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CPWD
GENERAL SPECIFICATIONS
FOR
PNEUMATIC TUBE TRANSPORT SYSTEM 2022



Published under the Authority of
Director General CPWD, Nirman Bhawan, New Delhi

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भारत सरकार
Government of India

केन्द्रीय लोक निर्माण विभाग

C P W D

GENERAL SPECIFICATIONS FOR PNEUMATIC TUBE TRANSPORT SYSTEM (PTTS) 2022

महानिदेशालय, के.लो.नि.वि., निर्माण भवन, नई दिल्ली 110011

DIRECTORATE GENERAL, CPWD, NIRMAN BHAWAN, NEW DELHI 110011

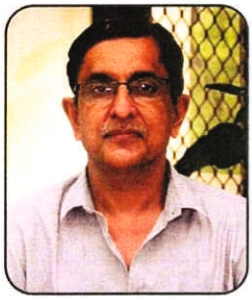
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1. **Whereas every care has been taken to ensure that all relevant and essential provisions required for execution of Construction and Maintenance Works are incorporated in this Specification in a simplified and transparent manner, all executing entities referring to are requested to bring it to the notice of the Directorate, if any conflicting provisions/ discrepancies are noticed in the Specification.**

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Shailendra Sharma
Director General

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CPWD

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FOREWORD

CPWD has been maintaining and executing hospitals all over the country. The new hospital works right from system design to installation, commissioning are executed and also operated and maintained under our supervision. Hospital buildings and projects have become highly important all over the country due to Government's priority and commitment to provide world class health infrastructure to the citizens of India. With advancement of technology and variety of services being involved, most of the hospital buildings or projects are complex in nature, sensitive due to human life being involved and also critical due to requirement of 24x7 operation. In recent past many major hospital projects have been allotted to CPWD all over the country for constructing AIIMS, CAPFIMS hospital project, ESI projects besides others. Hence, the need for bringing out the CPWD Specifications for highly specialized services like Modular OT, MGPS, Nurse Call System and Pneumatic tube Transport system was felt.

The first CPWD General Specifications for Pneumatic Tube Transport System (PTTS) has been framed and published for use by field units and others. Pneumatic Tube Transport System (PTTS)is a critical service of hospital infrastructure which involves complex design of Control PC with peripherals, Compact Automatic Linear Multi-zone Transfer unit, Control software (pre-loaded on Control PC), Side Channel Blowers, Standard or Compact Stations, Horizontal lab receiving Station, Diverter Units, System Tube Network, System Forwarding Bends, System Control Cable, Optical sensor, Power booster pack, Carriers or Capsules, Electrical Installations, Distribution Board ,Online UPS. This service helps hospitals in optimization of hospital logistics, reducing manual works and improving efficiency in transfer of different specimen for test, medicine, etc. This also reduces the threat of infection and chance of human error in handling these critical items.

The works have to be planned and executed in a perfect manner complying to standards with good workmanship to ensure trouble-free and smooth operation of Pneumatic Tube Transport System (PTTS) keeping in mind the important aspect of speed and reliability of these important services in emergency.

These specifications cover General Specifications for Pneumatic Tube Transport System (PTTS) and incorporate the latest developments in this field. References have been taken from the leading international standards and best practices being followed globally.

It is also to put on record my sincere appreciation of Sh. Dharmesh Chandra Goel, ADG(Tech.), Sh. Surendra Singh, then ADG(W), Sh. Vimal Kumar, CE(E) CSQ and his team for putting in their untiring efforts in preparing the specifications.

Any errors, omissions or suggestions for modification in this specification may be referred to CE(E) CSQ in the office of Chief Engineer, CSQ(E),CPWD, Nirman Bhawan, New Delhi-110011 on email delceecsq.cpwd@gov.in.

New Delhi
June, 2022

(SHAILENDRA SHARMA)
DIRECTOR GENERAL, CPWD



Dharmesh Chandra Goel
Addl. Director General (Tech)

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PREFACE

Various healthcare facilities & infrastructure are being dealt by CPWD for a long time on the basis of norms fixed by different statutory bodies. With changing needs and time, various modifications were proposed and inputs given from time to time by the different organizations with respect to norms & guidelines related to healthcare. Since, there is no Specifications available by BIS on the subject of Pneumatic Tube Transport System (PTTS), which is a critical component in Hospital Project. Therefore a need was felt to compile CPWD specifications for Pneumatic Tube Transport System (PTTS) for the use of architect as well as engineers of CPWD.

CPWD General Specifications for Pneumatic Tube Transport System (PTTS) provides detailing regarding critical components of Pneumatic Tube Transport System (PTTS).

Whole hearted commitment and considerable efforts has gone in to the preparation of this edition of CPWD Specifications for Pneumatic Tube Transport System (PTTS). I convey my deep appreciation and sincere thanks to Shri. Vimal Kumar, CE (E) CSQ, Sh. Saurabh Kumar, SE (E) TLQA, Shri. Rajiv Gupta, EE(E)TLQA, Shri Bhagwan Ram, AE(E) TLQA and staff of CSQ(E) unit whose names are not mentioned here for the sake of brevity for their sincere efforts made in the preparation of this document. Various individuals, firms dealing in similar type of work, field units, have immensely contributed with substantial inputs. CSQ (E) unit is indebted for their support.

I convey my gratitude to field offices at Delhi who rose to the occasion and provided sufficient data base to CSQ (E) office and thus enabled them to come out this publication. The team shall now be working on developing schedule of rates of various items involved for execution of Pneumatic Tube Transport System.

