

APPENDIX B: MOBILE STORAGE SHELVING AND STATIC SHELVING SPECIFICATIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Related Specifications Sections, apply to this Section.

1.2. SUMMARY

- A. This section includes the following:
 - 1. High-density mobile storage units mounted on mechanically assisted carriage, support rails, fabrication and installation including leveling of support rails and plywood floors.
 - 2. 4-Post shelving units, fabrication and installation on mobile carriage.
 - 3. 4-Post shelving units, fabrication and installation – full depth adjustable 18 gauge steel static shelving.
- B. Related Work, Not Furnished:
 - 1. Structural floor system capable of supporting live and dead loads required by prevailing building codes, including loads of storage units to be installed. Provide a maximum allowable sub floor deflection of $[L/480]$ under specified mobile storage loads.
 - 2. Finish floor covering and edging materials and installation on raised floors and ramps, or when on concrete with recessed rail installation.
 - 3. Fire suppression system is by others.

1.3. PERFORMANCE REQUIREMENTS

- A. Due to the user's preference and requirements for safety, performance, and flexibility, all following specification line items are mandatory.
- B. Design Requirements: All mobile carriage and shelving as per attached drawings and as described in the specifications.
- C. Color Samples: Provide sample for each exposed product and for each color required.
- D. Selection Samples: For selection of colors and textures, submit manufacturer's color charts consisting of actual product samples, showing full range of colors and textures available.
- E. Installer Qualifications: Hire an experienced installer who is the manufacturer's authorized and certified representative.
 - 1. Minimum Qualifications: 1-year experience installing systems of similar size and complexity to specified project requirements.
 - 2. Manufacturer Certification: Required by manufacturer on manufacturer's letterhead required at time of bid. Certifications by sales representatives, dealers, or distributors are unacceptable. Qualification must include resume of certified installation supervisor.
 - 3. Provide support within 24 hours for service call.
- F. Warranty: Submit a written warranty, executed by the Contractor, Installer and Manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified

warranty period. This warranty shall be in addition to, not limitation of, other rights the Owner may have against the Contractor under Contract Documents.

LIFETIME LIMITED WARRANTY: for the lifetime of the shelving and mobile carriages ("structural frames"). For the purposes of this warranty, structural frames shall be deemed to exclude all moving parts, controls and guides that have immediate contact with any moving parts.

5-YEAR LIMITED WARRANTY: for five (5) years from the date written hereafter*, for all equipment, other than structural frames, carriage drivemotors, new electronic components installed for an electrical upgrade of systems, light fittings and these electronic components: emergency power system (UPS), routers and WIFI remote controls. During the 5-year warranty period, all parts are included at no cost for 5 years. Labor installation is included at no cost during the first year of the 5-year warranty period.

- G. Reference List: Provide a list of three (3) minimum installed mobile storage installations to be contacted or visited by owner, architect and contractor. Installation must be of similar size, scope of specified system. Visit is intended to inspect operation, quality of installation and verify the suitability of manufacturer's products and comparison with materials and products specified. Manufacturer is required to address all issues raised by owner, architect and contractor. List must include contact names, phone numbers or e-mails, size and quantity of shelving units.
- H. Project Schedule: Provide a project achievement plan detailing all critical elements necessary to plan, manufacture, ship, and install shelving product. Include critical project milestones and risk mitigation plan.
- I. Manufacturer Qualifications:
 - 1. ISO 9001:2015: Engage an experienced manufacturer who is ISO 9001:2015 certified for the design, production, installation and service of powered mobile systems. Submit manufacturer's ISO 9001:2015 quality system registration certificate.
 - 2. ISO 14001:2015: Engage an experienced manufacturer who is ISO 14001:2015 certified. This international standard defines a process for monitoring and improving an organization's environmental performance. This process minimizes adverse impacts on the environment caused by the activities of the enterprise and helps to continually improve the environmental performance of the organization. Submit manufacturer's ISO 14001:2015 registration certificate, certifying the environmental performance of manufacturer.

