



HALCO PRODUCTS COMPANY
100 N. Gordon Street – Elk Grove Village, IL 60007-1193
Tel: 847-956-1600 Fax: 847-956-0595
E-mail: info@halco-products.com · Website: www.Halco-Products.com

SECTION 01 35 13.49

CLEAN ZONE CONSTRUCTION MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

Section Includes:

1. Requirements for the Clean Zone Contractor: The Clean Zone contractor is assigned by the Contractor and is responsible for direction and coordination of Clean Zone construction.
2. Responsibilities and authority for the Clean Zone Director, referred to as "Director" in this Section. The Director is assigned by the Contractor.

b. Related Sections:

1. Section 01 35 13.46 Clean Zone General Requirements.
2. Section 01 43 45 Outgassing Criteria for Clean Zone Products.
3. Section 01 74 13.13 Clean Zone Cleaning Procedures.
4. Section 08 71 00 Door Hardware.
5. Section 23 05 93 Air Systems Testing, Adjusting, and Balancing.

1.2 DEFINITIONS

Refer to Section 01 35 13.46, Clean Zone General Requirements, for applicable definitions.

1.3 QUALITY CONTROL

- a. Review the procedures and work performed on a continuous basis to verify compliance with these requirements.
 1. Report deviations from the Contract Documents to the Contracting Officer and the Director.
 2. Correct deviations to the satisfaction of the Contracting Officer prior to further work in the affected area.
 3. Continuously maintain cleanliness levels for each construction stage. Retest and reclean the area as required until specified cleanliness can be attained.
 4. Develop work-around procedures and obtain approval from the Contracting Officer and the Director for unusual work activities required out of protocol sequence or for freak occurrences that result in excursions from protocol contamination levels.
- b. Provide training for new construction personnel before they receive badges and clearance to work inside the building and Clean Zone.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

- c. Create and maintain weekly activity reports that summarize the following activities:
 1. Cleanup crew operations for the previous week.
 2. Clean Zone particle counts for the monitoring test stations on each day of the previous week.
 3. List of visitors entering the Clean Zone for the previous week.
 4. List of tools, equipment, materials, and other items entering the Clean Zone for the previous week.
 5. List of construction workers authorized to enter the Clean Zone for the upcoming week.

- d. Manufacturer Field Services: Provide a manufacturer's technical representative for whose products require field application, assembly, or installation by workers who are not direct employees of the manufacturer. The technical representative's duties include:

1. Observing field conditions, dimensional verification, quality of surface finishes, and other field conditions essential to acceptance and use of the finished product.
2. During subsequent work activities provide periodic, timely inspection and counseling to ensure system complies with factory requirements.

1.4 CLEAN ZONE DIRECTOR

- a. The Clean Zone Director is responsible for construction and startup activities covered by this section.
- b. General Responsibilities:
 1. Enforce the clean build policies (as described in the various specifications addressing the Clean Zone or Cleanroom).
 2. Supervise receiving, unloading and storage of products used in constructing the cleanroom, including but not limited to, ceiling grid, raised access floor, wall system, cleanroom filters, fan filters and recirculation air handlers.
 3. Direct testing, adjusting, and balancing contractor (TABCO) on retesting, adjusting, and balancing required during the cleanroom certification process.
 4. Verify Cleanroom Certification contractor (CCC) field correlation of instruments. Readings taken with equipment not qualified by this process will be considered invalid and unsuitable for test results or verification.
 5. Attend construction coordination meetings.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

6. Log and document major construction events, as well as decisions made in the course of their completion.
7. Plan the overall clean build program, organize the training program for workers, oversee the protocol training sessions required by persons entering the Clean Zone, and supervise and coordinate the cleaning procedures performed during construction.
8. Advise the Contracting Officer in writing when, in the Director's judgment, ongoing construction activities might jeopardize successful startup, operation, or performance of the cleanroom.
9. Clean Zone Director shall be on-site on a full-time basis during construction activities during Stage 3, 4, and 5 construction in the Clean Zone and Cleanroom.

c. Clean Construction Authority:

1. The Director will be vested by the Contractor with authority over construction operations inside the Clean Zone including workers, visitors, service personnel, and any others entering the Clean Zone or Cleanroom. If the Tool Install phase (by Others) occurs during construction of the Base Build project (see definition in Section 01 35 13.46 Clean Zone General Requirements), Tool Install contractors will be subject to the authority of the Director.
2. The Director may be supported by assistants necessary to help with Clean Zone access, inspections, protocol, training, documentation, and contamination monitoring. Such assistants shall be supervised by the Clean Zone Director.
3. Identify the Director and support staff by special clothing, hardhats, and badges.
4. Provide construction personnel regular training on clean construction protocol, whether through formal meetings or through on-the-spot counsel.
5. Provide special training on clean protocol for workers, visitors and the Owner's personnel prior to their entry into the Clean Zone.
6. Reprimand persons found in violation of posted construction protocol or security procedures. Reprimand persons who fail to comply with directives issued by the Director or who disregard the requirements of the clean construction protocol. Impose the following jobsite restrictions:
 - (a) First Violation: Issue person a verbal warning and place a written notice in their job record.
 - (b) Second Violation: Order person to leave the jobsite for the remainder of the work shift, and place a written notice in their job record.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