This maiden effort has been to bring out this publication in the due care. However, there is possibility of inadvertent errors made. Error or omission may be brought to the notice of Chief Engineer (E) CSQ, CPWD, Room No. 229-A Wing, Nirman Bhawan, New Delhi-110011 (Tele:- 011-23061418) for strengthening these specifications further in larger public interest and in the interest of service towards healthy Bharat.

Suggestions for improvement are welcome.

Place: New Delhi
Date: June, 2022

(Dharmesh Chandra Goel)
Addl. Director General (Tech.), CPWD

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CHAPTER 1

GENERAL

1.1 SCOPE OF WORK

The scope of this specification cover works of Supplying, Installation, Testing and Commissioning of Pneumatic Tube Transport System (PTTS) for high speed spontaneous automated vertical and horizontal transports of blood samples, tissue samples, pharmaceuticals, x-ray reports etc. including the following on turnkey job basis:

(a) Control PC with peripherals
(b) Compact Automatic Linear Multi-zone Transfer unit
(c) Control software (pre-loaded on Control PC)
(d) Side Channel Blowers
(e) Standard or Compact Stations
(f) Horizontal lab receiving Station
(g) Diverter Units
(h) System Tube Network
(i) System Forwarding Bends
(j) System Control Cable
(k) Optical sensor
(l) Power booster pack
(m) Carriers or Capsules
(n) Electrical Installations
(o) Distribution Board
(p) Online UPS
(q) Make in India Policy

(i) Pneumatic Tube Transport System, software and tube network and conform to different DIN / EN / CE.

(ii) Pneumatic Tube Transport System should be Flexible modular technology for Spontaneous transport with speeds up to 2.0 m/sec-8.0 m/sec.

(iii) Pneumatic Tube Transport System should have capability for Power Line and Power Train for multi-carrier transports and transports over long distances for optimization of transport frequency and efficiency.

(iv) Pneumatic Tube Transport System should have provisions for Automatic return feature of empty carriers to origin once the carrier is loaded on to the station using RFID technology (Optional).

(v) RFID technology for tracking and tracing the transport goods, eliminating the risk of loss with each station having RFID readers and each transport carrier/capsule with RFID transponders.

(vi) The System should be only PC (Computer) Controlled with PC Software driven with WINDOWS 10/ or latest upgraded version, 64-BIT operating system with remote accessibility using T-control and supervision software (Optional).

(vii) The system should have Live and Real Time Supervision with the Entire network view with remote accessibility.

(viii) The system should have Live and Real Time communications channels between all the devices and should be visible on PC monitor in graphs and numerical values.

(ix) All devices should be connected with LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication to all stations and devices in the network and hence are digital in nature and maintaining a real time live connectivity speed of minimum 70 – 120 devices per second which can be constantly monitored Live and Real Time on the PC monitor. The control cable of high-grade composite with grounding, power and data all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2 x 2 x 0.22 x 1.9^2 conforming to CE or EN standards with following specification:

- 4 Core (0.22 SQ MM ABC PE Insulated, polyester taped Cu-Braid & PVC Sheathed)
- 2 core (2.0 SQ MM ABC, PVC Insulated)
- Drain Wire (1.50 SQ MM)
- laid up collectively Aluminium Polyester tapped and overall PVC Sheathed

(x) All Stations and Diverter units should function using only linear gear mechanism with electronic digital communicating and self-sealing optical sensors and sensor based stoppers.

(xi) The system should run on low voltage 36V DC with power boosters to maintain signal & communications with each device in the system, (except blowers which should be 3 phase).

(xii) All devices should have built-in electronic proximity sensors, operable on low voltage frequency.

(xiii) All devices should also have built-in and integrated reset switch and termination point to prevent leakage of current.

(xiv) All devices should have Optical sensors switch which should be modular and provided with built-in various devices. Should be portable in nature and easily replaceable. Should be compatible for connectivity to various devices.

(xv) The system should be provided with integrated power pack at strategic points; made of plastic case as per IP66/67 rating; 200Va. The power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L connection.

1.2 INTEGRATION & CO-ORDINATION WORKS WITH OTHER SERVICES AGENCIES: –

(i) Pneumatic Tube Transport System firm has to share the Pneumatic Tube Transport System layout drawings to other firms providing services in same area, as required for superimposing the related pipes, components, cables etc. with other services to identify clashes and take remedial measures, before the commencement of Pneumatic Tube Transport System work at site, as per finally approved drawings from the department.

(ii) Pneumatic Tube Transport System firm has to provide details regarding required cutouts for Pneumatic Tube Transport System piping, wiring, power socket/Data cables/ Panel/etc. duly marked in drawings, taking in to account the services being provided by other firms and shall take up the work after approval of the drawings by the department.

(iii) Pneumatic Tube Transport System firm has to make provision in ceiling for installation of equipment related to Pneumatic Tube Transport System as per approved drawings.

(iv) In case of existing site, bidders are strongly advised to visit the site for assessment before the submission of tender offer. The layout/drawings of the hospital complex/project as attached with the NIT, if any, to be referred to.

(v) PTTS firm has to integrate their services with other services being executed in the building or existing already.

(vi) Planning and integration of multiple services along with Pneumatic Tube Transport System in the hospital complex is to be carried out in BIM software at the initial stage so that clashes of services can be identified and suitable decision can be taken at the planning stage.

1.3 SCOPE OF THE BIDDER

(i) Supplying, Installation, Testing and Commissioning (as applicable) of Pneumatic Tube Transport System, piping, conduiting and cabling, Online UPS, Earthing, control cabling and associated sensors, Site modifications, Comprehensive maintenance of Pneumatic Tube Transport System installations, Integration with other services of Hospital infrastructure (If any) and all items indicated in the NIT etc. as per technical specification.

