

CLEANLINESS CHALLENGES DUE TO AMHS MAINTENANCE

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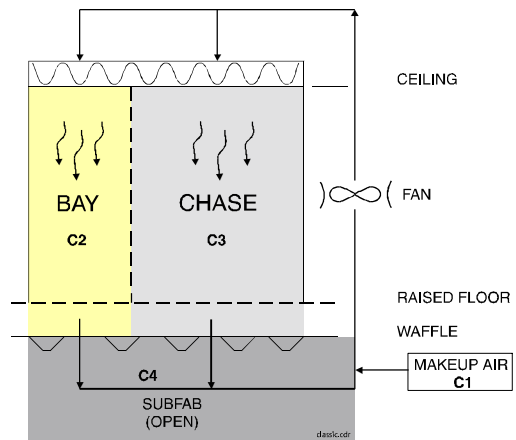
The automation tools used in the support of the manufacturing of wafers have evolved greatly over the past 10 years. What was once a simple loop of track connecting stockers at the head of the bay in order to help manage the WIP storage and lot delivery has quickly become one of the key enablers for manufacturing in the 300mm environment. Automation systems now reach into all areas of the fab as we continue to migrate to lot movement directly from tool to tool.

This extension to new areas of the fab requires that we consider how these developing material handling systems impact the operation of the cleanroom. Hoist systems, used to deliver from stockers to the process tool, now extend down every bay with track networks over each process tool. Systems are under development for the automation of reticle delivery from central stocker storage to lithography tools. These types of extension change how we need to manage the environment local to the process tool, and ultimately to the wafer level.

Further considerations are needed for both planned and unplanned maintenance of these systems. Such close proximity of the tools changes our procedures for support and maintenance.

First, it is important to understand the evolution in cleanroom air management systems. Significant changes have occurred in this technology during the transition from 200mm to 300mm manufacturing. Figure 1 represents the traditional ballroom approach. Air dedicated to the clean manufacturing areas (bay) was filtered to Class 1 quality. This was necessary because wafers were in open cassettes during handling.

As SMIF technology gained greater acceptance and minienvironments became more consistent, the cleanroom environment became more relaxed. All 300mm tools are designed with integral minienvironments by the tool manufacturers. 300mm facilities



Wafer Exposed to Contamination Sources: $C_1 + C_2 + C_3 + C_4$

Figure 1 - Classic Ballroom Cleanroom Schematic

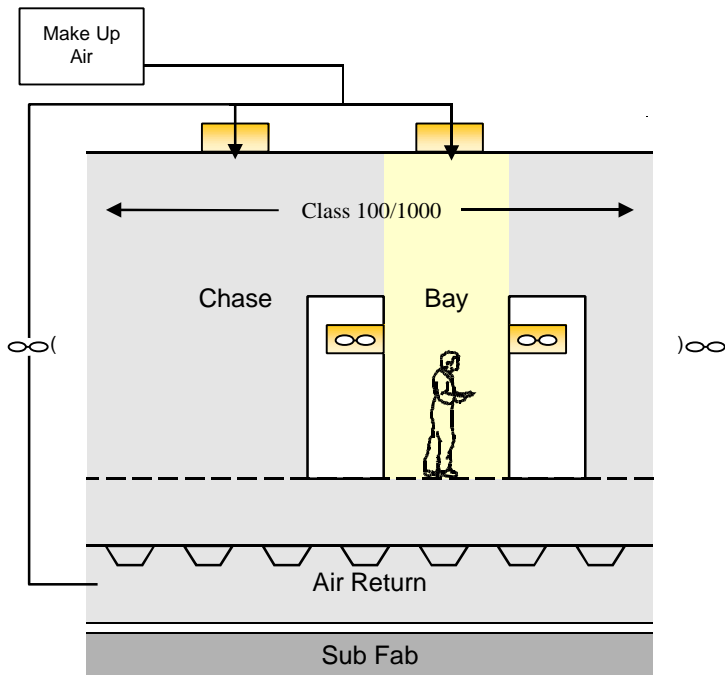


Figure 2 - Mini Environment Cleanroom

being built and operated now are specified at Class 100 to 1000. Air recycling is employed for heat management and removal of particulate generated from the maintenance areas of the process tools. Figure 2 illustrates an example of this configuration. Note that the minienvironments are responsible for the maintenance of the local environment of the wafer.

