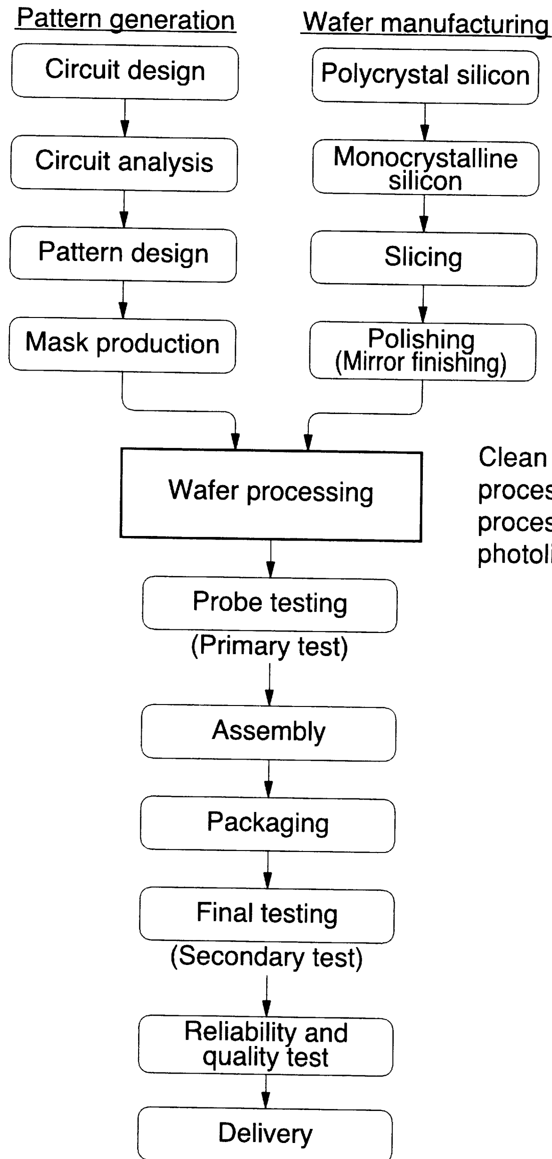
1.7 EQUIPMENT DESCRIPTION

1.7.1 Equipment Application

Clean Track MARK-7/8 is equipment used in various IC fabrication processes. The following figure shows IC development and fabrication processes.

