Kansas City Streetcar

Streetcar Operations and Maintenance Facility

Kansas City, MO

Technical Design Report

Functional *Innovative* *Sustainable*

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Streetcar Operations & Maintenance Facility Design

The design process for the Kansas City Streetcar Operations and Maintenance Facility (OMF) begins with a basic understanding about the essential design requirements of such a facility. The Streetcar OMF has three main components, an Administrative Support Area, Streetcar Operations Area, and Streetcar Maintenance Area.

Administrative Support Area

The Administration Support Area includes an entry lobby, reception, offices, storage and workrooms, conference space, small break area and restrooms. Administration Support provides Human Resource Services, Conference and Training Services and Management Support Services as well as Payroll Services and Public Relation Services. While it is preferred to keep agency functions together it is possible for the Administration function to be located off-site where other transit agency office space is available. Locating Administration where other agency office space is available can help keep initial build-out smaller and construction costs less however this function can be added onto the facility at a later phase of the project.

Streetcar Operations Area

The Operations (Transportation) Group provides streetcar yard movement control and supervision; and Operators' support functions for the Kansas City Streetcar Service Line. The Streetcar Operations Area includes a control room and dispatch; and support spaces including operators break area, locker alcove, restrooms with showers and changing areas, training room and offices. For smaller system operations the support spaces for Streetcar Operations can be sized to be shared with the Maintenance Staff to save on construction costs and building space avoiding redundant spaces.

Streetcar Maintenance Area

Streetcar Maintenance will be responsible for maintaining the new streetcar fleet in Kansas City. Maintenance activities typically include, but are not limited to:

- Service and Inspections to provide preventive maintenance and visual inspections
- Heavy Repair Bay
- Specialty Bays (optional)
- Wheel Truing Bay (optional)
- Blowdown/Chassis Wash Bay (optional)
- Servicing and Cleaning to include wash, day cleaning and detailing.
- Storage Areas

The architectural and operational design criteria for the Streetcar Maintenance Area differs from that of other fleet maintenance

facilities due to the special attributes and characteristics of the streetcars, such as: constraints of rail geometry, vehicle size, and power requirements for propulsion of rail vehicles. Special design features of a Streetcar OMF typically include the following:

- ✓ Extra long bay lengths of up to, but not limited to, 100 feet
- ✓ Embedded rail in the shop floors
- ✓ Overhead Power Catenary (typically)
- ✓ Larger Building Support Systems Rooms
- ✓ Heavy duty overhead crane lifting capability
- ✓ Rooftop vehicle access
- ✓ Extra height and clearance requirements to accommodate a 19-foot catenary clearance, plus cranes and MEP systems above catenary
- ✓ Extra circulation clearances and large shop spaces for oversized specialty equipment.
- ✓ Large storage areas with high capacity floor slab and storage equipment for larger rail vehicle parts

The size and functional requirements of a Streetcar OMF is determined by the Streetcar Fleet. The number of Streetcars being serviced, the type and size of the streetcars and the extent of inspections and repair services to be provided by the agency affects the number of bays and the complexity of the shops.

Regardless, the Streetcar OMF requires a minimum of two types of bays, Service and Inspection (S&I) Bay and Heavy Repair Bay. With the different functions within the facility, good facility design is important to understand what functions are long term work versus short term work and inspection functions and for these functions not to interfere with one another.

Service and Inspection Bay

The S&I Bay is 24 feet, 0 inches wide by 20 feet, 0 inches (minimum) longer than the length of Streetcars being inspected. The S&I Bay will be used to perform routine inspections and minor replacement repairs on the streetcars. Typically, access to the roof, sides, and undercarriage of the streetcar are required with a majority of the equipment located on the vehicle roof. In order to provide access to the underside of the vehicle, a Lower Level Work Area (LLWA) shall be provided. This area is typically, five feet, six inches deep with posted rail the length of the bay, to support the streetcar. Stairs at both ends of the work area are required and the LLWA shall be long enough for the headroom clearance from the stairs is unobstructed by the streetcar. Access to the roof of the streetcar shall be provided via mezzanine and upper level access platforms. When rooftop access is provided, with an Overhead Catenary System (OCS), then power interlocks must be used for the safety of workers. The typical rule-of-thumb ratio for S&I Bays is five to eight cars for every one bay.