1.4. SUBMITTALS

- A. Product Data: Submit manufacturer's product literature, schematics, testing data, and other items as described in this specification. Include data substantiating that products to be furnished comply completely with requirements of the contract documents and specifications. Include installed weight, load criteria, furnished specialties, and accessories.
- B. Shop Drawings: Prepared and detailing fabrication, assembly, and installation of mobile carriages and storage shelving, as well as procedures and diagrams. Include details of layout and installation, as well as clearances, spacing, relation to adjacent construction in plan, elevation, and section, components, assemblies, connections, attachments, reinforcements, and anchorage. Furnish floor layouts, technical, and installation manuals for every unit shipment.

1.5. **QUALITY ASSURANCE (Submittals due from all bidding contractors at time of bid, failure to do so shall be cause for disqualification.)**

- A. Manufacturer Certifications: Providing separate written certifications by manufacturer on manufacturer's letterhead at time of bid is required stating compliance with all specifications of shelving systems. Shelving certifications must confirm compliance with all shelf sizes and gauges as noted in these specifications. If bidding different manufacturers for mobile and shelving, two (2) certifications are required. Preference shall be given to one-source supplier.

1.6. PROJECT CONDITIONS

- A. Field Measurements: Verify mobile carriages and shelving unit location by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mobile carriage and shelving units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.
- B. Delivery, Storage, & Handling: Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.
- C. Sequence & Scheduling: Sequence mobile carriage and storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.
- D. Pre-Installation Conference: Conduct conference at project site. Review methods and procedures related to installation of mobile carriage and storage units including, but not limited to, the following:
 - 1. Inspect and discuss condition and levelness of flooring and other preparatory work to be executed under this contract. All required levelling for HDMS plywood floor by this contract.
 - 2. In addition to the Contractor and the installer, arrange for the attendance of the following:
 - a. Other Installers affected by the work of this section.
 - b. The Owner's Representative.
 - c. The Architect.
 - d. Manufacturer's representative.

PART 2 - PRODUCTS

2.1. BASIC MATERIALS

- A. Grout (for HDMS system):
 - 1. General: The compound shall be cementitious grout which, when mixed with water, will harden to produce a permanent bolt setting anchor. The compound shall conform to the following specifications, all of which are based on the performance of the test specimens at room temperature and in laboratory environment.
 - 2. Linear Movement: It shall not shrink on setting, but shall exhibit a slight expansion of not more than .002 inch per linear inch.
 - 3. Compression Strength: Two (2) inch cubes made in accordance with ASTM standards tested on a Balding-Southward machine of 60,000 pounds capacity shall have the following minimum average compression strengths:
Age: 1 hour - 4,500 PSI
7 days - 8,000 PSI
 - 4. All tracks shall be grouted the entire length of each run, including all track joints. As the grout slightly expands during the cure process, it shall be in permanent contact with the grouted structural members. This provides a continuous support to the system, and optimal weight distribution on the existing floor slab.

2.2. MANUFACTURED COMPONENTS – MOBILE

A. Tracks:

1. Rails shall be designed and manufactured to carry loads of 1,000 pounds per linear foot (1,488kg/m) of carriage. Made of minimum cold rolled steel (CRS) rail assembly of ¾" (19mm) high x 1" (25mm) wide inserted in a surface treated aluminum sub-rail. Rail contact surface shall be minimum 1" (25mm) wide. The inserted steel rail shall be replaceable. One-piece rails with no sub-rails are not permitted.
2. Sub-rails shall be leveled with self-leveling screws above or below the walking surface. Shims shall not be accepted.
3. Sub-rails shall be designed to be anchored on top of structural concrete floor and to allow for adjustment so sub-rails can be leveled over an uneven floor.
4. In the sub-rail, the opening adjacent to rail which accommodate manufacturer's carriages guidance system and/or anti-tip system shall not exceed 7/16" (11mm) wide x ¾" (19mm) deep.
5. All rail connections shall have interlock steel rail connectors. All sub-rail connections shall have interlock steel sub-rail connectors. All track connections shall be designed to provide horizontal and vertical continuity between rail/sub-rail sections, to gradually transfer the concentrated wheel point load to and from adjoining sections. To insure vertical and horizontal stability, tongue-and-groove connections are not permitted.
6. Tracks shall be layered and staggered to ensure a smooth weight transfer from one track to the other. Top-to-bottom track shall be without joints to support continuously the top steel rail at the junction point and provide greater structural rigidity. One-piece rails with tongue-and-groove joints and connections are not permitted.
7. Rail shall be located and positioned properly, leveled and grouted, allowing at least 3/8" (9.5mm) for grout under high point. Anti-slip grooves under sub-rail shall prevent track to slip when grout is poured. Grout shall infiltrate inside the grooves to anchor the sub-rail to the cement. Grout to be worked under rail, any voids completely filled and trimmed upsides and flush with rails. This allows proper weight distribution from rail to existing slab.
8. Levelness of rails: 3/32" (2mm) maximum variation from true level within any system; 1/16" (1.5mm) maximum variation between adjacent rails, perpendicular to rail direction; 1/32" (0.76mm) maximum variation in 10' 0" (3.05m) of rail length, along any rail.
9. Rails are to be verified for integrity of position and levelness, as well as anchored into structural concrete slab, using anchors in sizes and quantities as determined by manufacturer.
10. Sub-rail section shall be a minimum of 12' foot (3.66m) each and rail section shall be provided in shorter section of 10' foot (3.07m). Shorter sections are used to complete each individual rail assembly

