**Section 14.92.00**

Healthcare Pneumatic Tube System Specification

**1.00 General**

**1.01 Summary**

This specification applies to the design, installation and operation of a healthcare pneumatic tube system.

**1.02 System Description**

Specifically for use in a healthcare setting, a software controlled multi-point pneumatic tube system that transports plastic carriers containing drugs, specimens and blood products, as well as other small materials, from any pneumatic tube station to any other pneumatic tube station that is part of the same interconnected system.

**1.03 Description of Work**

**A.** The System is to be provided for the following project: *Project Names Goes Here*

**B.** Manufacturer shall provide all engineering, equipment, materials and labor for an automated software-controlled pneumatic tube delivery system.

**C.** All work shall be completed in a workmanlike manner, complete in all respects including all items specified herein and as may be necessary for the satisfactory installation and operation of the specified system.

**D.** The manufacturer shall test and warrant the system operation and performance.

**E.** Station locations shall be defined by drawings and guidelines provided by the General Contractor, Architect, Consultant or Owner.

**1.04 Definition of Terms**

**A.** Blower – Electro-mechanical industrial compressor blower assemblies that create air pressure and vacuum to propel carriers through steel tubing.

**B.** Blower Group – An interconnected set of 2 or more blowers along with a set of forward and reverse facing diverters, configured to allow any one blower to handle a transaction from start to finish.

**C.** Carrier – Reusable plastic containers that hold and protect contents (lab specimens, pharmaceuticals, blood products, etc.) sent through a pneumatic tube system.

**D.** Delivery Manager Software – Running on a server or virtual machine, software that controls the electro-mechanical devices and system-wide communications, accepts station commands, determines carrier delivery routes, monitors system status, manages system faults, and integrates with Microsoft Active DirectoryTM to provide users with secure sign-on and role-specific web application interfaces.

**E.** Database – A repository, like Microsoft SQL ServerTM, that stores delivery information including time, location, user/s, cargo and carrier data.

**F.** Data Network – An Ethernet network used to send and receive data between the electro-mechanical devices and the Delivery Manager Software, the web application and the database.

**G.** Diverter – Electro-mechanical route switching device used at branching points within a tube network to allow a carrier to move from one path to another.

**H.** Interzone Connection – A section of tubing that connects one zone to another zone.

**I.** Rapid Departure System – A group of electro-mechanical devices similar to diverters that temporarily hold and stage carriers after they have left their origin station and before they arrive at their destination station, enabling the system to accept and process more concurrent deliveries than the quantity of blowers in the system.

**J.** Station – Electro-mechanical device that is used to send and receive carriers. Stations include a 7” or 10” touch control computer user interface, carrier dispatcher, carrier receive bin and empty carrier storage – and optionally a barcode reader, RFID carrier reader/antenna and RFID proximity badge reader. Stations shall meet the ADA Standard for Accessible Design for Forward Reach (section 308.2) and Side Reach (section 308.3).

**K.** Third-Party Software Applications – Software applications provided by other manufacturers or developers that integrate with the Delivery Manager Software to provide features such as identifying who sends and receives deliveries and sharing delivery information with clinical dashboards.

**L.** Transaction – The act of sending an item or items in a carrier between two stations.

**M.** Tubing – 16-gauge steel tubing with an O.D. of 6” or 4” that form a network of paths through which carriers travel from origin stations to destination stations.

**N.** Web Application – The Delivery Manager Software’s graphical user interface application, running on a server or virtual machine and delivered over a hospital’s Ethernet network through a web browser, that provides an administrative view, maintenance view and clinician view depicting system, device and station settings, current status and history.

**O.** Zone – A collection of approximately 10 stations with direct tubing connections. Zones are interconnected with interzone connections to support systems of up to 900 stations.

**1.05 System Engineering and Coordination**

**A.** The manufacturer shall provide all necessary system engineering, layout and documentation using 2D and 3D CAD software as appropriate.

**B.** Final location of equipment and routing of tubing shall be coordinated with other trades using BIM (building information modeling).

