-COATING UNIFORMITY <sup>†</sup> :	
Across-Wafer:	±50Å for films ≤1μ ±0.5% for films >1μ
Wafer-To-Wafer:	±0.25% of average across-wafer film thickness
BAKE CONTROL:	52°C - 150°C: ±0.5°C 150°C - 275°C: ±0.5%
CONTAMINATION CONTROL:	Particles ≥1μ added per wafer pass: <0.03 particles/cm <sup>2</sup>
THROUGHPUT:	60 wafers per hour typical, dependent upon process
RELIABILITY:	98% uptime guaranteed; less than 0.01% wafer breakage guaranteed

<sup>†</sup>Unless otherwise specified by material manufacturer.