B. Floor/Ramp:

1. [Surface Mounted Floor / Ramp]:
 - a. Finished elevation of the raised floor shall be flush with the top of the rails.
 - b. The ramp shall not extend beyond the end of the carriages and shall have a maximum slope of nine (9) degrees. The vertical transition from the ramp edge to the floor shall be a maximum of 1/8". Ramps shall extend under all movable and stationary ranges except as noted differently. Ramps shall be made of 12-gauge steel.

- c. Floor panels shall be constructed of a minimum 5/8" (16mm) underlayment grade plywood. Floor panels must be provided between all rails the full-width of systems, except under stationary platforms.
- d. Floor panels shall be provided with built-in floor anchor to provide a continuous leveled floor surface.
- e. The floor and ramp shall be constructed in a manner preventing any warping or deformation of the floor panels in a normal operating environment.
- f. Floor covering is to be installed and supplied by others.

C. Carriages:

- 1. All carriages shall be riveted-bonding construction for flexibility and potential reconfiguration. Welded carriages or carriages with formed lips are unacceptable. Carriages and stationary platforms shall be constructed of a full "C" shape profiles 1 1/2" (38mm) deep x 5" (127mm) high, minimum 12-gauge steel, with 1,000 pounds (1,488kg/m) per linear foot maximum capacity. Wheel support sections shall be minimum 12-gauge steel and shall be riveted between the main support face sections, one per aisle assembly. Support sections shall be embossed to eliminate the need of filler plates between the shelving/cabinet and the C shape supports.
- 2. Stationary carriages, as shown on the drawings, shall be of same construction and height as the mobile carriages and anchored to rails. Setting of shelving on floor at ends of mobile runs is unacceptable.
- 3. Necessary carriage splices shall be bolted type designed to maintain proper unit alignment and weight load distribution.
- 4. Carriage face sections shall provide a smooth, clean appearance without any assembly holes or protruding hardware.
- 5. Carriage straightness shall have no more than 1/4" (6.35mm) maximum deviation from a true straight line. There shall be no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.
- 6. Carriage construction shall be designed to allow the shelving uprights to be secured to the carriage frame with two assembly kits per upright of vibration-proof graded 5" bolt, nut, and clamp anchor assemblies and so that there is no visible hardware on carriage face. Recess design carriages are not permitted. Self-drilling screw attachment is not acceptable method of attachment shelving units to the carriage. No shelving or cabinet attachment hardware shall be visible on exterior face of carriages
- 7. Each carriage shall have at least two wheels per rail.
- 8. Carriages shall have powder coat (1.5 mil) finish on all surfaces. Color selection by the Owner to match shelving. Powder coat paint finish is required for finish durability and elimination of any off gassing. Finish shall be inert, with no volatiles present in finished product. Visible galvanized steel structural carriage components are unacceptable.

D. Drive/Guide System:

- 1. Direct-Drive System: Provide with full-length drive shaft which prevents carriage whipping, binding and excessive wheel and rail wear under normal operation. All wheels shall be direct-driven at every rail location on one side of carriage. Synchronized drive with multiple chains, trolleys, and drive shafts are not acceptable.
- 2. Torque-Resistant Tubular Drive Shaft: Minimum of 1 5/16" (33mm) outside diameter by maximum 1 1/8" (29mm) inside diameter. Solid steel rod is not acceptable.