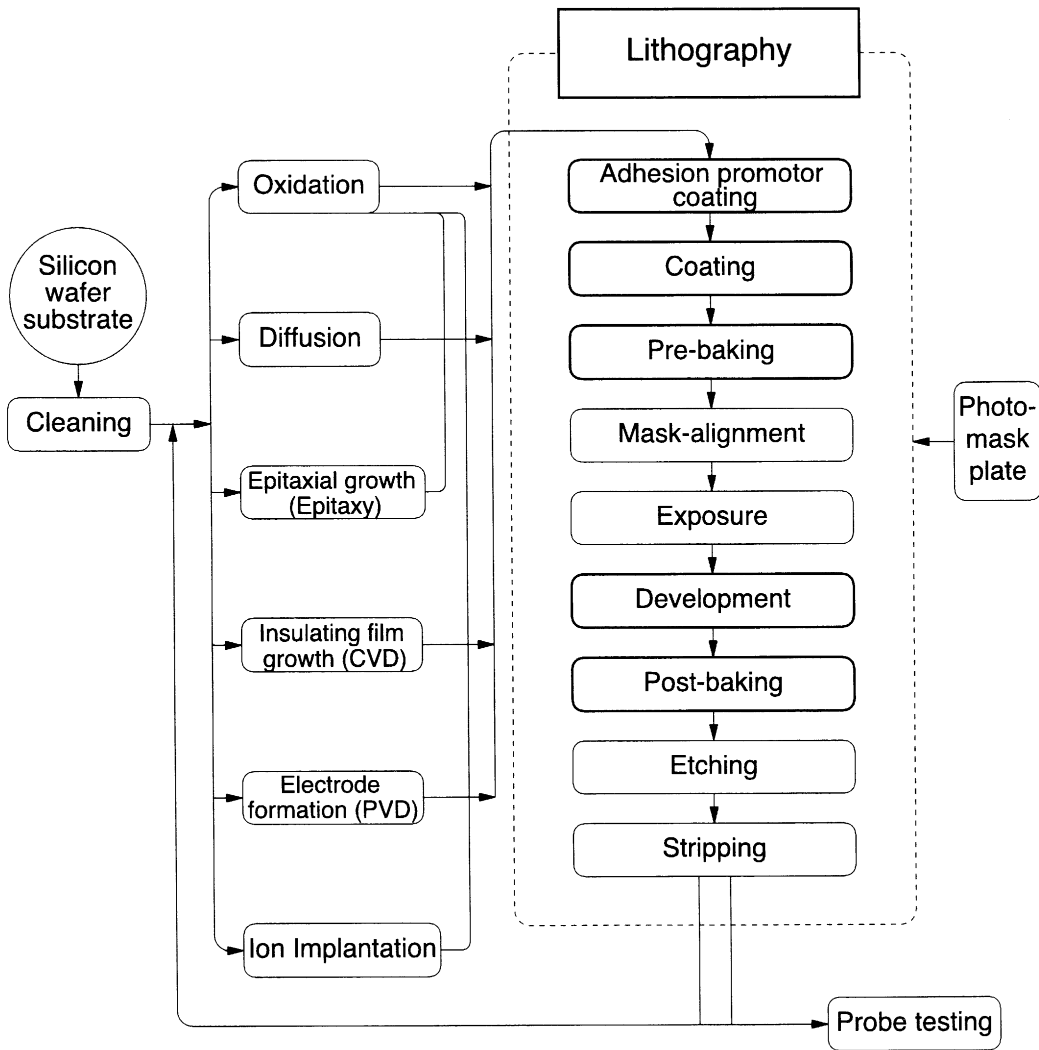


Clean Track MARK 7/8 is equipment used in wafer processing. The process is subdivided into several processes, and Clean Track is mainly used in the photolithography process.

IC Development and Manufacturing Processes

1.0 INTRODUCTION

The following figure shows the photolithography process.



Silicon Wafer Process Flow and Organization

Clean Track MARK-7/8 is primarily used for adhesion promoter coating, coating, pre-baking, development, and post-baking; it is usually called a resist processor (coater, developer, or oven). Clean Track MARK-7/8 automates each process in photolithography.
The units for all processes in photolithography in Clean Track are listed below. Equipment made by other companies is used for mask alignment, exposure, etching, and photoresist stripping.

Process Name	Unit Name
1) Adhesion promoter coating	Adhesion unit
2) Coating	Coater unit
3) Pre-baking	Hot-plate unit
4) Development	Developer unit
5) Post-baking	Hot-plate unit

1.7.2 Equipment Functions

The functions of each of the units installed in the Clean Track MARK-7 or MARK-8 are explained briefly. For details, please refer to *Chapter 4 Unit Overview* in this manual.

1) Carrier station (C/S)

Carrier stations are carrier-to-carrier, and are the block on which wafer import and export are based in wafer processing. A carrier station incorporates a carrier stage, on which up to four wafer carriers can be installed; a carrier station arm, which transfers wafers between carriers installed on the carrier stage and the main arm (M/A); a plasma display used to operate the carrier station; and a main controller that manages the overall equipment.

2) Process station (P/S)

This block contains units that perform wafer processing. Because a variety of units can be installed on this block, different wafer processes are executed by combining units as needed. The functions of each unit are explained below.

(1) Main arm (M/A)

The main arm is a mechanical transport mechanism within the process station, and having three pincettes. It uses combinations of the three pincettes to perform wafer transport between processing units and between neighboring blocks, in accordance with the flow of wafer processing.

(2) Coater unit (COAT)

The coater forms a uniform resist (photosensitive agent) film on a wafer by dripping resist onto the horizontal wafer, then rotating the wafer at high speed. It consists of a resist supply system, spin motor and cup; the wafer rate of revolution can be set to values of up to several thousand rpm.

(3) Developer unit (DEV)

After exposing a pattern on the resist coating the wafer, the developer drips developer solution onto the stationary wafer to develop the resist, after which the wafer is rotated at high speed, cleaned with deionized water, and spin-dried. Tokyo Electron's developer units are designed to specifications accommodating both spray and paddle processing. The developer unit consists of the liquid supply system, spin motor, and cup.

(4) Heat treatment unit (HT)

Heat treatment unit is a generic term for units that heat and cool wafers. In the Clean Track MARK-7 or MARK-8, this term refers to the adhesion unit, hot plate unit, cooling unit, and similar units. Following are explanations of the functions of each heat treatment unit.