(ii) All cable, piping, conduit, trenches etc. wherever required.

(iii) All electrical accessories used in installation of Pneumatic Tube Transport System like cable wire, electrical outlets, switches, Control panels, etc. should be fire proof, of reputed make, certified for electrical safety. All wire used in electrical wiring related to Pneumatic Tube Transport System shall be Halogen free flame retardant conforming to IS: 17048 as amended up to date.

(iv) Testing, Installation and commissioning of all equipment/services.

(v) Any other necessary work required for satisfactory working/performance of the Pneumatic Tube Transport System and not mentioned/specified otherwise.

1.4 ELIGIBILITY CRITERIA FOR PNEUMATIC TUBE TRANSPORT SYSTEM CONTRACTOR: -

Pneumatic Tube Transport System work is a specialized work as per CPWD Works Manual and the contractor shall have to fulfil the eligibility criteria or in case of composite contract engage a specialized Pneumatic Tube Transport System agency for complete design, construction, testing, commissioning and comprehensive maintenance of Pneumatic Tube Transport System.

Tender for the Pneumatic Tube Transport System work shall be called from following, satisfying the eligibility criteria for the work.

(a) Manufacturers / OEMs / Authorized Dealers
(b) Specialized Firms
(c) Approved and eligible CPWD composite category contractors.

The eligibility criteria shall be as per following:

The Pneumatic Tube Transport System firm should have successfully completed following Pneumatic Tube Transport System works during the last seven years ending last date of the month previous to the one in which tenders are invited:

Three similar works, each costing not less than 40% of the estimated cost put to tender,

or

Two similar works, each costing not less than 60% of the estimated cost put to tender,

or

One similar work costing not less than 80% of the estimated cost put to tender.

Here similar work shall mean supply, installation, testing and commissioning of Pneumatic Tube Transport System work, which may also include comprehensive maintenance of Pneumatic Tube Transport System installations. Comprehensive maintenance of Pneumatic Tube Transport System installations standalone work are not covered in similar work.

(The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of submission of bid).

1.5 RESPONSIBILITY OF THE CONTRACTOR

(I) The contractor shall be primarily responsible for successful supply, installation, testing, commissioning of complete PTTS, OEM warranty for products, defect liability and comprehensive maintenance of Pneumatic Tube Transport System installations for 10 (ten) years from the date of completion of the work.

(ii) The Pneumatic Tube Transport System firm shall execute complete work including submission of layout drawings, walk-through view and working drawings. If stand-alone Pneumatic Tube Transport System work is to be executed in an existing building, the autocad or PDF or hard copies of building layout drawings will be provided by the hospital for preparation of Pneumatic Tube Transport System drawings.

(iii) The contractor shall provide dedicated UPS power supply and dedicated earthing for Pneumatic Tube Transport System as per scope of work defined in NIT. The earthing shall conform to CPWD Specifications.

(iv) The contractor shall carry out necessary modification in civil and electrical components, demolition and other works as may be required for complete installation and trouble-free functioning of the Pneumatic Tube Transport System.

(v) The Pneumatic Tube Transport System firm shall coordinate with MGPS and other firms for the successful completion of Pneumatic Tube Transport System.

(vi) The Pneumatic Tube Transport System firm shall cooperate for installation and commissioning of other medical equipment in coordination with hospital authorities, respective firms and the department.

(vii) The Pneumatic Tube Transport System firm shall successfully complete installation, testing and commissioning of all Pneumatic Tube Transport System along with all equipment included in the scope of Pneumatic Tube Transport System work as per technical specifications of Pneumatic Tube Transport System.

(viii) The Pneumatic Tube Transport System firm shall provide factory test certificates for the materials used for the construction of Pneumatic Tube Transport System.

(ix) The Pneumatic Tube Transport System firm shall supply complete set of manuals for all the systems and sub-systems.

(x) The Pneumatic Tube Transport System firm shall arrange at his cost on-site training of consignee/user for a week by original equipment manufacturer (OEM), wherever required.

(xi) Final electrical safety test, system test, and calibration shall be done as per required standard by authorized persons using calibrated test equipment, and declaration to this effect shall be submitted by the Pneumatic Tube Transport System firm.

(xii) The Pneumatic Tube Transport System firm shall execute the work of electrical and other works as per CPWD Specifications (wherever applicable). All electrical conduiting shall be heavy duty PVC /MS conduits as per CPWD Specification.

(xiii) All queries/clarifications along with pre-installation requirements shall be submitted before pre-bid meeting.

(xiv) The contractor shall supply only new, unused material/goods and incorporate all recent improvements in design and materials in the work.

(xv) The contractor shall be responsible for defect liability, OEM warranty of products and comprehensive maintenance of Pneumatic Tube Transport System installations for 10 (ten) years from the date of completion of the work through the same Pneumatic Tube Transport System firm. Change of firm for CAMC, if required, shall be with the approval of department/ hospital/institute/ any other authority designated. The Pneumatic Tube Transport System firm shall be approved on the basis of work experience mentioned in eligibility criteria. The comprehensive maintenance of Pneumatic Tube Transport System installations includes complete Pneumatic Tube Transport System installations, labour, spares, all consumables and filters etc. In the case of Pneumatic Tube Transport System equipment, the comprehensive maintenance shall be done with back-to-back support from OEMs. In such cases, authorized agent of OEM shall reach the site within 24 hours of raising a service call. A recovery of ₹2000/- day shall be made if complaint is not attended by the contractor within one day of lodging the complaint.