3. Dual-Flange Wheels: Provide positive guidance and tracking. Guidance requiring cam followers and ball bearings running on either side of the rail is unacceptable.
4. Narrow Guidance Channels: Provide a maximum 3/8" (9.5mm) between sub-rail and rail sections to reduce tripping hazards, allow carts to easily roll over, prevent debris accumulation, and facilitate cleaning.

E. Wheels:

1. Wheels shall be constructed of solid minimum 1045 cold rolled steel (CRS) for smooth operation. Minimum load capacity per wheel 3,200 pounds (1,452kg) Wheels shall be precision ground, balanced. All bearings shall be permanently shielded and lubricated.
2. All wheels shall be minimum 5" (127mm) diameter (outside dimension). They shall be dual-flanged and sloped to insure efficient guidance. Single center flanged wheels are not acceptable.
3. Due to carriage length and shelving/racking heights, guide wheels shall be at all wheel locations.

F. Face Panels:

1. Materials: All exposed face panels shall be steel. Face panels shall be located on all operating ends of ranges as shown on drawings.
2. Finishes: Selected from manufacturer's standard available colors and patterns. Selected by the Owner and Architect.
3. Face panels must cover the full height and width of shelving.

G. Movement Controls:

1. The system shall be of the mechanical assist type having a chain sprocket drive system. A driving system is required to provide uniform movement along the total length of the carriage even with unbalanced loads on the carriage. The system shall be a positive drive to ensure that there is no play in the drive handle and the carriage will stop without drifting. All components of the system shall be compatible for smooth non-jerking, even movement along the total length of the carriage. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
2. Operating handles shall be three-spoke type (single spoke handle are unacceptable) of 18 3/4" diameter transmitting power through a chain drive to the drive wheels. Provide operating handles on drive end of carriages as noted in drawings. Each mechanical device shall come with a chain-tensioner. Handle must be mounted at 39 1/2" from the bottom of the carriage.

H. Safety Features:

1. Aisle Safety Push-Button Lock (for single access): Shall be located at the center of the handle. The user shall press the aisle safety push-button, which will lock the respective carriage. After being pressed, the aisle safety push-button shall protrude from the handle face to display a red band visible to users. After being re-pressed, the aisle safety push-button shall return to its unlocked state. Pull-out pins are unacceptable. Both carriages on either side of the aisle must be secured.
2. Optional Toe-level Safety Sweep (for single or dual access): Consisting of hinged aluminum safety bar running full length of the mobile carriages, flush with bottom of carriage frame and on both sides of carriage. Upon activation of the sweep, an internal device shall interlock with drive train resulting in positive stop anywhere in the module. A one and a half (1.5) pound pressure applied on the safety bar will activate the safety. The

safety shall automatically reset upon removal of the obstruction or if carriage is backed away from the obstruction. This active safety shall not require any electricity or battery to be activated (mandatory).]

2.3. MANUFACTURED COMPONENTS – 4-POST SHELVING (Includes components of HDMS as well as full depth adjustable 18 gauge steel static shelving)

