

Section 14 92 00

Pneumatic Tube System Specification

For Hospitals

1.00 Scope

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

2.00 Purpose

Hospital pneumatic tube systems transport small materials to and from pharmacies, laboratories, blood banks, surgery centers, emergency departments and nursing stations, as well as other locations throughout a hospital campus.

3.00 System Description

A software controlled multi-point pneumatic tube system designed specifically for use in a hospital that transports carriers containing pharmaceuticals, 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.

4.00 Definition of Terms

- A. **Blower Package** – Electro-mechanical industrial compressor blowers that move carriers through tubing with vacuum and pressure.
- B. **Blower Group** – An interconnected set of 2 to 6 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 between any two station with a direct tubing (non-interzone) connection.
- C. **Carrier** – Reusable plastic containers that hold and protect contents (lab specimens, pharmaceuticals, blood products, etc.) sent through a pneumatic tube system.
- D. **Control Center** – Software that controls all electro-mechanical devices and system-wide communications, accepts user station commands, determines carrier routes, monitors system status and provides a master engineering control graphical interface.

- E. Database** – A repository of information for each system transaction that contains both time-stamp data, station data and item-specific data.
- F. Data Network** – An Ethernet and/or serial communication network used to send and receive data between electro-mechanical devices, the control center and the database.
- G. Interzone Connection** – A section of tubing that connects one zone to another.
- H. Station** – Electro-mechanical device that is used to send and receive carriers. They include a touch control user interface, barcode reader, carrier dispatcher, carrier receive bin and empty carrier storage.
- I. 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.
- J. Transaction** – The act of sending an item or items in a carrier between two stations.
- K. Tubing** – 16 gauge steel tubing with an O.D. of 6” or 4” that form a network of paths in which carriers travel from origin stations to destination stations.
- L. Zone** – A collection of stations with direct tubing connections. Zones are interconnected with interzone connections. A traditional zone includes approximately 10 stations, while a Blower Group Zone can support up to 60 stations.

5.00 General Requirements

5.01 System Design

- A.** The system size shall be X inches (*system size indicates the outside diameter of the tubing and is typically 6 inch or 4 inch*).
- B.** The system shall include control software and database with a graphical user interface to display 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 divided evenly among the blowers.
- E.** The system shall include a sufficient quantity of diverters and tubing to link all stations.
- F.** The system shall be expandable up to 1,024 devices (stations, diverters and blowers) to accommodate future growth of the hospital.
- G.** The manufacturer shall provide four (4) carriers per station of a corresponding size.

5.02 System Engineering

- A.** The manufacturer shall provide all necessary system engineering.
- B.** The manufacturer shall (as required by the general contractor) create 2-D and 3-D CAD drawings of the system that show tube routing, network details and equipment locations, and participate in BIM (building information modeling) coordination.

5.03 System Characteristics

- A.** All equipment provided by the manufacturer shall be listed with UL (Underwriter's Laboratory).
- B.** The equipment shall be of durable steel construction with minimal use of plastics.
- C.** The system shall be designed specifically for hospital use and include the capability to track and document each item delivered.
- D.** Blowers shall be installed in Blower Groups to allow any one blower to handle a transaction from start to finish between any two station with a direct tubing (non-interzone) connection.
- E.** If more than one Blower Group is used they shall be connected with interzone tubes so that carriers can travel from stations attached to one Blower Group to stations attached to the other Blower Groups.
- F.** The system shall have the capability to manage empty carrier storage and distribution automatically.
- G.** The system shall dynamically calculate the most efficient route based on resource availability and transaction volume.
- H.** The system shall deliver carriers and their contents as quickly as possible and never store carriers with contents inside the system's tubing or equipment.
- I.** The equipment and software proposed shall be developed and functional at the time of quotation.

5.04 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 provide and install all required low voltage control wire.
- E.** The manufacturer shall install all equipment so that it is accessible for maintenance.
- F.** The manufacturer's installers shall be skilled trades people with experience with hospital pneumatic tube system installation, and be direct employees of either the manufacturer or the manufacturers authorized distributor.

5.05 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 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.