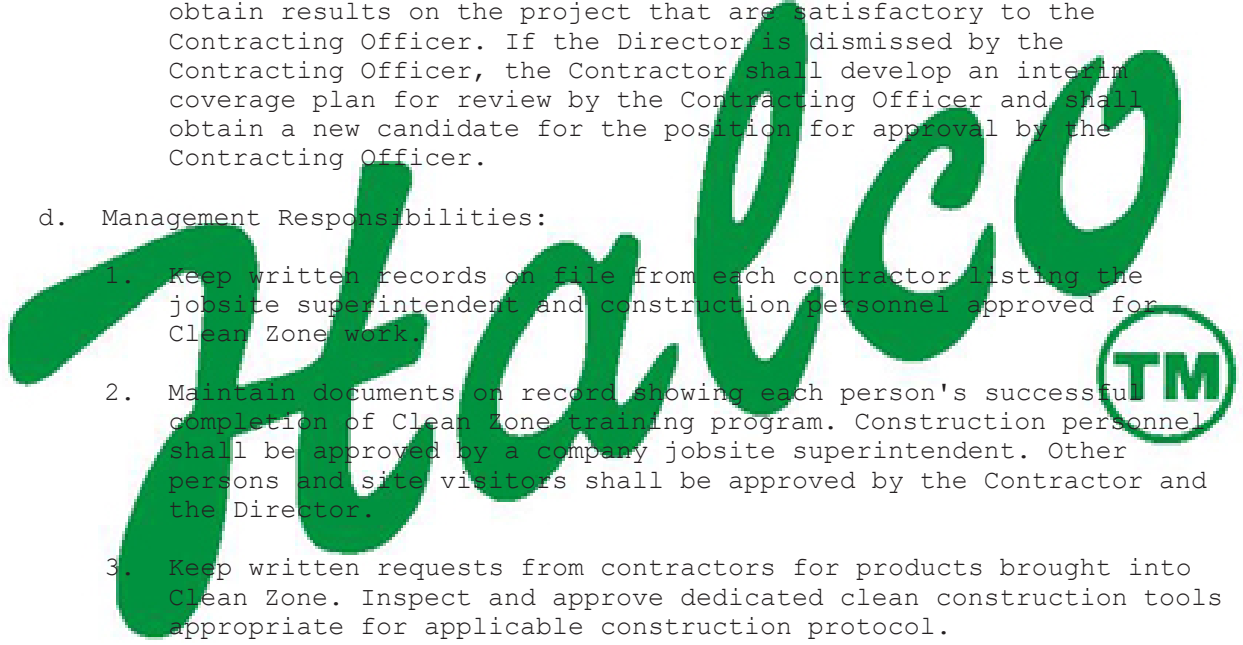
(c) Third Violation: Order person to leave the jobsite for the duration of the project. Place a written notice in their job records. Revoke their jobsite clearance.

(d) Deliberate or Flagrant Violation or Sabotage: Order person to leave the jobsite immediately for the duration of the project. Place a written notice in their job records. Revoke their jobsite clearance.

- 7. The Director shall be the sole judge regarding violations of protocol and security. Exemptions requested from posted procedures shall be approved in writing by both the Director and the Contracting Officer.
- 8. The Contracting Officer has the authority to dismiss the Clean Zone Director if he/she fail to perform their responsibilities and obtain results on the project that are satisfactory to the Contracting Officer. If the Director is dismissed by the Contracting Officer, the Contractor shall develop an interim coverage plan for review by the Contracting Officer and shall obtain a new candidate for the position for approval by the Contracting Officer.

d. Management Responsibilities:

- 1. Keep written records on file from each contractor listing the jobsite superintendent and construction personnel approved for Clean Zone work.
- 2. Maintain documents on record showing each person's successful completion of Clean Zone training program. Construction personnel shall be approved by a company jobsite superintendent. Other persons and site visitors shall be approved by the Contractor and the Director.
- 3. Keep written requests from contractors for products brought into Clean Zone. Inspect and approve dedicated clean construction tools appropriate for applicable construction protocol.
- 4. Access Clean Zone through designated personnel gowning and material staging and preclean areas only. Maintain separate Clean Zone log books for each construction stage beginning with Stage 3. Document timed entries for persons and materials entering or leaving the various construction areas. Exemptions requested by the contractors from posted procedures shall be approved in writing by both the Director and the Contracting Officer.
- 5. Manage the badge system, which identifies a person's protocol and safety training completion necessary to enter the Clean Zone.





HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

- 6. Maintain project files to document and validate clean construction activities. Include class presentation materials, test results, photos and videos, particle count charts and profiles, temperature and humidity charts and profiles, Clean Zone logs, and personnel violation notices. Deliver clean construction files to Contracting Officer before date of Substantial Completion.

e. Director Qualifications:

- 1. Minimum of 10 years' experience constructing, testing, and qualifying cleanrooms in the electronics industry.
- 2. Completed at least one project similar in design and arrangement to the type being constructed of a multilevel fabrication area to perform submicron wafer technology under ISO Class 4 or better conditions.
- 3. Previous projects supervised by the proposed Director shall not have been involved in litigation for reason of personal integrity, building or utility system performance, or nonperformance of his employer.
- 4. Comparable experience in design, construction, or operation of cleanrooms will be considered by the Contracting Officer.
- 5. The Contracting Officer reserves the right to accept or reject proposed Director candidate(s).

1.5 SUBMITTALS

Architect's approval is required for submittals with a "A" designation; submittals not having a "A" designation are for information only. When used, a designation following the "A" designation identifies the office that will review the submittal for the architect. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Clean Zone Director Experience; A, AE

Proposed protocol for temporary cleanrooms; A, AE

Proposed protocol training program; A, AE

Name and qualifications of independent certification testing agency for temporary cleanrooms; A, AE

Performance and Method Statements; A, AE

SD-02 Shop Drawings

Shop Drawings; A, AE



HALCO PRODUCTS COMPANY
100 N. Gordon Street – Elk Grove Village, IL 60007-1193
Tel: 847-956-1600 Fax: 847-956-0595
E-mail: info@halco-products.com · Website: www.Halco-Products.com

SD-06 Test Reports

Weekly activity reports; A, AE

Monthly Reports; A, AE

Refer to the Submittal Schedule at the end of Part 3 for more detail on the submittal requirements for this Section.

1.6 TRAINING AND BADGE REQUIREMENTS

a. Training Sessions:

1. Monitor the protocol training sessions organized and presented by the Director for workers who will be assigned tasks within Clean Zone. Workers shall undergo this training before they are permitted to work inside Clean Zone.
2. Implement a system of Clean Zone identification badges, which permit Director and Contracting Officer to know that workers within Clean Zone have been properly trained and are authorized to work within the area.

b. Badge Control:

1. Maintain logs of qualified personnel working on the jobsite and those authorized inside Clean Zone.
2. Issue photo identification badges to personnel on the jobsite.
3. Include a passport-size photograph of individual on the badge, along with name and company affiliation laminated onto a color-coded background with clip. Badges shall be worn at all times when personnel are on the jobsite.
4. Apply special color stickers to identify completion of protocol and safety training sessions required for clearance into Clean Zone.
5. Use separate color coding for each construction stage to identify clearance authorized for each level. Refer to the program specified in Section 01 35 13.46, Clean Zone General Requirements.

1.7 CLEAN BUILD CONSTRUCTION

a. Responsibility:

1. Aspects of clean construction including worker protocol, training, temporary gowning and staging cleanrooms, and cleanup. Follow Section 01 35 13.46, Clean Zone General Requirements, in the performance of this work.
2. Coordinate with the specialty cleaning contractor responsible for overall cleanliness and contamination control of Clean Zone. Perform continuous and special cleaning required for construction



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

Stage 1 and 2 by Section 01 74 13.13, Clean Zone Cleaning Procedures.

3. Provide enclosed containers with disposable liners placed strategically around Clean Zone for construction debris.
4. Provide walkway mats and sticky walkoff mats, clean or replace as described for each construction stage.
5. Arrange walkway to provide separation and identification barricades to achieve each protocol level.
6. Provide and maintain clean storage racks and hangers to hang garments when workers are outside Clean Zone.
7. Provide and maintain shoe lockers to store clean work shoes when workers are outside Clean Zone.
8. Provide work suits for workers as required by Section 01 35 13.46, Clean Zone General Requirements.
9. Provide and maintain temporary personnel cleaning accessories as described, such as shoe cleaners, hand washers, electric hand dryers, and portable HEPA vacuum cleaners, until the permanent systems are installed and accepted by the Contracting Officer.

b. Entry/Mud Rooms:

1. Provide, outfit, and maintain entrance mud rooms at each building entry control point.
2. Install shoe scrapers, grates, and cleanup mats at the mud room to permit removal of mud and debris from shoes.

c. Pre-enclosure Meeting:

1. Prior to completing enclosure of Clean Zone areas at the end of construction Stage 2, schedule a meeting to coordinate and explain upcoming cleaning procedures and construction requirements, as well as review the arrangement of proposed gowning and preclean areas.
2. Attendees shall include, but not be limited to, representatives from the Owner, the Contractor, Architect, superintendents for contractors performing work, and component manufacturer's representatives furnishing equipment and materials in Clean Zone.
3. Schedule the meeting 30 days prior to scheduled completion of Clean Zone enclosure. Notify attendees' 14 days prior to meeting.