Heavy Repair Bay (Flat Floor)

The Heavy Repair Bay is where all major repairs are performed including overhaul, component replacements, and heavy lifting. The Heavy Repair Bay should have dimensions of 24 feet, 0 inches wide by 20 feet, 0 inches longer than the vehicle being maintained. This bay shall have a 5- to 10-ton overhead lifting capability and also the ability to raise entire streetcars via car lifting system such as in-ground Lift or portable electric vehicle jacks. The Heavy Repair Bay shall be adjacent to the specialty repair shops and have either direct track connection to or turntables to access repair shops. Additional space around each Heavy Repair Bay is required for component assembly, common work areas, and portable equipment storage. The typical rule-of-thumb ratio for a Heavy Repair Position is one bay for every five to eight cars. However, if more intensive repairs and maintenance is being done, such as wheel truing, body work, truck, or wheelset repairs, another bay may be needed.

Specialty/Repair Shop and Bay Areas

Within the Streetcar OMF there are typically repair shops required to perform specialty maintenance and repairs on components that are removed from the vehicle that may require special tools and equipment not located within the repairs bays. There are several shops uniquely purposed for rail vehicles. Within smaller Operations and Maintenance Facilities these shops may not be completely separated shops but rather functional areas within the maintenance envelop. The following shops are typically found within a Streetcar OMF:

- **Common Work Area:** dedicated space typically adjacent to the repair bays. This area includes fixed equipment such as parts washers, drill presses, buffer/grinders, workbenches with a vise, abrasive blast cabinets, milling machine, etc. Located centrally and accessible to all Repair Positions.
- **Truck Shop:** required for the repair and change out trucks and components (gearboxes) adjacent to the Heavy Repair Positions and Truck Storage. The Truck Shop shall have either direct track access to a Heavy Repair Position or tracks with turntable access from other repair bays.
- **Cleaning Room:** area for parts cleaning, cleaning of entire truck assemblies, and smaller streetcar parts will include track with water collection sump and high pressure washer.
- **Weld Shop:** A specially enclosed shop that has dedicated ventilation for the purpose of welding and fabricating items that should be performed in a controlled environment for overall shop safety. Layout tables, ventilation units, drill press, buffer grinder and metal fabrication machines are typical items for the Weld Shop.
- **Electronics Repair Shop:** area able to accommodate repair space for all streetcar vehicle electrical components and test

procedures with associated test equipment. A clean environment shop with anti-static dissipative floors and work surface workstations is minimum requirement. This shop shall also accommodate any video and electrical equipment provided by streetcar manufacturer.

- **HVAC Repair Shop:** area for the inspection and maintenance of streetcar air conditioning system and for removal and replacement of HVAC components. This shop is usually located on a mezzanine level and also can serve as a Pantograph Shop and Storage Area.

Wheel Truing Bay

A Wheel Truing Bay is considered a specialty bay and the inclusion of such bay within a maintenance facility depends on the agency's philosophy of maintenance for wheels and the type of running gear a vehicle is outfitted with. In-ground wheel truing lathes generally cost over $2,000,000 and have significant building implications such as adding an additional and longer bay with a pit requirement to install the lathe into. Portable wheel truing units are available (MobiTurn) and are more cost effective from $1,500.000, and have minimal impact on the building as this item can be used in any available bay. Portable truing machines do require more setup time and also require vehicles to be lifted by some type of vehicle lift. A dedicated bay, with a wheel truing lathe, allows for the truing/profiling of streetcar wheel sets while still on the vehicle and while on the rails. This bay shall be 30 feet, 0 inches wide and long enough to keep the Streetcar inside during wheel truing process. To save on building construction costs, the wheel truing bay can be built shorter to cover a portion of the vehicle and the lathe equipment; however, some portion of the streetcar will be left outside during the truing process. As both of the wheel truing options present a large up front capital investment it may be more feasible for smaller fleet operations to outsource this process to a larger operation if one is in reasonable proximity within the region. If wheel truing is outsourced additional wheel storage space will be required for spare wheel sets and freight truck accessibility will be required to pick up wheel sets when scheduled to be picked up or delivered. The Kansas City Streetcar Operations must develop a plan for wheel truing before building design is finalized.

Blowdown/ Chassis Wash Bay

The Blowdown/Chassis Wash Bay is a specialty bay that may be required depending on the type of electric motors being used on the streetcars and/or depending on the intensity of the proposed maintenance program. This bay can either be attached to the main facility or constructed as a standalone service building within the streetcar storage yard. This bay is utilized for the complete cleaning of the lower side and under carriage of the streetcar requiring either compressed air and vacuum systems or high pressure water. The Blowdown Bay shall consist of an elevated

track section (posted rail) over a lower level water collection sump area that is equipped with compressed air reels, high pressure wash outlets, and a vacuum system to collect dust from electric motors. This specialty bay is not a necessity for a facility initial build-out however will likely be required as fleet size grows and vehicles age or as maintenance programs intensify.

