Alphabot System

User Manual

PN: 1000003-MN-01 - Rev E

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This manual must always be placed in an operator accessible location near the Alphabot® System.

This manual is intended to provide generic information related to all models of Alphabot® System. Due to specific design changes, contents of this manual may not entirely apply to the purchased model of the system.

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For any queries related to this manual, please contact our office at the address given below:

101 Billerica Avenue, Building 3
North Billerica, MA 01862
(978) 901-6050

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1. Reference Documents

Document	Part Number / Link
Alert Academy	https://academy.alertinnovation.com/
Alert Business Glossary	https://alertinnovation1.sharepoint.com/:x:/s/OperationsDiscipline/EUzsJl1d_dlKuycs_MyO8WsBx7GsJY7PwklQz5gGccXD9A?e=CBDc7w
Alphabot System - User Manual (this manual)	1000003-MN-01
Alphabot APSD System LOTO Manual	1000035-SF-01
Alphabot System Reference Guide	1010755-01
Alphabot System Master Control System (MCS) User Manual	1000016-MN-01
RCS User Manual	1010406-01
Maintenance Technician Safety Manual	1000011-MN-01
Procedure Single Aisle Request to Enter (RtE) Procedure	1000035-SF-01
Recovering Dynamic Workstation Lockout Tagout	1000035-SF-01
Alphabot - User Manual	1000004-MN-01
Alphabot Pre and Post Maintenance Procedures	1000067-SR-01

2. Introduction

This Alphabot® **APSD** System manual is intended to provide information for safe operation of the **A**utomated, **P**icking, **S**torage, and **D**ispense system. It is intended for installation technicians and operators working in the System.

Alphabot vehicles works in the Alphabot® System in concert with a number of other Alert products to fulfill customer orders. The term 'Alphabot' is interchangeable with "bot" and both refer to Alphabot vehicles.

System topics include APSD System, personnel safety, hazards, structure safety, power, totes, user instructions, dynamic and static workstations, and regulations.

For Bot system maintenance and troubleshooting see MCS: Master Control System PN1000016-MN-01 and Alphabot Fault Codes PN10000025MN-01

2.1 Alphabot System Overview

The Alert Innovation **Alphabot® System** is an automated storage and retrieval system utilizing autonomous, motorized, remote-controlled vehicles to store, assemble, and retrieve customer orders. The standard configuration of the Alphabot system is **A**utomated **P**icking, **S**torage, and **D**ispense (APSD). The APSD system is similar to a giant vending machine storing tote product containers. Employees interact with the APSD system at workstations where Alphabots (bots) pick up and drop off totes for building customer orders, loading and decanting products into the system, and pulling orders.

The Alphabot System includes storage modules, totes, sub-totes, tower modules, transit planes, dynamic workstations, and static workstations. Alphabots (bots) are at the heart of this system moving product from station to station and ultimately delivering completed customer orders.

The system is controlled by a computer "system operator" responsible for issuing tasks, monitoring system status, and resolving interruptions. The system operator issues commands to Alphabots within the system using a software known as the **M**aster **C**ontrol **S**ystem (**MCS)**. MCS will be replaced by a **R**obotic **C**ontrol **S**ystem (**RCS)**. See Alphabot System Terminology 31 for more information.

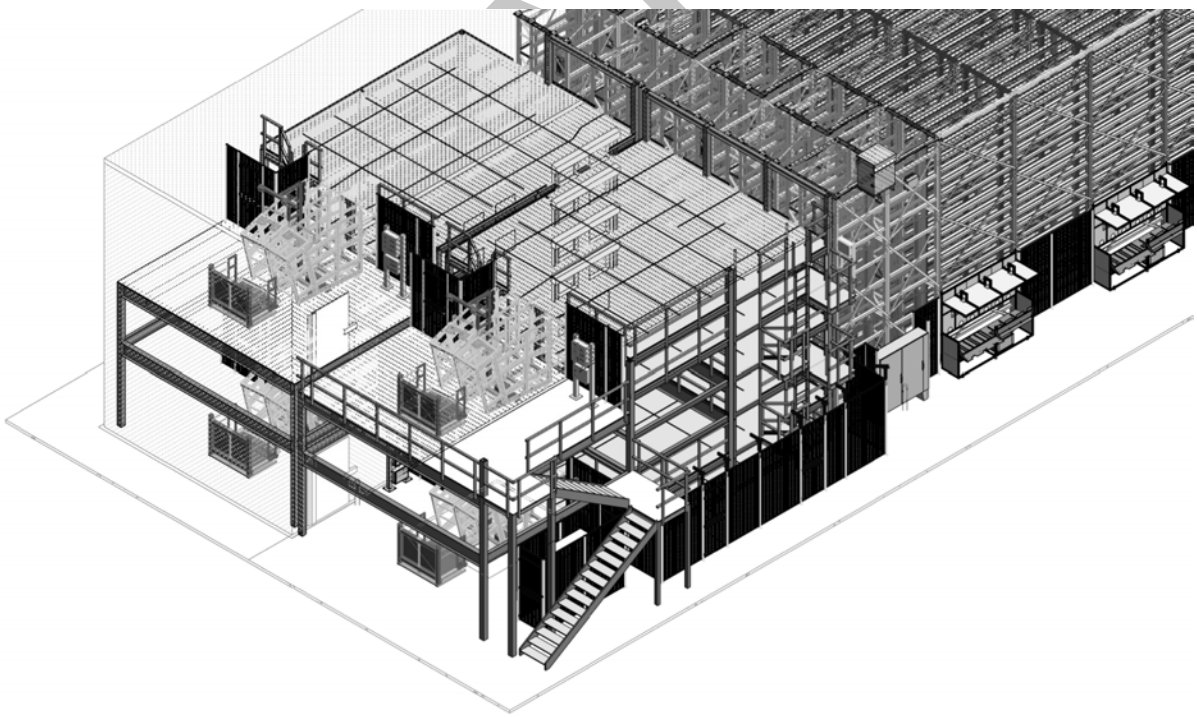


Figure 1: Alphabot APSD System. From left, dynamic workstations for product picking connect to transit planes (middle) bots use to navigate into storage module.

2.2 Alphabot (Bots)

The Alert Innovation Inc. Alphabot® is a compact, motorized, remote-controlled, semi-autonomous vehicle with vertical and horizontal movement capabilities. Alphabots handle all tote logistics, transportation, and dispensing in the larger Alphabot System. Alphabot is interchangeable with "bot" and both refer to Alphabot vehicles.

Alphabots retrieve, carry, and deliver totes in its "saddle" or payload bay. Bots easily transfer totes between the saddle and storage racks using a simple single-motor and chain mechanism. Several other motors propel bots forward, make turns, or move vertically with vertical-drive mechanisms. Drive wheels have extension and retraction capabilities enabling horizontal and vertical navigation to storage levels and locations. Power comes from a capacitor that charges rapidly when moving vertically by connecting a "charge toe" into an electrified rail.

Alphabot navigation is deterministic based on command instructions from the **M**aster **C**ontrol **S**ystem (**MCS**) software that receives continuous location information from Alphabot system RFID tags used to plan all Alphabot routes performing storage and retrieval work.

See Alphabot Bot Terminology 40 for more information.

Figure 2: Alphabot side view without a blue product tote.

2.3 Totes

Blue tote containers are used to hold grocery products in the system. A tote is either a "Product Tote" (P-tote) or an "Order Tote" (O-tote) based on its contents and system status.

Typically, empty totes are delivered to the static workstation where associates will open boxes and dispense product into them. Users induct products into the system by scanning crates, scanning products, and updating product quantity and expiration dates on a system user interface screen.

Customer orders can be filled from the Alphabot system or hand-picked with in-store product. When orders are filled at dynamic workstations bots automatically move totes to Alphabot system storage locations. Totes filled by associates with in-store product are inducted at either ambient or chilled static workstations where bots transport totes to assigned storage locations. When totes are inducted they are stored at white tote slots (bottom left) in a storage level.

When loading a tote into the system, an associate is prompted to use a hand scanner to scan QR codes (bottom right). Each tote contains two QR codes, one for Alert Innovation system identification and the other customer system identification.

Totes may contain yellow sub-totes partitioning tote space by half, quarters, or 1/6th space increments.

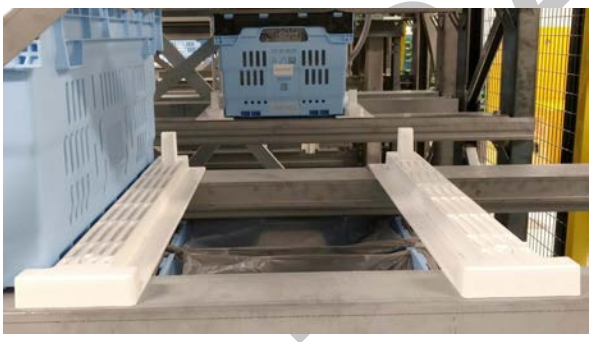


Figure 3: Totes Sitting in System Aisle Tote Slots

Figure 4: A user scans a QR code on a tote

2.4 Control System

Alphabots are controlled by several systems, primarily "**MCS**", the **M**aster **C**ontrol **S**ystem, which presents an ongoing status of each bot and component to a system operator, who may also send commands to bots and other system components. MCS is essentially the "air traffic control" for all Alphabots and system components. MCS is an on-site server rack resident at each customer site.

MCS will be upgraded to "**RCS**", or a **R**obotic **C**ontrol **S**ystem, with both equivalent and enhanced functionality. An "ACS" **A**lert **C**loud **S**ystem is planned for enabling cloud-based solutions.

See System Operation 128 for more information.

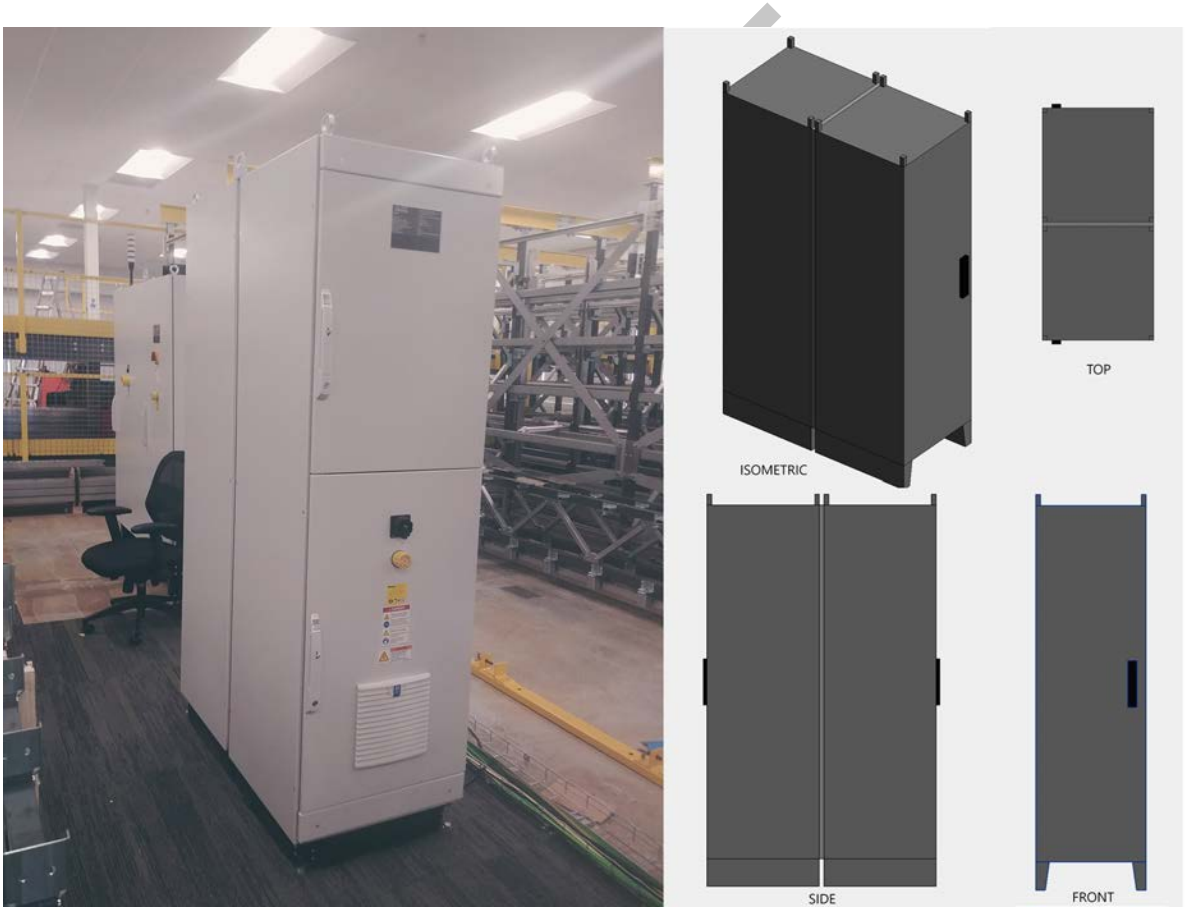


Figure 5: MCS Server Rack

2.5 Power

The Alphabot System receives power from a **main enclosure**, located at the ground level.

A **UPS cabinet** is situated next to the main enclosure. The UPS, short for Uninterruptible Power Supply, provides additional system run time in the event of a power loss - enough time to park bots and complete pending tasks.

Based on the size of the system, there may be additional enclosures present.

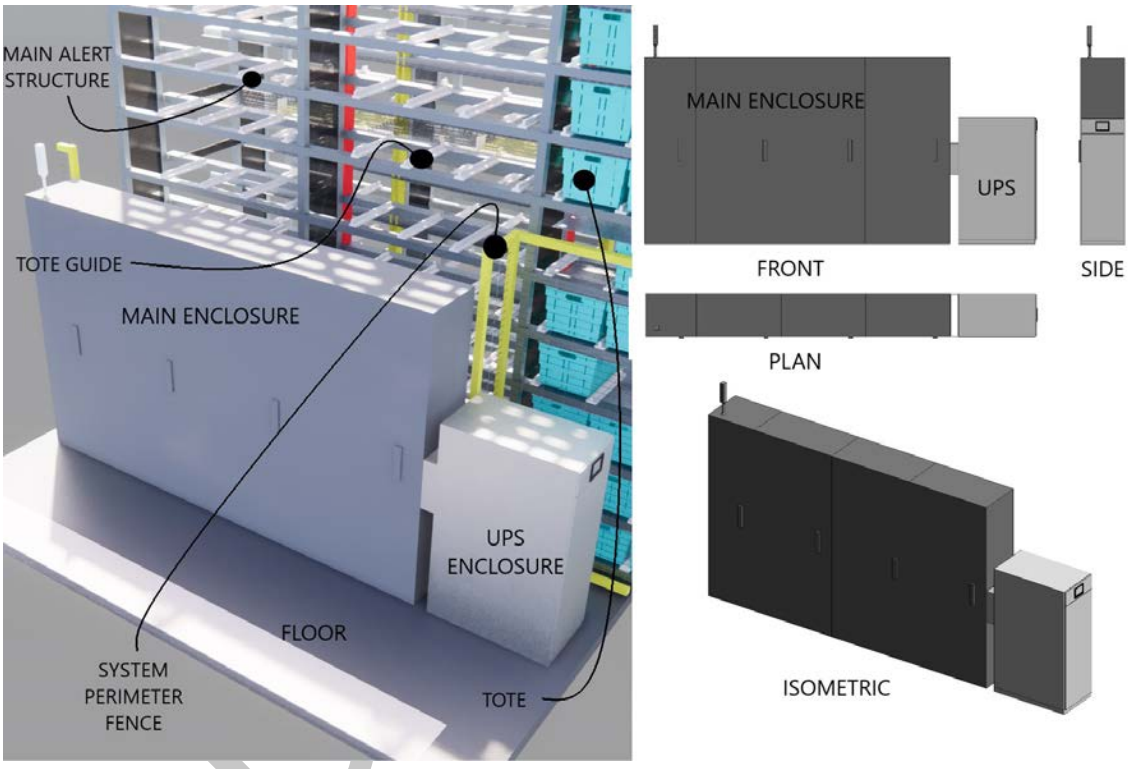


Figure 6: Main Enclosure (Center), UPS Enclosure (Right, Bottom), Tote (Right, Blue)

2.6 Temperature Zone

In the Alphabot System, bots and associates move between ambient, chilled, and frozen temperature environments. Static and Dynamic workstations, used by associates to interface with the Alphabot System, are present in ambient and chilled environments. Associates handle all frozen products through the chilled environment workstations. Temperatures range from:

- Ambient (15 °C to 25 °C)
- Chilled (0 °C to 5 °C)
- Frozen (-30 °C to 0 °C)

2.7 Aisles

Aisles are "hallways" Alphabots use to travel horizontally. Aisles also enable bots to access channels for vertical structure movement.

Most aisles have a service door at one end and are lined with openings to workstations. Aisles end at a "RollSeal" or standard service door. The purpose of RollSeal doors is to help maintain chilled and frozen system temperatures. RollSeal doors barriers also leading to flat "transit planes" used to navigate and access other aisles and workstations.

Technicians may enter aisles through an interlock door to service the system. A "Request to Enter" (RtE) process is input at the entry door by the technician, moving all bots out of the aisle, and preparing a section for entry. Yellow "dynamic catwalk panels" become floor level during the entry process allowing technicians to move through the aisle (bottom left). Otherwise catwalks are open enabling bots to travel vertically (bottom right).

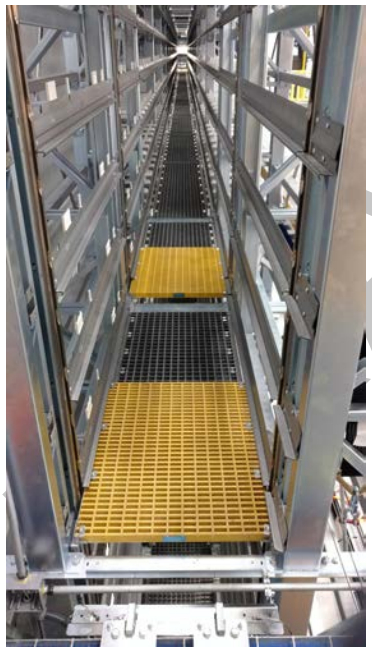


Figure 7: An aisle with engaged dynamic catwalks

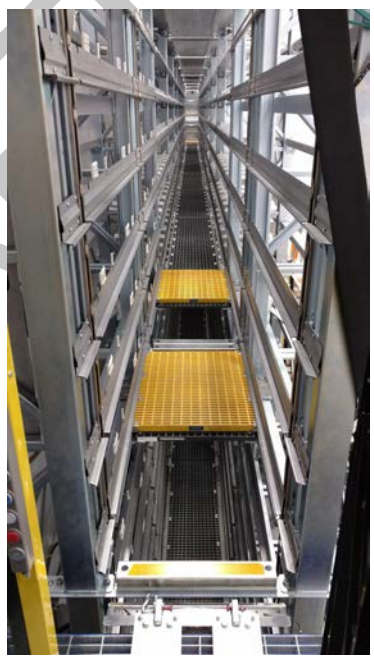


Figure 8: Catwalks disengaged

When a technician exits an aisle, the service door interlock mechanism locks, dynamic catwalks disengaged with a winch actuator, and the opening created allows bots to move unobstructed vertically.

Figure 9: The winch actuates a dynamic catwalk.

At each location where a dynamic catwalk is present, there is a channel containing a **charge rail** for bot capacitor charging. **Charge rails pose an electrical hazard** as they are always powered unless deactivated by an E-Stop.

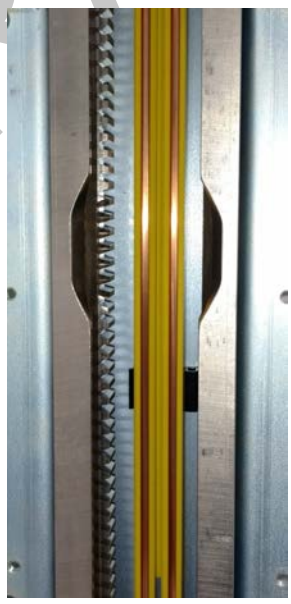


Figure 10: Charge rail

Aisles are lined with numerous **RFID Tags** and **Fine Position Flags** which are used by bots to navigate. RFID tags and position flags signal a bots location to the MCS/RCS for generating navigation instructions.

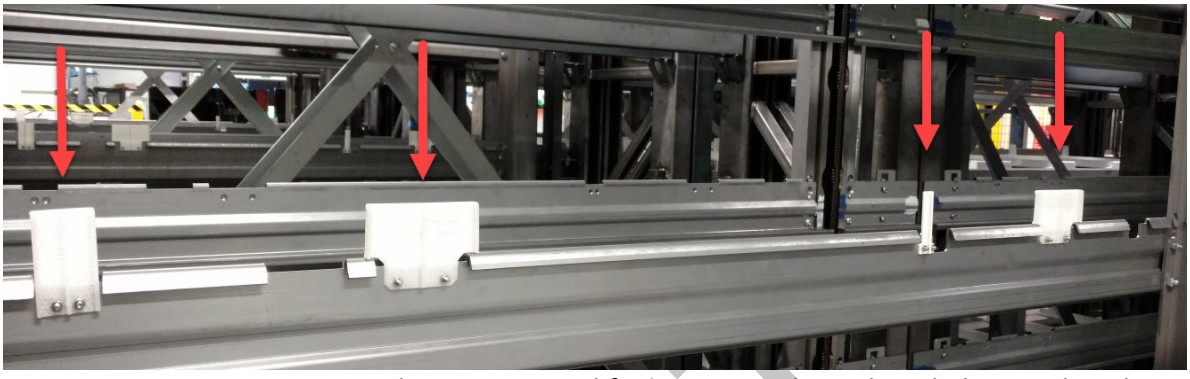


Figure 11: Bots navigate with RFID tags and fine position plags placed along aisle sides

HAZARDOUS VOLTAGE

Contact may cause electrical shock or burn. Turn off and lockout system power before servicing. Service of electrical equipment must be performed by qualified and trained personnel only.

Use only insulated tools and required PPE for work on electrical equipment.

Failure to comply will result in serious injury or death.

2.8 Service Doors

Service doors are present at the beginning of most aisles. Service doors are also located near transit planes and known as "interlock" or "fortress" doors.