1.6 RESPONSIBILITY OF CONTRACTOR FOR SITE MODIFICATION (APPLICABLE ONLY FOR STANDALONE PNEUMATIC TUBE TRANSPORT SYSTEM WORK TO BE EXECUTED IN EXISTING BUILDING)

The "Site Modification" work includes all modifications to the built-up space at the hospital site like civil works, electrical works, plumbing works, interior decoration, air conditioning ducting and other related works required for smooth and efficient functioning of the Pneumatic Tube Transport System. These works shall comply with all relevant safety and standards guidelines. The contractor shall be fully responsible for installation and commissioning of all equipment mentioned in the tender. Bidders are strongly advised to visit the site for assessment before the submission of tender offer.

1.7 RESPONSIBILITY OF CONSIGNEE/CPWD (APPLICABLE ONLY FOR STANDALONE PNEUMATIC TUBE TRANSPORT SYSTEM WORK TO BE EXECUTED IN EXISTING BUILDING)

(i) The hospital/institute/CPWD will provide Pneumatic Tube Transport System firm the shell structure/building/constructed areas (complete with brick works, plastering, etc.) wherever the system is to be installed.

(ii) The hospital/institute/CPWD will provide required power supply for the system at single point wherein the blowers are installed. Also, wherever receiving or sending stations are there, power supply as required shall be provided.

(iii) The hospital/institute/CPWD will provide electrical power supply for installation free of cost.

(iv) The hospital/institute/CPWD will provide all feasible facility which is required for installation of Pneumatic Tube Transport System. The Pneumatic Tube Transport System firm will provide suitable facility for further distribution in Pneumatic Tube Transport System.

(v) The Pneumatic Tube Transport System firm shall execute the work in-consultation with the engineers and technicians of the Institute/hospital during installation, testing and commissioning.

1.8 RELATED DOCUMENTS

These General Specifications shall be read in conjunction with the General Conditions of contract. These General Specifications shall also be read in conjunction with the tender specifications, schedule of work, drawings and other documents connected with the work. Each work has its own particular requirements. Therefore, in addition to the General Specifications, governing Health Technical Memorandum 08-03: Bed head services and Pneumatic Tube Transport System, Indian Electricity Rules 1956, Standard Contract Conditions and necessity of additional conditions/ specifications for a particular work shall also apply. In case of any discrepancy such additional conditions/ specifications will override these General Specifications. The tender inviting authority shall adopt either of the two standards (Health Technical Memorandum 08-03: Bed head services and Pneumatic Tube Transport System) in NIT for Pneumatic Tube Transport System in consultation with hospital/medical authority.

1.9 TERMINOLOGY

The definition of terms shall be in accordance with, Health Technical Memorandum 08-03: Bed head services and Pneumatic Tube Transport System, I.E. Rules 1956 which are defined in above mentioned specifications. Some of the commonly used terms are indicated in Chapter 2.

1.10 SUBMISSION OF TENDERS

(A) The tender shall be submitted complete with the following: -

(i) Complete tender documents as purchased from CPWD/ downloaded/ as on website duly filled in and submitted as required. The price part of the tender shall be indicated only on the tender schedule of work as per NIT.

(ii) Earnest Money deposit in one of the specified forms as per laid down rules issued from time to time, as applicable.

(iii) Any other supplementary details required for the evaluation of the tenders such as drawings, technical literature/ catalogues, data etc.

(B) Where two part tendering system is proposed to be adopted in any particular work, the procedure for submission and opening of tenders shall be indicated in tender documents for that work.

1.11 RATES

(a) The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including GST etc. if any), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials (including those, if any, supplied by the department) for the work at site etc.

(b) Prices quoted shall be firm. Price adjustments shall however be governed by Clause 10C/ 10CC of the Conditions of Contract as given in form CPWD 7 or 8 of the tender documents, for works executed under these forms, and as applicable. All relevant documents shall be produced by the contractor to the Engineer-in-charge, whenever called upon by him to do so, for working out such adjustments in rates.

1.12 TAXES AND DUTIES

(i) Being an indivisible works contract, GST, Excise Duty etc. are not payable separately.

(ii) The works contract tax shall be deducted from the bills of the contractor as applicable in the State in which the work is carried out, at the time of payments.

(iii) Octroi shall not be paid separately for the materials supplied by the contractor, but the Department, on demand, can furnish octroi exemption certificate. However, the Department is not liable to reimburse the octroi duty in case the concerned authorities do not honor such exemption certificates.

1.13 MOBILIZATION ADVANCE

No mobilization advance shall be paid for the work, unless otherwise stipulated in tender papers for any individual work.

1.14 COMPLETENESS OF TENDER

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

1.15 WORKS TO BE ARRANGED BY THE DEPARTMENT (IN CASE OF STAND ALONE WORK)

Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department:

(a) Storage space for all equipment, components and materials for the work.

(b) Supply of materials to the contractor as stipulated in the tender documents

(c) Space/structure for erection of Pneumatic Tube Transport System structure and related equipment/services.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT.

1.16 WORKS TO BE DONE BY THE CONTRACTOR

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost: -

(i) Foundations for equipment and components where required, including foundation bolts.

(ii) Making openings for pipes, cable etc. in wall/slab, cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other than pre- painted items. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-charge.

(v) Testing and commissioning of completed installation.

1.17 STORAGE AND CUSTODY OF MATERIALS

Suitable and lockable storage accommodation shall be provided by the Department free of cost to the contractor. However, the watch and ward of the stores and their safe custody shall be his responsibility till the final taking over of the installation by the Department.

Note: Item no. 1.17 shall not be applicable in case of EPC contract. It shall be the responsibility of EPC contractor only.