Current AMHS systems operate within a cleanliness range of Class 1 to Class 100. Stocker systems consistently achieve a Class 1 rating with inter- and intrabay systems achieving a Class 10 to 100 range, depending upon the vendor and defined configuration set. Some vendors provide the option of additional filter systems to help manage any particulate generated through the use of their systems. Thus, the clean operation of today's systems, coupled with the use of FOUP technology and minienvironments, has minimized the risk of direct contamination by the automation system.

However, application and support of the material handling system must be conducted in an appropriate manner to maintain acceptable levels of clean operation while maintaining adequate throughput. The approaches are very application dependent. For example, the constraints for a Class 1 clean facility will differ greatly for those of a Class 100–1000.

One key to proper support configurations is the importance of laying out the equipment consistently with the expected operation of the cleanroom. Examples include locating maintenance access for stockers in the gray areas for airflow, positioning interbay-stocker interfaces away from the main processing areas, and dedicating vehicle maintenance areas and offload points in areas outside of the main processing area.

Figure 3 illustrates the key areas of interest when considering stocker maintenance. Primary accesses to internal stocker systems are traditionally located in a fixed rear door position. While not mandatory, door location should be oriented in the fab area dedicated for support areas. The interbay interface point is also an area prone to maintenance issues, as certain stocker designs utilize dedicated robot system routing mechanisms to manipulate lot entry into the stocker. Again, location of these areas should consider proximity to the manufacturing environment.

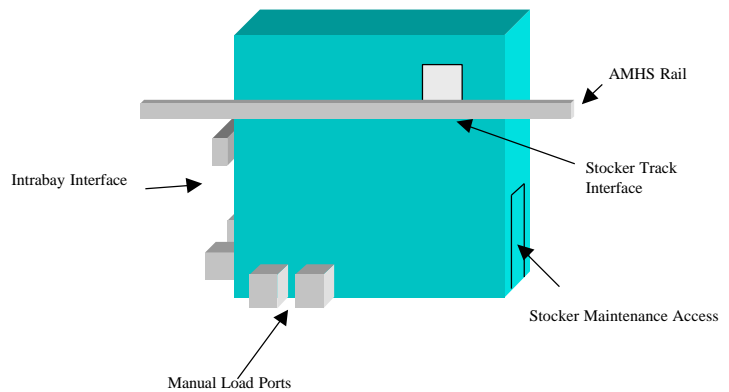


Figure 3 - Key Stocker Areas

Maintenance Planning
<ul style="list-style-type: none"> ● Stocker maintenance areas located in appropriate zones ● Vehicle maintenance area located away from main cleanroom area ● Vehicle removal using recommended methods ● Appropriate access to track systems located in tall central aisles ● Manual test wafer protocol relative to material handling equipment layout

Stocker placement usually takes one of two configurations. First is a traditional center aisle approach. Stockers are coupled more to the bay. There is usually a minimum of 2 stockers per bay. Stocker maintenance is usually provided along the chase-defined area of the local bay. Figures 4 and 5 illustrate this concept.

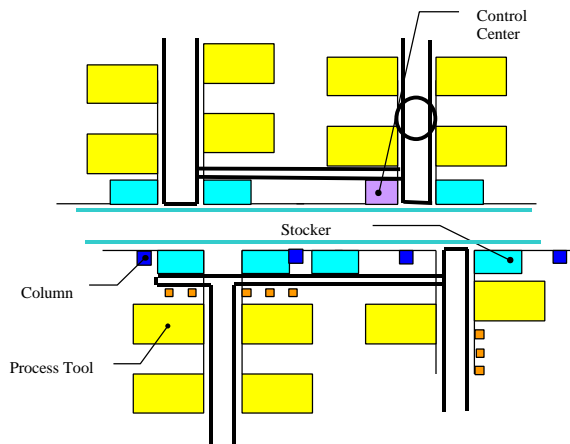


Figure 4 - Open Central Aisle

space along the central aisle is also utilized as part of the air return system. Further space study would then be required to understand the impact to available space for maintenance personnel during both installation and operational support.

As mentioned earlier, certain cleanroom configurations will feature tall central aisles. Figure 6 shows a version of this configuration. Noting the extreme elevation of the interbay system, maintenance technicians need to utilize special elevation equipment to reach these areas. Use of these types of equipment increases the risk of external contaminants being introduced to the environment. Interbay-stocker interfaces will be the focus of this type of activity.