Each service door contains a handle and an interlock mechanism which locks the door in place electronically. To enter, a technician must use the controls on the interlock to perform a "**Request to Enter**" or **RtE** process. This process sends all bots in region to other system areas and prevents new bots from entering.

Technicians are trained to perform lockout/tagout (LOTO) procedures on door handles to prevent a door from closing and locking behind a technician servicing the system.

Figure 12: A service door.

Figure 13: An open service door with safety straps

2.9 Tower

Towers are structure elements used to construct an aisle. Towers house gear racks and charge rails which allow the bots to travel vertically and re-charge their capacitor bank. Tower modules (top) are individual segments of a larger tower structure (bottom). Bot vertical travel rails are located in tote storage areas. In some configurations there are no independent tower modules.

Figure 14: A tower module, one component of a larger tower.

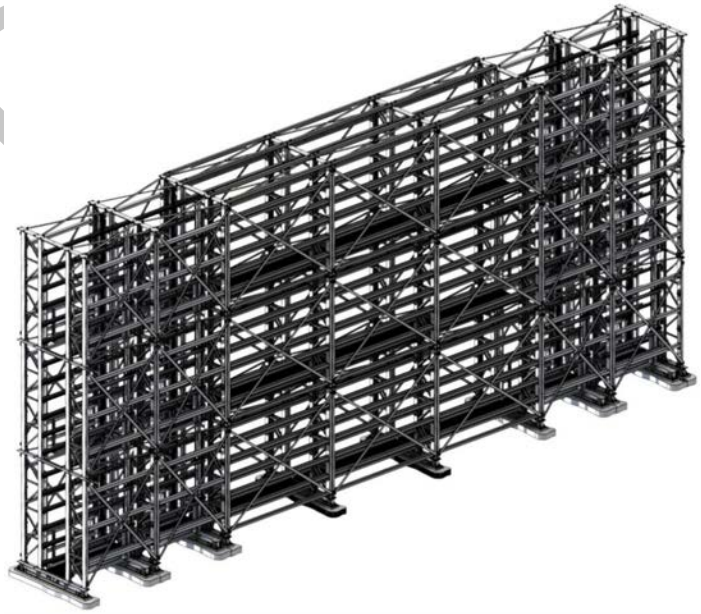


Figure 15: A tower, one component of the larger structure.

2.10 Transit Planes

Transit planes are horizontal areas that allow the bot to travel between aisles and navigate to dynamic workstations. They have embedded **magnetic lines** (dark gray lines in figure) which an Alphabot follows using its "line follower" sensor.

There are also **RFID tags** (*white rectangles*) embedded in the transit plane floor panels to assist with bot axis rotation and navigation.

The primary purpose of transit planes is to allow Alphabots to change aisles and queue for work at Dynamic workstations. When bots complete workstation activities, they move back through roll-seal doors to resume aisle storage and retrieval tasks.

Figure 16: A transit plane. Bots move from aisles through Roll Seal doors onto a transit plane. Dark gray lines are magnetic navigation paths.

2.11 Express Planes

Express planes are platforms allowing bots to move across aisles or cross-aisle amongst different storage units. They are also used as buffer zones where bots wait until another tower or lane is available for travel.

Express planes connect to other Alphabot system components vary based system installation designs. For example, they may be connected to Dynamic Workstations, customer dispense portals, or both.

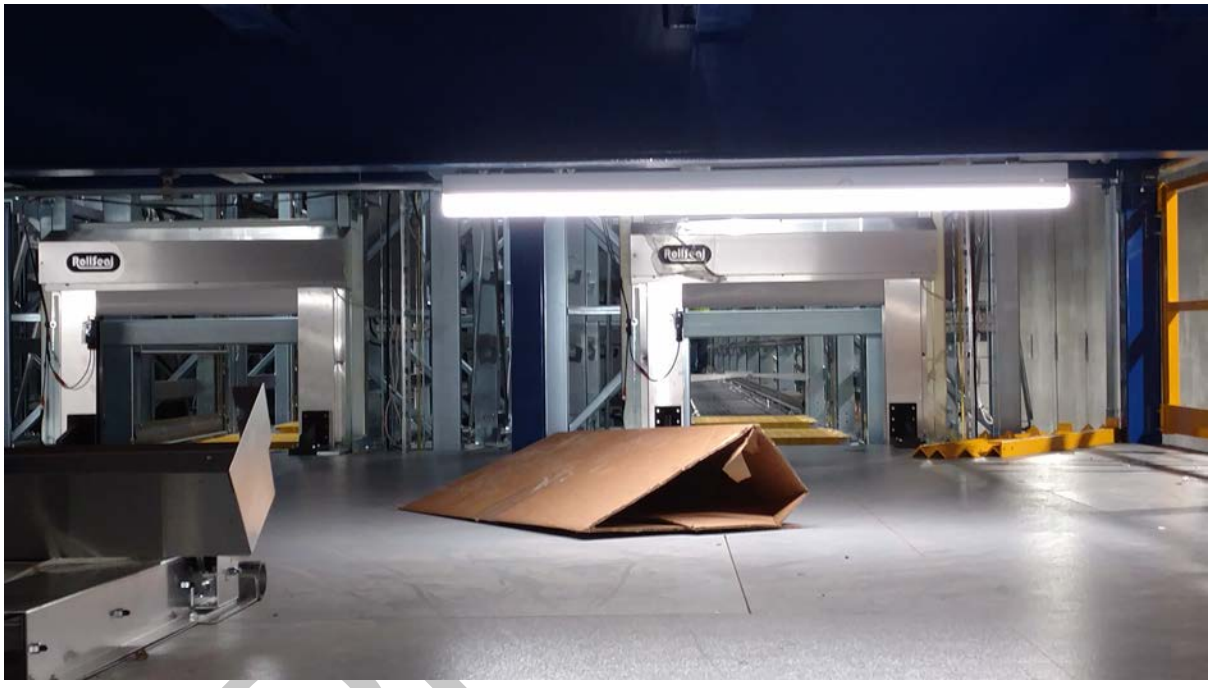


Figure 17: Express plane viewing the aisles through a overhead door. Overhead doors help with temperature control.

2.12 Dynamic Workstations (DWS)

There are two main system interfaces for associates, **static** and **dynamic workstations**. Workstations are the primary locations where associates directly interact with the Alphabot system.

The **Dynamic workstations** (DWS) are situated at the end of a transit plane. They are three bot levels in height enabling a bot to enter the bottom through a transit plane, engage its wheels, and climb to the height of the associate to present its tote. There are multiple DWS per system, typically installed on different tiers in ambient and chilled temperature zones. DWS are always situated at the end of a transit plane.

An associate begins work by stepping onto a DWS elevated platform, raising it, and initiating work through an MCS user-interface. The system selects a customer order and directs bots to retrieve product totes. Bots with product totes accumulate on the transit plane while an associate picks or transfers items, aka eaches, from product to order totes. Associates use light indicators and screen responses to ensure correct item selection from product totes. While building an order, bots rotate product, order, and empty order totes until an order is complete. MCS is updated as orders complete and directs bots to tote storage locations.

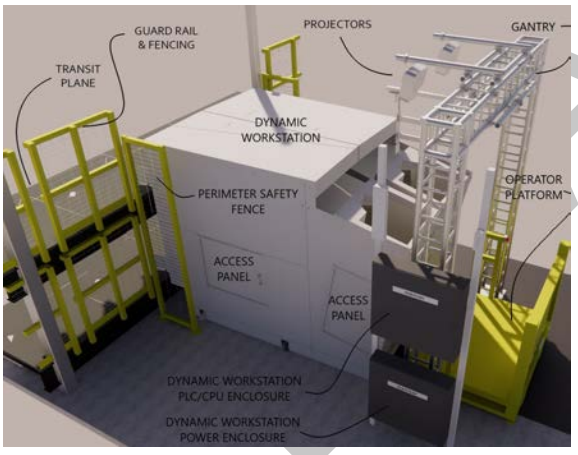


Figure 18

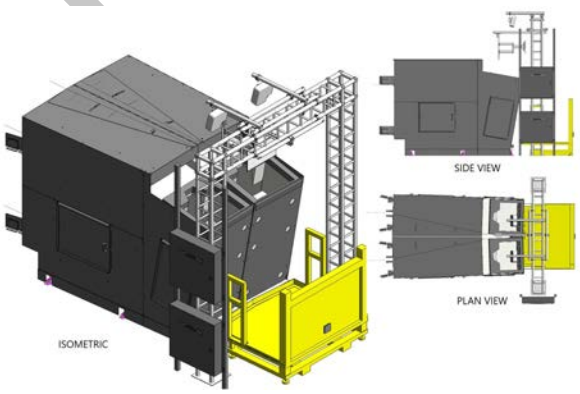


Figure 19

2.13 Static Workstations (SWS)

There are two main system interfaces for associates, **static** and **dynamic workstations**. Workstations are the primary locations where associates directly interact with the Alphabot system.

The static workstations (SWS) are fixed workstations providing an interface to introduce product totes into the Alphabot system storage module. These workstations are meant for collecting completed orders, dispensed orders, and handling any exceptions with a hospital function.

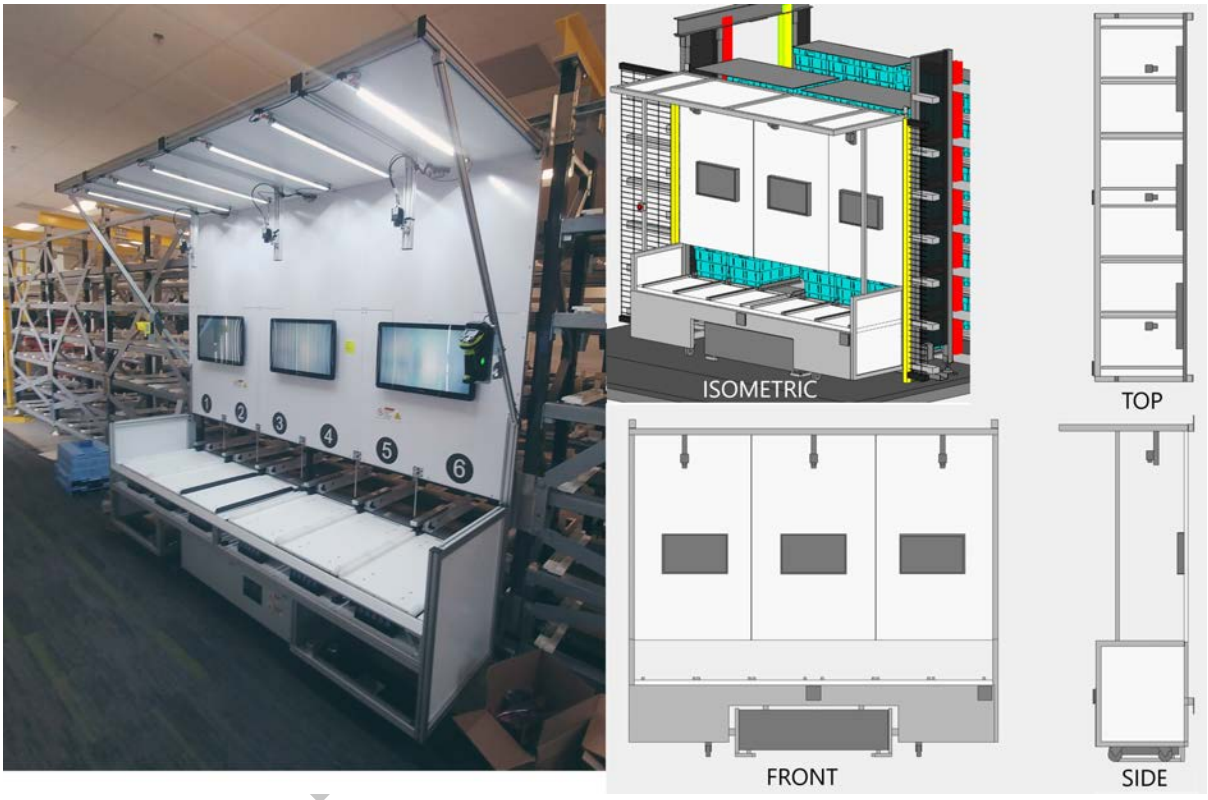


Figure 20: Actual and schematic view of an SWS

2.14 SWS Tote Wall

The Alphabot Automatic Storage and Dispense system (ASD) sites may have installed a reduced compact version of the static workstation known as a **Tote Wall** workstation.

Associates are able to receive and deliver totes from Tote Wall workstations. The are equipped with a tablet sized touch-screen interface for performing station functions.

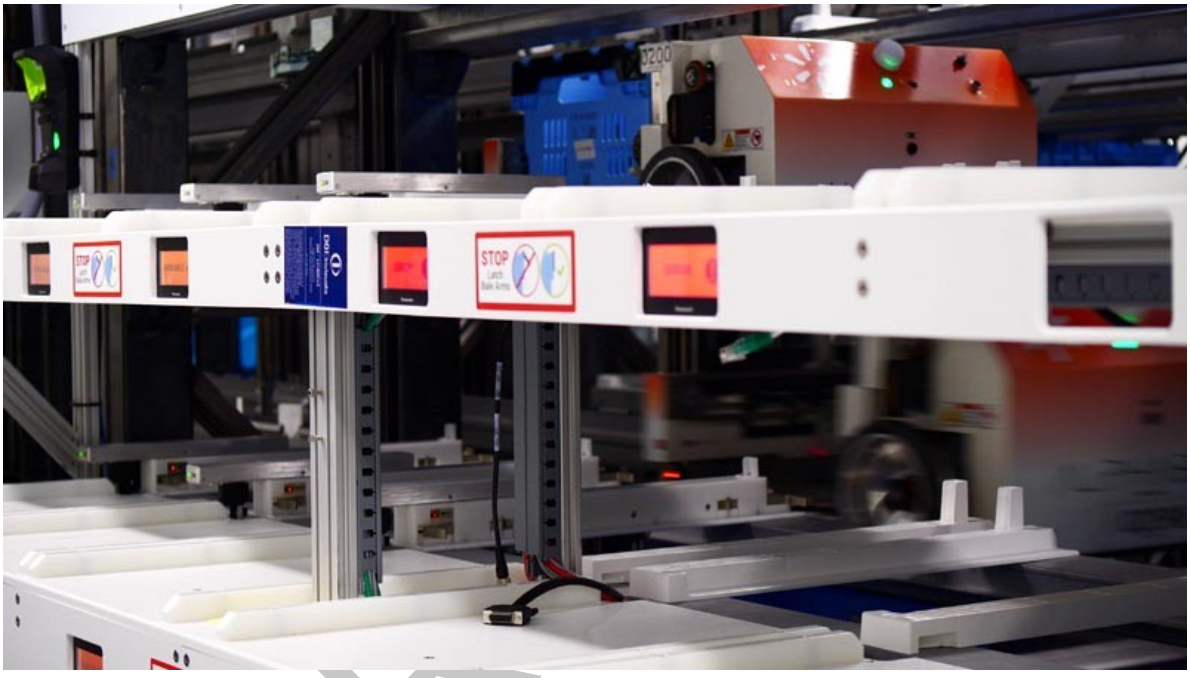


Figure 21: Tote Wall exclusive to ASD sites.

2.15 Customer Dispense Portals

Customer Dispense Portals are interfaces used by customers to retrieve their orders. Once a customer checks in through the control interface, the system will display the customer's order on the display panel. Bots are instructed to gather order totes and drop them off at the rear of the dispense portals. The system transfers totes from the rear to the customer facing side for pickup. When a customer arrives, a door opens on the portal front allowing them to reach in and gather their orders from the order totes.

In summary, this process allows customers to arrive, request their order, and have it delivered without interacting with a store associate. Customer dispense portals may be either built into the side of building or in a structure similar to a gas pump station serving customers on either side.

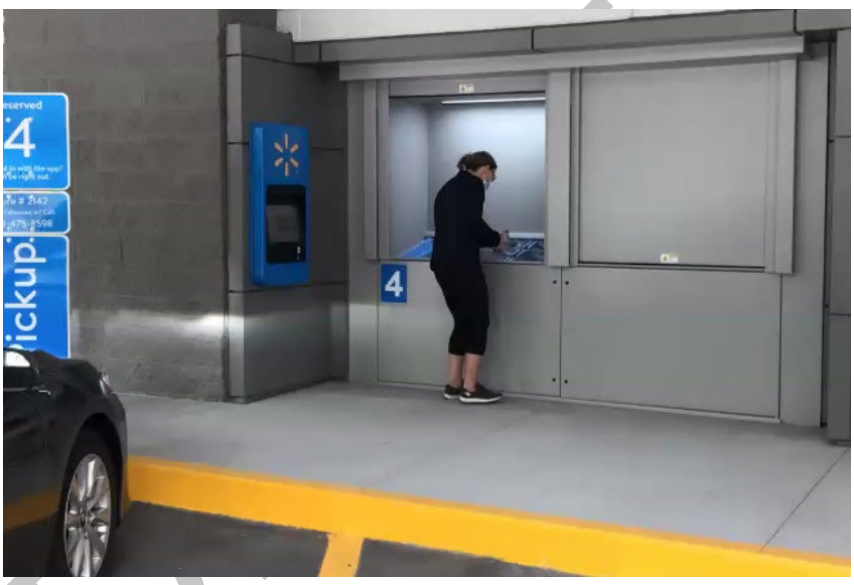


Figure 22: A customer interacts with the customer dispense portal.

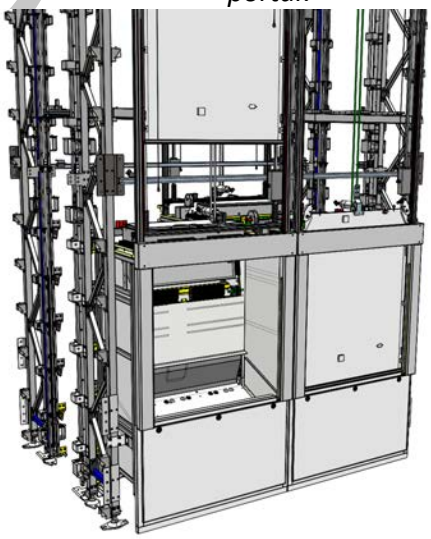


Figure 23: 3D render of the customer displense portal.

2.16 Tiers and Levels

Tiers and levels are used to describe vertical and horizontal components within an aisle. A tier consists of 6 levels and aisles are divided vertically into **tiers. Tiers are subdivided into 6 levels allowing storage for 6 totes per level for a total of 36 per 1/2 tower. A 1/2 tower is either a left or right storage tower and a full tower includes both a left hand-side and right hand-side for a total of 72 storage totes.**

In a 6-wide storage module, a level would consist of 6 aisles with each having tote storage locations on east and west sides.

The existing cadence for levels are multiples of 6, i.e. 6, 12, 18, etc. Thus, a system with less then or equal to 6 levels would be a 1-tier system. A a system with more than 6 levels and less than 12 would be a 2-tier system. A system with greater than 12 levels is a 3-tier system, and so on.

The bottom tier level is numbered "1" incrementing upward to 6. On the next tier, level resets to number 1 incrementing to 6 and reseting again for the next tier. For example, tier 1 levels 1 to 6, and tier 2 levels 1 to 6.

Figure 24: A side-view of a system with dynamic workstations on left, transit planes (center), and 3 tiers of storage on right each with 6 tote storage levels.

2.17 Fencing

The Alphabot System structure is surrounded by netting to prevent totes and product falling out. Fencing serves to prevent anyone from climbing into the system through tower gaps.

Designated entry points with lockout and tagout procedures also help ensure system and personnel safety.