**1.06 System Design**

A. The system size shall be X inches *(system size indicates the outside diameter of the tubing and is either 6 inch or 4 inch).*

B. The system shall include Delivery Management Software, a database and a graphical user interface web application that displays system information, real-time and historical data, configuration options and diagnostic tools.

C. The system shall include a quantity of X stations.

D. The system shall include a quantity of X blowers, with the stations and/or anticipated traffic flow divided evenly among the blowers.

E. The system shall include a sufficient quantity of diverters and tubing to link all stations and blowers.

F. The system shall be expandable up to 1,200 devices (stations, diverters and blowers) to accommodate future growth of the facility.

G. The manufacturer shall provide three (**3**) carriers per station of a corresponding size to the tubing.

**1.07 System Characteristics**

**A.** The system shall be designed specifically for healthcare use and include the capability to track and document each item delivered to provide a real-time audit trail.

**B.** If the system requires 2 or more blowers, the system shall support Blower Groups to allow any one blower to handle a transaction from start to finish between any two stations with direct tubing (non-interzone) connections.

**C.** If more than one Blower Group is used, they shall be linked with interzone connections so that carriers can travel from stations attached to one Blower Group to stations attached to the other Blower Groups.

**D.** The system shall have the capability to manage empty carrier storage and distribution automatically.

**E.** The system shall dynamically calculate the most efficient route based on resource availability and transaction volume.

**F.** The equipment and software proposed shall be developed and functional at the time of quotation.

**1.08 Submittals**

A. The manufacturer shall provide training materials that explain how to use the system.

B. The manufacturer shall provide product data sheets that include overall dimensions and electrical requirements for each type of equipment used in the system.

C. The manufacturer shall provide a list of recommended spare parts.

D. The manufacturer shall provide an operations manual that includes instruction for proper maintenance.

E. The manufacturer shall provide 2D drawings that illustrate the location of tube routing and equipment in the form of riser diagrams.

F. The manufacturer shall provide as-built drawings upon completion of the project.

G. Each submittal item listed in this section shall be provided electronically.

**1.09 Manufacturer Proposals**

The manufacturer’s proposal shall identify any requirements outlined in this specification which they cannot comply.

**1.10 Quality Assurance**

**A.** All equipment shall be furnished by an approved system manufacturer with manufacturing and corporate headquarters located in the United States.

**B.** All equipment supplied must be listed with UL (formerly Underwriters Laboratory) and meet UL’s 60950-1 Standard for Information Technology Equipment.

**C.** Manufacturer must specialize in healthcare pneumatic tube systems.

**D.** Manufacturer must have a minimum of 25 installed hospital systems of similar size and complexity as to the project being bid.

**E.** Manufacturer must provide 24/7 United States based helpdesk support.

**F.** It is the responsibility of the manufacturer to coordinate all tube routes and equipment placement.

**G.** The manufacturer shall ensure that all parts and equipment will be available for a minimum of seven (7) years following the system acceptance. If a part is discontinued before 7 years, the manufacturer shall offer a replacement of equal or greater quality.

**1.11 Warranty**

A. The manufacturer shall provide the hospital with a limited warranty that covers mechanical equipment for 12 months and electronic equipment for 24 months. During the warranty period, any defective part(s) returned to the manufacturer shall be repaired or replaced at the manufacturer’s discretion. The written warranty provided by the manufacturer shall supersede this section and outline the specific details of coverage.

B. Ordinary wear and tear of equipment, damage caused by improper use, and damage caused by improper maintenance is excluded from the limited warranty.

C. The warranty period commences on the date of substantial completion of the system installation.

**2.00 Product**

**2.01 Tubing**

A. Tubing shall be galvanized 16-gauge steel with one end belled to provide optimum fit and seal.

B. Tubing bends shall have a 48” centerline radius and be made from the same material with the same characteristics as the straight tubing.

C. Tubing shall be round and maintain a uniform cross section throughout its length.

D. All joints shall be airtight and secured with glue, tape and mechanical fasteners as required.

**2.02 Blowers**

A. Blowers shall be regenerative, factory assembled and tested -- and include air shifter assemblies, vibration isolators, screen boxes and motor starters with thermal overload protection.