1. Adhesion unit (AD)

To improve adhesion of the resist film to the wafer prior to resist coating, this unit applies HMDS -- hexamethyldisilazane or $(CH_3)_3SiNHSi(CH_3)_3$ -- in vapor form in an adhesion promoter coating process.

2. Hot plate unit (HP)

This unit subjects wafers to heat treatment on flat metal plates which have been surface-treated. A heater is mounted below the metal plate, and exhaust vents are located on the periphery and in the cover, to maintain the uniformity of the plate temperature.

3. Cooling plate unit (COL)

A cooled flat metal plate is used to cool wafers following heat treatment. Cooling water is circulated within the plate, utilizing electronic cooling based on the Peltier effect.

4. Dehydration hot-plate unit (DHP) <options>

This unit performs heat treatment to remove water so as to improve adhesion of the resist to the wafer, prior to resist processing.

5. Chilling Hot Plate unit (CHP) <options>

This unit has a mechanism for integrate heat history of heat treatment and cooling process of exposed wafer, prior to developing processing.

(5) Wafer edge exposure unit (WEE) <options>

In exposure systems and other systems, the resist at the edges of coated wafers may generate particles. This unit removes the resist at the edges of the wafer by exposing it. In contrast with removal by rinsing with chemicals, it is possible to remove the resist at the flat orientation edge.

(6) Scrubber unit (SCR) <options>

This unit uses either a high-pressure jet spray and brush or ultrasound to remove particles, organic and inorganic impurities, and other foreign matter that adhere to the wafer surface. The high-pressure jet spray is a stream of deionized water ejected from a nozzle under high pressure to peel and wash away impurities on the wafer surface; a rotating brush is pressed against the wafer surface and moved while applying deionized water to scrape away any matter adhering to the surface. In ultrasound cleaning (megasonic cleaning), ultrasound in the frequency range 800kHz to 1MHz is applied via deionized water to clean the wafer surface.

(7) Multipurpose exposure unit (MPE) <options>

After exposure, this unit irradiates the entire surface of a wafer with low-illuminance UV light to harden the resist surface, so as to improve the resolution of the resist pattern following development. After wafer exposure, either heating, or UV irradiation, or both methods are employed.

(8) Resist stabilizer unit (STB) <options>

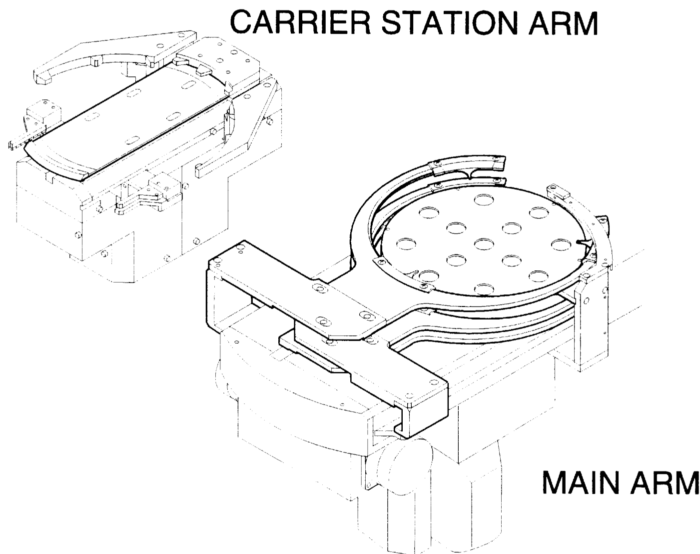
To ensure that the shape of the postdevelopment resist pattern is preserved up to higher temperatures, after development this unit irradiates the wafer with UV light to harden the resist and enhance its high-temperature stability. After wafer development, either heating, or UV irradiation, or both methods are employed.

3) Interface (I/F) *option

This block serves as a relay, transferring wafers between the Clean Track MARK-7 or MARK-8 and exposure units. The Clean Track system and exposure unit are joined in this block, for inline processing from resist coating to exposure and development processes.