Figure 25: Fencing surrounding an aisle interlock door

2.18 System North South Orientation

Dynamic workstations are used for identify the system's north orientation. In operation, associates are usually facing the system's north end. Structure components include:

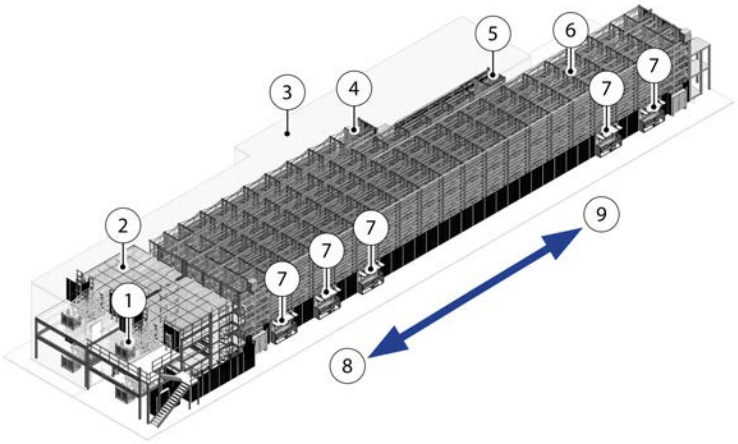


Figure 26: General View of the Alphabot® System

Number	Title
1	Dynamic Workstations (for picking)
2	Transit Plane
3	Refrigeration Wall
4	Frozen Aisle
5	Chilled Aisle
6	Ambient Aisle
7	Dispense Stations (5 total)
8	South End
9	North End

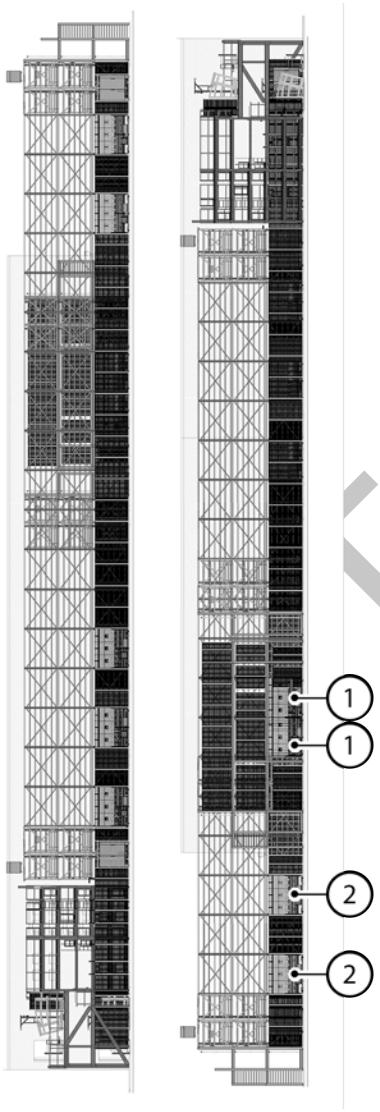


Figure 27: West and East Side Views

Number	Title
1	Chilled and Frozen Loading Stations
2	Ambient Loading Stations

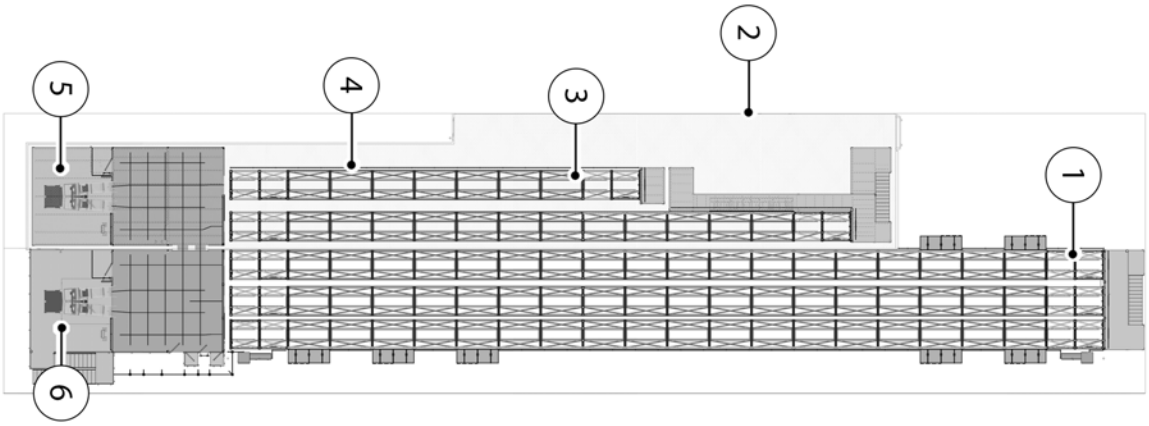


Figure 28: Top View

Number	Title
1	Tower
2	Refrigeration Wall
3	Storage Unit
4	Tower
5	Chilled Picking Station
6	Ambient Picking Station

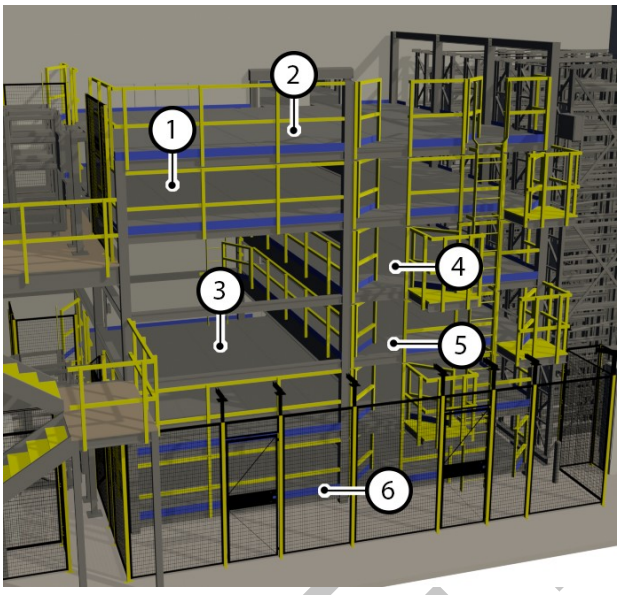


Figure 29: Transit and Express Decks

Number	Title
1	Upper Mid Level Transit Deck
2	Top Level Transit Deck
3	Lower Mid Level Transit Deck
4	Express Deck
5	Express Deck
6	Lower Level Transit Deck

2.19 Universal Coordinate Code

Universal Coordinate Code (UCC) is a numbering method to uniquely address and identify every discrete location in the Alphabot system. The UCC consists of 4 pairs of whole numbers, each with a major and minor component.

- Format: (A.t) X.x, Y.y, Z.z (**M**ajor, minor)
  - Major is the primary location
  - Minor the sub-location within the major location

- (**A**.t) **A** denotes the Alphabot system **A**rea
- (A.**t**) **t** denotes structure type: workstations, transit planes, or towers

- X, Y and Z represent different axes of the coordinate system
  - X-Axis from West to East
  - Y-Axis from South to North
  - Z-Axis from (floor) bottom to top in storage

2.20 System Terminology and Definitions

General System - Terms & Definitions	
Term	**Definition**
Master Control System (MCS)	The "brain" that controls the system. MCS controls the bots, manages tasks and inventory, accepts orders, and so on. The MCS client runs on operator laptops, and allows operators to see the status of bots, workstations, totes, and components within the system. Through MCS, an operator can interact with all components of the system.
Robotic Control System (RCS)	Same as above. This is a planned upgrade of the MCS system.
Alert Cloud System (ACS)	Used for cloud data management services relating to RCS.
Ahura	The UI, or user interface, for the RCS system. This is the interface the system operator users to input commands into RCS.
Order and Inventory Caching Service (OICS)	An on-premise component of the Alphabot System. Its primary function is to cache and synchronize information necessary for order fulfillment, but unrelated to bot movement, with the Alert Cloud System (ACS).
Alphabot Management System (AMS)	The collection of RCS, OICS, MCS, ACS, Ahura, and the Merchant Connector.
Associate	Laborers for clients like Walmart. These are the individuals that staff workstations and assist customers.
Maintenance Technician	Third-party individuals that perform maintenance tasks on Alert Innovation products.
Installation Technician	Third-party individuals that build and install systems.
Trainer	Technicians or associates that are selected and trained by Alert Master Trainers to train associates or technicians on-site.

General System - Terms & Definitions	
Alert Master Trainer	Alert staff who train and certify Trainers.
Universal Coordinate Code ("UCC Code")	UCC is a coordinate system to identify system positions for bots, totes, and storage locations It is an 8-digit code with the format M.m ,X.x, Y.y, Z.z: • M is a descriptor for the Module Type • X is the West to East Direction • Y is the South to North Direction • Z is the Vertical Direction 0,0,0 is intended to be the Southwest Corner of the system • East and North increment positive • Floor is Z Zero
Dynamic Workstation (DWS)	The workstation in the system where picking occurs. Bots move inside the DWS from transit planes, to bring product totes and order totes to the picker. The picker then assembles the order, following light prompts. When the order is complete, the order tote is returned to storage.
Static Workstation (SWS)	The workstation in the system where associates induct product totes, dispense order totes, decanting cases of product into empty totes, and pull flagged totes out of the system. Bots see this workstation as a normal rack that they can drop off and pick up totes from.
Portal (Customer-Dispense, Auto-Dispense)	The customer-dispense station that is connected to the outside, where customers can directly dispense their orders.
Safety Programmable Logic Computer (SPLC)	The computer system that deals with structure and bot safety, including coordination of E-stops, RTE, and all door sensors.
Human-Machine Interface (HMI)	A touch screen on the Master SPLC cabinet. The HMI allows an operator to interact with the SPLC system. It displays the SPLC functions with a user-friendly UI, where the operator can see the state

General System - Terms & Definitions	
	of the safety system, and can control different functions such as turning charge rails on/off or closing/opening automated doors.
Request to Enter (RtE)	The process for entering the system to maintenance and recoveries. View here, on Alert Academy.
Safety Zone	These are zones that can be created within the structure to shutdown part of the system for maintenance, while leaving the rest of the system operational.
Stack Light	The LED light on top of the SPLC. It consists of different color lights stacked on top of each other. The various light colors indicate the state of the system.
Global E-Stop	The red buttons located at every workstation, SPLC, and structure door of the system. When one is pressed, all bots in the system will stop moving. Used as a safety mechanism, in case of an immediate threat to a user or operator.
Aisle	A row of towers and racks in the system. Aisles are in the ambient, chilled, and frozen environments and may consist of multiple tiers.
Rack	A rack is a unit consisting of a grouping of all storage modules from tier 1, all the way to the top tier, for a given bay. At a standard APSD site, each rack is 6 bays long, and 3 tiers high. There are horizontal rails in the middle of a rack for bots to travel on, and on either side are shelves for totes. This term is primarily in MCS, to direct bots to the desired location. Example: I move the bot to rack 12 location 3 floor 3 level 2. I can move the bot in the same location 2 tiers below, and it would then be rack 12 location 3 floor 1 level 2. Not to be confused with "Gear Racks", which are a component within channels.
Bay	The individual location where a single tote can be stored in a rack. At a standard APSD site, there are 6 bays per level in each rack.
Tier, aka Floor	A set unit of levels for tote storage in an aisle, separated by catwalks. At a standard APSD site, there are 6 levels per tier, and the system is three tiers high.

General System - Terms & Definitions	
	The bottom tier is designated as "1", and increments upward. For example, if a system has a staircase that goes up three floors, that system is three tiers high.
Level	A single bot lane within a tier. Bots travel on levels horizontally, moving between levels within a tier to reach totes. A standard APSD site has 6 levels per tier, though this quantity may vary based in the height of the system. The bottom Level in a Tier is designated as "1", and increments upward, then resets and repeats at the next Tier. For example, "Tier 1 Levels 1 through 6", "Tier 2 Levels 1 through 6", and so on.
Planes	The part of the structure on the end of aisles that allows bots to move between aisles and environments. It contains magnetic strips in streets and avenues, that bots use for navigation.
Transit Planes	The plane that bots traverse to get to a DWS for picking or between aisles. There are two transit planes per DWS - top and bottom.
Express Planes	The plane that bots only use to move between aisles. It is smaller than the transit plane.
Street	When standing at the DWS looking north, streets are the “vertical” lines that go north to south. On transit planes, streets go from the DWS to the aisles. They contain magnetic strips for bot navigation.
Avenue	When standing at the DWS looking north, avenues are the “horizontal” lines that go across the planes east to west. They contain magnetic strips for bot navigation.
Tower	The structure component that allows bots to move vertically within the system. Each tower consists of two channel locations and two buffer locations per aisle.
Half Tower	A structure component half the size of a full tower, with only one channel location and one buffer location.
Universal Coordinate Code (UCC)	The coordinate system used by the system that defines each specific location within the structure. MCS uses UCCs to direct bot movement and tote storage.

General System - Terms & Definitions	
Location	The points in the system described by a unique UCC. All workstation, plane, tower, and rack points within the system, including bot travel lanes and tote shelves, are considered a location and have a unique UCC.
Channel Location	A vertical lane in a tower spanning all tiers. It consists of charge rails and has engagement points where bots can extend their pinions and charge toes to charge themselves and travel vertically between levels and tiers.
Buffer Location	The tower locations that are adjacent to channel locations. They do not have charge rails or bot engagement points and only allow for horizontal movement in towers.
Roll Seal Door (RSD)	The vertical doors located at the entrance of planes and separating planes of different environments within the structure. Referred to as “vertical barriers” in the HMI.
Catwalk	A horizontal door located at tower channel locations between tiers in aisles. They may be either manually controlled or automated depending on the site. During production these remain open for bots to travel between tiers. Referred to as “horizontal barriers” in the HMI.
Fortress Door, aka Interlock Door	The vertical doors at the end of aisles that operators use to enter into the system. Referred to as “vertical barriers” in the HMI.
North - South Directions	At a standard APSD site, dynamic workstations are considered the southernmost points of the system (disregarding actual cardinal compass directions). Standing at the DWS, looking north, would mean the main system is laid out as: dynamic workstations, planes, tower, racks, followed lastly by another tower.
LOTO	Lockout \ tagout procedures for entering and exiting the system or working with an Alphabot Bot
PRCS	Permit Required Confined Space

System Operation - Terms & Definitions	
Term	**Definition**
Pick	When an item is taken out of a product tote at the DWS, to be placed in an order tote.
Put	When an item is placed into an order tote at the DWS.
Each	An item that has been picked from a product tote and placed in an order tote at the DWS. Sometimes also referred to as a “pick.” Every item that moves from a product tote to an order tote is an each, including multiple picks of the same product.
Decant	The associate workflow at the static workstation that involves the associate opening a case of product, scanning the product, placing the product into a tote, and inducting that tote into the system for retrieval by an Alphabot.
Order Line	Orders are made up of “order lines.” An order line is a unique item (or SKU) picked, regardless of quantity. One order line may contain multiple eaches of the same product.
Nil Pick	An item that could not be picked or fulfilled by the system, whether due to an empty product tote, damaged product, product that is blocked from getting to the DWS by a down bot, etc.
Exception	The Walmart GIF system refers to nil picks as “exceptions.” When a pick becomes a nil pick, MCS sends it back to GIF, where it becomes an “exception” that associates can pick from the sales floor.
System Interrupt	An incident or error due to a bot, workstation, structure, or other cause that must be resolved by stopping production and entering the system.
Component Interrupt	An incident or error due to a bot, workstation, MCS, structure, or other cause that can be resolved without entering the system or fully stopping production, or that can be left unresolved until after production has ended for the day.
Bot MCBI	Bot Mean Cycles Between Interruptions (MCBI) - Measures reliability by dividing total "Bot Cycles" cycles achieved by the total bot-related interruptions.

System Operation - Terms & Definitions	
Bot Cycle	A "Bot Cycle" is recorded each time a bot picks up and puts down a tote.
Eaches Per Hour	Number of eaches picked per hour of session time.
Order Lines Per Hour	Number of order lines picked per hour of session time.

Workstation Terms & Definitions	
Term	**Definition**
Pick Light	The light over the pick side of the DWS. It can be white, orange, or red depending on the status of the pick.
Put Light	The light over the put side of the DWS. It can white, orange, or red depending on the status of the put.
Breakaway Panel	A panel on the top of the DWS that, if dislodged, will cause the bots in the workstation to stop moving until the panel is reset. Used as an operator safety mechanism.
Port	The tote locations of a SWS, where totes can be inducted into the system or dispensed from the system.
Flipper *(Formerly: Tote Lock)*	A locking mechanism in a SWS port that opens to accept or dispense totes. There are two flippers per port – one on the operator side, and one on the bot side.
Shelf	The area of a static workstation to hold totes before induction or after dispensing. Each port has its own shelf with a scale underneath it.
Scanner	A dockable hand scanner used by the associate to scan bar codes on product. It is in this way that the system knows what product the associate is loading into the tote.
Totes - Terms & Definitions	
Term	**Definition**

Totes - Terms & Definitions	
Tote	The containers used to hold products and customer orders, both inside and outside the system. Bots carry totes around in the system and store them in racks or bring them to workstations as needed.
Product Tote (P-Tote)	A tote containing inventory (a product), used for fulfilling orders during picking at the dynamic workstation.
Order Tote (O-Tote)	A tote that contains a customer order, or is waiting to be allocated to a customer order. It is typically a bag tote, though depending on the size of the product, such as with a case of water bottles, it may not a have a bag.
Bag Tote	An order tote with empty plastic bags, ready to be allocated to a customer order.
Full Order Tote	An empty order tote without bags, ready to be allocated to a customer order.
Full Product Tote	An empty tote, ready to be used for decanting and inducting inventory into the system.
Offline Order Tote	An order tote, containing items picked from the sales floor. This order tote is then inducted into the system at a static workstation, where it is stored by a bot, and later dispensed as normal.
Hospital/Defunct Tote	A tote with an error associated with it. It could be dirty, cold chain violated, have damaged products, etc. An order tote that gets blocked by a down bot will also become a hospital tote when MCS realizes it cannot reach the tote for dispense.

Alphabot Bot Tools - Terms & Definitions	
Term	**Definition**
Brake Box	A battery box that releases an Alphabot's brakes when plugged into a bot. Used for recovering bots. Plugs in through the front access port.
Tote Jogger	A control box that allows the operator to manually move an Alphabot's tote chain. Must be used in conjunction with a brake box during a bot recovery. Plugs in through the front access port.

Alphabot Bot Tools - Terms & Definitions	
Service Cart	A cart used for holding and transporting bots while outside of the structure.
Charge Tool	A tool used to charge the capacitor bank of the Alphabot. Plugs in through the front access port.
Discharge Tool	A tool used to discharge the capacitor bank of the Alphabot. Plugs in through the front access port.

Organizations and Miscellaneous	
Term	**Definition**
ANSI	American National Standards Institute
ASRS	Automate Storage and Retrieval System
CPU	Central Processing Unit
GUI	Graphical User Interface
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
NFPA	National Fire Protection Association
OHSA	Occupational Safety and Health Administration
PRCS	Permit Required Confined Space
SDS	Safety Data Sheet

2.21 Bot Terminology

Alphabot - Terms & Definitions	
Term	**Definition**
Front & Rear of Bot	The front of the bot is the larger section of the bot in front of the saddle. It contains most of the bot's components, including the capacitor bank and drive wheel motors. The front of the bot is always facing north while in the structure, unless the bot is traveling on a transit plane. The rear of the bot is the smaller section of the bot, behind the saddle. It is always facing south while in the structure unless the bot is traveling on a plane.
Left & Right of Bot	The left and right side of the bot are referenced from the bot's perspective. The charge toe is located on the right side of the bot. Looking at a bot from behind, the bot's left and right sides would be the same as the operator's left and right sides.
Charge Toe	The mechanism that engages in channel locations and connects with charge rails, allowing the bot to charge its capacitors.
Charge Toe Shoe	The segment at the end of the charge toe, containing the "blade" that connects with the charge rail. There are 2 charge toe shoes per charge toe.
Saddle	The tote saddle section of the bot is between the front and rear tote chains. This is where the bot carries totes.
Tote Chains (Front and Rear)	The chains on either side of the tote saddle that have tote fingers attached and work to load and unload totes from the bot. Each bot has two tote chains.
Tote Transfer Levers (Short and Long)	The plastic "fingers" attached to the tote chains, with small wheels at the end. These lock into the sides of totes to pull or push totes on or off the saddle.

Alphabot - Terms & Definitions	
	There are two tote fingers per tote chain - a long and a short. The long finger is used for pulling totes onto the saddle, while the short finger is used for pushing totes off the saddle.
Local E-Stop	The red "emergency stop" button on top of a bot that, when pressed, will cease that bot's motion. This button only stops the individual bot. To stop the entire system, one must press one of the Global E-Stop buttons located around the system.
Drive Wheels	The large wheels on the front of the bot that drive the bot forward, horizontally, on rails and transit planes inside the structure.
Vee Wheels	The four small wheels on the front of the bot that engage in channel locations and guide the bot as it climbs or descends towers.
Guide Wheels	The small wheels on the front and rear of the bot that help guide it through transit plane-to-aisle transition points.
Pinions	The gears on the front of the bot that engage in channel locations, and allow the bot to climb/descend vertically in towers.
Interlock	The rectangular-shaped plastic piece underneath the bot that prevents it from retracting its wheels while not in a channel location.
Status LEDs (Front and Rear)	Three LED lights found on the front and rear covers - Red (E-Stop), Yellow (Fault), and Green (Ready). These LEDs indicate the current status of the bot at a glance.
Cameras (Front, Rear, Left, Right, Top, Down)	Six cameras located at various points around the bot. These recordings are collected by the system for troubleshooting purposes.

Alphabot - Terms & Definitions	
Wifi Antenna (Front and Rear)	Small circular white antenna that receive and broadcast Wifi signals. Used to communicate with MCS/RCS.
Covers (Front and Rear)	Covers that protect the internal boards and components of the Alphabot. The front cover can be opened relatively easily. The rear cover is a bit more complicated.
Tote Presence Sensors	These sensors are located at the center of the bot, under the front and rear tote chains. These are used to detect the presence of a tote within the saddle.
Fine Position Sensors	These sensors are located on the rear of the bot, facing outwards. They are used to detect RFID tags within the system, so that the bot may properly align with the tag.
Tote Sensors (Emitter and Receiver)	Used by the bot to detect the presence of totes as they are loaded onto and offloaded from the saddle. There is an emitter, which emits an LED light, and a receiver, which receives the LED light. When this is blocked, the sensor knows a tote is in the way.
RFID Modules	These are used by the bot for navigation and identification.
Mode Switch	This switch is no longer used. A control switch on the front cover of the bot, with three options: Local, Stop, and Remote. The user may change the control state of the bot with these options. The switch should always set to "Remote".
Main Board Breaker Switch	When flipped into the off (down) position, this cuts power to the main board. This switch does not turn off power to the bot - power is stored within the capacitor board - it merely turns off the main board. The only approved way to remove power from the Alphabot is to use the discharge tool.

Alphabot - Terms & Definitions	
Bumper Bars	Plastic bumpers on the left and right sides of the saddle. Used for guidance while the bot is in horizontal motion.
Maintenance Access Port	This is a port found on the front cover of the Alphabot, allowing for various tools to be connected to the bot.

3. Personal Safety and Hazards

This safety chapter explains the precautions and procedures for safe interaction with the Alphabot System. Where appropriate, this Safety chapter identifies system safety features, components posing a hazard if used incorrectly, instructions for safe use and access to system machinery, locations and meanings of safety labeling, and regulatory compliance.

The best safety precaution is to read this, and all associated, instruction manuals to gain a thorough understanding of the equipment. Always take time to think through situations and use good judgment.

Safety pictograms and labels are located on the equipment and used within this manual to make the user aware of potential hazards and to indicate lockout/tagout (LOTO) locations. Visual alarms indicate possible hazardous conditions. Anyone operating this system must be fully conversant with all alarms and the actions to take when an alarm occurs.

The Alphabot® system, to the best of our knowledge, complies with national safety standards such as ANSI/RIA R15.06, NFPA 79, ANSI Z117.1, ANSI MH16.1 and ANSI Z535 and international safety standards like EN 60204-1, ISO 10218 and IEC 62061.

3.1 Hazard Description

The Alphabot System shall be operated, maintained, and serviced by trained personnel only.

Safety pictograms and labels are located on the equipment and used within this manual to make the user aware of potential hazards and indicate lockout and tagout (LOTO) locations.

Visual alarms indicate possible hazardous conditions. Anyone operating this system must be fully conversant with all alarms and what actions to perform when triggered.

Users must read the instruction manuals to gain a thorough understanding of the equipment and always use good judgment. Follow best practices and use the latest edition of any standards document to help ensure safety requirement compliance.

Installation, operation, and maintenance procedures that expose people, equipment, or data to possible risk are accompanied by specific hazard warnings by degree of importance, as follows:

Danger	**DANGER** indicates a hazardous situation which, if not avoided, **will result in death or serious injury**.
Warning	**WARNING** indicates a hazardous situation which, if not avoided, **could result in death or serious injury**.
Caution	**CAUTION** indicates a hazardous situation or unsafe practice which, if not avoided, **may result in minor or moderate personal injury**.
Notice	**NOTICE** indicates a situation or unsafe practice which, if not avoided, **may result in equipment damage**.