1.18 POWER SUPPLY, WATER SUPPLY AND DRAINAGE

A. POWER SUPPLY

(i) Unless otherwise specified, 3 phase, 415 Volts, 50 Hz power supply shall be provided by the department free of charge to the contractor at one point for installation at site. Termination switchgear however, shall be provided by the contractor. Further extension if required shall be done by the contractor.

(ii) The power supply for testing and commissioning of the complete installation shall be made available by the Department free of charge to the contractor. For this purpose, the power supply shall be given at the main incomer unit of the main electrical panel (provided by the contractor) through U.G. cable, or bus-trunking arrangement. The termination of this feeder in the main incomer unit shall be the responsibility of the contractor and nothing extra shall be paid on this account.

(iii) Unless otherwise specified in the contract, further power distribution to the various equipment shall be done by the contractor.

(iv) Where the power supply has to be arranged by the Department at more than one point as per the terms of the contract, the termination of all such power feeders in the incomer of respective control panels (provided by the contactor) shall be the responsibility of the contractor.

(v) The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power shall be used only for welding/ cutting works. The power supply shall be disconnected in case of such default and the contractor shall then have to arrange the required power supply at his cost.

(vi) Contractor may have to install their DG Set for construction activity. The department do not guarantee for continuous power supply for the work to be carried out.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT.

B. WATER SUPPLY

Water supply shall be made available to the contractor by the Department free of charge at only one point for installation. Further extension if required shall be done by the contractor.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT.

1.19 TOOLS FOR HANDLING AND ERECTION

All tools and tackles required for handling of equipment and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

1.20 PAYMENT TERMS

Payment shall be made in Indian Rupees as specified in the contract through electronic transfer in NEFT/RTGS subject to recoveries, if any, by way of liquidated damages or any other charges as per terms & conditions of contract in the following manner:

(a) On delivery: 75% payment of the contract price shall be paid on receipt of goods in good condition and upon the submission of the following documents:

Original copies of supplier's invoice showing contract number, goods description, quantity, packing list, unit price and total amount.

(b) On Acceptance: Balance 25% payment would be made against "Installation and Acceptance Certificate" of goods to be issued by the End User subject to recoveries, if any, either on account of non-rectification of defects/deficiencies not attended by the Supplier or otherwise. "Installation and Acceptance Certificate" need to be issued by the concerned

End User after installation, commissioning, testing and successful trial run (if applicable).

(c) Payment of Civil/Electrical Works at site: The payment related to Civil/Electrical Works at site will be made as indicated in the contract.

(d) Payment for Comprehensive Annual Maintenance Contract Charges: The consignee will enter into CAMC with the supplier at the rates as stipulated in the contract. The payment of CAMC will be made on six monthly basis after satisfactory completion of said period, duly certified by the End User on receipt of bank guarantee for an amount equivalent to 2.5% of the cost of the equipment as per contract in the prescribed format valid till 3 months after expiry of entire CAMC period.

1.21 WARRANTY AND CAMC

(i) Comprehensively all the goods supplied under the contract shall be new, unused and incorporate all recent improvements in design and materials unless prescribed otherwise in the contract. The supplier further warrants that the goods supplied under the contract shall have no defect arising from design, materials (except when the design adopted and/or the material used are as per the Purchaser's/Consignee's specifications) or workmanship or from any act or omission of the supplier, that may develop under normal use of the supplied goods under the conditions prevailing in India.

(ii) The warranty shall include all spares, labour and preventive maintenance from the date of completion of the satisfactory installation and acceptance till warranty period.

(iii) The Comprehensive Annual Maintenance Contract shall include all spares, labour and preventive maintenance from the date of completion of the satisfactory installation and acceptance till warranty period and there after till the period of completion of CAMC as stipulated in the NIT.

1.22 SAFETY CODES AND LABOUR REGULATIONS

(a) All the safety procedures outlined in the safety codes applicable for the works shall be complied with.

(b) In respect of all labour employed directly or indirectly on the work for the performance of PTTS contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty as provided in the labour laws/GCC for each violation. In addition the Engineer-in-charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

(c) The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, duct cable etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law

and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage occurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party issuance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

1.23 SUBMISSION OF PROGRAMME, APPROVAL OF DRAWINGS AND COMMENCEMENT OF WORK

A. SUBMISSION OF PROGRAMME

Within 10 days from the date of receipt of the letter of acceptance or as stipulated in NIT, the successful tender shall submit programme for complete work including activities like submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in-Charge etc. This programme shall be framed keeping in view the milestones stipulated in the contract, in which the building progress shall be given priority. In case of EPC contract, in which this is one of the work, the complete programme for the project will include Pneumatic Tube Transport System work also with detailing, matching the over all completion target for the project.

B. SUBMISSION OF DRAWINGS AND COMPLIANCE SHEET

The contractor shall submit the drawings and compliance sheet to the Engineer-in-charge for approval before start of work.

C. COMMENCEMENT OF WORK

The contractor shall commence work as soon as the drawings and compliance sheet submitted by him are approved.

1.24 QUALITY OF MATERIALS AND WORKMANSHIP

(i) The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.

(ii) The entire work including manufacture/fabrication, assembly and installation shall conform to sound engineering practice. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

(iii) All equipment and materials to be used in work shall be manufactured in factories of good reputation having excellent track record of quality manufacturing, performance and proper after sales service.

(iv) None of the equipment/ machines supplied shall be more than six months old from date of supply at site. Copy of GST Gate Pass/ Invoice/ Shipment / Custom Clearance certificate/ details (in case of imported equipment) shall be submitted to prove the date of manufacture & genuineness of the equipment/ machines supplied.