- A. Upright Frames: Upright frames are made of two or more cross members welded to the top and bottom (and center if necessary) of the post and forming a rectangular upright frame. Each post shall be made of 16-gauge 1 ¼" x 1 ½" rectangular shaped cold rolled steel. The lateral sides of the posts are slotted at every one inch increment. The slots are 3/16" wide x 5/8" long and are designed to accommodate a variety of shelf and roll-out drawer configurations. The back of the post is also slotted at every 1 ½" increment with two rows of slots side by side from top to bottom. They are 3/16" wide x 5/8" long with 3/8" between the two rows. The uprights must allow for component integration on either 1" or 1 ½" increment depending only on the selected shelf component. Due to aesthetic concerns, user's performance requirements, safety of users and stored materials, and to provide maximum flexibility, "L & T 4-Post" utility shelving system styles are unacceptable.
- B. Cross Members: Cross members are 4" high x ½" wide. They are made of 16-gauge steel folded to create a "U" shape channel. At both ends, hook type design allows to snap the cross members in both rows of slots at the same time. The cross members shall be welded to the post. Non-welded frames must be available to minimize shipping volume, thus reducing truck pollution.
- C. Levelers: Each post shall have an integrated leveler, inserted into formed upright tube, which allows for ¾" adjustment to accommodate for uneven floor surface. No temporary shims or other third party leveling device will be accepted.
- D. Supported type:
1. Full-depth shelves: Full-depth shelves are made of box rolled formed 18-gauge steel, with "Four Bend" ¾" edge construction which adds additional strength and capacity as well as it creates a hidden safety edge to protect people and items. The full-depth shelves are supported by two longitudinal shelf supports and the appropriate number reinforcement channels.
 2. Longitudinal supports: ¾" high supports are made of one "U" shaped 12-gauge steel channel. A standard formed steel claw is welded at each end to form a complete support. These supports are inserted into the slots located at the back of the post.
 3. Front-to-back reinforcement channels: [¾" high reinforcement channels] or [1 ¼" high reinforcement channels for heavy duty application] are made of 12-gauge steel formed in a "U" shaped channel and are sitting on the longitudinal shelf supports.
 4. Base support: A 12-gauge steel special "U" shaped channel is provided for the bottom shelf. The support is inserted at the bottom of each post and anchored to the floor or to the carriage, in compliance with seismic standards.
- E. Sway Brace (required with back-to-back hooked type): 1 1/8" wide sway braces are made of two 16-gauge steel bars, assembled with a rivet. Sway braces are connected to the posts by means of mechanical rivet or dowel pins. Sway braces are positioned where needed on taller shelving sections to add lateral stability.
- F. End Panels: Shall be constructed of 20 gauge steel, 2" thick, they are bolted to bottom and top upright cross members.
- G. Optional Sliding Reference Shelf – 1 per row of shelving: Shall be 11" deep and made of 18-gauge steel reinforced on each side with steel angles to secure slides. Shall operate on double extension ball bearing slides equipped with rubber bumpers on each end of travel. The assembly is securely attached to underneath the storage shelf, flush with the front edge.

2.4. FINISH SPECIFICATIONS

- A. Shall be the finest of their respective kinds and those best adapted to the construction for which they are employed to meet ISO 9001:2015 quality standards. All steel shall be superior quality milled, cold rolled, pickled, and double annealed, free from scale and buckle. All gauges are U.S. standard. The design of all parts shall be such that the completed installation shall present a neat and finished appearance and shall be free from exposed sharp edges or projections. All other special materials shall be as hereinafter specified.
- B. All components shall be painted with an electrostatically applied powder coat finish. All steel parts shall be machined smoothed and thoroughly cleaned by a process of completely washing in a phosphatizing solution to insure removal of oil, grease or other foreign material which could interfere with the adhesion of the priming coat in any way. Following the cleaning process, all parts shall be coated and confirming every part is thoroughly and completely covered with fine powder coat, and baked to the paint manufacturer's recommendation. The finish for powder coat shall be medium gloss, giving a reading of 35 to 65 degrees on a standard gloss meter and must be capable of withstanding severe hammer and bending tests without flaking. The finish for epoxy-polyester hybrid powder coat shall be a minimum 1.2 mil thickness capable of resisting methyl ethyl ketone, salt spray, abrasion and printing, and all normal usage resistant requirements of a good finish. In addition, powder coat shall not be off gassing to prevent deterioration of collection and other stored materials. Colors to be selected by owner.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Examine subfloor surfaces, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of mobile storage units.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

- A. Install components and accessories after finishing operations, including painting, have been completed. Install shelving units to comply with final layout drawings, in strict compliance with manufacturer's printed instructions and structural calculations. Position unit's level and plumb at proper location relative to adjoining units and related work
- B. Field Quality Control: Remove and replace components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.
- C. Adjust: Adjust components and accessories to provide smoothly operating, visually acceptable installation.
- D. Cleaning: Immediately upon completion of installation, clear components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.
- E. Protection: Protect system against damage during remainder of construction period. Advise Owner of additional protection required to ensure shelving units will be without damage or deterioration at time of substantial completion.

3.3. DEMONSTRATION/CUSTOMER TRAINING

- A. Provide complete training to end-user's staff. Training shall include general safety and operation instructions, and basic preventative maintenance procedures.