3.2 Personal Protective Equipment (PPE)

Some procedures require the use personal protective equipment (PPE). The necessary PPE is detailed at the start of each procedure, however always remain and protect yourself while working in any capacity on or near Alert Innovation equipment. Use common sense, wear appropriate personal protective equipment, and ask questions whenever necessary.

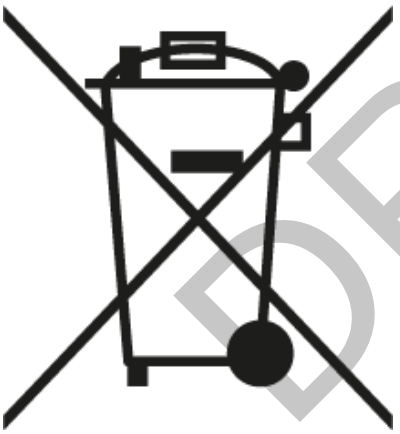
The following symbols indicate PPE equipment required. Each PPE needs to be inspected for defects before use.

	Wear safety glasses or goggles		Wear protective hard hat
	Wear protective gloves	 	Wear shock resistant gloves
	Wear protective footwear		Wear safety harness
	Read User Manual		Consult safety data sheets

	Wear protective clothing		Wear ear protection
	Wear face shield		

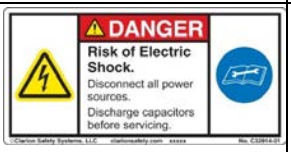
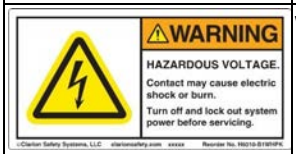
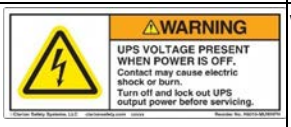
3.3 Environmental Safety

Alert Innovation Inc. is committed to designing and manufacturing products in an environmentally responsible manner. Alert recognizes eliminating certain hazardous substances from our products is beneficial to the environment, customers, and consumers.

	Dispose of capacitors in accordance with local regulations for electronic waste. • Do not incinerate capacitors or recycle with batteries. • Do no crush, cut, or otherwise damage the capacitors. • Do no dispose the capacitors in trash.

3.4 Safety Labels Description and Location

Descriptions and locations of Alphabot System Safety labels:

Label	Hazard	Text in Label	Location
	DANGER	**Shock and Arc Flash explosion hazards.** Follow ALL Requirements in NFPA 70E for Safe Work Practices and for Personal Protective Equipment. **Hazardous Voltage** Contact May Cause Electric Shock or Burn. Turn Off and Lock Out System Power Before Servicing.	Main enclosure (1)
	DANGER	**Risk of electrical shock.** Disconnect all power sources. Discharge capacitors before servicing	Bot (1)
	DANGER	Fall Hazard. Do not enter. No exit.	Every structure or DWS entry from plane on Roll seal door.
	WARNING	**Hazardous Voltage.** Contact may cause electric shock or burn. Turn off and lock out system power before servicing.	Main enclosure (1) Work Stations (1)
	WARNING	**UPS Voltage present when power is off.**	Main enclosure (2)

Label	Hazard	Text in Label	Location
		Contact may cause electric shock or burn. Turn off and lock out UPS output power before servicing.	
	WARNING	Access restricted to authorized personnel ONLY. Serious bodily injury may occur.	Each plane access gate Each Aisle access gate
	WARNING	Low Head Clearance	plane levels or any height under 78” within the system
	WARNING	**Avoid Injury.** Apply your lockout/tagout device before entering this area.	Each electromechanical solenoid locked interlock (1
	WARNING	**Magnetic Field.** Can be harmful to pacemakers wearers. Pacemaker wearers stay back 30 cm (12 in.).	Bot (1)
	WARNING	Moving parts can crush and cut. Keep hands clear.	Bot (2)
		Exit	Each structure end of aisle (South side) On planes secondary routes
		Exit	Each structure end of aisle (North side)

Label	Hazard	Text in Label	Location
	CAUTION	**Confined Space.** Trained Service Personnel Only Read and Understand Service Manual	Each plane access door Each aisle access door
	CAUTION	**Pinch Points.** Keep hands clear.	Picking Workstation (6)
	WARNING	**No Step.** Do not step, stand or sit on this surface. May cause injury and/or equipment damage	Each electrical horizontal tray covers
	WARNING	Shock hazard	Inside Bot (2)
	WARNING	**Body Crush Hazard.** Equipment starts automatically Stay Clear	Static Workstation (2)

3.5 Alphabot Safety Hazards

⚠ WARNING

UNEXPECTED BOT MOTION

Ensure that the Alphabot's main board breaker switch is in the OFF position, and that bot LOTO procedures have been performed.

This will prevent the bot from executing any move commands.

No actuation of the tote chain or drive wheels can occur while the breaker switch is OFF.

Failure to follow these guidelines could result in serious injury or death.

ELECTRICAL SHOCK HAZARD

Verify that the bot is **fully discharged** before beginning this procedure.

Contact with the internal capacitor board prior to discharging the bot will result in serious injury or death.

BODY CRUSH HAZARD

Do not stand under a Bot/object stuck in a tower at any level or under any condition. Serious injury or death may occur. Use a winch to attach the Bot from above when possible, or secure a maintenance cart under the Bot/object before attempting to move it.

Failure to comply will result in serious injury or death.

CAUTION

PINCH HAZARD

Watch your fingers as you close the front panel.

The hinged segment at the bottom presents a pinch hazard.

Failure to do so may result in minor or moderate injury.

Operators / Authorized employees who perform operation activities on the Alphabot System shall be qualified and trained on proper handling of the equipment and safe entry procedures into the system.

3.6 Padlock Safety Equipment Rules

Padlocks are used when servicing an Alphabot and any time an access door is opened to enter the structure. On an Alphabot, a padlock, or lockout hasp, is applied to the main switch to prevent the Alphabot form being turned on during service. When entering the structure, a padlock is applied to the access door to prevent the door from being closed when personnel is inside the system.

Padlock Rules

Alert Innovation Inc. shall provide each Authorized Employee with a durable padlock for locking an Alphabot. The padlock must meet the following minimum requirements:

- The padlock must have a key-retaining feature to ensure that the padlock is not accidentally left unlocked.
- Each padlock must be keyed differently and only have one key.
- Each Authorized Employee will be assigned unique padlocks and the padlocks shall be labeled with the Authorized Employee's name.
- The padlock shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as, with the use of bolt cutters or other metal cutting tools.
- A lockout hasp, snap on is needed for multiple padlocks.

Padlock Removal Rules

- Maintenance and/or service personnel servicing an Alphabot shall be trained on affixing and removing a padlock.
- Maintenance and/or service personnel servicing an Alphabot shall have their own padlock marked with their name.
- The person servicing the Alphabot shall keep their key with them at all times during the maintenance activity. This padlock rule ensures no Alphabot under service will be re-inducted into the Alphabot system.
- Padlock devices shall not be removed by anyone but the employee who placed the lock. Removing a padlock device from a Bot belonging to another employee could result in a fatal or serious injury.

EXCEPTION CASE: If an Authorized Employee becomes disabled inside the Alphabot Structure during access or is physically incapable of removing their padlock, the Supervisor is allowed to remove the Authorized Employee's padlock device from the interlock device under the following conditions:

- The Supervisor ensures the Authorized Employee has been physically removed from the Structure.
- The Authorized Employee is incapable of removing the padlock device themselves.
- The Authorized Employee is informed their padlock device has been removed.
- The reason for the padlock removal must be documented and the record maintained for a minimum of one year.

For more information see Alphabot APSD System Lockout Tagout Procedure Safety Manual PN-10000325-SF-01 chapter Bot Lockout Tagout.

3.7 Slippage

Maintenance technicians tasked with performing maintenance work or bot recovery around open dynamic catwalk doors are required to complete fall protection training. This training is carried out by a third-party group, which Alert Innovation contracts for this purpose. Fall protection training covers fall protection requirements and reviews the proper usage of fall protection equipment for maintenance and bot recovery procedures that pose a fall hazard. Maintenance technicians that have completed training are required to secure a fall protection harness prior to beginning any maintenance or recovery action that poses a fall hazard, such as work around an open dynamic catwalk door. Any action requiring fall hazard protection requires the presences of a second technician.

Fall hazard protection involves ensuring the presence of a second technician, inspection of the fall hazard equipment, inspection of the retractable lanyard, donning the equipment, properly securing the equipment, connecting a carabiner to the end of a D-rig extender, connecting the retractable lanyard to one or many system anchor straps, and clipping in a retractable lanyard. *See "Fall Protection" section of 1000004-MN-01: Alphabot User Manual for more information.* Fall protection training and equipment meet OSHA standard 29 CFR, part 1910 – Docket No. OSHA-2007-0072.

FALL HAZARD

Fall hazards exist when working in the tower with interlock doors and catwalk plates open.

Towers are open shafts from floor to ceiling. Access is normally protected with interlock doors and catwalk plates that need to cover the opening before the back of the structure.

You MUST complete the Alert Innovation, Inc. Fall Protection safety course to work in an open catwalk condition. The following safety guidelines are required:

- Wear a Safety Harness
- Use a Self Retracting Lifeline (Retracting Lanyard)
- Be connected to one of the Anchor Straps strategically placed within the system at all times.
- Use the procedure to create a safe zone in the system

Failure to comply will result in serious injury or death.

Fall Protection Kit	
Tool	**Part Number**
KIT, FALL PROTECTION SAFETY HARNESS, MAINTENANCE CAGE	1200001-04-01
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE HARNESS, LARGE SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	7000056-00-01
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE HARNESS, SMALL SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	7000055-00-01
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE	7000052-00-01

Fall Protection Kit	
HARNESS, MEDIUM SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	
EQUIPMENT, 4' CROSS ARM STRAP	7000177-00-01
EQUIPMENT, SELF RETRACTING LIFELINE, WEB SNAP HOOK CARABINER, 11', MAINTENANCE CAGE.	7000001-01-00
EQUIPMENT, HARD HATS, MAINTENANCE CAGE.	7000005-00-01
EQUIPMENT, TOOL LANYARD, 30" TO 50", MAINTENANCE CAGE.	7000000-01-00
EQUIPMENT, D-RING EXTENDER 12", MAINTENANCE CAGE.	7000053-00-01

Figure 30

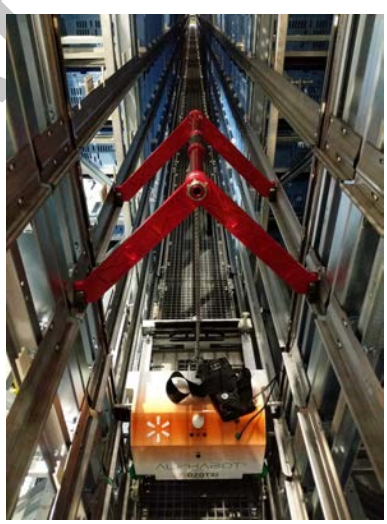


Figure 31

3.8 Structure Egress

Technicians interact with ladders and dynamic catwalks to perform Alphabot system maintenance work.

Platforms and Stairs

Maintenance technicians servicing the Alphabot System and associates using a second-floor dynamic workstation use staircases to move vertically between levels.

Ladders

At the front of the system, maintenance technicians use ladders to move from interlock doors to transit planes.

Dynamic Catwalks

Aisles within the Alphabot System have dynamic catwalks along the floor that are open when the system is running so bots can move vertically between tiers. Technicians are prevented from entering an aisle when a dynamic catwalk is open. A technician must complete a "Request to Enter" command at an interlock door control panel in order to open the access door. Also, catwalks must be closed for the system to grant a Request to Enter.

To close dynamic catwalks, a technician actuates the dynamic catwalk motor with a switch found by the entry door.

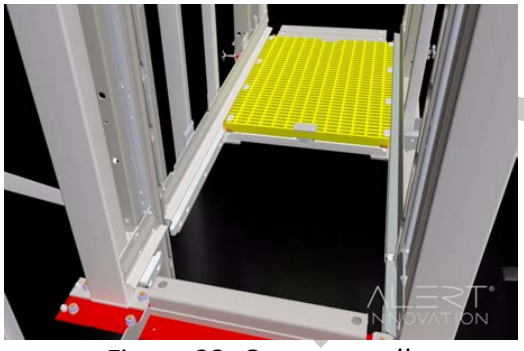


Figure 32: Open catwalk

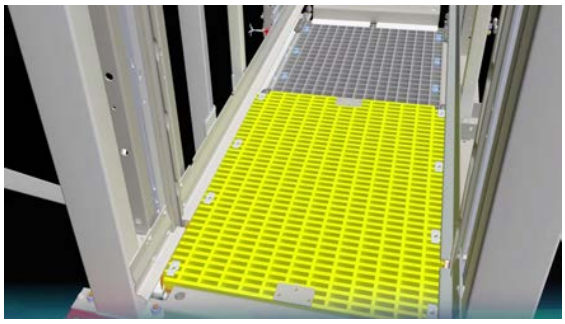


Figure 33: Closed catwalk

Aisles and Transit Planes

When a maintenance technician must perform work within an aisle or transit plane, the technician will follow a standard "Request to Enter (RtE)" process to request entry into the System. This process will clear all bots from the aisle or transit plane, and confirm that all dynamic catwalks are closed. Once these requirements are met, the technician enters the aisle or transit plane, and performs a Lockout Tagout procedure on the entry door.

PPE for maintenance technicians includes a safety helmet, safety shoes, a high-visibility vest, a voltage tester, and a light source such as a head lamp or flashlight.

Aisles and transit planes are both considered low-light confined spaces. Maintenance technicians are required to fill out a confined space form prior to entry, and must be certified in Alphabot System maintenance.

See "Single Aisle Request" procedure in 10000035-SF-01: APSD System LOTO Manual for more information.

3.9 Persons with Pacemakers

⚠ WARNING

MAGNETIC FIELD

Can be harmful to pacemaker wearers.

Pacemaker wearers approaching bots during troubleshooting or servicing must stay a minimum of 30 cm (12 in.) away from traction wheels and electronic assemblies.

Failure to follow these guidelines could result in serious injury or death.

3.10 Power Outage and Lighting

The Alphabot System is designated as a low-light confined space. PPE for maintenance technicians requires a head lamp, safety helmet, two-way radio, and high-visibility vest, as well as the completion of a confined space form prior to entry. All maintenance technicians are required to be certified on Alphabot System maintenance procedures.

In the event of a power outage to the Alphabot System, employees will remain at their workstations until further instructions are received.

In the event where a maintenance technician is within the structure during a power outage, the maintenance technician is to use their light source to calmly proceed to the interlock door to exit the system.

See Chapter 8, "Power Outage" in document 1000002-SF-01: DOCUMENT, SAFETY DOCUMENT, 1000002-SF-01, EA PLAN for more details.

3.11 Corrective Action Records

Corrective Action records must be maintained for any violations of safe entry procedures.

Please see your manager for site processing.

4. System Safety and Hazards

Please be cautious and never perform tasks you have not been trained to perform. Never enter the Alphabot System if you have not been trained to do so.Performing maintenance or repair tasks can result in serious injury or death and may cause damage to the equipment. Only maintenance personnel trained to enter the Alphabot System may enter the locked entry gate. Alphabots require trained and qualified operators. Please contact DTE Support for assistance with any tasks outlined in this manual.

The best safety precaution is to read this instruction manual, and all associated manuals, to build a thorough understanding of the equipment. Always take time to think through situations and use good judgment.

System safety mechanisms include emergency system stops, structure lockouts and tagouts, circuitry, and various safety procedures for system planes, workstations, and hazards.

4.1 Structure Safety and Hazards

4.1.1 Global E-Stop Buttons

There are system emergency stop (E-Stop) buttons located throughout the Alphabot System known as "global E-stop buttons". When pressed, global e-stop buttons stop the entire Alphabot System requiring a restart procedure.

Emergency stops are included at workstations, entry, and exit doors.

Figure 34: Display of E-stop buttons

4.1.2 Alphabot System E-Stop Circuitry

The Alphabot System uses a certified **S**afety **P**rogrammable Logic **C**ontroller (“Master SPLC”) located in the main electrical enclosure. The main architecture includes conventional Safety I/O modules, and the Actuator Sensor interface (ASi) technology for safe and common connections to devices such as the emergency stop devices, safety interlocks, and conventional proximity sensors.

The emergency stop buttons are located at each operator station, on main enclosures, and at the rear of the structure, at each level. These "E-Stop" buttons are connected on the ASi bus within the system, originating from the ASi power supply and associated safety node in the main enclosures. The Ethernet communication permits the transmission of safe information throughout the entire system network. Any E-stop button activated within the system will generate a category 1 stop to the Bots per NFPA 79 and IEC 60204-1, and automatically de-energize the power to the rails.

Each Bot is provided with a certified simplified Bot SPLC to communicate via wireless Ethernet with the Master SPLC, and with a main CPU, to communicate with the Master Control Software (MCS) for operational purposes. A category 1 stop provides a Bot controlled stop with final power removal of drive motor, tote motor, and applied brakes to drive motors. The Bot SPLC directly removes the power to the redundant contractors, de-energizing the charging rails in the entire system as a category 0 stop. In case of emergency, the Dynamic Workstation is also designed so the Bot E-stop button is accessible to perform a Category 0 bot motion stop.

A red LED is on at the depressed E-Stop button, as well as the electrical enclosures' tower lights. Each Bot is safely-stopped, with their red LEDs blinking red as well.

In order to start the system, an E-Stop button must be unlatched by a twist or pull and any reset button must be pressed.

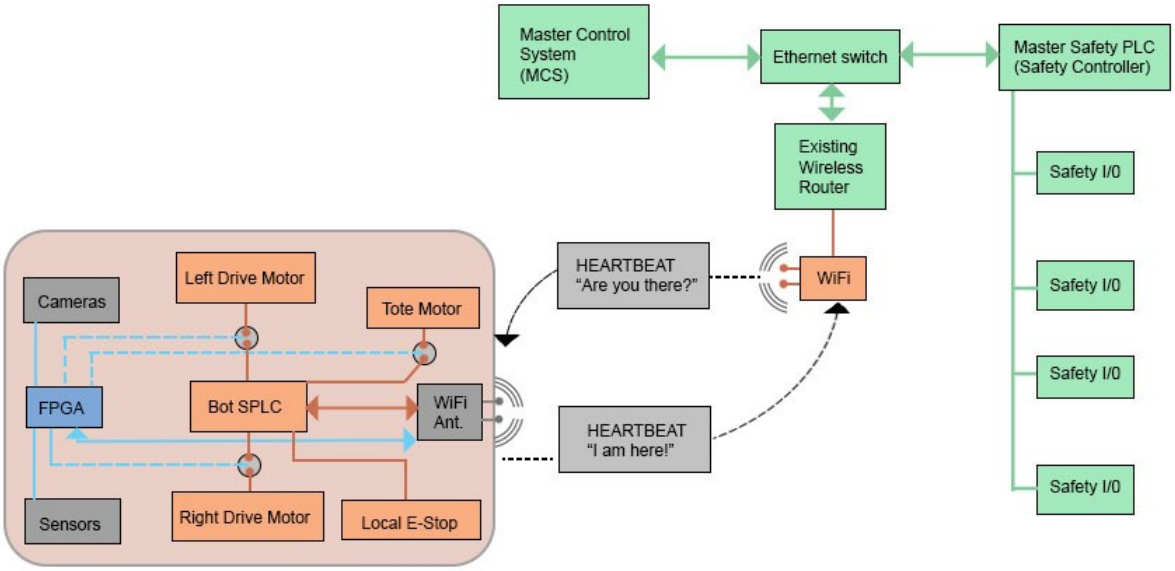


Figure 35: Display of bot E-stops

The E-stop circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.

4.1.3 Structure Operation Hazards

⚠ WARNING

GENERAL HAZARDS

Inherent hazards may be present within the structure upon entering between the levels. When you have a specific reason to perform a maintenance task at a given area(s), be aware of the surroundings. Take sufficient lighting to inspect your path; packages may be in the way or package content/liquids may have spilled, thus creating additional hazards. Hazards may arise from falling boxes or items. Be aware of potential hazards caused by fallen/crushed product such as wet floors, or spilled chemicals in and around the structure.

PPE required upon entering the structure and make sure the area(s) you cross are clean. Hard hat (or bump hat) and safety shoes are the minimum PPE to enter the decks or the structure during the lifetime of the Machinery. Additional PPE will be needed based on the activities performed in the system such as safety glasses, gloves or masks.

⚠ CAUTION

LOW LIGHT & DARK CONDITIONS

Working in low light & dark conditions may result in minor to moderate injuries.

Always wear head lights.

⚠ WARNING

CHEMICAL HAZARD

Chemicals used or present in this procedure may contain elements that are hazardous to the skin or eyes. Read and understand the SDS before use.

The following may be required per the SDS:

- Use proper eye protection.
- Use Nitrile gloves to protect hands.

Failure to follow these guidelines could result in serious injury or death.

FALL HAZARD

Fall hazards exist when working in the tower with interlock doors and catwalk plates open.

Towers are open shafts from floor to ceiling. Access is normally protected with interlock doors and catwalk plates that need to cover the opening before the back of the structure.

You MUST complete the Alert Innovation, Inc. Fall Protection safety course to work in an open catwalk condition. The following safety guidelines are required:

- Wear a Safety Harness
- Use a Self Retracting Lifeline (Retracting Lanyard)
- Be connected to one of the Anchor Straps strategically placed within the system at all times.
- Use the procedure to create a safe zone in the system

Failure to comply will result in serious injury or death.

BODY CRUSH HAZARD

Do not stand under a Bot/object stuck in a tower at any level or under any condition. Serious injury or death may occur. Use a winch to attach the Bot from above when possible, or secure a maintenance cart under the Bot/object before attempting to move it.

Failure to comply will result in serious injury or death.

WARNING

COLD HAZARD

Chilled areas of the system range from 0 to 5°C (32 to 41°F).
Frozen areas of the system range form -30 to 0°C (-22 to 32°F).

The following are required to enter into these areas:

- Confined Space Program with a buddy system.
- Thermal PPE: safety-toed shoes, jackets, gloves, and hats.
- 2-way radio.