Service and Cleaning Areas

In order to keep the streetcars in top condition both internally and externally, it is important to have areas to perform cleaning functions. Typically these service areas are out in the vehicle storage yard and possibly right off of the Main Line for convenient access right after an operator finishes a shift. The following areas are service functions typical of a Streetcar OMF.

- Automated drive through wash system in an enclosed and heated (for inclement weather around or below freezing) Wash Bay. This system can be touchless system or use brushes depending on agency preference and rail car requirements. For a more sustainable design, automated wash systems can include reclaim water systems with Reverse Osmosis (RO) Final Rinse System. The washer may also include a blower system for drying vehicles. A Wash Equipment Room is required and is typically sized to accommodate all associated wash equipment, reclamation sumps, and water storage tanks. This streetcar wash area could be added at a later phase of the facility construction or phasing as the fleet grows however keeping the vehicles clean is assumed to be a top priority of the Kansas City Service Maintenance Program. If the capital costs of an automated wash system cannot be secured in initial build-out then there are a portable wash brush system that allow for the manual cleaning of vehicles but is labor intensive. A portable brush was will require flat slab space around where the streetcar will be washed, still either a dedicated wash bay or around the storage locations.
- Day Cleaning Area may be required for daily routine interior cleaning of vehicles, performing daily inspections, and adding traction sand to each streetcar as required. Two options for locating this function are typical, the first being that vehicles are cleaned in their storage positions with use of ladder steps and cleaning carts and the other being a dedicated position at the platform. A dedicated cleaning platform is typically a raised platform that would include a canopy and small structure to house a storage room and utility room for power, water and compressed air to be supplied to cleaning stations. In cold climate areas this day cleaning area should be performed in an interior building space which is assumed to be the preferred configuration for Kansas City. Wipe down function, vacuuming capability (fixed unit station system or back pack units), trash collection and sand box filling (mobile

sanding cart versus a storage silo with sand distribution system) are also other tasks that are typically performed at the Day Cleaning Platform.

- Traction Sand Filling Area is a requirement on Streetcar Vehicles. Each vehicle is equipped with a sanding system to assist with traction and braking the vehicles when tracks are wet or covered on materials such as leafs or grasses. Various sand filling systems are available ranging from storage and distribution systems with storage silo, pump stations and sand cart with conveyor to simple mobile pneumatic sanding cart for smaller operations. The mobile sanding cart allows smaller operations to store more economical amounts of sand in bags delivered on pallets yet still fill sand boxes efficiently fast while limiting the costly infrastructure associated with a complete sand storage and distribution system; assume a mobile sanding cart will be used for the Kansas City Streetcar Maintenance Facility initial build-out.

Streetcar Maintenance Storage Area Requirements

Dedicated storage areas are required within the facility for a clean, safe, and efficient operation. On the main shop floor, portable equipment that is used on a daily basis, needs dedicated space to be put away at the end of each maintenance task, and at the end of maintenance shifts. In order to conveniently store this equipment, Portable Equipment Storage alcoves are located adjacent to Repair Bay Positions. Spare Streetcar parts and component storage takes place in a dedicated Parts Room adjacent to the Repair Bay Positions, linked via a central facility forklift aisle. The Parts Room shall be comprised of three areas Small Component Storage, Large Component Storage and a Shipping and Receiving Area (with lift table for delivery loading/unloading).

- **Small Component Storage** is comprised of anything from nuts and bolts to medium sized items that will fit on a shelf or in high density drawer units. Storage units in this area include high density drawer units, shelving units and bulk storage units. As the fleet grows and the need to store more spare parts increases, large computer controlled vertical storage units may be incorporated (however these units require planning in the design phase as they require additional height clearances). Specialty hand tools also are stored in a Secure Tool Room.
- **Large Component Storage** is an area used to store large components that may be palletized. This space shall be high bay materials warehouse space. The Large Component Storage area should be sized to accommodate a quantity of spare truck assemblies and wheel sets. Kansas City is considering off-wire capable streetcars and if the streetcars utilize batteries for any accessory power or part of the

propulsion system a separate Battery Storage Room should be provided with adequate ventilation, charging capability and eye/shower safety equipment. Access to a mezzanine linked to the mezzanine level shops is advantageous and is best served by a high capacity parts lift from the main shop floor to the storage mezzanine.

- **Shipping and Receiving Area:** a dedicated area should be included as a part of the Part's Room. This area should include a dock or other method for offloading deliveries.