1.8 TEMPORARY CLEANROOMS

- a. Provide, outfit, maintain, and dismantle temporary cleanrooms as required.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

- b. Maintain continuous environmental control and air supply.
- c. Provide scanned cleanroom filters for temporary cleanrooms. Attach air diffuser plates/blades to the filter face to disperse discharge air laterally.
- d. Maintain temporary rooms until permanent rooms have been completed and certified or until the temporary rooms are no longer required and then dismantle and remove from the facility.

e. General Temporary Cleanroom Requirements:

1. Gowning:

(a) Provide gowning area to serve as contractors' change area for entering into Clean Zone. Include benches, shoe lockers, clothing racks, enclosed garbage containers with disposable liners, vertical laminar flow clean air hoods, portable drinking water stands and cups, and walkway identification barricades.

(b) Place semi-permanent barricades to restrict movement of personnel and materials to controlled entry points into Clean Zone. Separate the gowning area from other construction site activities by walls and doors.

(c) Provide packaged portable electric shoe cleaners at the entry into the gowning area. Provide and maintain two operable units at each gowning area.

(d) Provide auto-closing doors or strip curtains at the entrance to this area.

(e) Provide a multilayer tacky mat immediately inside the entry door.

(f) Provide hooks for hanging outdoor protective garments.

(g) Provide an area for storage of outdoor shoes.

(h) Locate benches in the gowning areas to create a barrier to unobstructed walk-through traffic. Use the benches to provide a convenient place to change from outdoor shoes to dedicated cleanroom shoes.

(i) Mount hanger or bar rods with hangers and curtains underneath HEPA-filtered supply air inlets. Provide sufficient storage racks for one dedicated garment, spaced 2 inches apart, for each worker who has been trained and authorized to enter Clean Zone, plus a quantity of 25 extra to be used by inspectors and the Contracting Officer's personnel. Locate rows of cleanroom ceiling filters strategically over the storage racks for cleanroom work garments.

(j) Place barriers or markers at the exit from the personnel gowning to identify separate pathways for people and material throughout the Clean Zone. Arrange barriers to minimize movement through the Clean Zone and reduce cross-traffic patterns.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

2. Equipment Staging, Preclean, and Storage Areas:

(a) Provide temporary equipment and tool staging area, material pre-clean area and storage areas. Include cleaning supplies, worktables, storage racks, and enclosed garbage containers with liners.

(b) Separate staging, preclean, and storage area from other construction site activities by walls and doors.

(c) Provide a staging area to serve as the staging and unpacking area for material and equipment entering the pre-clean area. Provide autoclosing doors or strip curtains at the entrance to this area.

(d) Provide a preclean area to serve as cleanup area for material and equipment entering Clean Zone. Provide auto-closing doors or strip curtains at the entrance to this area. Provide a multilayer tacky mat immediately inside the entry door.

(e) Provide a clean material storage area, separate from staging and pre-cleaning work areas to serve as the material/equipment secured and controlled storage area. Provide double lockable doors at the entrance to this area.

(f) Provide a small gowning room for equipment preclean and storage areas inaccessible from the main personnel gowning room.

(g) Place a packaged portable shoe cleaner at the exit from the staging area into Clean Zone and also at the entry into the pre-clean area. Provide and maintain one operable unit at each location.

(h) Provide a portable canister HEPA-filtered vacuum cleaner in the staging and pre-clean area for cleanup of material being moved into Clean Zone. Provide and maintain one operable unit at each location until the permanent housekeeping vacuum system is operable in this area.

(i) Place barriers or markers at exit from the staging and pre-clean areas to identify separate pathways for people and material throughout Clean Zone.

3. Temporary Clean Pipe Fabrication Shop:

(a) Provide cleanrooms used for the receipt, inspection, cutting, facing, cleaning, welding, and certification of components manufactured for ultrahigh-purity piping and distribution systems, including cleaning supplies, worktables, storage racks, and pipe holders.

(b) Provide a pipe staging area to serve as a material receiving, initial packaging inspection, and controlled storage area to



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

enable handling and storage of 20 foot lengths of tubing. Connect this area to adjacent prefab area with autoclosing doors and a manual door to the cutting and facing work area. Provide autoclosing doors at entrance and exit of this staging area, sized large enough to receive and unpack 20 foot lengths of tubing. Provide a multilayer tacky mat immediately inside the entry door.