Work Guidelines:

- Do not stay in a Frozen environment for more than 55 minutes at a time.
- It is mandatory to stay in a warm environment for a minimum of 10 minutes before re-entering a Frozen environment.
- **At the end of every 4th work interval**, it is mandatory to stay in a warm environment for a minimum of 30 minutes.

Failure to follow these guidelines could result in serious injury or death.

4.1.4 Ergonomics

⚠ CAUTION	
	**HEAVY OBJECT** May cause strain or back injury. Do not attempt to lift a bot. Bots weigh up to 95 kg (210lbs.) when loaded. Do not lift the driving wheels to push or pull a disabled Bot. Use the provided power pack to release the bot brakes, then use standard lifting techniques to push or pull the disabled bot. Failure to do so may result in minor to moderate injury.

4.1.5 Fall Protection

Maintenance technicians tasked with performing maintenance work or bot recovery around open dynamic catwalk doors are required to complete fall protection training. This training is carried out by a third-party group, which Alert Innovation contracts for this purpose. Fall protection training covers fall protection requirements and reviews the proper usage of fall protection equipment for maintenance and bot recovery procedures that pose a fall hazard. Maintenance technicians that have completed training are required to secure a fall protection harness prior to beginning any maintenance or recovery action that poses a fall hazard, such as work around an open dynamic catwalk door. Any action requiring fall hazard protection requires the presences of a second technician.

Fall hazard protection involves ensuring the presence of a second technician, inspection of the fall hazard equipment, inspection of the retractable lanyard, donning the equipment, properly securing the equipment, connecting a carabiner to the end of a D-rig extender, connecting the retractable lanyard to one or many system anchor straps, and clipping in a retractable lanyard. *See "Fall Protection" section of 1000004-MN-01: Alphabot User Manual for more information.* Fall protection training and equipment meet OSHA standard 29 CFR, part 1910 – Docket No. OSHA-2007-0072.

FALL HAZARD

Fall hazards exist when working in the tower with interlock doors and catwalk plates open.

Towers are open shafts from floor to ceiling. Access is normally protected with interlock doors and catwalk plates that need to cover the opening before the back of the structure.

You MUST complete the Alert Innovation, Inc. Fall Protection safety course to work in an open catwalk condition. The following safety guidelines are required:

- Wear a Safety Harness
- Use a Self Retracting Lifeline (Retracting Lanyard)
- Be connected to one of the Anchor Straps strategically placed within the system at all times.
- Use the procedure to create a safe zone in the system

Failure to comply will result in serious injury or death.

Fall Protection Kit	
Tool	**Part Number**
KIT, FALL PROTECTION SAFETY HARNESS, MAINTENANCE CAGE	1200001-04-01
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE HARNESS, LARGE SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	7000056-00-01
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE HARNESS, SMALL SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	7000055-00-01

Fall Protection Kit	
EQUIPMENT,HI-VISIBILITY ORANGE VEST STYLE HARNESS, MEDIUM SIZE, FRONT & BACK D-RING, MAINTENANCE CAGE.	7000052-00-01
EQUIPMENT, 4' CROSS ARM STRAP	7000177-00-01
EQUIPMENT, SELF RETRACTING LIFELINE, WEB SNAP HOOK CARABINER, 11', MAINTENANCE CAGE.	7000001-01-00
EQUIPMENT, HARD HATS, MAINTENANCE CAGE.	7000005-00-01
EQUIPMENT, TOOL LANYARD, 30" TO 50", MAINTENANCE CAGE.	7000000-01-00
EQUIPMENT, D-RING EXTENDER 12", MAINTENANCE CAGE.	7000053-00-01

Figure 36

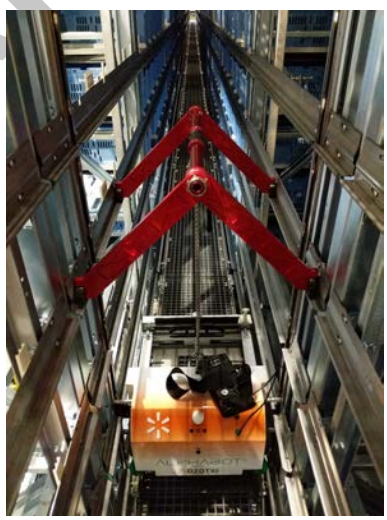


Figure 37

4.1.6 Creeper Safety

⚠ WARNING

GENERAL HAZARDS

Inherent hazards may be present within the structure upon entering between the levels. When you have a specific reason to perform a maintenance task at a given area(s), be aware of the surroundings. Take sufficient lighting to inspect your path; packages may be in the way or package content/liquids may have spilled, thus creating additional hazards. Hazards may arise from falling boxes or items. Be aware of potential hazards caused by fallen/crushed product such as wet floors, or spilled chemicals in and around the structure.

PPE required upon entering the structure and make sure the area(s) you cross are clean. Hard hat (or bump hat) and safety shoes are the minimum PPE to enter the decks or the structure during the lifetime of the Machinery. Additional PPE will be needed based on the activities performed in the system such as safety glasses, gloves or masks.

4.1.7 Ladder Safety

⚠ CAUTION	
 	**FALL HAZARD** Inspect all ladders before use: ▪ Ladder material is fiberglass ▪ Rungs are intact ▪ Rubber feet are present and intact on all sides ▪ Metal spreader lock functions and is intact ▪ Weight capacity Maintain three points of contact while working on a ladder and ensure the ladder is sitting on a level surface. Failure to comply with the inspection or precautions may result in minor to moderate injury.

- Working on or around ladders is hazardous. Anyone who needs to use a ladder for purposes of operating, maintaining, and troubleshooting this equipment should practice rules for ladder safety to minimize these hazards.
- Inspect the ladder before use for wear and damage and ensure appropriate for the job.
- Don't use metal ladders when doing electrical work.
- Place the ladder on a firm, level, and non-slip surface. Fully open, lock ladder sides into position, and ensure to keep area around ladder clear.
- Don't carry objects or loads that could cause you to lose your balance.
- When working from a ladder, don't lean sideways, and always work within an easy arm's reach. Always face the ladder and maintain a 3-point contact (two hands and a foot, or two feet and a hand) when climbing.
- Stay on the middle of the ladder when climbing up or down.
- Carry your tools and other materials in a tool belt or pouch, use a rope to raise and lower them, and do not overload the ladder beyond its rated load.
- OSHA standard 29 CFR 1910.26 offers detailed information on ladder safety.

4.1.8 Confined Space

CONFINED SPACE HAZARD

Read and follow all regulations and completely fill out the form in the Alert Innovation, Inc. Confined Space Program (PN 1000011-SF-01).

Known confined space areas:

- Freezers
- Structures when catwalks are open
- Dynamic Workstations (DWS)

Minimum PPE required:

- Hard Hat
- Safety Glasses
- Safety Harness
- Safety Shoes

Failure to comply will result in serious injury or death.

4.1.9 RF Safety

The Bots use Wi-Fi wireless communication within the system, with bridges operating at 2.4/5 GHz. The vehicles use RFID wireless communication operating at 13.56 MHz. Both units comply with FCC requirements.

4.1.10 Seismic

All Alphabot Systems and subsystems are bolted to the floor.

Seismic designs, engineering and anchoring is provided depending on the end user's location following the IBC code requirements (United States) or ISO 3010 for international use.

4.2 Workstation Safety and Hazards

4.2.1 Dynamic Workstation Safety and Hazards

⚠ CAUTION

ENTANGLEMENT HAZARD

Refrain from wearing dangling jewelry or loose/baggy clothing. Long hair must be tied back or in a hairnet so it does not become entangled by moving bots. Failure to do so may result in minor or serious injury.

⚠ WARNING

CRUSH HAZARD

A Bot may arise in the Workstation at any time. Reaching into an empty Workstation may cause hands to be crushed resulting in serious injury.

Before completing any maintenance at the Workstation:

- Isolate the Workstation with the safety bars.
- Use the E-Stop button on any bot(s) present.

Failure to follow these guidelines could result in serious injury or death.

At any picking location, any contact of the operator's body with an upwards moving Bot will disengage the break-away panel

Warning Label	Description of Hazard
 ***Confined Space Hazard***	The interior of the dynamic workstation presents a **Confined Space Hazard**.  *See "Dynamic Workstation Entry" training module in [1000035-SF-01: APSD System LOTO Manual] for more information.*
 ***Electrical Hazard***	When performing maintenance work within the dynamic workstation, the charge rails present an **Electrical Hazard**. Use a voltage checker to ensure the station has been properly e-stopped and depowered before you begin your work.  *See "Single Aisle Entry" and "Dynamic Workstation Entry" in [1000035-SF-01: APSD System LOTO] Manual for more information.*

4.2.2 Static Workstation Safety

Static workstations (SWS) are comprised of three tote load and unload ports with a global E-stop button in middle of station. The port opening height where moving bots pass in the structure is below the minimum guarding height required by national and international safety standards. However, the distance between the operator and passing bots in the structure is 65 inches (1650 mm) making it very difficult to reach or interact with a bot. Safe bot distance is achieved when working with both feet on the floor. Do not lean or crawl on the interior or exterior of the SWS. Other safety features include a tote flipper used to lock and unlock a tote when on the interior side of the SWS. Flipper lock helps ensures a family or group of totes are processed as a unit. They are also and additional safety as it is extremely difficult to reach inside, push a tote, and potentially interact with a bot. At all times maintain two feet on the floor when working with the station.

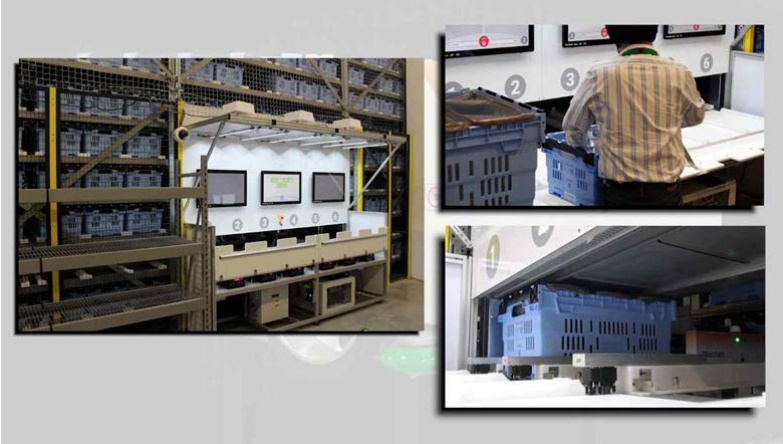


Figure 38: SWS

⚠ CAUTION

LIFTING HAZARD

Lifting heavy objects without proper technique may result in minor to severe injury.

Use safe lifting, handling and transportation techniques when loading the products at all

times:

- Keep legs bent
- Keep back as straight as possible
- Load close to body
- Grip object from opposite corners
- Lift with legs; not your back

4.3 Electrical Lockout and Tagout

National and international standards address the practices and procedures necessary to disable machinery and equipment to help prevent the release of hazardous energy while operators perform servicing and maintenance activities. These standards detail measures for controlling hazardous energies including electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and other.
Major standards include:

- In USA, the OSHA standard The Control of Hazardous Energy (Lockout/Tagout), Title 29 Code of Federal Regulations (CFR) Part 1910.147.
- In Europe, ISO14118 2000, Safety of Machinery - Prevention of unexpected start-up.

***Note**: Customers are responsible for providing the appropriate program(s) and lockout/tagout devices to ensure the safety of personnel operating and maintaining this equipment.*

4.3.1 Power Drop Warnings

The Alphabot system includes several power enclosure such as main circuit panels at system position North and South, Dynamic Workstations, and secondary enclosures such as Roll Seal doors and junction boxes. Other warning devices include UPS with device disconnect. To ensure system competence, please read and understand system specific electrical layouts before switching power ON or OFF any enclosure.

ELECTRICAL ARC FLASH HAZARD

Do not shut off power while the system is under electrical load.

Turning power off while the system is under load will create an electrical arc flash hazard.

Will cause severe injury or death.

Wear appropriate personal protective equipment (PPE) before opening or performing diagnostic measurements while energized. See NFPA 70E for the appropriate PPE requirements.

Failure to comply will result in serious injury or death.

WARNING

HAZARDOUS VOLTAGE

Contact may cause electrical shock or burn. Turn off and lockout system power before servicing. Service of electrical equipment must be performed by qualified and trained personnel only.

Use only insulated tools and required PPE for work on electrical equipment.

Failure to follow these guidelines could result in serious injury or death.

Charge Rails GFCI Breaker Procedure 93

⚠ WARNING

ELECTRICAL SHOCK - UPS

The UPS input power can be sourced either from the main enclosure or from a facility (UPS) feed depending on the store configuration.

If work is necessary on the input side of the UPS, power off and LOTO (Lockout/Tagout) the Alphabot main enclosure or local feeder before performing electrical work.

Failure to follow these guidelines could result in serious injury or death.

4.3.2 Main Enclosure Power Feed Procedure

Periodicity: As necessary.

Materials: Lock, Tag, Tie wrap, Pen & calibrated Voltmeter (CAT III 1000V)

PPE: Make sure your PPE is at least equivalent to the Arc Flash PPE recommendations labeled on this enclosure.

Safety information: Power incoming to the line side of the main disconnect is live when the main disconnect is opened.

Initial conditions: Proper planning is necessary to perform the enclosure LOTO, as the system will not be operable. See Main Enclosure UPS Output Disconnect Procedure 86 to remove power to the entire enclosure.

Refer to 1000035-SF-01 Electrical Enclosure Lockout Tagout Procedure" for detailed instructions on LOTO relating to electrical cabinets.

For more information see procedures 1012116-01 Site Power Outage Recovery and 1012115-01 Site Power Outage Shutdown.

Power OFF procedure:

Step	Action
1	Check with Control Center before removing power to a specific enclosure.
2	On the Human Machine Interface (HMI), disable the power to all charging rails.
3	At the specific Main (North, South, etc.) enclosure(s), place the disconnect switch in the OFF position. Note: Image on left for reference only as the actual enclosure appearance and location of on/off handle may vary.

Step	Action
	
4	If electrical enclosure equipped with a Panduit test, press down the test button to begin process in absence of another voltage test. The caution indicator will flash to indicate a test in progress. After a few moments the Panduit tester will illuminate green to indicate the absence of voltage. 
5	Insert the lock into the handle opening and tag the lock.

Step	Action
	
6	Open the enclosure and verify the absence of voltage on the load side on the main disconnect, both phase to phase and phase to ground.
7	Live conductors are present within the enclosure with the main power OFF. The live wiring is colored Orange as per NFPA 79 and IEC 60204-1.

NOTICE
It may be necessary to repeat this procedure at several enclosures in order to shut off the entire Alphabot system.

Power ON procedure:

Step	Action
1	Verify that all work is complete, and tools/parts are removed from the work area.
2	Close the main enclosure door.
3	Remove the tag and lock.
4	On the HMI, verify the main breaker is ON indicating all power rails are ON.

Step	Action
5	If necessary, press the reset button to clear faults with the **Blue** button on the aisle door.
6	Check the Control Center to verify when all affected sub-assemblies are ready.
7	Where appropriate, notify equipment operators and inspect area to ensure unnecessary items removed.

4.3.3 Main Enclosure UPS Output Disconnect Procedure

Periodicity: As necessary.

Materials: Lock, Tag, Tie wrap, Pen and calibrated Voltmeter (CAT III 1000V)

PPE: Make sure your PPE is at least equivalent to the Arc Flash PPE recommendations labeled at this enclosure.

Safety information: Power incoming to the line side of the main disconnect is live when the main disconnect is opened.

Initial conditions: Proper planning is necessary to perform the UPS output LOTO as the system will not be operable.

Power to the 3 phase mains remains ON with the UPS output disconnect OFF. See Main Enclosure Power Feed Procedure 82 to de-energize and lock the main power to the enclosure.

Power OFF procedure:

Step	Action
1	Notify personnel of an upcoming shutdown to the electrical enclosure.
2	At the specific enclosure rotate the disconnect switch to the OFF position to shut down system. See System North South orientation 26. Note: Image on left for reference only as the actual enclosure appearance and location of on/off handle may vary. On right, blue highlighted box indicates a system with a Panduit safety tester to test for absence of voltage.

Step	Action
	 
3	Verify HMI turned OFF on the door and tap screen to verify HMI not in screen saver mode. If the screen does not turn on the HMI is powered off. If electrical enclosure equipped with a Panduit test, press down the test button to begin process in absence of another voltage test. The caution indicator will flash to indicate a test in progress. After a few moments the Panduit tester will illuminate green to indicate the absence of voltage. 
4	Insert the lock into the switch opening and tag the lock.

Step	Action
	
5	On the enclosure, the left door is interlocked with the right one. In order to gain access to the left side of the enclosure, the main disconnect locking mechanism needs to be bypassed so that the right door can be opened.
6	Open the left enclosure door and verify the absence of voltage on the load side on the main disconnect, both phase to phase and phase to ground.
7	Only the Orange wiring is de-energized within the enclosure with this disconnect locked out. Power to the mains remains ON.

NOTICE
It may be necessary to repeat this procedure at several enclosures in order to shut off the entire Alphabot system.

Step	Action
1	Verify all work is complete, and tools/parts are removed from the work area.
2	Close the main enclosure door.

Step	Action
3	Remove the tag and lock.
4	Place the disconnect switch in the ON position.
5	If necessary, press the reset button to clear faults.
6	Check with Control Center to verify when all affected sub-assemblies are ready.
7	Where appropriate, notify equipment operators and inspect area to ensure unnecessary items removed.

4.3.4 UPS Enclosure Procedure

⚠ WARNING

ELECTRICAL SHOCK - UPS

The UPS input power can be sourced either from the main enclosure or from a facility (UPS) feed depending on the store configuration.

If work is necessary on the input side of the UPS, power off and LOTO (Lockout/Tagout) the Alphabot main enclosure or local feeder before performing electrical work.

Failure to follow these guidelines could result in serious injury or death.

Periodicity: As necessary.
Materials: Calibrated Voltmeter (CAT III 1000V)
PPE: Make sure your PPE is at least equivalent to the Arc Flash PPE recommendations labeled at this enclosure.
Initial conditions: Proper planning is necessary to perform the UPS power off as the system will not be operable and the system server will be also de-energized.

Power OFF procedure:

Step	Action
1.	Unlock the enclosure and turn off the server and switches.
2.	Turn off the UPS. Note: Image on left for reference only as the actual enclosure appearance and location of on/off handle may vary. On right, blue highlighted box indicates a system with a Panduit safety tester to test for absence of voltage.

Step	Action
	 
3.	Verify all equipment within the enclosure is turned off. If electrical enclosure equipped with a Panduit test, press down the test button to begin process in absence of another voltage test. The caution indicator will flash to indicate a test in progress. After a few moments the Panduit tester will illuminate green to indicate the absence of voltage. 
4.	Verify HMI turned OFF on the door and tap screen to verify HMI not in screen saver mode. If screen does not turn on HMI is powered off.
5.	Lock the enclosure door.

***Note**: The UPS batteries are hot swappable, it's unnecessary to turn off the UPS to change batteries. Refer to the UPS manual to change batteries properly.*

Step	Action
1.	Unlock the enclosure and turn on the UPS.
2.	Turn on the server and switches.
3.	Verify the presence of external communication LEDs.
4.	Check with Control Center when all affected sub-assemblies are ready.
5.	Where appropriate, notify equipment operators and inspect area to ensure unnecessary items removed.

4.3.5 Charge Rails GFCI Breaker Procedure

GFCI = Ground Fault Circuit Interrupter

Periodicity: As necessary.

Materials: Mini Lock, Lever blocking device, Calibrated Voltmeter (CAT III 1000V)

PPE: Make sure your PPE is at least equivalent to the Arc Flash PPE recommendations labeled at this enclosure.

Safety information: Power incoming to the line side of the GFCI breakers is live when the main disconnect is closed and redundant contractors are energized.

Initial conditions: Plan ahead in order to perform a specific power rail LOTO instead of powering off and locking the entire system. A specific zone or the entire aisle may be created as a safe zone, if work is needed with that specific rail off and locked, while the rest of the system may remain in operation.

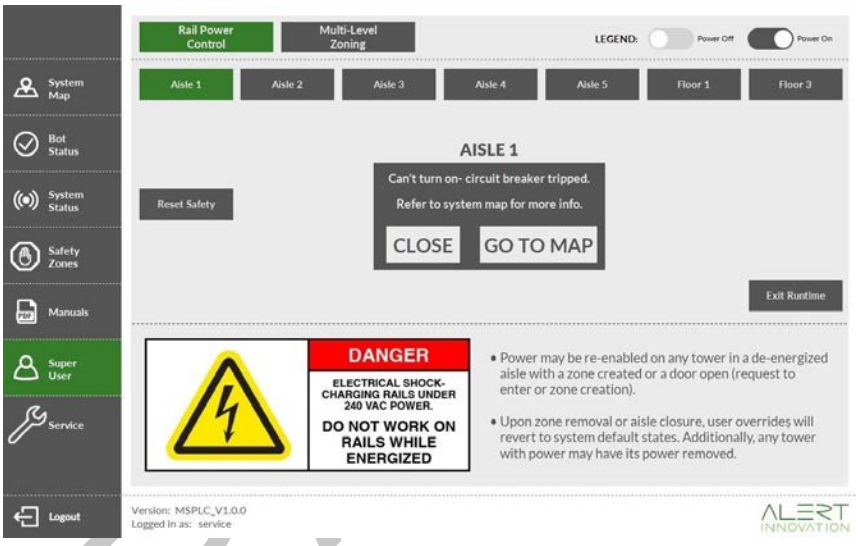
Power OFF procedure:

Step	Action
1	At the HMI, select the tower(s) to de-energize. ***Note**: An operator with "super user" credentials must be logged in to perform this function. Use the HMI navigation side bar on the left of the screen to navigate to "Super User", and then to the desired aisle and tower. Tap the slider on the screen and confirm the action via the displayed pop-up.*
2	At the specific GFCI breaker, switch the lever to the OFF position.
3	Insert the provided block into the breaker lever and lock it: Part # 1001196-00-01.

Step	Action
	
4	Ensure the absence of voltage on the load side of the breaker, both phase to phase and phase to ground.
5	Close the main enclosure.

Power ON procedure:

Step	Action
1	Verify that all work is complete, and tools/parts are removed from the work area.
2	If a safe zone was created in the structure, close the safe zone.
3	Open the main enclosure (bypass if it was deemed to leave the system ON while working on a rail(s)).
4	Remove the lock and insert.
5	Put the lever to the ON position.
6	If necessary, press the reset button to clear faults.