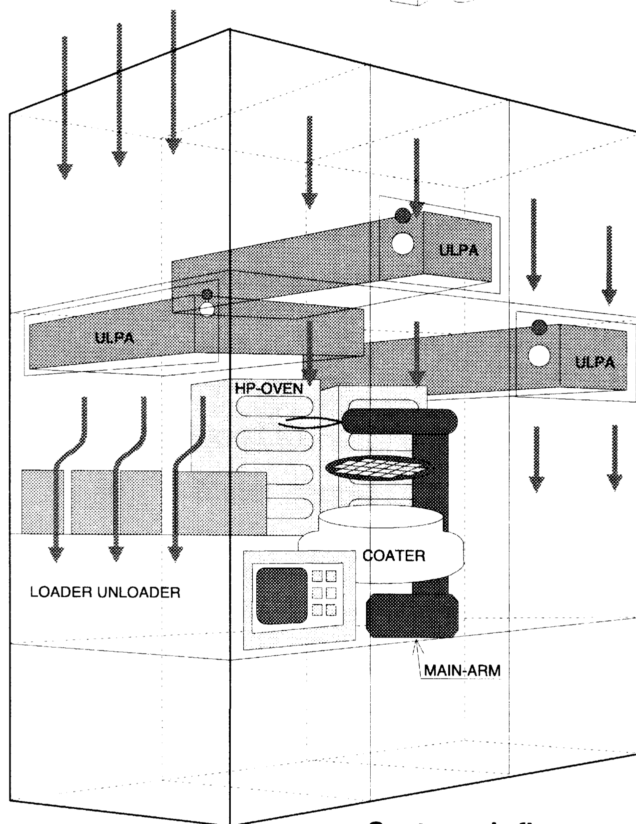
1.7.3 Overview of the Equipment

The Clean Track MARK-7/8 has made it possible for formation of firm strutum in multi piping process and for the consistence process of level by the photolighography which is based on the highly regarded MARK-7 and MARK-8 system for 8" wafers, but upgraded to fully meet customer demands for next-generation performance. The increase in equipment installation area accompanying the various changes of process is held to a minimum through the use of the perfect module method of each unit, which makes flexible system configuration possible, enhancement of the internal chemical processing areas, adoption of a side-loading type of the carrier station, and a shift to a four-stage vertical (stacked) design for the heat treatment unit.



Vacuum-free wafer handling during indexing is now possible. Wafer transport within the system is accomplished entirely through low-contact peripheral support for completely vacuum-free handling, greatly reducing the occurrence of particles on the wafer back.
By providing the main arm with three pincettes, it is possible to dedicate the wafer handling arm to the heat treatment unit, thus eliminating the influence of heat on wafers prior to coating and minimizing fluctuations in film thickness uniformity.

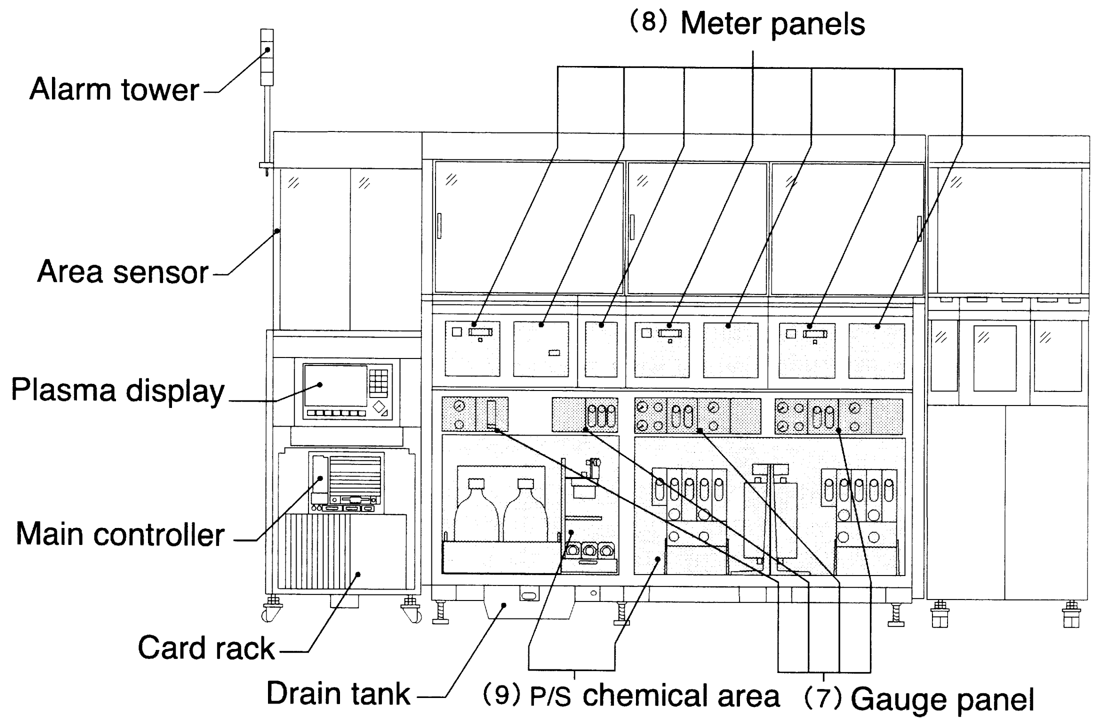
The closed system design of the MARK-8 system acts to suppress fluctuations in processes due to external influences, and control of the air flow within the system results in an even cleaner environment.