B. Blowers shall provide vacuum and pressure sufficient to propel carriers a minimum of 22 feet per second.

C. Printed circuit board controls shall be interchangeable with the controls used in diverters.

D. Blowers shall connect to the first inline diverter by 4” diameter tubing, except when the distance between blower and diverter is more than 150’ in which case 6” diameter tubing shall be used.

E. Blowers shall include electronics that sense the presence of pressure and vacuum.

F. Blowers shall turn off when not in use to conserve energy.

G. Blowers shall communicate with the Delivery Manager Software over an Ethernet network.

H. Blowers must be UL Listed.

**2.03 Diverters**

A. Diverters may be supplied in one configuration or a combination of configurations. Configurations may include 2, 4 and 6 port - with 1 line in on one side and either 2, 4 or 6 lines out on the opposite side.

B. Printed circuit board controls shall be interchangeable with the controls used in the blowers.

C. Diverters shall include electronics that sense the passing of carriers through their tubing.

D. Diverters shall include electronics that sense the alignment of the input line with the various output lines.

D. Components like chains, gears, sprockets and cogs must be steel – plastic of any type is not permitted.

E. Diverters shall include removable covers that guard against inadvertent human access.

F. Diverters shall communicate with the Delivery Manager Software over an Ethernet network.

G. Diverters must be UL Listed.

**2.04 Stations**

A. Mechanical and General Attributes

1. Stations shall be recessed into a wall or placed on a countertop. The specific station style provided shall be based on the overall system design as specified by the architect or other designer designated by the owner. When a specific station style is not designated, the tube system manufacturer shall choose a style based on anticipated user and facility needs. When counter mounted, the counter shall be provided by others.

**2.** Stations shall be meet the ADA Standard for Accessible Design for Forward Reach (section 308.2) and Side Reach (section 308.3), enabling a wheelchair user to send and receive carriers.

3. To maximize the safety and integrity of transported items, the station shall provide carrier dispatch and arrival from its top only. Pass-through type stations are not allowed.

4. The station shall support the safe dispatch and arrival of carriers and payload with a combined weight of up to 8 pounds.

5. The station shall provide an air cushion for arriving carriers.

6. An optional password protected security door shall be available.

7. The station must be UL Listed.

8. The station shall be installed using industry standard methods for securing the station to the floor or counter.

9. The station’s carrier receiving bin shall be accessible from the front and present carriers in the order they arrive so that the carrier sitting in the bin the longest is the first to be retrieved.

10. The station shall be able to store 4 empty carriers while maintaining the capability to send and receive carriers.

11. The station shall be constructed to minimize noise.

12. Wall recessed stations shall include a trim frame to mate the station with the surrounding wall.

13. All mechanical and electronic components shall be accessible and/or removable for repair or replacement from the front of the station without the use of a lift or other mechanical aid.

14. The stations shall include a “carrier on dispatch” sensor, and “bin full” sensor and a “carrier on slide plate” sensor.

15. A remote carrier arrival indicator that produces both a visible light and an audible alarm shall be available.

16. An optional integrated 2D barcode scanner shall be available to document the items being delivered.

17. An optional integrated proximity badge reader shall be available to document the employee IDs of sending and receiving users.

18. An optional integrated carrier RFID reader and antenna shall be available to document carrier locations and movement.

B. User Control Features

1. The User Controls shall be a 7” or 10” color touch screen computer.

2. The User Control shall support Standard, Passcode, Tracked and Tracked Secure deliveries.

a. *Standard deliveries* require the user to place a loaded carrier in the dispatch position, select a destination address from either a shortcut menu, an A to Z menu, or by manually entering a numerical address using a key pad, and then pressing the “send” button. Upon arrival at the destination, the carrier automatically drops into the station’s arrival bin. All delivery data is stored in the database and available to users via the web application.