Maintenance of Way

Maintenance of Way (MOW) is a maintenance program associated with maintenance of the "Way", tracks and systems associated with the operations of those tracks. MOW is also responsible for the re-railing of rail vehicles when a vehicle is somehow derailed. Smaller Streetcar Operations, MOW functions can be outsourced and should be evaluated on whether to build space into a new facility. For a small fleet of four to five streetcars a hydraulic re-railing packaged system is available to use to take care of minor situations of derailment, however, major derailment would require larger more costly equipment that an outsourced company would be responsible for. As a Streetcar Operation grows in track miles and streetcar quantity any outsourced MOW services can be brought in-house and the Maintenance Facility expanded to accommodate. As a MOW program is adopted, track space within the OMF storage yard will be required for rail bound equipment and lay down space for rail and other materials. Interior storage and shop space to the maintenance building may also be required for shop space and storage.

Streetcar Storage Track Requirements

There are several ways to store streetcars depending on the site available. Storing four to five streetcars on a single storage track line may be the most efficient approach limiting track, turns and switches. Streetcars should be stored with 14 feet, 0 inches (minimum) clearance between track centers if multiple storage lines are used. Track layout on-site shall take fleet growth into consideration as to where additional storage tracks would be added to keep a safe and efficient site flow. Streetcar movements within the storage yard and around the maintenance facility shall be kept to a minimum with large radius turns where required to reduce wear on vehicle wheels, tire and truck components as well as to reduce wheel squeal. In cold weather climates such as Kansas City, covered vehicle storage shall also be considered.

General Site Requirements

There are specific site requirements necessary to ensure a safe, efficient, and functional facility. Specific site requirements includes (but are not limited to) the following:

- Security perimeter fence/wall should secure the entire site

- Site lighting should provide efficient and even light throughout the entire site with no light pollution
- Sustainability shall be a key goal with the development of the new Streetcar OMF
- TPSS systems shall be integrated into the site in a location that does not interfere with any streetcar movement or the operational placement of OMF facility buildings
- The mainline TPSS and the Facility TPSS shall be kept separate on site. The Maintenance Building TPSS shall have the ability to turn off tracks as required and all rail shall be grounded within the facility
- Primary and secondary access points should be provided for the main OMF site
- Vehicles must be able to move in and out of the facility quickly and safely and be easily moved between tracks
- Drainage and storm water quality requirements elements must be incorporated into site civil design
- Service roads and aprons should be provided to allow access to perimeter of vehicle maintenance tracks and vehicle storage yard
- A guard station shall be provided at a secured, main entry to the site (optional)
- Site Video Surveillance may be required (optional)
- Employee Parking shall be located as near as possible to the facilities while minimizing conflict of employees entering streetcar storage yard or crossing tracks
- A drive through Streetcar Maintenance Building would be beneficial to the efficient operations, however this can vary based on site conditions to include a stub-in shop or loaded shop for multiple cars on one line

Facility Expansion Opportunities

When Master Planning a new Streetcar Operations and Maintenance Facility it is important to consider future growth of the system and fleet and in doing so identify opportunities for possible facility expansion. Depending on the type of construction selected for the initial facility the cost and difficulty of the expansion can vary. If facility expansion is determined to be a necessity because of a phased project approach then the initial build-out method and building placement should be chosen with ease of expansion in mind.

The Preliminary Space Needs Program identified the minimum size facility and maintenance shops for an agency with the planned fleet size such as Kansas City anticipates. As the anticipated fleet grows the need to add space for administration staff and operators will increase. Additionally there will be the requirement to add Service and Inspection Bays and Heavy Repair Bays. The assumption is that the current space requirements identified will suffice until the fleet grows beyond

seven streetcars. For every seven to ten additional streetcars another Service and Inspection (S&I) Bay will be required. The initial single Repair Bay shall suffice for the anticipated fleet of five streetcars and accommodate up to six streetcars, however as the streetcar fleet grows (each additional six streetcars) and ages or if maintenance programs intensify another Repair Bay should be considered.

Additional bays can be added to the facility by either adding bays lengthwise (in line with existing bays, adding length) or by adding bays adjacent to existing bays (adding width). If streetcar storage positions are adjacent to the initial facility then adequate storage shall be available or be able to be constructed nearby to allow for facility expansion.