1.25 CARE OF THE BUILDING

Care shall be taken by the contractor during execution of the work to avoid damage to the building. He shall be responsible for repairing all such damages and restoring the same to the original finish at his cost. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

1.26 INSPECTION AND TESTING

(I) Initial inspection of materials & equipment at manufacturers premises as per details given will be done by the engineer-in-charge or his representative. For item/ equipment requiring initial inspection at manufacturer's works, the contractor will intimate the date of testing of equipment as applicable at the manufacturer's works before dispatch. The Contractor shall give sufficient advance notice regarding the dates proposed for such tests to the department's representative(s) to facilitate his presence during testing. The Engineer-in-charge at his discretion may witness such testing. Equipment will be inspected at the manufacturer/ authorised dealer's premises, before dispatch to the site by the contractor. For equipment sourced from abroad, the contractor shall at his own expense arrange for the required pre-dispatched tests at the manufacturer's works and submit to the department the details of the tests carried out and the results there of. Once the go head is given, the material shall be dispatched from manufacturer's works.

(ii) The department also reserves the right to inspect the fabrication job at factory and the successful tender has to make arrangements for the same.

(iii) The materials duly inspected by Engineer-in-Charge or his authorised representative shall be dispatched to site by the contractor.

(iv) No additional payment shall be made to the contractor for initial inspection/ testing at the manufacturer's works by the representative of the Engineer-in-Charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

(v) Final Inspection & Testing

(vi) Final inspection & testing will be done by the Engineer-in-Charge or his authorized representative for the equipment and services provided at site.

(vii) Safety Measures
All equipment shall incorporate suitable safety provisions to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment

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CHAPTER 2

PLANNING & DESIGN OF PNEUMATIC TUBE TRANSPORT SYSTEM

2.1 PLANNING OF PNEUMATIC TUBE TRANSPORT SYSTEM

The Pneumatic Tube Transport System is a fully automatic, monitored, software driven system to transport small materials, to and from Laboratories, Pharmacies, Blood Banks, Surgery Centres, Emergency Departments and Nursing Stations, as well as other designated locations throughout a hospital facility in a single campus. PTTS can move the said material across a number of building blocks and across a number of Floors. PTTS is a specialised complex transport system, which works 24 x 7. It integrates the clinical areas with non-clinical areas and must meet specific standards for prevention of nosocomial infections, privacy of data and safety of both the samples as well as safety of Hospital staff handling these samples.

PTTS consists of a network of Transport Tubes, an Air Blower Unit which provides the needed power in the form of Air Pressure or Suction Power in the form of Vacuum to move the PTTS Transport Carriers. The PTTS diverters are deployed to change the travel path from one tube to another. In larger PTTS installations, a Central Interchange Unit is deployed to change the travel path in multiple tubes simultaneously to accelerate the carriers travel. The material to be moved is placed securely in the Transport Carriers.

Pneumatic Tube Transport System is software controlled, “Point-To-Point” or a “Multi-Point” or a Hybrid (mix of both), automatic, Pneumatic Tube Distribution System designed specifically for use in a hospital, that transports carriers containing Laboratory specimens, Blood products & Pharmaceuticals, as well as other small materials, from any Pneumatic Tube Transport System Station to any other PTTS Station that is part of the same interconnected Pneumatic Tube Transport System.

The prime mover is a blower with a change-over valve called Air Diverter, which can alter the pressure to vacuum, as required, to move the carrier through the system. The destination of the carrier may be controlled by zonal or inter-zonal diverters which switch the carrier from one branch to another. It may deploy RFID based Real Time Locating System (RTLS) to keep track of PTTS carriers.

Each carrier movement is called a Transaction. Each sub-system transaction is linked to all other transactions taking place, to move the carrier from the send station to destination station accurately and in the shortest time. The effective speed of the system can be up to 8 metres per second which contributes to timely Healthcare delivery. The efficiency of the Pneumatic Tube Transport System installation depends on its physical layout as well as on the PTTS software deployed. The Pneumatic Tube Transport System software also monitors System Status and records all transactions, sub-transaction and generates reports.

Pneumatic Tube Transport System performs only 60 to 70% of sample and material movement service in any Hospital and cannot replace the material movement service completely, even for the small item group. Therefore, the PTTS design evaluation must be based on Value analysis. The design should then be approved by a Hospital Team in terms of any deterioration of sample quality and analysis results and establish the Hospital Policy. Additionally, this should also be considered in the Internal Traffic Analysis of the Hospital.

Pneumatic Tube Transport System installation is a complex engineering plant which requires proper study and evaluation of the built areas of the Hospital, therefore, the design of PTTS installation is assigned to the Pneumatic Tube Transport System Vendor. The vendor must endeavour to provide cost effective, reliable, safe and fast material movement system after understanding the clinical requirements. The vendor must evaluate all available technologies in terms of Hospital Supplies and design the Pneumatic Tube Transport System as a state of art system. Pneumatic Tube Transport System installation can be a Point-to-Point PTTS System or a Multipoint, Software controlled PTTS System or a Hybrid PTTS System which has both - the Point-to-Point Pneumatic Tube Transport System and Multipoint, System.

The Point-to-Point Pneumatic Tube Transport System is based on two Pneumatic Tube Transport System Stations connected by a transport tube and controlled by a microcontroller deployed using a control cable and has a dedicated Air Blower Unit with independent Electrical Power. Pneumatic Tube Transport System Carriers can be moved one way (Back to one location only) or two ways (Back and Forth) from both locations. The Point-to-point system has limited transport options.

There are two types of Point-to-Point Systems

Pressure – Pressure System

This System has a blower on each end and requires no control cable between the stations. Power is required on both ends of the system.

Pressure – Vacuum System

This System has a blower on one end and requires a control cable between the stations. Power is only required on one end of the system.