b. *Passcode* deliveries begin the same way as Standard deliveries begin with the user placing a loaded carrier in the dispatch position, selecting a destination address and pressing the send button. The Delivery Manager Software then generates a random 3-digit code and displays it on the touch screen display. When the carrier arrives at its destination, it is held above the station until the receiving user enters the passcode that was communicated to the receiver by the sender. The delivery data is then stored in the database and available to users via the web application.

c. Tracked deliveries require the sending user to scan the contents with a barcode reader before placing the carrier in the dispatch position. The user may also identify themselves by scanning their employee badge. Once the carrier is placed on the dispatcher, the user selects a destination address from either a shortcut menu, an A to Z menu, or by manually entering a numerical address using a key pad, and then pressing the “send” button. Upon arrival at the destination, the carrier automatically drops into the station’s arrival bin and the delivery data is stored in the database and available to users via the web application.

d. Tracked *Secure* deliveries, a subset of Tracked, are similar to *Tracked* deliveries with the additional security feature of the carrier waiting above the destination station until a user scans their employee badge to link themselves to the arriving carrier – thus creating an end-to-end audit trail. Once the user’s badge scan is verified by the Delivery Manager Software, the carrier drops into the station’s arrival bin.

3. The User Control’s main menu shall provide the capability to display one, two or three types of deliveries (Secure Tracked is a subset of Tracked with the user opting for Secure on a sub menu).

4. The User Control shall provide a Home Page with the following information and functions:

a. Station name and identification number

b. Station Status message including Station Ready, Station Not Ready, Lost Connection to Server and Carrier Pending

c. Incoming carrier count

d. Carrier queue indicator and pending timer

e. A listing of the last two send requests

f. Any combination of Standard, Passcode and Tracked send buttons

g. An Empty Carrier Send button

h. An Empty Carrier Request button

i. An Options button

j. An icon to indicate the arrival of a carrier sent via Tracked Send

k. An icon to indicate a carrier has arrived and a remote indicator is active

5. The User Control shall provide three methods for selecting the destination of a carrier --12 shortcut keys, an A to Z directory of all system stations, and a key pad to enter a station number.

6. The User Control shall support an empty carrier management system where an empty carrier can be redistributed into the system by selecting the Empty Carrier Send button on the home screen or an empty carrier can be retrieved from the system by selecting the Empty Carrier Request button on the home screen.

7. The listing on the Home Page of the last two send requests shall indicate the intended destination and if the request was accepted or denied.

8. After selecting Standard Send from the Home Page, the User Control shall display a screen with up to 12 shortcut keys. The same page shall provide buttons to access a directory listing of all stations in the system and a key pad to enter an address manually.

**9.** After selecting Tracked Send from the Home Page, the User Control shall display a screen that documents the scanning of the carrier’s barcode, barcodes on each item being sent and an employee ID. Once the required scans are complete, the Select Destination button shall become active, allowing the user to proceed to the shortcut screen.

10. The Tracked Send screen shall have a toggle button that enables the Tracked Secure Send feature.

11. The User Control shall support the documentation of arriving carriers by providing a screen that allows a user to scan barcodes on recently arrived carriers along with their contents, and the ID badge of the user accepting the delivery. When recently arrived carriers along with their contents are available to be documented, an icon of a barcode shall appear on the home page.

12. When a station’s carrier bin is full, the station shall sign-off so that no carriers can be dispatched or received. Once the bin is cleared, the station shall automatically sign back on.