5.06 Manufacturer Proposals

- A.** The manufacturer's proposal shall clearly identify any requirements outlined in this specification which they cannot comply.

5.07 Submittals

- A.** The manufacturer shall provide training materials to teach hospital staff how to use the system to send and receive materials.
- 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, communication wire and equipment in the form of riser diagrams and floor plans.
- F.** The manufacturer shall provide as-built drawings upon completion of the project.
- G.** The manufacturer shall provide its warranty in written form.
- H.** Each submittal item listed in this section shall be provided electronically in the form of a PDF on a CD or memory stick.

5.08 Warranty

- A.** The manufacturer shall provide the hospital with a limited warranty that covers mechanical equipment for 12 months and computer and electronic equipment for 24 months. During the warranty period, any defective parts 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 signed acceptance of the system or the hospital's first use of the system -- whichever occurs first.

5.09 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.

5.10 Work Excluded

- A.** Ethernet network wiring and jacks, along with necessary switches and routers.
- B.** Construction, finishing and painting of architectural enclosures around stations.
- C.** Cutting, patching, finishing and painting of walls, floors or ceilings as required during installation.
- D.** Removal and replacement of ceilings, if and when required.
- E.** Core boring, fire stopping and the furnishing and setting of sleeves through walls and floors.
- F.** Furnishing and installing access panels.
- G.** Excavation, backfill and finishing of surfaces for underground tube installation.
- H.** 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.** 120 volt, single phase, 50/60 hertz power source at the computer control area. This power source shall be uninterrupted and dedicated.
 - 4.** Emergency power to each system device as required.
 - 5.** Temporary power service which may be required during the installation and testing of the system.
- I.** Conduit for communication cable, if required.
- J.** Sound proofing, fire protection and asbestos abatement.
- K.** Receiving of materials prior to the start of installation, and safe dry storage for all equipment and materials before and during installation.
- L.** Elevator and hoist services

- M.** Removal and relocation of existing equipment that may hinder the installation of the pneumatic tube equipment.
- N.** Cleaning off of plaster, mortar, glue and other debris on and in pneumatic tube system equipment resulting from activities of other trades.
- O.** Repair or replacement of damaged pneumatic tube equipment that results from the activities of other trades.
- P.** A temperature and humidity controlled room or area for the control center computer
- Q.** Licenses and permits

6.00 Technical Requirements

6.01 Tubing

- A.** Tubing shall be electric-welded hot dipped galvanized 16 gauge steel with one end belled and the other chamfered to provide optimum fit and seal.
- B.** Tubing shall include centerline radius 48" bends 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.** Field cut joints and equipment connections shall use solid and split steel sleeves.
- E.** All joints shall be airtight and secured with glue, tape and mechanical fasteners as required.

6.02 Blower Packages

- A.** Blower packages shall be regenerative, factory assembled and tested -- and include air shifter assemblies, vibration isolators, screen boxes and motor starters with thermal overload protection.
- B.** Blower packages shall provide vacuum and pressure sufficient to propel carriers at speeds up to 25 feet per second.
- C.** Printed circuit board controls shall be interchangeable with the controls used in diverters.
- D.** The blower package shall shut down automatically during times of low usage.
- E.** Blower packages shall connect to the first inline diverter by 4" diameter tubing.
- F.** Blower packages shall include electronics to sense the presence of pressure and vacuum.
- G.** Blower packages shall turn off when not in use to conserve energy.
- H.** Blower packages shall communicate with the control center over either a serial or Ethernet network.

6.03 Diverters

- A.** Diverters may be supplied in one configuration or a combination of configurations. Configurations may include 2, 3, 4 and 6 port - with 1 line in on one side and either 2, 3, 4 or 6 lines out on the opposite side.