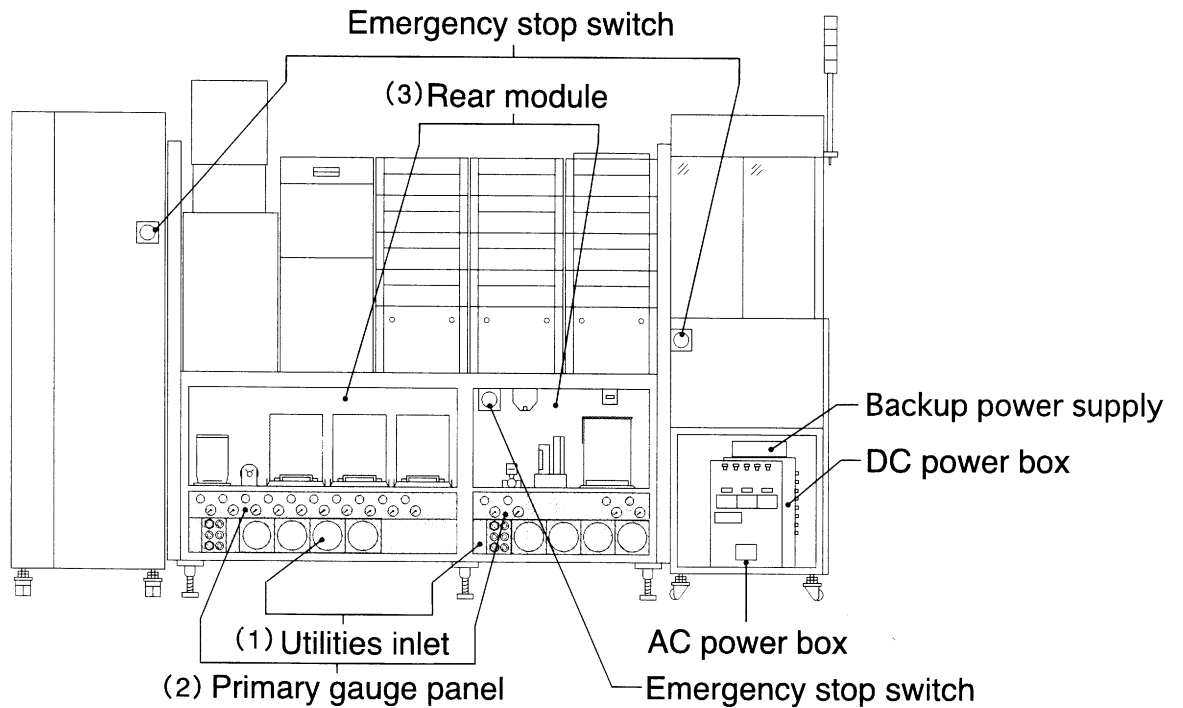


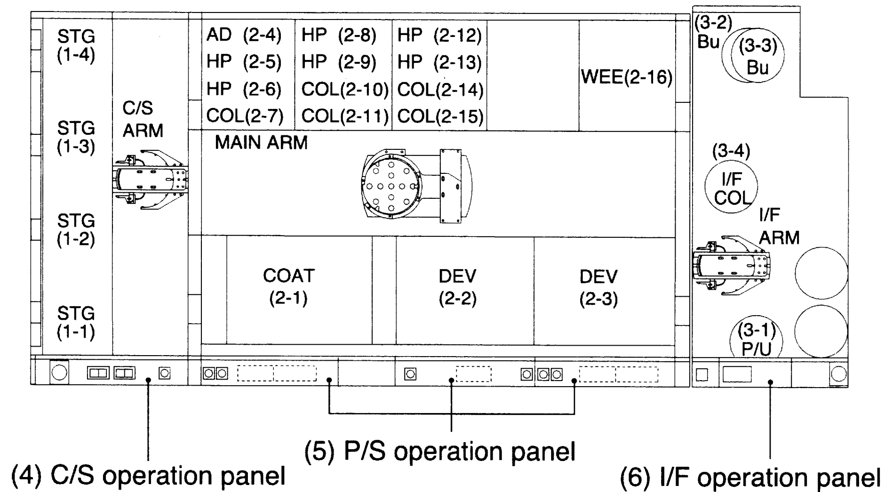
System air flow control

1.7.4 Basic System Configuration

1) MARK-7 specification system







(1) Utilities inlet

For connection of tubes for air, N_2, vacuum, D.I. (deionized) water, city water, developer solution, exhaust, waste liquid, etc.

(2) Primary gauge panel

For regulation of primary utilities.

(3) Rear module

Includes circulator pumps, motor drivers, air filters, and other equipment.

(4) C/S operation panel

Includes switch for 'ARM PAUSE' switch of C/S arm, 'SYSTEM ON/OFF' switch, emergency OFF switch, 'WEE ON/OFF' switch, and other switches.

(5) P/S operation panel

Includes switch for 'ARM PAUSE' switch of M/A, 'SPIN STOP' switch, WEE 'ILUMI MEAS' switch, the dummy dispense panel, step controller box, and other switches.

(6) I/F operation panel

Includes switch for 'ARM PAUSE' switch of I/F arm, cassette switch, emergency OFF switch, and other switches.

(7) Gauge panel

Includes flow meters, pressurized secondary regulators, drain tank sensor amps, and other equipment.