(c) Provide a prefab work area for visual inspection, cutting, facing, and initial cleaning area. Separate inspection area from the cutting, facing, and cleaning area. Provide autoclosing doors at exit of this area to the ISO Class 5 inspection area described below. Provide a multilayer tacky mat immediately inside of entry door.

(d) Provide an inspection area for final inspection, final cleaning, fabrication, welding, and pipe bagging area. Provide a multilayer tacky mat immediately inside entry door. Provide an emergency exit door in this area. Isolate this area from the cutting and facing area by self-closing swing doors and pass-throughs. Limit access to this area to persons actually involved in the fabrication of the process piping.

(e) Incorporate a small gowning room if the pipe shop is separated and inaccessible from the main personnel gowning room.

(f) Place a portable canister HEPA-filtered vacuum cleaner in pipe staging area for cleanup of material being moved into the pipe shop. Provide and maintain one operable unit until the permanent housekeeping vacuum system is operable in this area.

(g) Provide makeup ventilation and fume exhaust that meets applicable safety standards. Provide sensing equipment to give audible alarms in the event of low oxygen levels.

(h) Size clean work areas to accomplish the defined tasks.

f. Room Criteria:

TABLE 1 - Temporary Cleanroom Criteria							
Criteria	Gowning	Material and Equipment			Pipe Fabrication		
		Preclean	Staging	Storage	Staging	Prefab	Inspect
Construction Stage cleanroom required	3	3	3	3	3	3	3
Cleanroom classification per ISO 14644-1	ISO 6	ISO 6	ISO 7	ISO 7	ISO 7	ISO 6	ISO 5



HALCO PRODUCTS COMPANY
 100 N. Gordon Street – Elk Grove Village, IL 60007-1193
 Tel: 847-956-1600 Fax: 847-956-0595
 E-mail: info@halco-products.com · Website: www.Halco-Products.com

Minimum filter coverage (percent)	25	25	10	10	10	25	50
Nominal filter face velocity (feet per minute)	100	100	100	100	100	100	100
Minimum filter efficiency, at Most Penetrating Particle Size (percent)	99.99	99.99	99.99	99.99	99.99	99.99	99.99
Average room velocity (feet per minute)	20	25	N/A	N/A	N/A	25	45
Minimum air changes per hour	N/A	N/A	30	30	30	N/A	N/A
Pressurization, relative to adjacent non-classified rooms (in. H2O)	0.03	0.03	0.02	0.02	0.05	0.05	0.02
Temperature (degrees F)	70 +/- 5	70 +/- 5	70 +/- 5	70 +/- 5	70 +/- 5	68 +/- 5	68 +/- 5
Relative humidity (percent)	45 +/- 15	45 +/- 15	45 +/- 15	45 +/- 15	45 +/- 10	45 +/- 5	45 +/- 5

TABLE 1 - Temporary Cleanroom Criteria

Criteria	Gowning	Material and Equipment			Pipe Fabrication		
		Preclean	Staging	Storage	Staging	Prefab	Inspect



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

Protocol (per construction Stage as identified in Section 01 35 13 46)	4CR	4CR	3	3	3	4CR	4CR
--	-----	-----	---	---	---	-----	-----

Table 1 Notes:

1. Relative to adjacent temporary clean areas.
2. Refer to Section 01 35 13.46 - Clean Zone General Requirements for protocol. Follow requirements for construction stage shown, unless otherwise modified in Protocol paragraph.

g. Protocol:

1. Keep entry into the cleanroom to a minimum, limited to those persons properly trained and badged. Entrance to the cleanroom is only through the gowning area. Maintain a sign-in log of persons entering the cleanroom.
2. Personnel entering the pipe staging area are required to don booties and cleanroom gloves before stepping off the tacky mat at the area entrance. If the individual's work will be confined to this area, no other cleanroom garment is required.
3. When leaving the cleanroom, store cleanroom apparel with user's nametag in the gowning area on racks provided.
4. Attach a pad of tacky mats to the floor just outside the entrance to the cleanroom.

h. Housekeeping:

1. Locate cabinets, pipe racks, and shelving to optimize safety for both workers and material.
2. Place only one type and/or size of each material in the storage space, compartment, shelf, or bin. Provide material label with the part number and complete description of the material it contains.
3. No material is allowed on the floor.
4. Clean floors, work surfaces, tools, etc., at the end of each shift.
5. Clean walls, ceilings, doors, and shelving weekly. Vacuum floors daily and mop floors weekly.
6. Maintain adequate stock of gowns to ensure they are readily available.

i. Materials:



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

1. Walls, ceilings, and floors suitable for the cleanroom classification.
2. Provide work tables of sufficient length to accomplish the anticipated tasks, constructed of stainless steel surfaces with perforated tops inside the clean environment work area.
3. Provide unpainted stainless steel shelves, racks, and other accessories approved for cleanroom use and supplied by a cleanroom supply company.

j. Acceptance and Testing:

1. Certify the temporary cleanrooms per ISO Standard 14644-1 and obtain approval from the Owner prior to beginning work in the area.
2. Recertify the cleanrooms as required by the Director. Correct cleanrooms not in compliance.
3. Monitor the static pressure weekly at locations approved by the Director.
4. Monitor particle counts daily in the ISO Class 5 areas and weekly in the ISO Class 6 and 7 areas at locations approved by the Director.
5. Make documentation available on site.
6. Post particle counts data weekly on an information board in the gowning area.