In Hospitals, Point-to-Point PTTS system are deployed where High carrier Traffic is anticipated like Laboratories or Pharmacies. Provision of a Point-to-Point Zone improves PTTS efficiency considerably.

Multipoint PTTS System provides full intercommunication between all PTTS Stations in the system. To manage heavy carrier traffic, the Multipoint PTTS System is split into zones. This allows local transport of PTTS carriers in each zone, as also the transfer to another zone when required. Multipoint systems are controlled centrally by a dedicated microprocessor or Software.

In Multipoint PTTS System, when the system controller receives transfer instructions, it first carries out status monitoring of the system and then queues up carriers as per their assigned priority and then moves the carriers.

A Pneumatic Tube Transport System Installation can handle any number of PTTS stations and any number of PTTS zones depending on its configuration and capacity of its blowers but generally the following parameters can be considered for an efficient PTTS Installation design. It brings out an efficient system layout, design, price, features and Engineering Details.

(Note: The parameters shall vary dependent on the system selection, speed, payload etc.)

Average Number of Zones in a PTTS Installation	10
Maximum Number of Zones in a PTTS Installation	128 (or less)
Number of PTTS Stations in one Multipoint Zone	10 (8-15)
Maximum Queue of Carriers at any PTTS Station	05
Average Distance that PTTS Carriers travel	300 M
Maximum Distance that PTTS Carriers should travel	500 M
Average Delivery Time for a PTTS Carrier	3–5 minutes
Maximum Delivery Time for a PTTS Carrier	10 minutes
Maximum waiting time for loading a PTTS Carrier	3 minutes
Speed of Transport of a PTTS Carrier with Lab payload	3 M/S
Speed of Transport of a Carrier with non-lab payload	5 M/S
Speed of Transport of an Empty PTTS Carrier	6 M/S
Average No. of Transactions in a PTTS Station	30 per Hour
Maximum No. of Transactions in a PTTS Station	55 per Hour

(M= Meters, M/S = Meters per Second)

PTTS efficiency coupled to Hospital's Laboratory Automation and electronic reporting system, has eliminated the Lag Time from the Laboratory Process and improved the outcome of the Healthcare Delivery Process.

2.2 DESIGN OF PNEUMATIC TUBE TRANSPORT SYSTEM INSTALLATION

The Pneumatic Tube Transport System installation will be a software controlled, unified, with specific pipe size based (as selected/designed) PTTS Transport Tube Network Installation, with integrated control wire, connecting all PTTS Stations as a single installation.

The underground section, where required, of this PTTS Transport Protected Tube will be laid in 1000 mm deep and 900 mm wide accessible Trench(s) in ground which will connect two or more building blocks.

Provide the Seismic data for the site. This shall be used to design all pipe entries to the buildings and building floors.
The following is to be confirmed with Hospital:-

- What the PTTS is going to transport.
- Hospital Policy and working practices, to convert sample volumes to carrier volumes
- What will be the likely PTTS carrier traffic
- What will be the PTTS Network structure to handle the predicted traffic
- Volume Estimates of carrier traffic in each zone
- Define peak traffic periods

Define Number of carriers available with each PTTS Station (Usually it start with 4 carriers per PTTS Station which can go up to 6, then it can be adjusted, or a zone added, or dedicated return tube added, or a robotic carrier server can be added, based on the sending volumes of each station).

The overall efficiency of the PTTS network is determined by the performance of the Hardware which make up the network and the controlling software which sits on top of the Hardware.

At the Building Design stage, the primary design element of the Hospital PTTS installation will be the PTTS Stations.

The PTTS Transport Tube network will be categorised as Point to Point, and Multipoint systems and Hybrid Systems (where both Point-to-Point and Multipoint systems are provided). Generally, all Hospitals with 50 Beds or more, may requires a Hybrid PTTS System.

The hospital authorities should specify the number and type and desired locations of the PTTS Stations. If slide and bend attachments are required, these shall also be specified. This information should be compiled properly, preferably in excel sheet working out complete inventory of items required.

Typically, all Nursing Stations, Laboratory Coding Area, Blood Bank, Pharmacy should be provided with PTTS Stations.

Preferably, the receive operation will be specified as soft landing using an air cushion, cushioned basket or using a slide and bend attachment.

PTTS Stations at Nursing Stations shall be placed in direct sight of and not further than 6 meter from the attendant responsible for that station.

The Daily PTTS Traffic Volume is unique to each Hospital. It has to be determined based on Historical Data Analysis of the Hospital or a number of similar Hospitals. Based on this Estimated Transactional Volumes of the PTTS requirements, a system matrix should be generated which quantifies the total number of PTTS transactions that will be realized between any two stations during a 24-hour period and the total PTTS transactions volume.

Once we know the number of PTTS Stations, and the daily PTTS transactions volume, they are categorised into a number of PTTS Zones.

A PTTS ZONE is defined as several PTTS stations connected with tubing and diverters and containing one APU. A single zone can have 8 – 11 PTTS Stations. It has one Free Run End Station to purge the Zone.

Zone utilization is defined as the percentage of time a zone is being used during a given time frame. For example: If a zone is used 36 minutes during a given hour, its zone utilization is 60% (36÷60).

Zone Utilization should not exceed 55% during the peak hour with the total average utilization over 3 consecutive hours with the peak hour being the middle not exceeding 50%.

For design purposes, we limit the zone utilization of any zone to about 55% during its peak hour.

Unless direct evidence shows otherwise, assume the peak hour is quantified as 7% of the total daily transactions (i.e., a 24-hour period).