As the fleet grows and maintenance programs intensify, specialty bays and shops shall be added which include (but are not limited to): Wheel Truing Bay, Blowdown/Chassis Wash Bay, Automated Vehicle Wash Bay, Specialty Electronics Repair, Brake Shop, Machine Shop, Facility Maintenance Shop and Maintenance of Way (MOW) Storage and Repair Shop space. As the Kansas City Streetcar fleet and facilities continue to grow, the requirement for more Administration Staff and Operations Support space and storage areas within the facility, also increases. Additionally, Streetcar storage track requirements also increase.

Industrial Equipment Design

In order to safely, efficiently and effectively maintain streetcars certain maintenance equipment, tools and systems are required in order to perform maintenance tasks properly. During the design process Maintenance Design Group (MDG) provides the Industrial Equipment Design. Industrial Equipment Design places specific equipment items and systems within the maintenance facility and other service areas for safe and efficient repair, maintenance and storage tasks that are performed on a daily basis. Equipment items specified are coordinated with the design team to fully addressing architectural, structural, mechanical, plumbing and electrical requirements. The equipment design starts with industry standard equipment that would be placed in any streetcar maintenance facility: this equipment includes (but is not limited to):

- Steel Top Workbenches (repair bays, shops)
- Swivel base vises (improved functionality at work benches)
- Layout Tables, welders and plasma cutter (welding)
- Vehicle Lifting System, portable electric vehicle lifts
- Bridge Cranes (five to ten ton capacity depending on repair bay function and vehicle)
- Parts carts (tool and parts mobility)
- Fluid Lubrication Distribution System (distribution system including bulk tanks, pumps, and distribution reels in the

Maintenance Building to improve the efficiency of changing vehicle fluids and store fluids in bulk for cost effective inventory purchases)
- Used fluid receivers (used gear oil collection from vehicle gearboxes) and used fluid evacuation pump station
- Shop desks and chairs, file storage units
- Equipment storage shelves, storage cabinets and large storage rack (pallet rack systems) - medium to high density systems
- Air compressor (building compressed air system)
- General Shop hand tools (items that allow more efficient and safe work conditions)
- Shop fabrication equipment (buffer/grinder, drill press, media blaster, saws, and sanders)
- Battery bench and charger
- Electronic dissipative equipment (improved safety and efficiency for Electronics Shop)

In a Streetcar OMF specialty equipment is required in addition to the standard equipment listed above. Large equipment items to perform common streetcar maintenance tasks are specified by the design team, however, usually there is additional equipment required that will be provided by the Streetcar manufacturer at time of order of vehicles and delivery. These specialty items must be documented with the design team to be fully coordinated with the construction of the new facility. Equipment items associated with streetcar maintenance include the following items, again dependant on maintenance requirements, Agency program or required from manufacturer:

- Vehicle Lifts w/body supports
- HVAC Maintenance Dolly
- Test Equipment (vehicle specific)
- Profile Gauge Tooling Equipment
- Wheel and Tire Assembly Jig, press
- Brake Test and Repair Equipment
- Truck/Bogey Assembly Jig
- Track Turn Tables
- Sand Filling System or Portable Filling Cart
- Streetcar Mover (Shunting)
- Hydraulic Re-Railing Equipment (associated with Maintenance of Way program)
- Wheel Truing Lathe
- Streetcar Paint Booth (typical of large transit fleets for in-house repairs and color re-paints)

The table on the following page (Exhibit A) shows equipment to be considered minimal requirements for a streetcar maintenance facility and also items considered to be optional or upgrades as maintenance program requirements change. Included is the

equipment description, anticipated manufacturer list price, assumptions about the equipment and whether or not this item is optional for the initial build-out of the facility.

Exhibit - A: Industrial Equipment Design Summary

Equipment Description	*MFG. Suggested List Price*	*Equipment Design Assumption*	*Equipment Optional?*
Steel top Workbench	$1,500 ea.	Fabricated item for use in all repair bays and shop areas	Required
Swivel Base Vises	$640 ea.	Large vise utilized on each workbench.	Required
Layout Table	$6,500	Large heavy duty tables used in Weld Shop.	Optional
Parts Carts	$430 ea.	Heavy Duty	Required
Welder	$4,000	.	Required
Plasma cutter	$2,260		Optional
Portable Fume Extractor	$6,100	Required if weld is to occur in the facility.	Optional
Hydraulic Press	$7,500	Common Work Area or Fabrication Shop tool.	Optional
Drill Press	$2,100	Common Work Area or Fabrication Shop tool.	Required
Buffer/Grinder	$8,500	Common Work Area or Fabrication Shop tool.	Required
Media Blast Cabinet	$7,800	Common Work Area or Fabrication Shop tool.	Optional
High Pressure Hot Water Washer	$13,000	A truck wash area is required if teardown and repair of complete truck assemblies will be performed.	Optional
Portable Electric Lifting Jacks	$100,000	Set of four. Flat Floor Bay Lifting	Required
In-ground Vehicle Lifts w/Body Supports	$500,000	Custom in ground lifting solution built to streetcar specifications.	Optional
Bridge Crane	$45,000	Bridge Crane over Inspection Bay and Mezzanine Shops.	Required