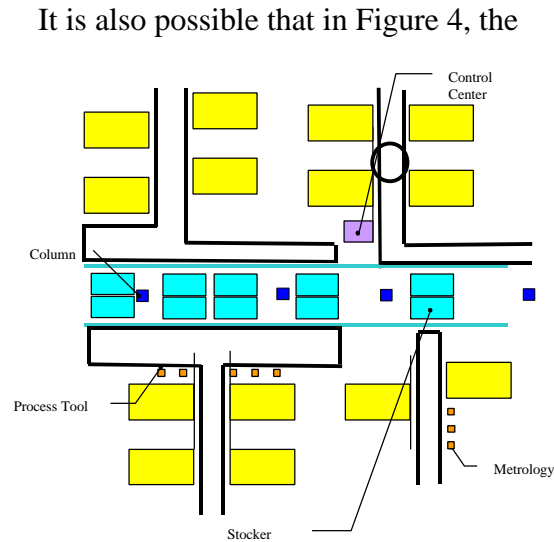
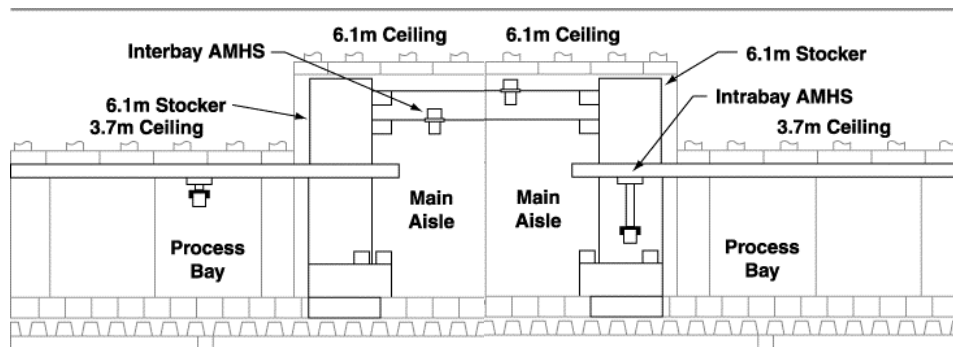


Figure 5 - Split Central Aisle



300MM AMHS Concept

Figure 6

Tall stocker configurations are not limited to the application of central aisles. Figure 7 illustrates additional configurations that will challenge cleanroom maintenance staff. Access to alternate floor storage or processing

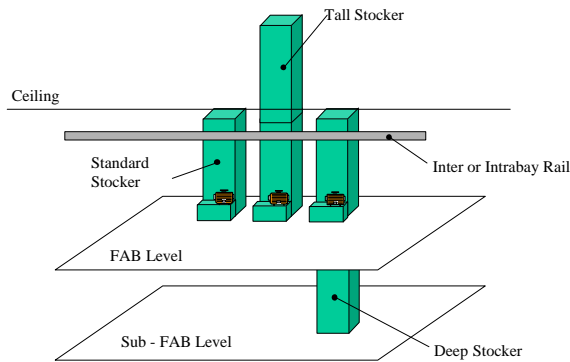


Figure 7 - Stocker Elevation Versions

areas and extensions above the cleanroom ceiling constitute challenges in maintaining these systems. Consider gaining access to an interbay track system that operates above the cleanroom ceiling. Such a configuration requires that personnel can gain access to this area quickly to resolve any stoppage along the track line. Adequate access to the stoker-track interface is necessary, as well as special maintenance procedures to minimize contamination within the stoker due to service activity in a non-clean space.

It is important to recognize that the impact of AMHS systems on cleanliness in the fab has been reduced with the advent of minienvironment technology. This relaxation provides for greater flexibility when routing track over process and measurement tools, and developing alternate storage locations and track routing opportunities external to the manufacturing floor of the cleanroom. However, it is still necessary to locate these equipment sets so that maintenance is performed in acceptable areas of the cleanroom, and not in the proximity of the load ports or air intakes of the minienvironment systems. It is mandatory to consider these situations when designing the AMHS layout. This need is further amplified in systems that utilize multiple floor manufacturing or tall stoker systems both inside and outside the cleanroom.