2.05 Delivery Manager Software

1. Infrastructure Requirements
2. The Delivery Manager Software shall run on a virtual server (VM), or application server.
3. The Delivery Manager Software shall use SQL Server for data storage.
4. The Delivery Manager Software shall communicate with the database, mechanical equipment and user interface applications over an Ethernet network.
5. The Delivery Manager Software shall communicate with a Microsoft Active DirectoryTM server in real time for user authentication and sign-on.
6. The Delivery Manager Software’s graphical user interface (GUI) shall be a multi-user web application accessible through a web browser.
7. The Delivery Manager Software web application shall support multiple languages that can be switched in real-time.
8. The Delivery Manager software web application shall include three levels of sign-on and access: Administrative User, Maintenance User and Clinical User.
9. The Delivery Manager Software shall integrate with employee access systems Tyco CCureTM and United Technologies Lenel OnGuardTM for user identification and access at the stations.
10. The Delivery Manager Software shall have the ability to integrate with industry standard clinical communication, workflow and nurse call systems like Vocera.
11. The Delivery Manager Software shall support remote access protocols so that technicians located outside the hospital can access the system’s engineering controls.
12. The Delivery Manager Software shall support traditional interzone systems, as well as blower group systems.
13. The Delivery Manager Software shall support empty carrier management, including storing empty carriers within specially designated tubing and automatically managing the acceptance and distribution of empty carriers to and from stations.
14. The Delivery Manager Software shall provide for on/off periods per day per station.
15. The Delivery Manager Software shall allow for the purging of the entire system or specific zones.
16. The Delivery Manager Software shall provide an emergency stop feature.
17. **System Management Properties**
    1. The Delivery Manager Software shall be capable of executing over 100 concurrent transactions, while allowing for system monitoring, fault handling and real-time transaction data retrieval.
    2. The Delivery Manager Software shall control all electro-mechanical equipment and manage system-wide network communications.
    3. The Delivery Manager Software shall accept station generated user commands and execute transactions accordingly.
    4. The Delivery Manager Software shall employ an algorithm that dynamically builds transaction routes based on the resources available at a given point in time, and then selects the most efficient route to complete a given delivery.
    5. The Delivery Manager Software shall set, monitor and dynamically change transaction priorities based on system configuration, settings and real-time use.
    6. The Delivery Manager software web application shall include a minimum of four tabs or views, including Home, Clinical, History and Options.

1. **Clinical User Properties**

**1.** Displays a Clinical tab that communicates information on every transaction in real-time including, time requested, time completed, sending station, destination station and status.

**2.** Provide the ability to filter information by specific station or stations so that a given user only sees deliver information relevant to them.

**3.** Provide the ability to assign colored flags to certain stations so deliveries to and from them are highlighted

**4.** Provide the ability to view historical transaction reports, filtered based on send type and status.

**5.** Provide the ability to create reports of historical data in Microsoft ExcelTM format

1. **Maintenance User Properties**

**1.** All properties available to the Clinical User

**2.** Displays the primary Home screen tab that includes:

a. A system map dashboard configured by zone

b. A graphical system map of the entire system

c. A device draw that provides access to information, settings and controls for all devices

d. A Transaction view that displays each active and pending transaction including detailed information about route and every device involved

e. A Purge view that displays a system purge process

f. A Stat view that displays information on each device, information on RFID carrier locations, carrier count information, and distances between devices

g. A Job view that allows for the creation of rules / jobs and displays their status

h. A Fault view that displays information about system faults

**3.** Displays a History tab that displays detailed information of past system transactions and performance with the ability to export data in Microsoft ExcelTM format

1. **Administrative User Properties**

**1.** All properties available to the Clinical User and the Maintenance User

**2.** Displays an Options tab that provides access to global systems settings, including configuration files, timeout settings, authorizations, rules, station groupings, email notifications, contacts, email settings, Active Directory settings, LDAP settings, CCure and Lenel OnGuard settings, and language settings

1. **Software Components**

1. A primary software framework for routing control

**2.** An API (HTTP Interface) to integrate with Third-Party Software Applications

**3.** A Web Application with an embedded Tomcat Server

**4.** A lightweight LDAP server and the ability to integrate with a hospitals LDAP or Active Directory Server (provided by hospital)

**5.** The ability to link to a SQL Server database (provided by hospital)

**6.** An Apache ActiveMQ message broker

**2.06 Data Network and Servers**

1. The manufacturer shall use the Hospital’s Ethernet network to connect all equipment to the Delivery Management Software. The manufacturer shall specify any requirements regarding IP addresses and protocols.
2. The manufacturer shall use the Hospital’s database and web servers for transaction data storage and retrieval.
3. The database shall be a SQL database capable of real-time documentation of every transaction request, including:
   1. Transaction status data
   2. Transaction time stamp data
   3. Transaction carrier identity
   4. Transaction content identity
   5. Transaction user identity

**2.07 Carriers**

A. The carriers shall have a diameter compatible with the tube size to ensure a proper seal.

B. The carriers shall be constructed of two plastic halves -- with one half clear and the other opaque.

**C.** 6” system carriers shall be leak resistant with a gasket that seals the carrier when in the closed position. 4” carriers, because of their limited capacity, shall be non-leak resistant.