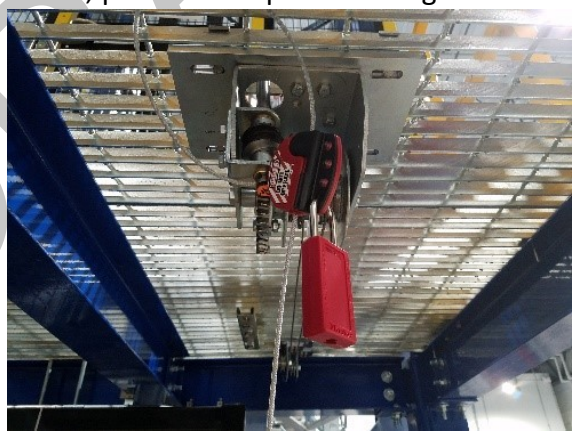
Step	Action
7	At the HMI, energize the tower(s). ***Note**: An operator with "super user" credentials must be logged in to perform this function. Use the HMI navigation side bar on the left of the screen to navigate to "Super User", and then to the desired aisle and tower. Tap the slider on the screen and confirm the action via the displayed pop-up. The HMI slider will not work if the breaker is tripped.* 
8	The contractors shall be energized and verify that the breaker(s) is (are) not tripped.
9	Close the enclosure.
10	Check with Control Center when all affected sub-assemblies are ready.
11	Where appropriate, notify equipment operators and inspect area to ensure unnecessary items removed.

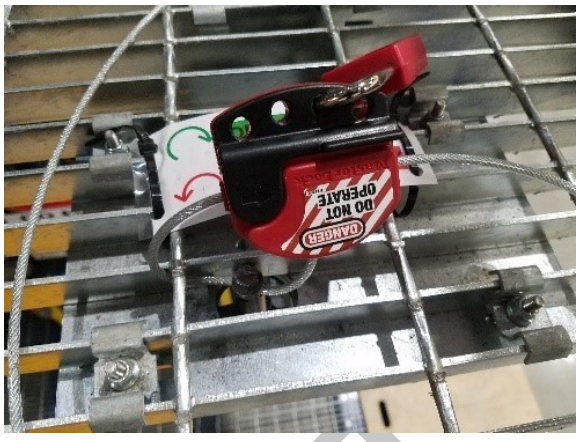
4.3.6 Aisle Plates Lockout Procedure

Materials: Power Tools Kit,. **PPE**: PPE Tool Kit.

See also oSAFETY MANUAL,LOCKOUT TAGOUT PROCEDURES,APSD SYSTEM,ALPHABOT - 1000035-SF-01

"Catwalk" Closing procedure:

Step	Action
1	Coordinate with system operator of the structure entrance.
2	Press "request to enter / white" button at the desired aisle for 2 seconds, if an aisle entry is followed.
3	Wait for the Red LED to blink at the door to make sure all bots are stopped before the next step. Failure to do so will result in Bot damage by trying to pass through an opening, and longer recovery/service time.
4	Turn the 10 mm winch hex head counterclockwise to close the plates.
5	When plates are closed, pass the hasp wire through the shaft and flooring. 
6	Hand tight the cable and lock the hasp.

Step	Action
	

“Catwalk” Opening procedure:

Step	Action
1	Making sure that no one is present in the serviced aisle.
2	Close the aisle’s access door.
3	Remove lock(s).
4	Remove the hasp cable.
5	Turn the 10 mm winch hex head clockwise to fully open the moving plates.
6	Coordinate with the system operator for the aisle restoration.

4.4 Structure Safe Entry and Exit

⚠ WARNING	
	**READ BEFORE SERVICING** Read and fully understand this procedure before you begin any work. Failure to follow these guidelines could result in serious injury or death.

Operators / Authorized employees who perform operation activities on the Alphabot System shall be qualified and trained on proper handling of the equipment and safe entry procedures into the system.

This safe entry procedure provides the steps required to safely enter the Alphabot structure if routine and/or emergency maintenance/repair on the Bots or related equipment is needed in restricted areas of the Alphabot System.

The interlock circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.

- Structure Definitions 99
- PPE and Safety Equipment Rules 100
- System Entry Overview 103
- System Exit Overview 106
- Plane Entry Overview 109

4.4.1 Structure Definitions

Padlock Device: A device that utilizes a positive means such as a keyed lock to hold an energy-isolating device in a safe position and prevent the energizing of a machine or equipment.

Supervisor: Person responsible for enforcing the safe entry program and insuring compliance with the procedures affecting the system.

Affected Employee: An employee who is responsible for insuring nobody attempts to restart or re-energize machines or equipment that are locked out. An affected employee is defined as a person whose job requires him to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or whose job requires him to work in an area in which such servicing or maintenance is being performed.

Authorized Employee: An employee who locks out machines or equipment in order to perform servicing or maintenance on Bot or equipment. An affected employee becomes an authorized employee when employee's duties include performing servicing or maintenance exposing them to potentially hazardous energy.

Lead Authorized Employee: An authorized employee who is responsible for coordinating a group's safe access into the Alphabot Structure. The Lead Authorized Employee is responsible for insuring all authorized operators have exited the Alphabot Structure before closing the safety interlock at the entry access point.

Other Employee: An employee whose work operations are or may be in an area where safe entry procedures may be utilized.

Servicing and/or Maintenance: Workplace activities, including but not limited to, adjusting, inspecting, maintaining, or servicing Bots and equipment. These activities include lubrication, cleaning, unjamming Bots or totes, making adjustments, and equipment startup. Any activity can potentially expose an employ to release of hazardous energy.

4.4.2 PPE and Safety Equipment Rules

⚠ CAUTION	
	**BUMP HAT AREA** Low head clearances and sharp edges exist inside the Alphabot structure. Wear a bump hat while performing routine maintenance inside the structure. Failure to do so may result in minor or moderate injury.

⚠ CAUTION	
	**SAFETY-TOED SHOES** Safety-toed shoes must be worn when working inside the structure. Objects may fall down in the system. A falling object can result in minor to moderate injury.

Padlocks are used when servicing an Alphabot, and any time an access door must be opened to enter the structure. On an Alphabot, a padlock, or lockout hasp, is applied to the main switch to prevent the Alphabot form being turned on during service. When entering the structure, a padlock is applied to the access door to prevent the door from being closed when personnel is inside the system.

Padlock Rules

Alert Innovation Inc. shall provide each Authorized Employee with a durable padlock for locking the Alphabot. The padlock must meet the following minimum requirements:

- The padlock must have a key-retaining feature to ensure that the padlock is not accidentally left unlocked.
- Each padlock must be keyed differently and only have one key.
- Each Authorized Employee will be assigned unique padlocks and the padlocks shall be labeled with the Authorized Employee's name.

- The padlock shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as, with the use of bolt cutters or other metal cutting tools.
- A lockout hasp, snap on is needed for multiple padlocks.

Padlock Removal Rules

Maintenance and/or service personnel servicing an Alphabot shall be trained on affixing and removing a padlock. Maintenance and/or service personnel servicing an Alphabot shall have their own padlock marked with their name. The person servicing the Alphabot shall keep their key with them at all times during the maintenance activity. This padlock rule ensures that no Alphabot under service will be re-inducted into the Alphabot system.

Padlock devices shall not be removed by anyone other than the employee who placed the lock. If an unrepaired bot is re-inducted into the Alphabot System.Removing a padlock device from a bot belonging to another employee could result in death or serious injury,

EXCEPTION CASE:
If an Authorized Employee becomes disabled inside the Alphabot Structure during access or is physically incapable of removing their padlock, the Supervisor is allowed to remove the Authorized Employee's padlock device from the interlock device under the following conditions:

- The Supervisor ensures that the Authorized Employee has been physically removed from the Structure.
- The Authorized Employee is incapable of removing the padlock device themselves.
- The Authorized Employee is informed that their padlock device has been removed.
- The reason for the padlock removal must be documented and the record maintained for a minimum of one year.

4.4.3 System Entry Overview

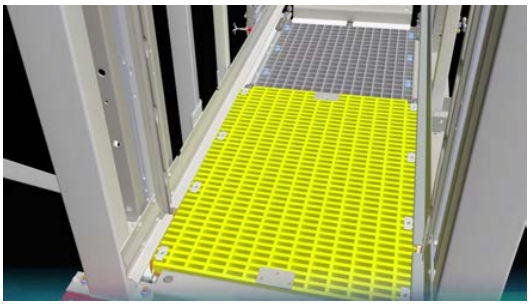
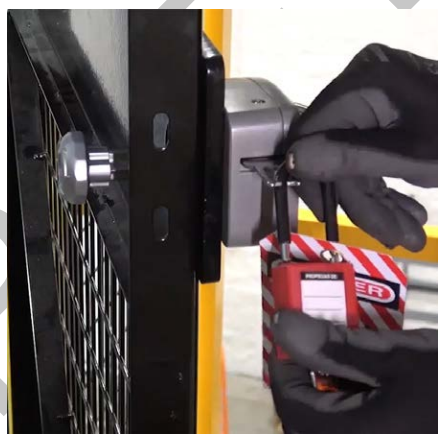
The structure is protected with plastic netting all around and access to the aisles is secured with interlocked doors. . The door interlock is provided with a solenoid to keep the door closed even if power is lost. The safety contacts are redundant and connected to the ASi bus. The floor & ceiling plate interlocks and plane and Exit gates interlocks are Radio Frequency Identification (RFID) non-contact certified safety interlocks.

When a technician intends to enter the Alphabot System, they will perform a "Request to Enter" or "RtE" at a System access door

This process begins with the technician notifying the site supervisor of the upcoming shutdown for maintenance. All workstation activities are stopped, and associates cancel/exit their current workstation mode.

See also the "Single Aisle Request" section of 1000035-SF-01: Lockout-Tagout Procedures.

Step	Action
1	The technician will use the control interface on the interlock door to perform a "Request to Enter" command, directing all bots within the aisle/transit plane/workstation to leave, and park in the tower. Bots that are unable to move will remain in place. All bots then become globally e-stopped. 
2	The technician will close the dynamic catwalk panels, providing a physical barrier between the horizontal towers, and providing a clear path of entry to walk across.

Step	Action
	 The technician will now verify that the interlock on the access door has unlocked by reading the lights on the control panel. If this is the case, the technician opens the interlock door.
3	Technician places an approved lock and completed tag to the door interlock catch. 
4	Technician then uses an approved and tested non-contact voltage tester to verify that the charge rails are de-powered. If so, the technician proceeds to their maintenance task.

Step	Action
	
5	For any disabled bots that the technician encounters during their work, they will depress the local e-stop button on those bots, and perform lockout/tagout procedures on each bot. 

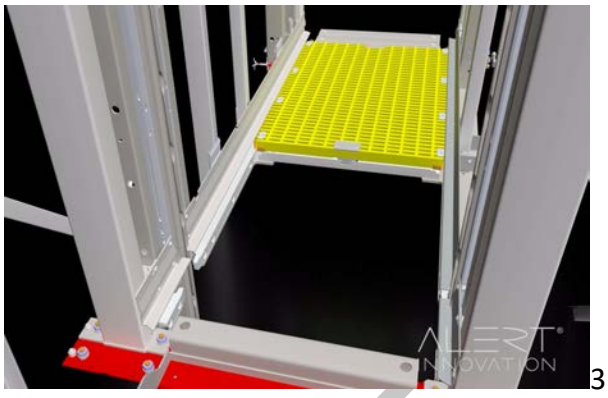
4.4.4 System Exit Overview

When a technician has completed system maintenance tasks they will exit the system and return it to normal operation.

See also the "Recovering Single Aisle RtE" section of 1000035-SF-01: Lockout-Tagout Procedures.

Step	Action
1	Recover bots in aisles, transit planes, and workstations by releasing the local E-Stop button and remove the lock and tag from the breaker switch. Ensure all tools are removed from the system.   *Press breaker switch down*
2	Ensure the red Escape Release plunger on the internal side of the interlock panel is not pressed in. If pressed in, reset by pushing silver plunger on interlock panel door exterior. Step outside of the location and remove the lock and tag from the access door interlock.

Step	Action
	
3	Close the access door and verify the access door LED turns green to indicate the door is locked. 
4	Re-open any catwalks, horizontal barriers, that were closed during the entering process.

Step	Action
	 3
5	Verify all bots are fully charged as indicated by a solid yellow or solid green LED on the bots. If the bot LED is flashing yellow or red, press the blue button on the interlock panel once more. 

4.4.5 Transit Plane Entry Overview

System transit planes are comprised of multiple dual planes or mini planes depending on the number of mezzanines supporting dynamic workstations. Planes protected by metal fencing and railing at both floor and upper levels. Request to enter a specific level, floor, or mezzanine will impact operation of the level's dual planes and workstations

Technicians apply a lock out device on the door handle before entering. Upon pressing the button for entry,

- Bots leave the plane area
- Affected workstations and aisle gates on different levels automatically close
- Bots enter global E-stop mode
- The door interlock solenoid is energized enabling it to be open.
- Door opening will not de-energize the power to any rail as out of reach from the planes

The interlock circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.

For more detailed procedures see 1000035-SF-01: Lockout-Tagout Procedures

4.5 Workstation Safe Entry and Exit

The Dynamic Workstation (DWS) is provided with safety interlocks at the following sub assembly locations:

Interlock A: Between the station and the deck on *the* roll seal doors at the lower position of each door (2: upper and lower sub decks).

Interlock B: On each side of the station, front and rear rail access panels: one interlock per panel.

Interlock C: At the picking area with 3 interlocks per panel.

During normal operation, the “A” interlocks can be engaged or not (deck access procedure or DWS in use) as the “B & C” interlocks protect the safety perimeter of the workstation or no hand pinch egress situation. Removing any side panel while one or both roll seal doors are open will cause a system E-stop.

The DWS interlock circuitry corresponds to a Category 2 PLd per EN ISO 13489-1 and SIL 1 per IEC 62061.

- Dynamic Workstation Entry 111
- Dynamic Workstation Exit 115
- Enter Structure Aisle Procedure 118
- Enter Structure with Abnormal Conditions 119
- Enter DWS Without Interrupting 121

4.5.1 Dynamic Workstation Entry

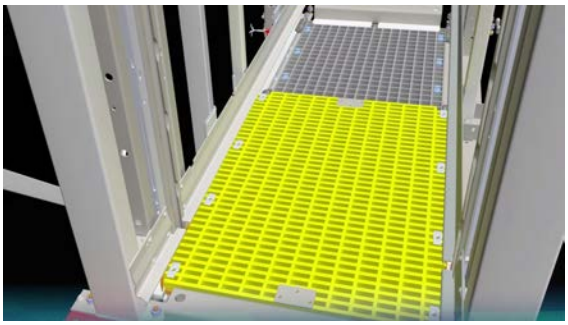
When a technician intends to enter a dynamic workstation (DWS), they will perform a "Request to Enter" or "RtE" at the System access door nearest to the DWS.

For detailed procedures see "Dynamic Workstation Lockout Tagout Procedure" section of 1000035-SF-01: Lockout-Tagout Procedures.,

For details on Maintenance Technician see Maintenance Technician Safety Manual PN 10000011-MN-01

Dynamic Workstation Entry

Step	Action
1	This process begins with the technician notifying the site supervisor of the upcoming shutdown for maintenance. All workstation activities are stopped, and associates cancel/exit their current workstation mode. The technician uses the control interface on the interlock door to perform a "Request to Enter" command, directing all bots within the transit plane/workstation to leave, and park in the tower. Bots that are unable to move will remain in place. All bots then become globally e-stopped. 
2	The technician will close the dynamic catwalk panels, providing a physical barrier between the horizontal towers.

Step	Action
	
3	The technician will now verify that the interlock on the access door has unlocked by reading the lights on the control panel. If this is the case, the technician opens the interlock door. Technician places an approved lock and completed tag to the door interlock catch. 
4	With the interlock door opened, locked, and tagged, the technician returns to the DWS. On the side most appropriate for the procedure, the technician opens both access panel doors.

Step	Action
	
5	The technician then inserts a lock and tag into the DWS access door handles of the removed door(s). 
6	Technician then uses an approved and tested non-contact voltage tester to verify that the charge rails within the DWS are **de-powered** and **not energized**. If so, the technician proceeds to their maintenance task.

Step	Action
	
7	For any disabled bots that the technician encounters during their work, they will depress the local e-stop button on those bots, and perform lockout/tagout procedures on each bot. 

4.5.2 Dynamic Workstation Exit

When a technician has completed their maintenance task within the dynamic workstation (DWS), they will exit the DWS and return the System to normal operation.

For detailed procedures see "Dynamic Workstation Lockout Tagout Procedure" section of 1000035-SF-01: Lockout-Tagout Procedures.

For details on Maintenance Technician see Maintenance Technician Safety Manual PN 10000011-MN-01

Dynamic Workstation Exit

Step	Action
1	This process begins with the technician recovering all bots within the workstation they were servicing. This is done by releasing the local e-stop button, removing the lock and tag from each bot, and turning on the main board breaker switch.  

Step	Action
2	The technician then ensures the red "Escape Release" plunger on the internal side of the interlock panel is not pressed in. The technician then steps outside of the workstation and removes the lock and tag from the access door interlock. 
3	The technician closes the access door, and verifies the access door LED turns green to indicate the door is locked. 
4	With the door closed and locked, the technician then opens the dynamic catwalks, opening the way for bots to move vertically via the channels. The technician then uses RCS/MCS to confirm horizontal barriers and dynamic catwalks are fully opened. The technician will then return to the DWS, and remove the locks and tags from the side door locks.

Step	Action
	 The technician then installs and locks the side door(s) onto the DWS. 
5	Lastly, the technician uses the control panel to verify all bots are charged, and validates that all bots are communicating with the System.

4.5.3 Enter Structure Aisle Procedure

Human access entrance locations leading into the structure at aisles and zones are protected by electro-mechanical safety interlocks. A Request Access to the structure must be initiated via the HMI interface on an electrical enclosure or at the specific zone to enter.

Please use links below to system detailed procedures authorized users follow to enter the system using the safety communication sequence between the Safety PLC (SPLC) and the MCS.

Please see Alphabot APSD System Lockout Tagout Procedures Safety Manual PN 10000035-SF-01. And, sub-topics for entering a Single Aisle/Deck Safety Zone Creation Procedure or Multi-zone Lockout Tagout Procedure.

4.5.4 Enter Structure with Abnormal Conditions Procedure

This procedure needs to be followed in the rare event a bot, tote, product, or cable break prohibits the closing a set of sliding plates at any North or South tower location. The safety system under normal conditions e.g. operations and regular maintenance, will not allow any entry if sets of interlocks to render a safe zone are not met. It is possible to request such an entry at the HMI only under a password protected "super user" screen or bypassing the interlocked door with the Fortress bypass key. The aisle or set of aisles to be entered become a Permit Required Confined Space (PRCS). This means a fall hazard is present in the open tower shafts and additional safety precautions shall take place requiring a fully signed permit, additional PPE, and retrieval equipment are needed before attempting to enter zones or aisle(s) in question.

***Note**: The activity that requires an entry into a PRCS shall fully be understood and signed off by the entrant(s), attendant(s) and supervisor.*

Procedure for Aisle entry with no restart

Step	Action
1	At the selected entry door, press the white button "Request to Enter" for 2 seconds (it will remain blinking for 15 minutes).
2	MCS will finish the bots current operations and will send them to the towers for charging.
3	Once all bots are safely stopped, the red LED will blink at the interlock.
4	The supervisor can introduce the fortress bypass key into the interlock and rotate it to the right.
5	The upper tiny red LED besides the green one will be ON: this means that the solenoid is bypassed.
6	When the door handle is lowered, the tiny green LED is OFF: this means that the safety circuit is interrupted, and the system cannot be restarted in this condition.
7	Entrant(s) lock the door handle.
8	Entrant(s) equipped with PPE and tools can proceed into the aisle.

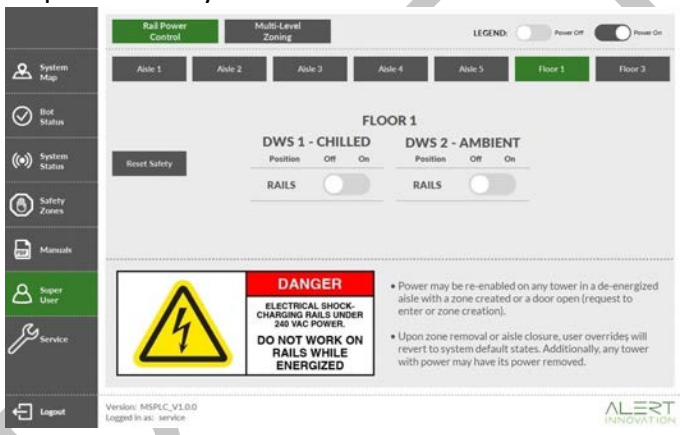
Step	Action
9	The key can be turned left, retrieved (no tiny LEDs ON) and kept with the supervisor.
10	If openings are present on the floor, attach your lanyard to the module D-ring.
11	Proceed to the first one marked with reflective tape, engage the first cover plate and swing it closed with the stick tool.
12	Proceed on closing the openings until you reach the stuck plate.
13	Make sure the lanyard is attached to the tower D ring where the opening(s) is remaining, before performing any work in front of open shaft.

Procedure for exiting the area

Step	Action
1	Proceed on removing the cover plates by positioning yourself on the north end of each plate.
2	Remove all tools and accessories from the aisle.
3	Check the plates actuation and visualize the aisle sensor/interlock at the HMI for proper function.
4	Remove locks from the door handle.
5	Close the aisle door.
6	Press the lit Reset button.
7	The red LED at the interlock goes off.
8	MCS resumes operation.
9	A copy of the written entry report shall be forwarded to Alert Innovation Inc. for further analysis.

4.5.5 Enter DWS Without Interrupting Operations Procedure

DWS Entry Without Interrupting Operations

Step	Action
1	Plan the maintenance activity with system operator(s).
2	MCS command to evacuate all bots from the DWS.
3	Close both roll seal doors either automatic or manually.
4	Remove power to the rails at the HMI. If work on rails is needed, follow rails LOTO procedure within the DWS enclosure. This sub-procedure shall be performed by trained electricians. 
5	Remove any side panels needed.
6	Press the emergency stop on any bot trapped (defective) inside.
7	Power OFF and lock out any bot trapped (defective) inside.
8	Enter station following the Confined Space Program if needed.
9	Never enter the DWS from the roll seal door side, fall hazard from the upper plane roll seal doors.
10	Maintenance can be performed within the station.