Equipment Description	*MFG. Suggested List Price*	*Equipment Design Assumption*	*Equipment Optional?*
Duplex Air Compressor w/ Compressed Air Dryer	$17,600	Compressed air loop around Bays and Shops. Does not include piping or compressed air outlets.	Required
Battery Storage Bench	$1,800	Custom Fabricated Item.	Optional
Electronic Dissipative Workbench and Shop Storage	$18,000	No electronics shop planned initially.	Optional
HVAC Maintenance Dolly	$ N/A	Included with Streetcar	Required
Steel Rail Tire Mounter	$125,000	Used for replacing tires and wheels that will not to be turned to track profile.	Optional
Brake Test Equipment	$ N/A	Included with Streetcar	Required
Profile Gauge Tooling	$ N/A	Included with Streetcar	Required
Streetcar Test Equipment	$ N/A	Included with Streetcar. Various Items.	Required
Truck/Bogey Assembly Jig	$158,000	Used for extensive truck teardown and reassembly.	Optional
Track Turntable	$75,000	Used on main shop track lines to transfer trucks from streetcar position to shops.	Optional
Sand Filling System w/Silo	$250,000+	Typically used on large scale operations	Optional
Sanding Cart	$50,000	An automatic/pneumatic	Optional
Vacuum System, Multi-Station	$180,000+	Utilized by large fleet operations with multiple cleaning positions.	Optional
Vacuum Backpack	$300 ea.		Required
Re-railing Equipment	$62,000	Packaged system to assist with minor de-railment.	Optional
Wheel Truing Lathe	$2,000,000 +	Assumed this function will be outsourced.	Optional
Portable Wheel Truing Lathe	$1,500,000 +	Assumed this function will be outsourced.	Optional

Equipment Description	***MFG. Suggested List Price***	***Equipment Design Assumption***	***Equipment Optional?***
Streetcar Paint Booth	$225,000	Used by larger fleet operations. Assumed this function will be outsourced.	Optional
Automatic Streetcar Washer	$250,000+	Assumed design is a high pressure touchless wash with Detergent Arch, undercarriage spray, spinner washers and rinse arch with Reverse Osmosis and Water Reclaim. Brushes and dryers can be added.	Recommended
Storage Systems	$115,000	Includes multiple storage units including cabinets, shelving, small parts drawers, bulk racks and pallet racks. Most items located in Parts Storage Warehouse or Mezzanine. Some items in shop areas.	Required
Lift Table	$21,500	Parts/Cart lift from Inspection Pit to Main Shop Floor	Recommended
Fluid Delivery/ Collection System	$17,335	System includes Tanks, pumps and reels for Gear Oil Delivery/Recovery and assumes a chassis grease drum w/pump for grease guns. Piping costs not included.	Required

Preliminary Space Needs Program

The Preliminary Space Needs Program for the new Kansas City Streetcar Operations and Maintenance Facility (OMF) is based on the anticipated requirements of up to a five Streetcar fleet. The Space Needs Program outlines the space requirements for a safe and efficient operation and is based on applicable industry standards. A summary of the Preliminary Space Needs Program is provided on page 15, Exhibit B. The summary includes the projected square footage needs for all buildings and exterior areas. These projected space needs are subtotaled into net square footage requirements and totaled to include site access, landscaping, and setbacks for a total site acreage requirement. All of the assumptions made in regard to staffing and vehicle counts are derived from projects similar in size and industry standards. The fully detailed Preliminary Space Needs Program is provided starting on page 16, Exhibit C.

Circulation Factors

The space requirements shown for each function are net usable area. There are three Circulation Factors utilized in the Preliminary Space Needs Program. These factors are:

Interior or Building Circulation: This factor is applied to the program as a percentage of the total building square footage. It accounts for miscellaneous building spaces such as hallways, stairwells, janitor closets, mechanical, electrical, and plumbing rooms, wall thickness, and structure (**MEPS**), and access requirements. The following is a list of the factors (in general) that have been applied to the program:

- Streetcar Operations Administration - 35%
- Streetcar Operations (transportation) - 35%
- Streetcar Maintenance Administration - 25%
- Streetcar Maintenance Shops & Storage - 20%
- Streetcar Service Areas - 10%
- Streetcar Materials Handling - 10%
- Maintenance of Way - 10%

Parking Lot Circulation: This factor is usually included in the calculations for each space and not applied as a percentage. The factor equates to 100% of the actual space occupied by a vehicle. This additional space must be included in the calculation to account for the drive aisles, walkways, islands, and other areas created by site and access inefficiencies.