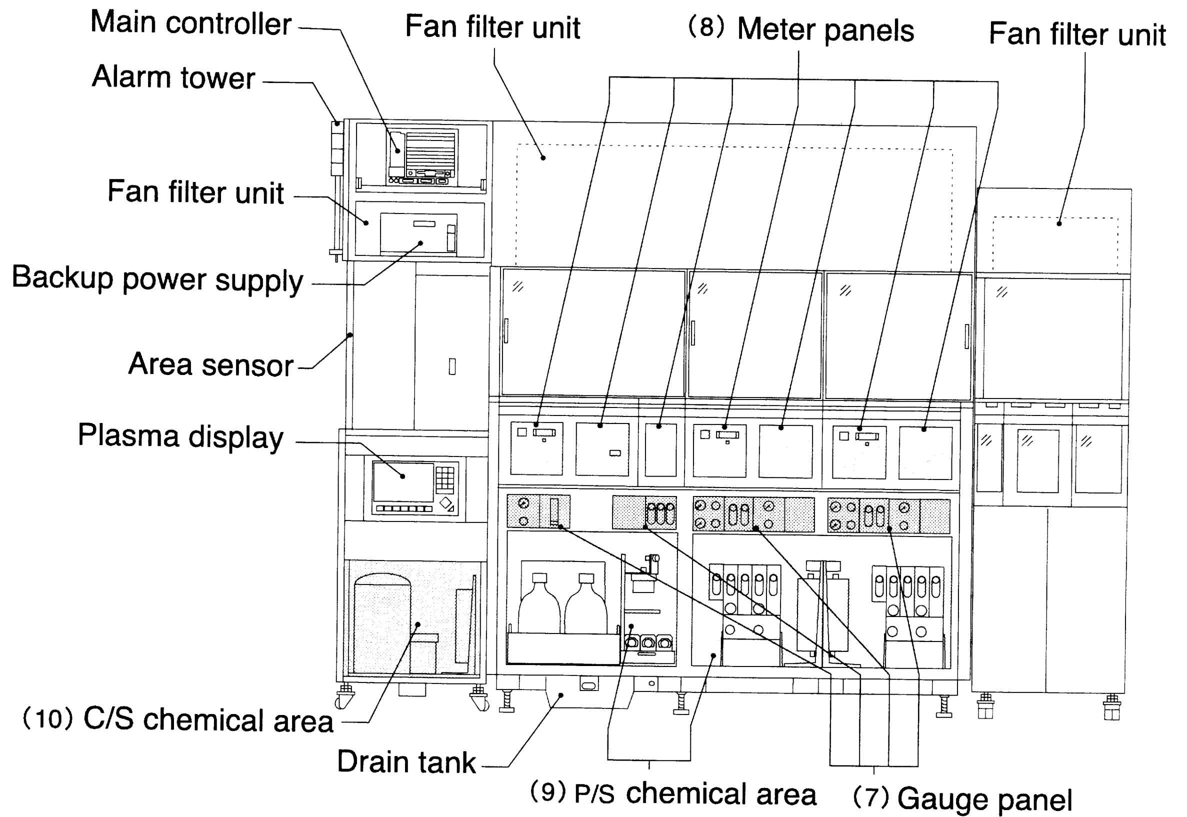
(8) Meter panels

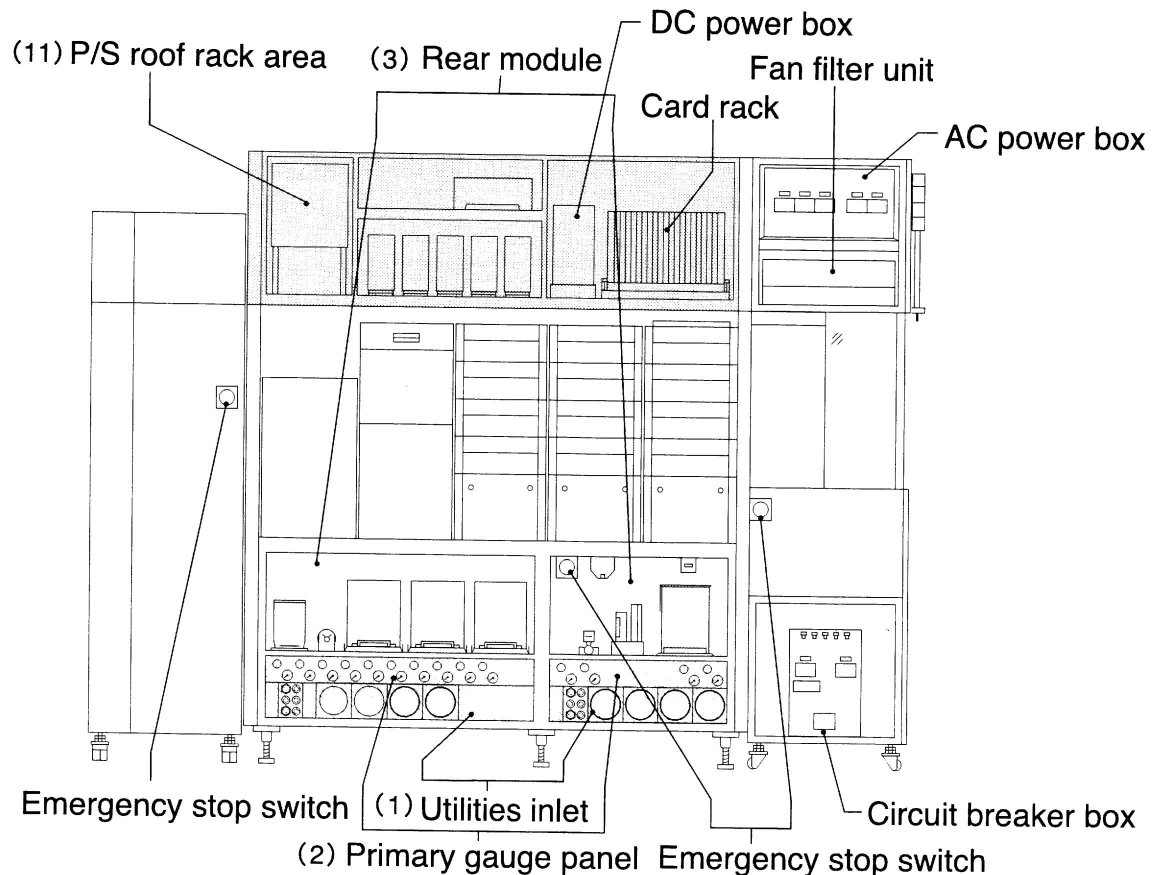
Include spinner vacuum sensors, spinner exhaust gauges, user boards, cup temperature and humidity controller wind velocity display panel, HMDS auto-supply operation panel, and other equipment.