4.6 Transit Plane Safe Entry and Exit

4.6.1 Transit Plane Confined Space Safe Entry and Exit

The authorized maintenance personnel either selects the plane from the HMI or simply walks to the door protecting one from entering the plane.

Plane entry with no system restart:

Step	Action
1	The technician pushes the white button “Request to Enter” for 2 seconds, on the interlock block at the door.
2	The button will flash white as long as the bots need to leave the affected area, finish their current jobs and park onto towers to recharge. Messaging between the MCS and the safety PLC will bring all the bots to a system E-stop mode (characterized by red flashing bots and tower lights on electrical enclosures).
3	The lighted white button will turn steady white (for 15 minutes: timed out if no one enters) to show the person that the guard is now unlocked.
4	Upon opening the door safety contacts, the white button is no longer lit.
5	The Technician opens the door and places their padlock onto the rear side of the handle module.
6	Maintenance can be performed within that set of planes with the entire system being in E-stop.

Exiting the entered plane:

Step	Action
1	When the work has been finished, all tools, cleaning supplies, etc. must be removed from the area.
2	The Technician shall remove their padlock from the door handle. (All padlocks shall be removed for multiple entry at that door) and close the door. The reset button shall illuminate to authorize a system reset.
3	The Technician shall press any “Reset” button.

Step	Action
4	The reset button goes off and the MCS resumes the bot operations.

4.7 Fire Safety

4.7.1 Fire Safety and Smoke Alarms

The structure is mainly composed of painted welded steel, with planes made of 1.125” processed wood panels. The platform and walk areas are made with a slip resistant, flame retardant Fiber Reinforced Plastics (FRP) surface. The electrical equipment is compliant to NFPA 79 using metallic enclosures and flame-retardant components. The Bots are mainly metallic including UL 94 V- rated components, e.g. conformal coated printed circuit boards and flame-retardant components. The Super Caps or UltraCaps pack is protected against collision as located in the middle of the vehicle. A certified early smoke detection system is included with each system in compliance with local, state, federal regulations, and connected to the building sprinkler system. In order to park and stop all the Bots upon an early smoke detection alarm, the main SPLC has two reserved safety inputs to be connected with a building fire control unit.

In the event a fire or smoke alarm is triggered, users are directed to immediately leave the Alert system following site evacuation plans. The Alert system is designed to require no additional input from users in this event. After 3 minutes have elapsed, if the alarm is still active, all bots within the System will park and stop.

Alert Innovation does not recommend the storage of flammables or organic products within the system. The Alphabot System is not designed for the storage of flammables or organic products.

For additional information, see "Fire/Explosion" section in document 1000002-SF-01: DOCUMENT, SAFETY DOCUMENT, 1000002-SF-01, EA PLAN, as well as the "Fire Alarms & Smoke Alarms" section in 1000006-MN-01: Associate Safety Training Manual.

4.7.2 Evacuation Floor Plan

Each Alert Innovation System is provided with an evacuation floor plan. Two means of exiting the system either from an aisle or plane are shown on the plan with green arrows. Aisles are provided with photo-luminescent exit signs on both ends of each aisle. The natural aisle exit is through the entry interlocked door. In the eventuality of a fire behind you in the aisle, the second option for exit is passing through the LOWER roll seal door. Lower roll seal doors are marked as an exit with white and green tape. The Roll Seal door command shall be put from automatic to manual mode by pressing the UP command. If the command does not respond, for e.g. power outage, a red glass break enclosure located at the door vicinity permits access to a knife to cut the roll door fabric if trying to lift the door assembly is too difficult.

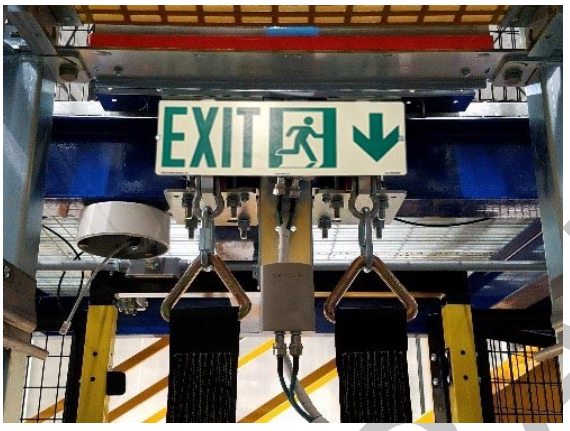


Figure 39: Full Aisle Exit

Figure 40: Frozen Aisle Secondary Exit

Figure 41: Ambient/Refrigerated Aisle Glass Box

Figure 42: Roll Seal Door Controller to Set to Manual

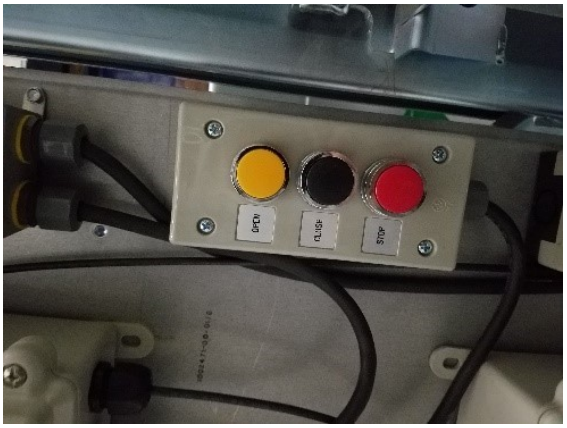


Figure 43: Press Yellow Button to Open

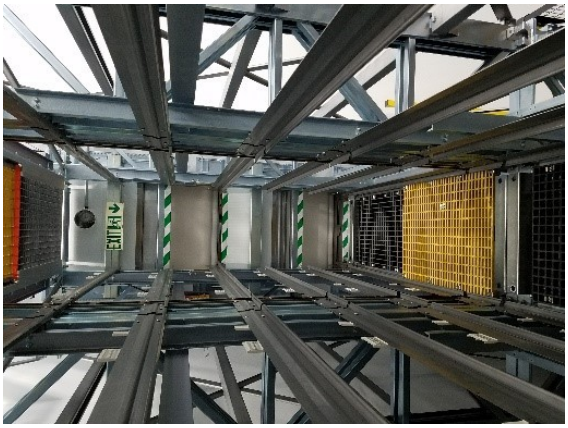


Figure 44: Aisle RSD Secondary Exists

Exiting a plane would typically be through the door used for entry, but if an obstruction a secondary exit is provided through RSD to reach a vertical ladder in ambient zone. The same controls and glass boxes are provided to escape the RSD.

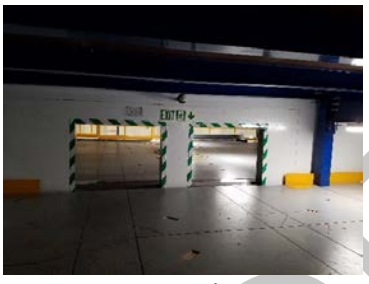


Figure 45: Deck RSD Exit

Figure 46: RSD Control

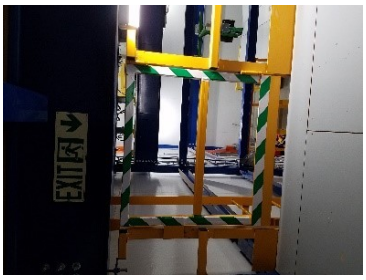


Figure 47: Mini Deck Exit

The Alphabot system is connected to the building fire alarm system and will come to a process stop and power rail OFF upon a smoke detection alarm from periodic air sampling built above the system or a regular building fire alarm. Upon any alarm activation, MCS cancels current orders and the Bots return frozen or chilled food totes to their respective aisles. Bots then park at the South towers to permit first responders structure entry for easy system inspection.

4.7.3 First Responders System Entry Procedure

Procedure for first responder entry:

Step	Action
1	Press any Emergency stop button to ensure that the system is in Global E-stop condition (tower lights on main enclosures and Bots blinking RED).
2	Break glass door near the aisle/plane E-stop button to retrieve the interlock bypass key. 
3	Insert the key into the interlock and turn clockwise to lower the handle.
4	Place the emergency access plates above the holes (one set per level) as you move forward.
5	Remove the plates with the handle stick as you move out. 
6	Close the door and turn the key counterclockwise to remove the key. Doors shall not be left unsecured with open shafts.

5. System Operation

Operators / Authorized employees who perform operation activities on the Alphabot System shall be qualified and trained on proper handling of the equipment and safe entry procedures into the system.

⚠ WARNING

READ THE SAFETY CHAPTER

Operators are responsible for observing the safety practices described in the safety chapter.

Failure to follow the safety instructions can result in serious or life-threatening situations.

5.1 Theory of Operation

Alphabot® System operation primarily entails loading grocery products into storage through the static workstations, product storage and retrieval in totes by Alphabots, picking retrieved products at dynamic work stations, storing picked items as customer orders, and delivering customer orders to customer dispense portals.

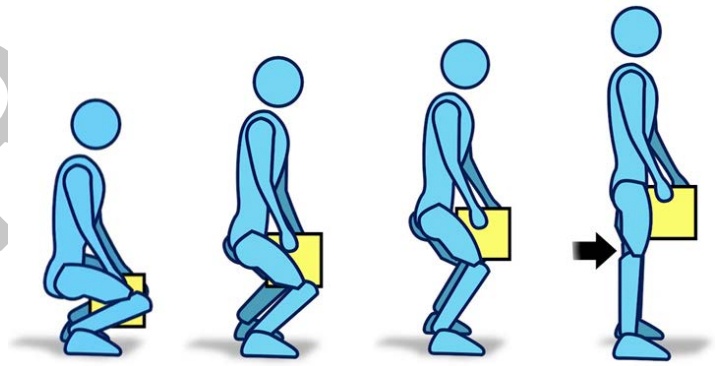
When a customer order is placed in the system, the Master Control System (MCS) translates it into a list of totes to retrieve from storage aisles. The MCS builds travel routes Alphabots use to retrieve totes from storage and deliver to workstations for associate processing. For each process step, bots acknowledge MCS commands, execute them, notify MCS via WiFi when complete, and wait for new MCS instructions. Bots periodically update their location to MCS by reading aisle RFID tags for route planning and 3-D animation.

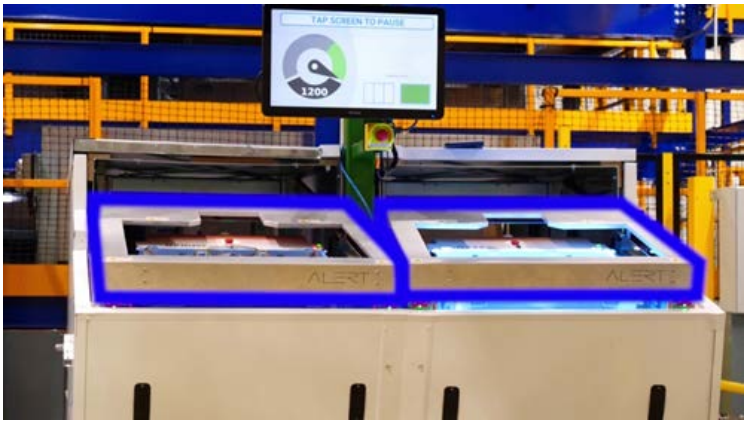
Alphabot® bots facilitate customer orders by retrieving Product Totes (P-Totes) and navigating to Dynamic Work Stations (DWS). DWS associates perform picking tasks transferring grocery items, a.k.a. eaches, from Product Totes (P-Totes) to Order Totes (O-Tote). Bots continuously cycle additional P-totes and empty O-totes until an order is complete. Bots return all totes to storage or may deliver a completed order to a customer dispense portal for pickup.

Inventory replenishment is a continuous process performed at Static Workstations (SWS). Bots deliver empty product totes to a SWS where associates decant and induct inventory into the Alphabot System. While performing replenishment, associates may address damaged or dirty totes.

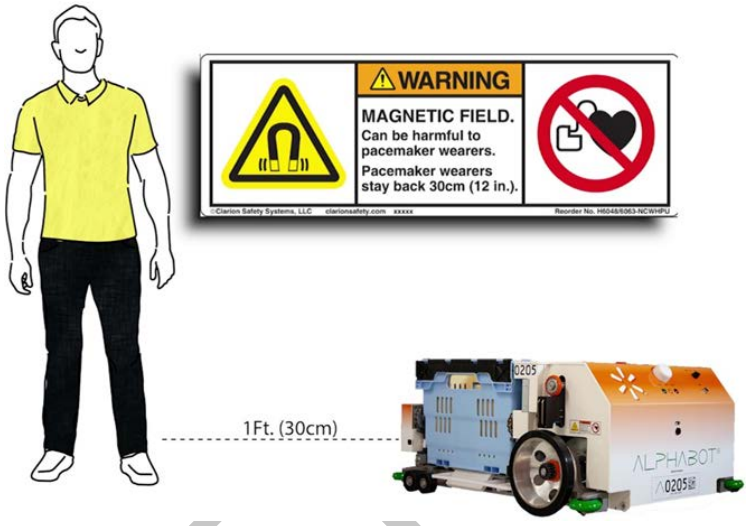
5.2 Operational Hazards

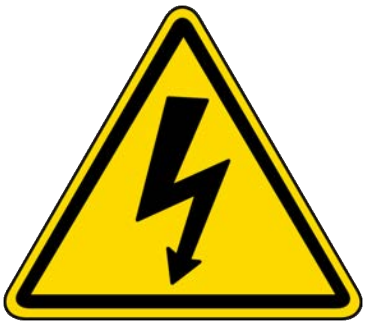
For Alphabot System operators, the interaction between the operator and the bots occurs at three main locations, static workstations, dynamic workstations, and customer dispense portals.

Warning Label	Description of Hazard
 ***Lifting Hazard***  ***Foot Crush Hazard***	When lifting totes from the ground or a pallet onto the static workstation's stage, there is a **Lifting Hazard** and a **Foot Crush Hazard**. Do not attempt to lift an object heavier than 50 lbs without the assistance of another operator. An operator shall use a lifting assist tool whenever possible. An operator shall adhere to the safe lifting standards outlined in the "Safe Lifting Hazards" training module.  *See "Safe Lifting Standards" in 1000006-MN-01: Associate Safety Training Manual for more information.*
	When loading totes into the bot acceptance cavities in the static workstation, grasp the tote by the handle, and not the top lip of the tote. You may scrape your hand if they fail to use the handle when pushing in the tote. This presents a **Pinch Hazard**.

Warning Label	Description of Hazard
Pinch Hazard	 *See "Grasp by Handles" training module in 1000006-MN-01: Associate Safety Training Manual for more information.* While at the dynamic workstation, the operator will not attempt to hold a bot or tote in place after it has begun to move. This presents a **Pinch Hazard** if the operator does not let go of the bot or tote. A breakaway panel is present, which stops the dynamic workstation if it is disengaged from its seat. In the event of the above scenario, the station would be stopped as the breakaway panel is dislodged.  *See "Breakaway Safety Panel" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*

Warning Label	Description of Hazard
 ***Hand Entanglement Hazard***	When working at the static workstation, do not climb into the station cavity. Interacting with the Alphabot while it is actuating its tote chain may present a **Hand Entanglement Hazard**.  *See "Pinch Hazards, Liquids" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*
 ***Magnetic Field Hazard***	When active, Alphabots produce a weak magnetic field. This field is significantly less powerful than that of a cell phone. This poses a hazard to operators and technicians with **pacemakers or similar medical devices.** These individuals should keep a distance of 1 ft, or 30 cm, at all times.

Warning Label	Description of Hazard
	 *See "Pace Makers" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*
 ***Fall Hazard***	When working at the dynamic workstation, failing to secure the chain on the operator lift can present a **Fall Hazard**. *See "Dynamic Workstation - Hazards" training module in 1000006-MN-01: Associate Safety Training Manual for more information and Safety Around the Alphabot System*
 ***Temperature Hazard***	Exceeding the time limits for working in the chilled or frozen temperatures zones can present a **Temperature Hazard**. *See "Warning Labels" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*

Warning Label	Description of Hazard
 ***Slip Hazard***	Chilled and frozen temperature environments can pose a **Slip Hazard**. *See "Warning Labels" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*
 ***Electrical Hazard***	Operators should never climb into the dynamic or static workstations, nor enter the System entry door. If an operator climbs into the System while it is in operation, the Alphabot charge rails pose an **Electrical Hazard**.  *See "Pinch Hazards, Liquids" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*

Warning Label	Description of Hazard
 ***Do Not Sit***	Do not sit or climb the static or dynamic workstation. This presents a **Sit/Climb Hazard**.  *See "Movement & Weight Hazards" training module in 1000006-MN-01: Associate Safety Training Manual for more information.*

5.3 Workstation Operation

There are two main system interfaces for associates, **static** and **dynamic workstations**. These stations are the only locations where associates directly interact with the Alphabot System.

Static workstations (SWS) are fixed workstations providing an interface to introduce product totes or sub-totes into the Alphabot system storage module. These workstations are meant for collecting completed orders, dispensing orders, and exception handling referred to as ***hospital*** functions.

Dynamic workstations (**DWS)** are situated at the end of a transit plane. They are three levels tall so a bot can enter the bottom of the station through the transit plane, engage its wheels, and climb to the height of the associate to present its tote. When the associate reaches into a tote to retrieve an item the bot will progress back into the system to perform other activities. Alphabots continuously retrieve and delivery totes to a DWS from frozen, chilled, or ambient food storage locations until a customer order is complete.

High-level steps are performed for workstation processing:

Step	Action
1	User logs into a workstation.
2	Select the desired workflow from the touch-screen menu such as, ***Load Order Tote, Pull Order Tote, Re-pick, etc***
3	Bots deliver requested totes to workstation where user performs work as directed by on-screen prompts.
5	Steps 2 and 3 repeated for shift's duration.
4	User logs out of a workstation.

For detailed Static Workstation (SWS) training see 1000022-MN-01: Alphabot ASD System Associate Workflow Training and for detailed Dynamic Workstation (DWS) training see 1000008-MN-01: Alphabot APSD System Associate Workflow.

5.4 Control System Operation

Alphabots are controlled by several systems with primary being the **M**aster **C**ontrol **S**ystem (MCS) which presents an ongoing status of each bot and component to a system operator who may override bot and system component instructions. MCS is the "air traffic control" for all Alphabots and system components.

The Alphabot System is directed by a human System Operator who works with MCS to direct bots and perform normal operations or pause the system for maintenance, bot recovery, or requested operational changes. MCS will be upgraded to the **R**obotic **C**ontrol **S**ystem (RCS).

For detailed information see 1000016-MN-01: MCS User Guide and 1010406-01: RCS User Guide

6. Regulatory, Compliance, and ADA

6.1 Standards Compliance

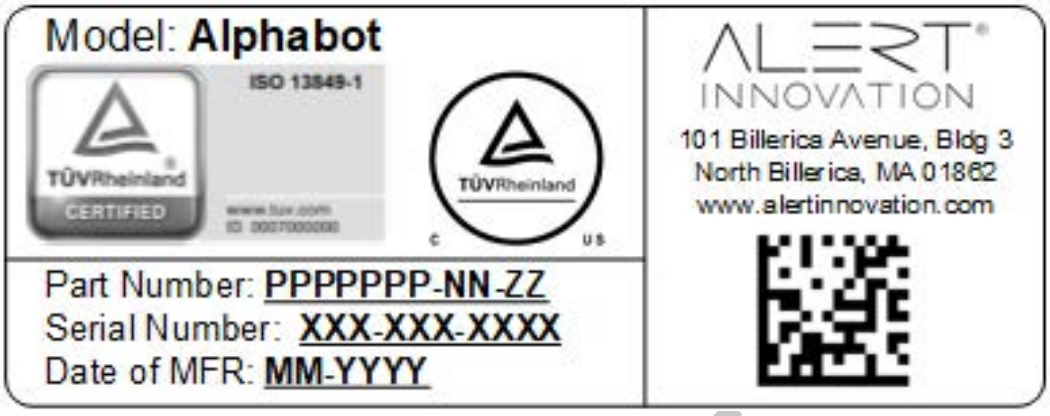


Figure 47: Alphabot 1101-series label

Figure 47: Alphabot label for series 995 and 441

The Alphabot System is TUV-certified and in compliance with NFPA 79; CSA C22.2 No.301-2016 and UL 2011 standards. Other referenced standards of compliance are shown in the table below.

The Alphabot® system, to the best of our knowledge, complies with national safety standards such as ANSI/RIA R15.06, NFPA 79, ANSI Z117.1, ANSI MH16.1 and ANSI Z535 and international safety standards like EN 60204-1, ISO 10218 and IEC 62061.

Il directly de-energize all motor controllers achieving a category 0 stop per NFPA 79 and IEC 60204-1.

Standards Compliance	
Standard	**Title**
SA / UL 2011	**Outline of Investigation for Machinery**

Standards Compliance	
NFPA 79	Electrical Standard for Industrial Machinery
UL 508A	"Standard for Safety – Industrial control panels"
CSA C22.2 No. 14	Industrial Control Equipment
ISO 13849 -1	Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design
ISO 12100	Safety of machinery — General principles for design — Risk assessment and risk reduction
IEC 61508	Functional Safety Of Electrical/Electronic/Programmable Electronic Safety-Related Systems
IEC 62061	Safety Of Machinery - Functional Safety Of Safety-Related Electrical, Electronic And Programmable Electronic Control Systems
IEC/UL/EN/CSA C22.2 # 61010-1	Safety Requirements For Electrical Equipment For Measurement, Control, And Laboratory Use - Part 1: General Requirements
IEC/EN 60204-1	Safety Of Machinery - Electrical Equipment Of Machines - Part 1: General Requirements
IEC 60947-5-1	Low-voltage switchgear and control gear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices
ANSI Z535.xx	American National Standards for Safety Signs and Colors
ISO 13850	Safety of machinery. Emergency stop function. Principles for design
EN 842	Safety of machinery - Visual danger signals - General requirements, design and testing

Standards Compliance	
UL 94 V	**Tests for Flammability of Plastic Materials for Parts in Devices and Appliances**

6.2 TUV Compliance

cTUVus Mark (CU-Certificate)

Certificate No. CU 72214060 (Link)	
Certificate Holder	**Alert Innovation** 101 Billerica Avenue, Bldg 3 01862 North Billerica United States
Certificate Number	CU 72214060
Order Number	0234121573
Certified Product	Factory Automation Equipment Accessory - Movable Platform Model Designation: Alphabot (1000995-01-01)
Fulfilled Standards	UL 2011:2020 CSA C22.2 No. 301-2016 NFPA 79:2018 The standard(s) listed here reflect the status at the time of the release of this certificate.
Date of Issue	2021-11-08
Certificate Type	US + Canada Certificate **cTUVus Mark (CU-Certificate)** ***Approval for the North American Market*** This test mark, also referred to as the "cTUVus mark," serves as proof of compliance with the Canadian national standards adopted by the Standards Council of Canada (SCC) and US national standards. Provincial Regulators across Canada and U.S. Authorities Having Jurisdiction (AHJs) recognize the cTUVus mark as proof of product compliance to published national standards and code requirements. Retail buyers accept it on products they're sourcing. Consumers recognize it on products they purchase as a symbol of safety. It shows that a product has been tested and certified by an independent accredited third party laboratory.