Site Circulation Factor: This factor is also applied to the program as a percentage of the total program square footage. It accounts for areas around buildings, site drive aisles, building access, and site access. A 100% factor has been applied to account for all site requirements and inefficiencies. As such, the

better the site conditions, access, easement, etc., the more efficient the site layout can become, possibly reducing this factor even further.

Exhibit - B: Preliminary Space Needs Program Summary

Area Description	Space Standard	5 Streetcar Fleet - Program			
		Quantity		Area (sf)	Remarks
		Staff	Space		
SPACE NEEDS PROGRAM SUMMARY					
Building Areas		***Staff***			
Streetcar Operations Administration		***3***		***1,439***	
Streetcar Operations (Transportation)		***12***		***2,099***	
Streetcar Maintenance Administration		***2***		***335***	
Streetcar Maintenance Support		***0***		***0***	*Shared with Operations Areas*
Streetcar Maintenance Shops & Storage		***4***		***15,595***	*Ground Floor*
- Mezzanine Areas				***1,200***	*Not included in Ground Level Total*
Subtotal Ground Level		***21***		***19,468***	
Other Buildings					
Streetcar Services Areas		***2***		***6,435***	
Maintenance Of Way		***0***		***0***	
Subtotal Other Buildings		***2***		***6,435***	
Total all Buildings		***23***		***25,903***	
Exterior Areas					
Agency Vehicle Parking				***8,372***	
Employee/Visitor Parking				***7,416***	
Storage				***5,700***	
Total Exterior Areas				***21,488***	
Total Building and Exterior Areas				***47,391***	
Site Circ./Landscaping/Setbacks	***100%***			***47,391***	*Includes some Yard Leads and Special Track*
Total Site Requirements				***94,783***	
Acres				***2.18***	

Exhibit - C: Preliminary Space Needs Program

Area Description	Space Standard	5 Streetcar Fleet - Program			
		Quantity		Area (sf)	Remarks
		Staff	Space		
STREETCAR OPERATIONS ADMINISTRATION					
Office Areas					
Manager of Operations	12 x 14	1	1	168	Private office w/ chair & table for 6 people
Administrative Assistant	8 x 8	1	1	64	Workstation
Clerical	8 x 8	1	1	64	Workstation
Future Office	10 x 12		1	120	Private office
Lobby Area				100	
Conference Room				200	5 to 8 people, 20sf/person
Office Supply/Copy/Files/Work Room				150	Adjacent to Admin Asst.
Data/Communications Room				120	
Lost and Found				80	
Subtotal				1,066	
Circ/Mech/Elec/Struct	35%			373	
TOTAL - STREETCAR OPERATIONS ADMINISTRATION		**3**		**1,439**	
STREETCAR OPERATIONS (Transportation)					
Control Room / Streetcar Operations Supervisors		2		200	Room with console and view of Yard
Report/Sign-out Station/Storage				100	With storage shelving
Radio Storage Area				25	
Support Areas					
Operators' Room		10		500	Shared with Maintenance Staff
Chair/Table Storage				100	Adjacent to Conference/Training Room
Locker Alcove	3.5		12	80	1/2 size lockers
Women's Shower/Changing/Restroom				200	2 sinks, 2 toilets, 1 shower Maint. Lockers
Men's Shower/Changing/Restroom				300	2 sinks, 1 toilet, 1 urinal, 1 shower Maint. Locker
Janitor Closet				50	w/mop sink
Subtotal				1,555	
Circ/Mech/Elec/Struct	35%			544	
TOTAL - STREETCAR OPERATIONS (Transportation)		**12**		**2,099**	