- B. Printed circuit board controls shall be interchangeable with the controls used in the blower package.
- C. Diverters shall include electronics to sense the passing of carriers through their tubing.
- D. Diverters shall include electronics to sense the alignment of the input line with the various output lines.
- E. Diverters shall include covers that can be removed for maintenance that otherwise guard against inadvertent human access.
- F. Diverters shall communicate with the control center over either a serial or Ethernet network

6.04 Stations

A. Mechanical and General Attributes

1. Stations shall be wall recessed, self-standing, or countertop style. The specific station style provided shall be based on the overall system design as specified by the hospital architect or other designer designated by the hospital owner. When a specific station style is not designated, the tube system provider shall choose a style based on anticipated user and facility needs. When counter mounted, the counter shall be provided by others.
2. The station shall provide carrier dispatch and arrival from its top only.
3. The station shall support the safe dispatch and arrival of carriers and payload weighing up to 8 pounds.
4. The station shall provide an air cushion for arriving carriers.
5. An optional password protected security door shall be available.
6. The station shall be UL Listed.
7. The station shall be installed using industry standard methods for securing the station to the floor or counter.
8. The station, along with its electronics and user controls, may be installed at the same time providing the electronics and user controls are protected during general construction.
9. The station shall be constructed primarily from steel with no plastic components except for the slide plate and seal. All visible surfaces shall be powder coated.
10. 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.
11. The station shall accommodate storage of 4 empty carriers.
12. The station shall be constructed to minimize noise. Specifically, the station shall include a replaceable noise absorbing pad in the bottom of the carrier bin and a replaceable slide plate pad.
13. Wall recessed stations shall include a trim frame to mate the station with the surrounding wall.

14. All mechanical and electronic components shall be accessible and/or removable for repair or replacement
15. The stations shall include a “carrier on dispatch” sensor, and “bin full” sensor and a “carrier on slide plate” sensor.
16. A remote carrier arrival indicator shall be available that produces both a visible light and an audible alarm
17. Carriers shall be dispatched one at a time.
18. An optional integrated 2D barcode scanner shall be available with mounting provided near the dispatch arm.

B. User Control Features

1. The User Controls shall be a 7” or larger color resistive touch screen computer.
2. The User Control shall support Standard, Secure, Barcode Tracked and Barcode Tracked Secure sends.
 - a) *Standard* sends do not require a security code or scanning of barcodes. When standard sends arrive at their destination, they automatically drop into the receiving bin.
 - b) *Secure* sends require a 3-digit code to be entered into the touch control at the destination station before a carrier is released into the receiving bin. The code is randomly generated by the system and displayed on the touch control of the origin station.
 - c) *Tracked* sends use a barcode scanner to track the specific items sent along with their carrier. Users at the origin and destination can also scan barcodes on their ID badges to document the users involved with a given transaction. With Tracked sends, the specific items delivered are documented in a database to create a real-time audit trail.
 - d) *Secure Tracked* sends also use barcodes to track the specific items sent along with their carriers. Secure Tracked sends also require a user at the destination station to scan a barcode on their badge before a carrier is released into the receiving station bin. Once the carrier is released, the user may scan the carrier and its contents to complete the process.
3. The User Control shall provide the capability to display one, two or all three of the primary send types (standard, secure and tracked) in any combination.
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, Secure 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, a complete 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. As a safety feature, when selecting Secure Send from the Home Page, a pop-up window shall appear that asks the user to confirm their selection.
 9. After selecting Standard or Secure 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.
 10. After selecting Tracked Send from the Home Page, the User Control shall display a screen that documents the scanning of the carriers barcode, barcodes on each item being sent and optionally an employee ID. Once the scans are complete, the Select Destination button shall become active, allowing the user to proceed to the shortcut screen.
 11. The Tracked Send screen shall have a toggle button that enables the Secure Tracked Send feature.
 12. 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.
 13. The User Control shall automatically display a pop-up window to alert a user when a carrier arrives that was sent via Secure Send. The pop-up window shall include an "ok" button that when pressed displays a keypad to allow a user to enter the 3 digit secure code.
 14. The station shall integrate with nurse call systems so that an arriving carrier triggers an event that can be interpreted by industry standard nurse call systems.

15. 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.