D. The carriers shall be side opening and travel bi-directionally.

E. The carriers shall use nylon monofilament glide bands that include static-reducing copper filament.

F. The glide band, latches and hinges shall be replaceable.

G. The carriers shall include a uniquely numbered integrated 2D barcode and RFID tag.

H. The carriers shall include compatible foam inserts.

1. **Execution**

**3.01 Installation**

A. Unless specifically excluded, the manufacturer shall provide all labor, material, equipment and supplies required to install the system.

B. The manufacturer shall conform to appropriate building codes and standards.

C. The manufacturer shall install all equipment required to create a working system that meets or exceeds this specification.

D. The manufacturer shall install all equipment so that it is accessible for maintenance.

E. The manufacturer’s installers shall be skilled trades people with healthcare pneumatic tube system installation experience.

**3.02 Customer Training and Support**

A. The manufacturer shall have a training facility with a working pneumatic tube system that includes the equipment being installed to teach the hospital’s maintenance staff how to manage and care for the system.

B. The manufacturer shall offer regularly scheduled 2 and 3 day classes at its training facility for hospital maintenance staff that covers software use, equipment maintenance and basic system troubleshooting.

C. The manufacturer shall provide the hospital’s maintenance staff with an overview on how to operate and monitor the system in a teach-the-teacher format before the system is handed over.

D. The manufacturer shall teach representatives from the hospital how to send and receive carriers in a teach-the-teacher format before the system is handed over.

E. The manufacturer shall employ its own customer support personnel and be able to provide onsite service when requested.

F. The manufacturer shall offer, free of charge, a U.S. based 24/7 help desk staffed by factory trained technicians to assist hospital staff with troubleshooting and overall system support.

**3.03 System Handover**

A. The manufacturer, upon completion of the installation, shall test the system in the presence of the hospital owner or owner representative. The test shall confirm that all equipment is functional, and all work has been executed in accordance with this specification.

B. The manufacturer shall repair, replace or rework any part of the system that fails the test.

**3.04 Work Excluded**

A. Ethernet network, including cabling, jacks, switches and routers.

B. An active Ethernet network jack connected to the hospital network installed within four (4) feet of each blower and diverter

C. An active Ethernet network jack connected to the hospital network installed inside each station.

**D.** Servers and databases to support the delivery manager software

E. Construction, finishing and painting of architectural enclosures around stations.

F. Cutting, patching, finishing and painting of walls, floors or ceilings as required during installation.

G. Removal and replacement of ceilings, if and when required.

H. Coring, fire stopping and the furnishing and setting of sleeves through walls and floors.

I. Patching/fireproofing of openings in floors, walls and ceilings where required.

J. Furnishing and installing access panels.

K. Excavation, backfill and finishing of surfaces for underground tube installation.

L. Furnishing and installing electrical power as follows:

1. 208/230/460 volt, 50/60 hertz, 3-phase power source and fused disconnect to support a 10 HP motor within five feet of the blower package.
2. 120 volt, single phase, 50/60 hertz power source at each station, diverter and blower package
3. Emergency power to each system device as required.
4. Temporary power service which may be required during the installation and testing of the system.

M. Conduit for communication cable, if required.

N. Sound proofing, fire protection and asbestos abatement.

O. Receiving of materials prior to the start of installation, and safe dry storage for all equipment and materials before and during installation.

P. Elevator and hoist services.

Q. Removal and relocation of existing equipment that may hinder the installation of the pneumatic tube equipment.

R. Cleaning off of plaster, mortar, glue and other debris on and in pneumatic tube system equipment resulting from activities of other trades.

S. Repair or replacement of damaged pneumatic tube equipment that results from the activities of other trades.

T. Licenses and permits.