Area Description	Space Standard	5 Streetcar Fleet - Program			
		Quantity		Area (sf)	Remarks
		Staff	Space		
STREETCAR MAINTENANCE ADMINISTRATION					
Office Areas					
Maintenance Supervisor	12 x 14	1	1	168	Private office
Technician's Counter/Manuals		1		100	Counter adjacent to Supervisor
Subtotal				268	
Circ/Mech/Elec/Struct	25%			67	
TOTAL - STREETCAR MAINTENANCE ADMINISTRATION		**2**		**335**	
STREETCAR MAINTENANCE SUPPORT					
Support Areas					
Lunch/Break Room				0	Shared with Rail Operations
Women's Lockers/Showers/Restroom				0	Shared with Rail Operations
Men's Lockers/Showers/Restroom				0	Shared with Rail Operations
Subtotal				0	
Circ/Mech/Elec/Struct	20%			0	
TOTAL - STREETCAR MAINTENANCE SUPPORT				**0**	
STREETCAR MAINTENANCE SHOPS & STORAGE					
Repair/Shop Areas					
Service & Inspection Bay w/LLWA and ULWA	24 x 100	1	1	2,400	Work Platform access. Offset OCS for crane
Repair Bay (Portable Lifts)	24 x 100	0.5	1	2,400	
Truck/Tire Shop	24 x 40		1	960	Inlcudes Wheel/Tire Shop
Parts Cleaning Area	24 x 24		1	576	
Common Work Area				350	
Brake Shop		0.5		150	
Electronics Repair Shop		0.5		350	Could be enclosed Room
HVAC Repair/Pantograph Shop		0.5		500	Mezzanine Shop
Roof Mounted Component Storage/Staging				500	Mezzanine Storage Space
Storage Areas					
Portable Equipment Storage Area				350	Adjacent to Bays and Shops
Battery Room				150	
Lube/Compressor Room				250	
Building OCS/Electrical Room				350	
Materials Handling					
Storeroom Clerk	80	1		80	Workstation
Storeroom Parts Issue Window				50	Casework Counter Area
Parts Storeroom				1,000	Below Mezzanine - Small fast moving parts.
Large Parts Storage				1,000	Hi-Bay Storage
Parts Storage Mezzanine				0	See Roof Mounted Component Storage/Staging
Receiving Area				0	Incl.
Freight Elevator/Parts Lift				100	
Subtotal Ground Floor				11,516	Not Incl. Mezzanine Shop Areas
Circ/Mech/Elec/Struct	25%			2,879	
Subtotal Mezz Level				1,000	
Circ/Mech/Elec/Struct	20%			200	
TOTAL - STREETCAR MAINTENANCE SHOPS & STORAGE		**4**		**15,595**	

Area Description	Space Standard	5 Streetcar Fleet - Program			
		Quantity			
		Staff	Space	Area (sf)	Remarks
MAINTENANCE OF WAY					
Office Areas					
M.O.W. Manager/Systems Engineer	12 x 14	1	1	168	Private office
M.O.W. Supervisor	10 x 12	1	1	120	Private office
Shop/Storage Areas					
M.O.W. Shops					
- Track Shop	15 x 20	2	1	300	
- Traction, Power & Signals Shop	15 x 20		1	600	
Compressor Room				100	
M.O.W. Interior Storage				500	
Re-Railing Equipment Storage				250	Adjacent to and with rail access.
Subtotal				2,038	
Circ/Mech/Elec/Struct	10%			204	
TOTAL - MAINTENANCE OF WAY		**0**		**0**	**Not immediately required**
STREETCAR SERVICE AREAS					
Service Areas					
Cleaning Position w/platform	25 x 100	2	1	2,500	Canopy Covered Platform for a single car.
Vehicle Wash	25 x 100		1	2,500	Minimum Length
Wash Equipment Room				600	
Electrical Room				150	
Cleaning Supplies Storage				100	Adjacent to Cleaning Platform
Subtotal				5,850	
Circ/Mech/Elec/Struct	10%			585	
TOTAL - STREETCAR SERVICE AREAS		**2**		**6,435**	
EXTERIOR AREAS					
Agency Vehicle Parking					
Streetcar Rail Vehicles	100 x 14		5	7,000	
Agency Vehicles	9 x 18		2	648	Includes Circulation
Controller/Supervisor Vehicle	9 x 18		1	324	Includes Circulation
Parts Truck	10 x 20		1	400	Includes Circulation
M.O.W. Vehicle Parking	10 x 20		0	0	Includes Circulation
Employee/Visitor Parking					
Employee Parking	9 x 18		18	5,832	Incl. Circulation (minus 5 operators per shift)
Accessible Parking	13 x 18		2	936	Includes Circulation
Visitor Parking	9 x 18		2	648	Includes Circulation
Storage					
Storage Yard				5,000	
Receiving Area Loading Dock	12 x 15			180	Covered
Receiving Area (at grade)	12 x 30			360	Covered
Hazardous Materials Storage/Staging				160	
TOTAL - EXTERIOR AREAS				**21,488**	