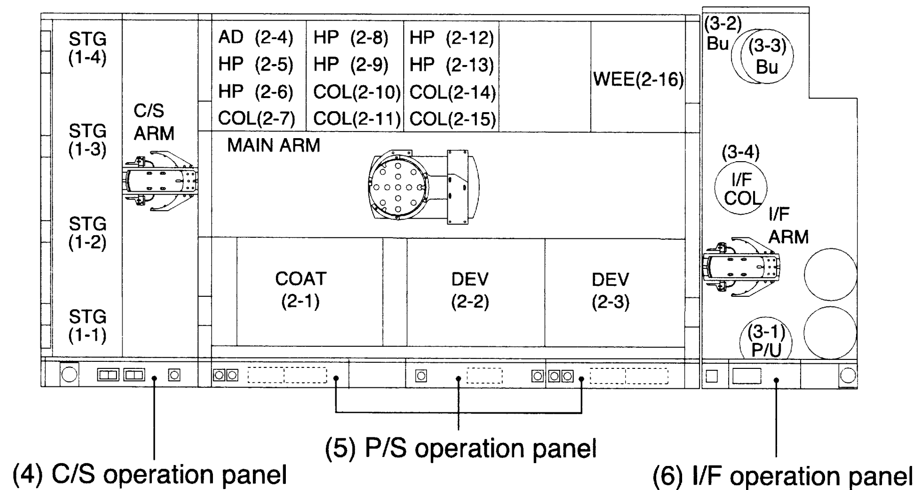
(9) P/S chemical area

Includes bottle carts (resist bottles, bubbler tanks), pump filter panels (resist), DEV panels (flow meter, filters), W/J panels (heat exchanger, air-operated valves, and other equipment.

2) MARK-8 specification system







(1) Utilities inlet

For connection of tubes for air, N_2, vacuum, D.I. (deionized) water, city water, developer solution, exhaust, waste liquid, etc.

(2) Primary gauge panel

For regulation of primary utilities.

(3) Rear module

Includes circulator pumps, motor drivers, air filters, and other equipment.

(4) C/S operation panel

Includes switch for 'ARM PAUSE' switch of C/S arm, 'SYSTEM ON/OFF' switch, emergency OFF switch, 'WEE ON/OFF' switch, and other switches.

(5) P/S operation panel

Includes switch for 'ARM PAUSE' switch of M/A, 'SPIN STOP' switch, WEE 'ILUMI MEAS' switch, the dummy dispense panel, step controller box, and other switches.

(6) I/F operation panel

Includes switch for 'ARM PAUSE' switch of I/F arm, cassette switch, emergency OFF switch, and other switches.

(7) Gauge panel

Includes flow meters, pressurized secondary regulators, drain tank sensor amps, and other equipment.

(8) Meter panels

Include spinner vacuum sensors, spinner exhaust gauges, user boards, cup temperature and humidity controller wind velocity display panel, HMDS auto-supply operation panel, and other equipment.

(9) P/S chemical area

Includes bottle carts (resist bottles, bubbler tanks), pump filter panels (resist), DEV panels (flow meter, filters), W/J panels (heat exchanger, air-operated valves, and other equipment.

(10) C/S chemical area

Includes resist gallon bottles, filters, HMDS canister tank, drain bottles, 45cc L/E (liquid empty) sensors, and other equipment.

(11) P/S roof rack area

Includes motor drivers, multithermocontrollers, cooling plate power BOX, WEE lamp housing, and other equipment.

3) Features of the MARK-8 that differ from the MARK-7

(1) The main controller and the AC power box, and other power supply equipment is installed in the carrier stations or in the process station layered section.

(2) Fan filter units (ULPA filter) can be installed in the layered section of each block. These are standard equipment in the process station section, but are options in the carrier station and interface sections. In addition, when cup temperature and humidity controller filters are installed in process station spinner units, it is not possible to install an ULPA filter in the top of the spinner unit.

(3) A C/S chemical area is included, and piping parts of the chemical supply line can be stored.

(4) Outside temperature controller racks and outside-rack chemical boxes have in essence been abolished, and the motor drivers, multithermocontrollers, and other equipment which had been installed in outside racks are installed in process station stacked parts.

1.7.5 Equipment Flowchart

! NOTE

This flowchart shows wafer processing in the general in-line equipment of Clean Track MARK-7/8 marketed by Tokyo Electron.