1.9 TEMPORARY CLEAN ZONE CONDITIONS

a. Climate Control:

1. Provide a prefiltered and pretreated source of outside makeup air for temporary cleanrooms and for the entire Clean Zone beginning with construction Stage 3. Maintain a positive pressure of at least 0.05 inch WC in the Clean Zone with respect to outdoor ambient conditions continuously, beginning with construction Stage 3.
2. Provide a prefiltered source of recirculation clean air for temporary cleanrooms and for every cleanroom or clean area under protocol, initiated during construction Stage 3 after intermediate cleaning procedures have been completed.
3. Provide temporary air-handling systems for makeup and for recirculation until such time as permanent systems are operable.
4. Provide electric power for fans from two separate power panels, connected in an alternating pattern so power is available to maintain partial uninterrupted climate control in the Clean Zone should either panel fail.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

5. Fewer fans may be operated during off-peak hours, provided that cleanliness requirements and environmental conditions are maintained.

b. Air-Handling Systems:

1. Makeup Air Handlers:

(a) Makeup air handlers may be temporary units or the permanent units. Where permanent units are used, take necessary precautions to protect against damage or irreparable contamination.

(b) Select makeup air quantity to provide proper space pressurization and environmental conditions, with a minimum quantity of 1 cfm per gross square foot of conditioned space.

(c) Include a 30 percent ASHRAE prefilter, a 95 percent ASHRAE main filter, and a 99.99 percent scanned HEPA filter rated on 0.3 micron particle size. Provide a gel-type seal for the HEPA filter.

(d) Include heating and cooling coils, humidifier, and controls compatible with services available in the facility during this phase of construction. Do not use direct-fired combustion heaters.

2. Recirculation Air Handlers:

(a) Recirculation air fans may be temporary units integral with the HEPA ceiling filter modules or permanent recirculation air-handler units where precautions are taken to protect against damage or irreparable contamination.

(b) Provide recirculation air fans to provide air change rates specified for each temporary cleanroom.

(c) Include the following components on permanent recirculation air handlers: two banks of filters consisting of 95 percent ASHRAE prefilters with a 30 percent ASHRAE prefilter upstream and in series until the construction has been upgraded to construction Stage 4.

c. Temporary Flooring, Partitions, and Doors:

1. Provide products for temporary protective flooring that are water resistant, sealed against particle gathering or release, airtight, and suitable to maintain cleanliness requirements. Refer to requirements in Section 01 43 45, Outgassing Criteria for Clean Zone Products.

2. Place one layer of minimum 8 mil-thick Visqueen over floor openings prior to placement of temporary plywood or metal hole covers.

3. Provide door hardware with automatic closers and self-latching key locks compatible with door hardware specified in Section 08 71 00, Door Hardware.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

4. Provide 22 gauge steel door and knockdown door frame.
- d. Temporary Signage:
 1. Post the following signs prominently at every entrance to personnel gowning and material preclean areas:
 - (a) "Controlled Area".
 - (b) "Protocol Level X" with current protocol level filled in the blank.
 - (c) "Badged Personnel Only".
 2. Post the following signs prominently at every entrance or exit leading to isolated Clean Zone protocol construction areas:
 - (a) "Clean Area".
 - (b) "Protocol Level X" with current protocol level filled in the blank.
 3. Material:
 - (a) Sign: Painted sheet metal.
 - (b) Sign Background Color: Safety yellow.
 - (c) Lettering: 2 inches high with colors selected by the Director.
 4. Mount temporary sign to front of entry doors and to back of exit doors.
- e. Construction Filters:
 1. Filters Furnished with the Air Handlers:
 - (a) Two (2) sets of filters provided with the air handlers are intended for use by the customer as operating/replacement sets, not for construction use.
 - (b) Install one (1) set of filters when cleanroom served is upgraded to construction Stage 4.
 2. Construction Filters Provided by the Contractor:
 - (a) Provide twelve (12) filter sets for air handling systems for use during construction to permit replacement as described below. Replace filters according to following schedule, beginning with unit startup at beginning of construction Stage 3.
 - 1) Replace the 30 percent ASHRAE prefilters in makeup and



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

recirculation air handlers every 30 days during construction operation.

2) Replace the 95 percent ASHRAE main filters in makeup and recirculation air handlers every 45 days during construction operation.