6.05 Control Center and Database

- A. The control center software shall run on a Windows 7 personal computer
- B. The manufacturer shall provide a computer capable of running the required software, as well as a word processor application, a spreadsheet application and a web browser application.
- C. The manufacturer shall provide an uninterruptible power supply (UPS) suitable to power the computer for one hour.
- D. The control center software shall be capable of executing multiple concurrent transactions, while allowing for system monitoring, error handling and real-time transaction data retrieval.
- E. The control center shall control all electro-mechanical equipment and manage system-wide network communications.
- F. The control center shall accept station generated user commands and execute transactions accordingly.
- G. The control center software shall employ an algorithm that dynamically builds transaction routes based on the resources available at that point in time, and then selects the most efficient route to complete a given delivery.
- H. The control center software shall set, monitor and dynamically change transaction priorities based on system configuration, settings and real-time use.
- I. The control center shall include a graphical user interface that allows for transaction monitoring, settings and option configuration, error handling, transaction data retrieval and manual operation of all equipment.
- J. 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
- K. The control center shall include a standalone web application with a graphical user interface to enable the monitoring of transactions and the review and analysis of historical transaction data.
- L. Once the system and the control center are handed over to the Hospital, the personal computer or server and database become the responsibility of the hospital for all operating system updates and virus/spam/malware protection.
- M. The control center shall support both serial and Ethernet communications to the stations, diverters and blowers.

- N.** The transaction data generated by the control center shall reside in the database and be fully accessible to the hospital.
- O.** The control center shall support remote access protocols to so that technicians located outside the hospital can access the system's engineering controls.
- P.** The control center shall support traditional interzone systems, as well as blower group systems.
- Q.** The control center 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.
- R.** The control center shall have the ability to produce and send to all station displays user developed discrete messages.
- S.** The control center shall provide for on/off periods per day per station.
- T.** The control center shall provide multiple priority send schemes per station.
- U.** The control center shall provide password protection for all levels of system control.
- V.** The control center shall provide a menu command to purge either the entire system or an individual zone
- W.** The control center shall provide an emergency stop feature.
- X.** The control center shall provide the following display windows for operator interaction:
 - 1.** System Navigator – Displays the system as a directory tree. System commands and parameters are accessed through this window.
 - 2.** Traffic – Allows for the viewing of all active transactions.
 - 3.** Current Alarms – Allows maintenance operators to view problems within the system and provides details on the active alarms. Diagnostic screens allow for corrective action.
 - 4.** Advisor History – Displays a list of advisories.
 - 5.** Alarm History – Displays a list of alarms.
 - 6.** Carrier Counts – Displays the number of carriers at each station, the number of incoming carriers, and the date the count was last updated.
 - 7.** Journal – Allows maintenance operators to create messages in the system's notepad.
 - 8.** Maintenance History – Displays cycles of each system device since its last preventive maintenance.
 - 9.** Purge History – Displays results of purges of the entire system or by zone.
 - 10.** Station Summary – Displays all information pertaining to stations including address, priorities, type, zone, COM line and name.
 - 11.** User History – Lists who logged in or out of the system.
 - 12.** Transaction History – Displays transaction numbers, sending and receiving station involved and time for each transaction.

6.06 Data Network and Servers

- A.** The manufacturer shall provide and install a serial network to connect all diverters and blowers to the control center software.
- B.** The manufacturer shall use the Hospital's Ethernet network to connect each station to the control center software. The manufacturer shall specify any requirements regarding IP addresses and protocols.
- C.** For the serial network, the manufacturer shall provide all necessary cabling, switches and distribution boards – and secure the communication cabling to the tubing.
- D.** The system's control center shall have the capability to connect to a hospital LAN so that the system controls can be accessed from other computers on the same LAN or that have remote access to the LAN.
- E.** The manufacturer shall use the Hospital's database and web servers for transaction data storage and retrieval.

6.07 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 blue, green, black or red.
- C.** The carriers shall be leak resistant with a gasket that seals the carrier when in the closed position.
- D.** The carriers shall be side opening and travel bi-directionally.
- E.** The carriers shall have glide bands to both protect the carrier's cargo and create an air seal within the tubing.
- F.** The glide band, latches and hinges shall be replaceable.
- G.** The carrier latches shall be of durable construction and include a red/green close/open indicator.
- H.** The carriers shall include a uniquely numbered integrated 2D barcode.
- I.** The carriers shall include compatible foam inserts.