Certificate No. CU 72214060 (Link)	
	TÜV Rheinland tests a product sample and conducts repeat factory inspections to assure continued compliance. The validity of the certificate does not expire unless the standard(s) expire or the client cancels it. Certified products may be labeled with a test mark. More information about this service here.
misc test details	TÜV (TÜV Rheinland Group) performed a force test per ISO/TS15065 around the crushing break away zone and the maximum force measured was 129 N for a 140 N maximum force permitted per standard.

6.3 ISED Regulatory Compliance

Canada (ISED) Regulatory Information:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 26910-ALPHABOT) a été approuvé par ISED Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Let types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Antenna Type: PCB Etch

Impedance: 50 ohm

Maximum Gain: 0 dBi

The OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

This Module is labelled with its own IC ID. If the IC ID Certification Number is not visible while installed inside another device, then the device should display the label on it referring the enclosed module. In that case, the final end product must be labelled in a visible area with the following:

"Contains Transmitter Module IC: 26910-ALPHABOT" OR "Contains IC: 26910-ALPHABOT"

Ce module est étiqueté avec son propre ID IC. Si le numéro de certification IC ID n'est pas visible lorsqu'il est installé à l'intérieur d'un autre appareil, l'appareil doit afficher l'étiquette sur le module de référence ci-joint. Dans ce cas, le produit final doit être étiqueté dans un endroit visible par le texte suivant:

"Contains Transmitter Module IC: 26910-ALPHABOT" OR "Contains IC: 26910-ALPHABOT"

6.4 Decommissioning Equipment

The decommissioning and dismantling of the Alphabot or the Alphabot System shall be performed by authorized personnel. Dispose of waste equipment and material is in accordance with local regulations.

6.5 Electronical Component Compliance

Alert Innovation is committed to safety and a new repository of for managing safety data sheets is being created for 1Q2022. This section will be updated with a website link indicating all products and sheets.

Il directly de-energize all motor controllers achieving a category 0 stop per NFPA 79 and IEC 60204-1.

The E-stop circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.

ID	Electrical Compliance
Structure Access	The interlock circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.
Plane Access	The interlock circuitry corresponds to a Category 3 PLd per EN ISO 13849-1 and SIL2 per IEC 62061.
DWS	The interlock circuitry at the Picking Workstation corresponds to a Category 2 PLd per EN ISO 13489-1 and SIL 1 per IEC 62061.
Main Enclosure Power Feed Procedure	The live wiring is colored Orange as per NFPA 79 and IEC 60204-1

6.6 Safety Data Sheets

NOTICE
Before using this product, ensure you have the current revision of the Safety Data Sheet.

Alert Innovation is committed to safety and a new repository of for managing safety data sheets is being created for 1Q2022. This section will be updated with a website link indicating all products and sheets.

Alert Innovation Safety Data Sheet Website: pending 1Q2022

ID	Safety Data Sheet Product
1	PowerStor Electrochemical Double Layer Capacitors
2	Multipurpose Synthetic Grease
3	Synthetic Lubricant (AF2 Grease)
4	Synthetic Lubricant (Syn GR-13)

6.7 ADA Compliance

Alert Innovation strives to make our products and websites accessible to all people. We are committed to comply with the Americans with Disabilities Act (ADA) and relevant U.S. regulations.

Alert Innovation recognizes that accessibility and usability might not always be available in every one of our products and websites, or for those using assistance technologies and devices. Please be aware that our ADA compliance efforts are ongoing as we improve our products' accessibility features.

This ADA Compliance Statement provides our current ADA status. We will update this Statement as our compliance efforts continue.

Customer-Dispense Portals

The Alert Innovation Customer-Dispense Portal is the primary customer interface with the Alphabot System. The Portal is designed with ADA reach requirements in mind.

The Portal meets 2010 ADA Standard 707.2 in providing "A clear floor or ground space complying with [Standard] 305".

The Alert Innovation Customer-Dispense Portal exterior input controls are designed to be accessed at 37 ½” above finish adjacent grade, in compliance with 2010 ADA Sections 205 & 308.

The display screen's user interface, including all font and display specifications, are under the purview the client. The area surrounding the Customer-Dispense Portal, including the curb and parking area, is under the purview of the building's Engineer of Record (EoR). The EoR provides guidance regarding site plans outside of the Alert System, to ensure the site meets ADA compliance recommendations.

See Hansel Requirements for more information.

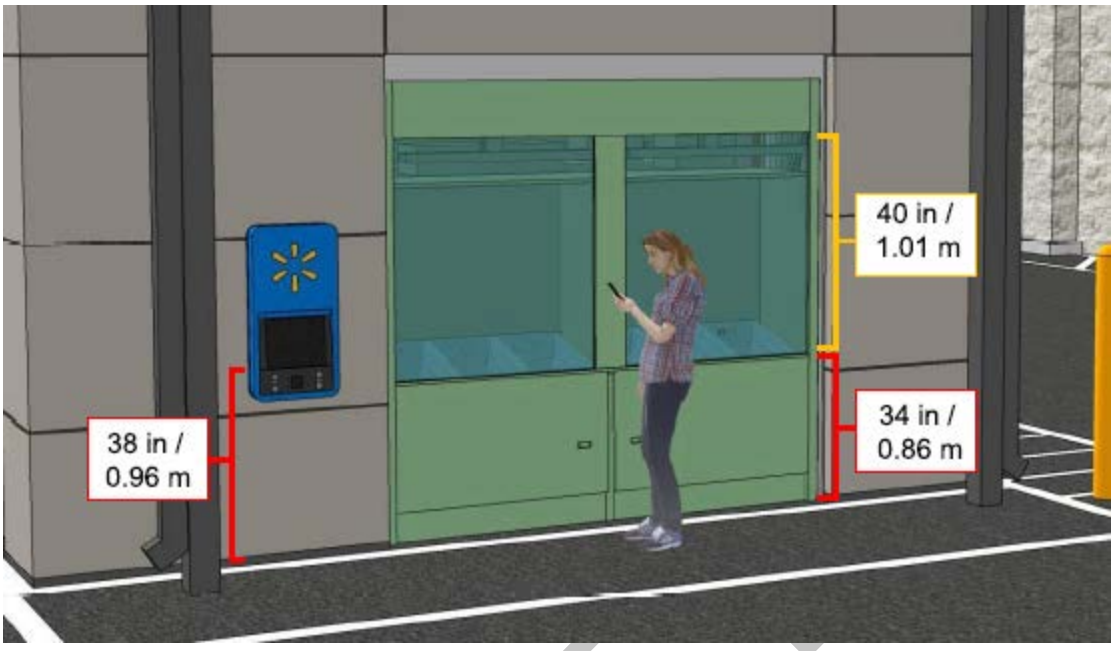


Figure 1a: Kiosk (Left) and Customer-Dispense Portal (Right).

Figure 1b: Accessibility to Kisosk and Portal

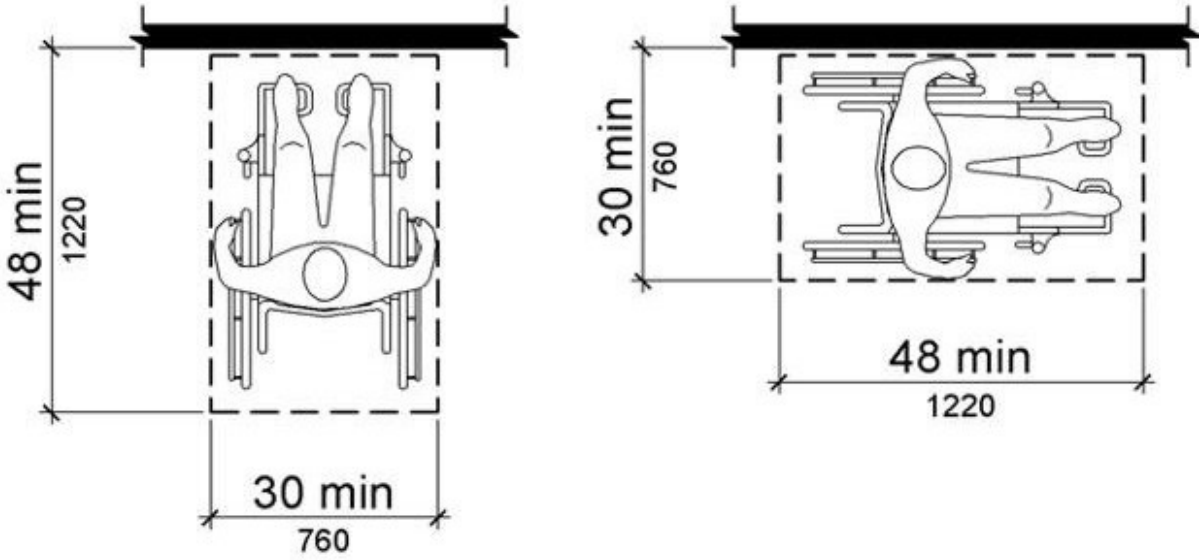


Figure 2a: Clear Space Options. Forward (Left-side) and Parellel (Right-side).

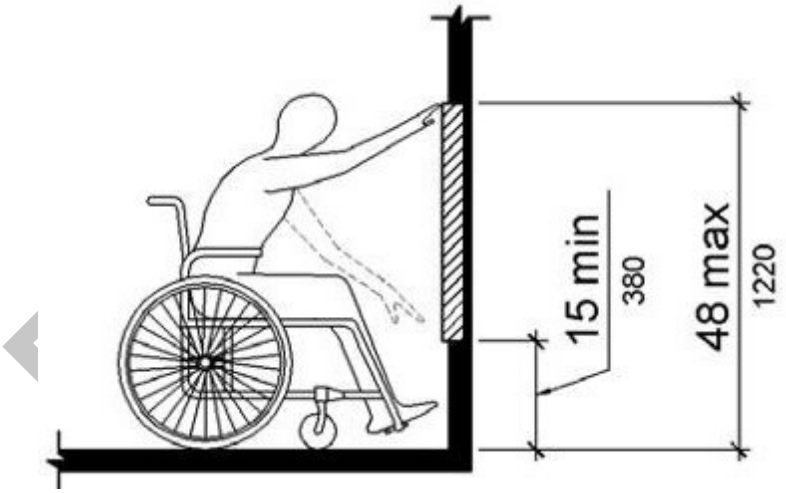


Figure 2b: Clear Space Options. Forward (Left-side) and Parellel (Right-side).

Customer-Dispense Kiosk Requirements	
Kiosk Width	20 in / 50.8 cm
Kiosk Height	25.5 in / 64.7 cm

Customer-Dispense Kiosk Requirements	
Kiosk Depth	5.25 in / 13.3 cm
Distance from Ground to Screen	38 in / 96.5 cm
Interface	Touch-Screen
Audio	Built-In Speaker

Customer-Dispense Portal Requirements	
Portal Opening Height	40 in / 101.6 cm
Portal Opening Width	38 in / 96.5 cm
Minimum Head Clearance	78 in / 198.1 cm
Distance from Ground to Screen	38 in / 96.5 cm

Static Workstations

The Alert Innovation Static Workstation (SWS) provides reasonable accommodation for individuals with disabilities.

Alert Innovation products are designed with ADA compliance in mind,

SWS Dimensions:

Length = 110.3 in. (2.8 m)

Width (with Shelf Open) = 38.97 in. (0.99 m)

Height = 99.6 in. (2.53 m)

Dynamic Workstations

The Alert Innovation's Dynamic Workstation (DWS) provides reasonable accommodation for individuals with disabilities.

Staffing of the Dynamic Workstation includes a requirement that the operator be able to comfortably stand at the DWS for the duration of their shift.

DWS Dimensions:

Length = 127.1 in. (3.23 m)

Width (transit deck side) = 91.22 in. (2.32 m)

Height = 123 in. (3.12 m)

See document "17-1649 Alphabot C1 Prototype Workstation Quantitative Ergonomic Analysis" for further details on the ergonomic design of the Dynamic Workstation.

System Operator Station

The Alert Innovation System Operator Station provides reasonable accommodation for individuals with disabilities.

This station consists of multiple monitors connected to multiple laptops and PCs, set to display RCS/MCS.

Alphabot System: Structure

The Alert Innovation Structure is considered a confined space within a machine.

Staffing of maintenance technicians includes a requirement that the operator be able to walk within the aisles of the structure, perform maintenance tasks within an enclosed space, and push/pull Alphabots to charge locations throughout the Structure.

7. Training and Corrective Records

7.1 Personnel Training Records

Authorized Operators and Supervisors must take safe entry training on an annual basis and shall be trained before entering the system. Safe entry training records must be maintained for each Authorized Employee. The documentation shall include:

- Subject of training
- Date of training
- Employee's Name
- Name of Supervisor administering the training
- Employee Test Results from the training

Examples of documentation associate to keep on file at site location.

7.2 Corrective Action Records

Corrective Action records shall be maintained for any safe entry procedure violations. Please discuss with site DTE manager for specifics.

Site record keeping example.

8. Revision History

Revision	ECO	Date	Author	Change Description
A	(fill in actual)	12/31/2020	S. Kintali	• initial release of system user manual
B		1/5/2022	B. Hogan	Alphabot System Manual PN: 1000020-FM-01 Rev B • Combined Alphabot User and System Manuals aligning topics, consolidated naming conventions, and ensuring continuity. • Migrated to new Onedrive and performed all line spacing adjustments for styles with 0.15 after line size. • Updated snippets but master snippets still need color adjusted • added new page breaks **Topic Additions:** **(**per Jason 1/14/22 from 1000059-ST-01 updates) • Electrical LOTO\Main Enclosure Power Feed Procedure, added detail from PN-1000059-SR-01 to validate the UPS power cut w/wo Panduit or other voltage tester. • ibid to Main Enclosure UPS Output Disconnect Procedure • ibib to UPS Enclosure Procedure **Pending January 2022:** • add link to SDS in Regulatory section **Topic Title Harmonization:** • Safety \ OLD=Safety Equipment Rules, New Padlock Safety Equipment Rules • change Safety \ old=Inherent Safety Hazards in Alphabot Structure, new = Structure Safety and Hazards

				• Safety \ old=Station Safety and Hazard Labels, new-Safety System and Hazards • System Safety to System Safety & Hazards • Safety\Structure Safe Entry Procedures changed name adding Exit • Safety\Structure Safe Entry & Exit \ change name for "Instructions to enter Structure Aisle" to "Procedure to Enter Structure Aisle) o Change to Procedure from (Instructions) to Enter the Structure Under Abnormal Conditions • Safety\Structure Safe Entry & Exit \ change Deck to Plane Safety Entry Procedure • Replaced "DWS Exit procedure" with "DWS Exit" from System • change "DWS Entry procedure without interrupting operations" to "Procedure DWS Entry wo interrupting operation" • align titles in Safety\Personal Safety: (old) Workstation Interlock Scheme and Entry Procedure); New=Workstation Safe Entry & Exit • Title alignment: Safety \ Old=Procedure DWS Entry Without Interrupting Operations), new=Procedure to Enter DWS Without Interrupting Operations • Title alignment: Safety\ old=Plane Safe Entry Procedure, new=Plane Safe Entry & Exit (---update table) • Title alignment \ Safety\ old=Personnel Safety, new=Personnel Safety and Hazards • Safety \ old=Plane Safe Entry & Exit, new=**Transit** Plane Safe Entry & Exit (---update table) • Safety\System Safety and Hazards \ Structure Safe Entry & Exit \ old=Procedure to Enter Structure Aisle, new=Procedure System Entry Structure Aisle • Safety\System Safety\old=Description of the Alphabot System E-Stop Circuitry, new= Alphabot System E-Stop Circuitry

				• Safety\System\Structure Safety and Hazards \ old=Maintenance PPE (Personal Protective Equipment), new=Maintenance PPE • Operation\Regulatory, Compliance, Structure\ADA old= ADA-Portals, new ADA-Portals & Totes • Operations \ Functions DWS, old=Picking Procedure - Dynamic Workstation, new= DWS Picking Procedure • from Acronyms to Definitions • old=Charge Rails Breaker (Ground Fault Circuit Interrupter) Procedure, new=Charge Rails GFCI Breaker Procedure. Added GFCI description in text body • old=Safety\Structure Safe Entry and Exist \ Procedure to System Entry Structure Aisle, new=Procedure to Enter Structure Aisle • old=Structure\Safe Entry and Exit\Plane Access, new=Plane Entry Overview • old=System LOTO\Multiple Power Drop Warnings, new = removed multiple • Safety\System...\Transit Plane old=Instructions to enter the Confined Space area, new=Confined Space Safe Entry and Exit • Replace ampersands with "and" • old=Fire Safety, Fire, and Smoke Alarms, new=Fire Safety and Smoke Alarms • old=Station Safety and Hazards, new=Workstation Safety and Hazards • old= Operational Hazards, new=Structure Operation Hazards • Intro\old=General Definitions and Terminology, new=Terminology and Definitions **Data Removal:** • from: Mechanical Specifications put SWS, DWS, and Tote dimensions in ADA section. Team decision: all bot, aisles, temperature, and plane sizing removed • System\Technical Specifications : now hidden in document

				• Maintenance PPE : team removed maintenance and this PPE topic was part of it. • Operation\Software\deleted: MCS, GUI split screen, and Split screen layout guidelines as all dated material • Deleted: Operation\Description of Interlock Circuitry\Door Interlock Reset • Detailed procedures at DWS and SWS referred to procedures in Workstation Operations reducing several sections. • per Jason, removed all Troubleshooting info • Definitions removed "Automated Each-Picking System" • from General Definitions removed last section with bot tools in the system user guide **Topic Consolidation:** • deleted 'ergonomics' topic in Safety\Personnel Safety and Hazards, left in Safety\System Safety and Hazards\Structure Safety and Hazards • consolidated "Safety\Safety Systems Hazards" into Safety\System Safety and Hazards\System Maintenance Hazards • Combined Safety\Operational Safety Hazards into Safety\System Safety and Hazards\Operational Hazards • Combined Safety\Personnel Safety and Hazards\Fall Protection into Safety\System Safety and Hazards\Structure Safety and Hazards\Fall Protection • Combined "Persons with Pacemakers" removing copy from Safety\System Safety and Hazards\Structure Safety and Hazard to Safety\Personnel Safety • Combined "Fire Safety, Fire and Smoke Alarms" from Safety\Personnel Safety and Hazards into System Safety and Hazards\Structure Safety and Hazards\Fire Safety [changed name to prior]

				• Migrate SDS into Regulatory, Compliance, and Records • Combined Safety\Personnel Safety and Hazards\Workstation Safety Hazards into Safety\Safety System and Hazards\Station Safety and Hazards \ Workstation Maintenance Hazards • Combined Safety\System Safety\Station Safety and Hazards Workstation Safety Hazards + Dynamic Workstation Hazards • Name change Safety\Station Safety and Hazards\DWS Workstation Hazards to DWS Workstation Safety and Hazards • combined Safety\Station Safety and Hazards Static Workstation Safety with <same path> + static workstation hazards • Safety\Systems Safety\Structure Safety\System Safety and Maintenance Hazards merged and same content as in Operations Hazard • Operation\Troubleshooting consolidated to one page • old System manual had 4 topics under "Description of the Interlock Circuitry" they were moved to o from ...\Dynamic Workstation to • Consolidated Description of Interlock Circuity\Door Interlock Reset was combined into Safety\Structure Safe Entry and Exit\System Exit Overview • Consolidated from Description of Interlock Circuity\Door Interlock Reset\Dynamic Workstation into Safety\Workstation Safe Entry and Exit. Part of language was also moved to • Consolidated Description of Interlock Circuity\Structure Access into Safety\Structure Safe Entry and Exit\System Entry Overview • Created System Operation\Workstation Operation with basic login and step activities + reference to PN10000008 &

				10000022. This removed details functions in prior guide at SWS and DWS • Safety\Operational Safety merged into Safety\Structure Safety and Hazards\Operational Hazards (same warning labels) • Safety\Structure Safety..\Fire Safety... merged into System Safety\Fire Escapes... • Combine Safety\Personnel Safety an Hazards\Fall Protection into Safety\Structure Safety and Hazards\Fall Protection • Combined RF from Safety Personnel to Safety\Structure Safety and Hazards • Only 1 system glossary at start of doc. Copy in Operation\System Glossary removed • old=System Safety and Hazards\Fire Escapes and Alarms, new=Fire Safety and Alarms • Merged 'system glossary" into system overview and consolidated any redundant topics • consolidated Definitions from original version into Terminology and Definitions • System Safety and Hazards\Global E-stops button and Alphabot System E-Stop moved into this chapter **Topic Options Sheet Naming Convention** • to expedite page linking renamed all topics as follows • (manual)+(parent chapter)+(child chapter or topic)+(topic name) • s-s-psh = <system manual)Safety\Personnel Safety Haz. • s-o-Theory... = <system manual>Operation\Theory of Operation • u-i-Alphabot = <bot user manual>Introduction\Alphabot • u-ssh-structure-Operation-Hazards=user\system safety and hazards\structure operation hazards

				Edits: • System Safety and Hazards\ Structure Safe Entry and Exit\System Exit Overview - updated text for box 4 for the Interlock panel. Said to press the silver button and Alert Academy said the blue button **Misc:** • added linked to power outage procedures in Safety\System LOTO...\Main Enclosure Power Feed Procedure
			pending update	add link for SDS website when available to topic 'Safety data sheets"