3) Replace the 99.99 percent scanned HEPA filters in makeup air handlers every 90 days during construction operation.

1.10 CONTAMINATION MONITORING

a. Responsibility:

1. Monitor, record, and publicly display particle counts taken during Clean Zone construction sequence.
2. Use most current generation measurement and test equipment for field readings, based on specified particle counters.
3. Calibrate equipment in accordance with manufacturer's requirements at the beginning of certification work, traceable by serial number to the National Institute of Standards and Technology (NIST) within the previous 6 months.

b. Procedures:

1. Take particle counts with a calibrated portable counter on a rotating schedule, during construction Stage 3 and 4. Take readings at 0.3 and 0.5 micron particle sizes in Clean Zone at random times and locations while construction work is in progress. Minimum interval between particle count readings is weekly.
2. Share instantaneous particle counts with workers in vicinity of the probe whose activities influence the readings.
3. Take particle counts with a calibrated, fixed multipoint counter on a continuous basis, during construction Stage 3 and 4. Locate the counter and multiple sample probes as selected by the Director to match construction activity. Take readings at 0.3 and 0.5 micron particle sizes at the test stations.
4. Take surface particle counts with surface scanner on products and materials, as identified by Director, entering Clean Zone during construction Stage 3 and 4. Log particle counts for each product in Clean Zone log. Take readings at 0.1, 0.3, and 0.5 micron particle sizes to permit future evaluation.
5. Post recorded particle counts inside the gowning area on an information board, arranged so that at least 2 weeks of particle count historical data can be compared.

c. Documentation:



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

1. Record particle counts for sizes: **A.** 0.3 **B.** 0.5 **C.** 5.0 micron in each teststation mapped on a cleanroom layout.
2. Create bar chart showing particle counts versus frequency/repeatability count.
3. Copy one representative strip chart from each clean aisle/test grid printed during the test procedures.
4. Develop a comparative history graph by construction month of target contamination levels versus actual measured particle counts.

PART 2 PRODUCTS

2.1 HOUSEKEEPING EQUIPMENT

a. Cleanroom Filtered Vacuum Cleaners:

1. Individual new canister dry-vacuum units affixed with four-stage filtration, including 0.12 micron HEPA filter rated at 99.999 percent efficiency on the air discharge, with wheeled cart, 3 gallon tank, 10 foot hose, and selection of wands.
2. Approved Manufacturers: Nilfisk-Advance Group, Hako, or Minuteman Industrial, with tools compatible for the surfaces to be cleaned.
3. Quantity: Provide six (6) new vacuum cleaners for this project. Vacuumcleaners will become the property of the Owner at completion of the project.

b. Shoe Cleaners:

1. Packaged portable shoe cleaner with integral vacuum cleaner, 0.3 micron HEPA filter cartridge rated at 99.99 percent efficiency on the air discharge, and five scrub brushes.
2. Quantity: Provide six (6) shoe cleaners for this project. Shoe cleaners will become the property of the Owner at the completion of the project.

c. Walkoff Mats: Removable sticky mats of 2 mil polyethylene, 120 per pack.

2.2 PARTICLE COUNTERS

a. Contractor to provide one (1) new, calibrated particle counter of each type for the duration of this project.

b. Fixed, multipoint particle counter for airborne particle count tests.

1. Description:

- (a) Optical laser light-scattering particle counter rated on 0.1 to 5 micrometer particle size sensitivity with equal to or greater than 90 percent counting efficiency and 5 percent maximum sizing error on a 0.1 micrometer range at sample flow rate of 28 liters



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

per minute. Sample air discharged from the counter through a HEPA filter with minimum efficiency of 99.97 percent removal efficiency.

(b) Counter complete with data storage and statistical calculation capability, remote data output, front panel control and readout, eight-channel measurement display for 0.1 to 5.0 micrometer particle size, thermal tape printer with cleanroom data paper, internal filtered vacuum pump, isokinetic sample probes, handheld probes, room sample probes, temperature and humidity environmental sensors, stainless steel cart, and storage/carrying case.

c. Portable hand-held particle counter for airborne particle count tests

1. Description:

(a) Portable handheld laser particle counter rated on 0.3 to 5 micrometer particle size on a sample flow rate of 2.8 liters per minute.

(b) Counter complete with rechargeable battery pack and charger, internal memory to record particle counts and size distribution, compatible computer taps to print data on remote printer or computer, integral isokinetic probe, purge filter, and storage/carrying case.

d. Surface particle detector for testing of cleanliness of cleanroom materials

1. Description:

(a) Surface particle detector rated on 0.1 micrometer and larger particle sizes on a sample flow rate of 28 liters per minute.

(b) Counter complete with external printer, cleanroom printer paper, HEPA discharge filter, and storage/carrying case.



PART 3 EXECUTION

3.1 INSTALLATION

Perform cleanliness reviews as required by Section 01 74 13.13 - Clean Zone Cleaning Procedures.

The nature of the completed facility demands special attention to maintaining an overall cleanliness in the project area. Methods of construction that minimize the generation of contaminants are essential to avoid major cleanup problems. The construction of the cleanroom represents a potential for surface contamination unless careful attention is paid to the manner in which the erection and placement are handled.

Use the latest written recommendations of the component manufacturer in the installation methods.

Installation of cleanroom materials shall be done only by personnel who



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

have satisfactorily completed the Clean Zone protocol and safety training requirements.

Unwrap finished materials which will be directly exposed to cleanroom operating procedures or to the airstreams serving the cleanrooms in the staging area and installed in the cleanroom during final clean erection phase.

Approved cleanroom gloves shall be worn by workers when handling finished cleanroom products or any materials installed in the clean airstream.

3.2 ERECTION

Verify by field measurements, the dimensions of building shell structure so cleanroom work will be accurately designed, fabricated, and fitted to the structure.

Coordinate cleanroom work with the work of other sections to avoid delays in completion.

Maintain air pressurization regime between areas of different contamination levels or protocol levels so cleanest areas are at the highest-pressure gradient.

3.3 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	UFC CLASSIFICATION	AS INDICATED
13 21 10-01	<p>Clean Zone Director Experience:</p> <ul style="list-style-type: none"> - List of at least three projects completed within the last 10 years that involved the proposed Director. - At least one project with a cleanroom constructed of 20,000 square foot of clean space or larger. - The project name, address and phone number of responsible people from the previous project for which the proposed Director served as cleanroom supervisor, superintendent, or equivalent position. - The most recent project completed within the previous 10 years. 	SD-01	



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

13 21 10-02	<p>Shop Drawings: Provide shop drawings for temporary cleanroom(s). Include the following as a minimum:</p> <ul style="list-style-type: none"> - Product data including catalog cuts on materials, air handlers, filters, cleanroom apparel, housekeeping supplies, benches, etc., purchased by the Contractor. - A detailed description of the cleanrooms, including: <ul style="list-style-type: none"> o Cleanroom floor plan. o Filter layout. o Services required. o Map of building protocol as it involves temporary cleanroom areas and access. 	SD-02	
-------------	--	-------	--

ITEM NO.	SUBMITTAL REQUIREMENT	UFC CLASSIFICATION	AS INDICATED
13 21 10-03	Proposed protocol for temporary cleanrooms.	SD-01	
13 21 10-04	Proposed protocol training program.	SD-01	Per construction schedule.
13 21 10-05	Name and qualifications of independent certification testing agency for temporary cleanrooms. Agency must submit experience of certification for at least 3 temporary or permanent cleanrooms in the past 10 years.	SD-01	Per construction schedule.

ITEM NO.	SUBMITTAL REQUIREMENT	UFC CLASSIFICATION	AS INDICATED
13 21 10-06	<p>Performance and Method Statements:</p> <ul style="list-style-type: none"> - Written performance and method statements by the specialty firms that will perform tasks and services for this project, outlining the organization, manpower, procedures, sequence, products, and equipment to be used in performance of the service. 	SD-01	Submit at least 30 days before the service is scheduled to commence.



HALCO PRODUCTS COMPANY

100 N. Gordon Street – Elk Grove Village, IL 60007-1193

Tel: 847-956-1600 Fax: 847-956-0595

E-mail: info@halco-products.com · Website: www.Halco-Products.com

	<ul style="list-style-type: none"> - Prepare method statements for each of the construction stages for the following activities and services: <ul style="list-style-type: none"> o Monitoring and enforcement of clean construction protocol and construction sequence activities necessary to achieve contamination performance. o Construction, monitoring, and security of personnel gowning room, equipment and process tool pre-clean area, and clean material storage area. o Placement, use, and monitoring of temporary wall partitions, walkway mats and barriers, tacky mats, particle counters, lighting, and environmental air handlers. o Contents, format, and instructor for each protocol training class. o Location, schedule, and procedures to create mock-ups of cleanroom systems. o Procedures for continuous and special cleaning to show compliance with Section 01 74 13.13 - Clean Zone Cleaning Procedures. o Procedures for air and piping system testing and balancing. 		
--	---	--	--

ITEM NO.	SUBMITTAL REQUIREMENT	UFC CLASSIFICATION	AS INDICATED
13 21 10-07	Submit weekly activity reports.	SD-06	Within 3 days of report completion.
13 21 10-09	Monthly Reports: Submit monthly Contamination Monitoring reports. Build each subsequent month's report from the previous report so that the final submission at the end of construction will provide a history of the contamination levels monitored in the facility. See Part 1 Article on Contamination Monitoring for required information.	SD-06	Within 3 days of report completion.

-- End of Section --