PTTS Transactions are called inter zone, if the source and destination stations are in different zones and intra-zone, if in the same zone.

The PTTS Transport Tubing Network should be designed based on equilibrium queue i.e., one where the capacity to deliver is always greater than demand when measured over a reasonable time period. This enables to predict for different capacity loadings and the probability of different queue lengths forming. This also assists in creating enough capacity to deliver efficiently.

Where PTTS stations are required to handle heavy traffic volumes, provide simplex (One Tube) or duplex (Two Tube) or triplex (Three Tube) Point-to-Point systems to handle the required system traffic.

Upon finalization of this transport matrix, create the PTTS network layout, layout the system zoning and tube pathways, the central interchange location, central control station location and other accessories.

All PTTS Stations should, preferably, be stacked, one on another on different floors, so that Pass through PTTS Stations can be used to minimise the number of Zones. This also helps to reduce the number of bends in the PTTS installation.

Each PTTS Station will be provided with 04 PTTS Carrier and a storage rack for 06 PTTS Carrier or as decided by hospital authority.

Preferably, design, all PTTS Stations for top/front load only. Provide a Soft Air Cushioned Landing at each PTTS receiving Station into the receiving baskets. Determine the requirement of Exhaust Airline and Air Disposal point for PTTS stations.

The PTTS Station will be provided with a carrier arrival basket or cabinet of sufficient size and capacity to accommodate the number of carriers allotted to the PTTS Station, above or below the PTTS Station.

The PTTS Station will be provided with a programmable carrier arrival alarm and audio-visual indicators integrated with a LCD or a LED display panel and a touch screen keypad.

The PTTS installer can change the configuration as provided in the Design matrix. The system shall deploy judicious number of PTTS Stations. Any deviation from Design matrix must be pre-approved by the Project Engineer or the Hospital Consultant.

Then, the PTTS Plant room with minimum 45 SQM floor area will be identified. The room must be a clean, ventilated, dust-free room, isolated from areas in which patients may be sleeping. It must have direct access to Clean Air, as specified, later. It will not be in a parking area as it will increase the nosocomial infection rate of the Hospital.

The PTTS Plant Room provides accommodation for;

- The Air Blower Unit (ABU) sets for the PTTS installation
- The Central Interchange Unit
- The Free Run End Station for System Purge of the PTTS Installation, when required
- The PTTS installation Central Control Station
- UPS Power Supply
- The PTTS Technician Duty Station
- Store for extra carriers, spare parts and Tools
- When required, the Air Purifier unit will also be located here

The PTTS Plant Room will be provided with 3 Phase, Electrical Supply from essential feeder of the Hospital, terminated in a 4 Pole Isolator or MCCB unit. All further work of electrical distribution, provision of distribution Boards, etc. will be in the scope of the PTTS installer.

The PTTS installer will then design the PTTS Transport Tube network for moving the PTTS Carriers to and from the PTTS Stations. This PTTS Transport Tube network layout will be put on the Hospital's Building Plans and all conflicts with other services, other service paths, etc., and this layout must meet the workers safety standards, PTTS Transport standards, etc.

Tubing pathways and diverters shall not be located over acoustically sensitive spaces, in the Hospital. Take special care in all wards and patient rooms, Treatment rooms, etc.

The maximum noise limit emanating from the tubing during carrier transmission for all areas including corridors shall be no greater than 55 dBA when measured from 165 cm (5'6") above the finished floor.

Preformed Large radii Transmission Tubing Bends, (of ± 1200 mm radius to centre line) shall be used.

Transmission Tubing pathways shall be supported on centres,
At every 3 Meter run of the straight tube
At each tangent of a 90° bend
At each end of an offset of 600 mm or more

Brace Transmission Tubing pathways on centres, as under;

- Longitudinally and Transversely, at ± 12 Meter run of the straight tube
- Diagonally, at each tangent of a 90° bend
- Diagonally, at each partial bend or offset of 45° or more

The PTTS Transport Tube network will be categorised as Point to Point, and Multipoint systems and Hybrid Systems and these will be grouped as PTTS Zones. PTTS tubing routes should avoid the use of the Building Shafts. This is to prevent damage to the PTTS Transport Tubing from rodents.

PTTS Diverters shall be installed in easily accessible areas. These shall not be installed above or near patient beds, patient care work areas, examination rooms, etc.

PTTS Diverter designation label shall be provided on access panel and clearly visible when accessed.

The maximum noise limit emanating from the PTTS diverter for all areas including corridors shall be no greater than 55 dBA when measured from 165 cm above the finished floor.

The maintenance access to PTTS diverters shall have a minimum clear width of 600 mm everywhere in the Hospital, except in the PTTS Plant room, where PTTS diverters shall have a minimum clear width of 750 mm for maintenance access.

Access to the PTTS diverters shall always be from the side, not from above or below the unit.

If there are 4 or more PTTS Zones, an automatic Central Interchange Unit of suitable size, will be deployed. When the PTTS Zones are 3 or less, design a Diverter based Zone Interchange Unit. These unit will be placed in the PTTS Plant room.

Determine if a Central Carrier Storage Unit needs to be deployed in the specific PTTS installation. If required, this unit will be placed in the PTTS Plant room.

Add one Free Run End Station for System Purge of the PTTS Installation. This shall also be placed in the PTTS Plant room.

Define the number of Air Blower Units that need to be deployed. These shall also be placed in the PTTS Plant room.

Determine the requirement of Underground Protected PTTS Transport Tube network(s).

Work out the type and number of Diverters, Large Radii Bends, Number of PTTS Carriers, Carrier Inserts, Carrier racks, Tools, and all other accessories, etc.

Determine Primary Power Supply requirement. Provide this information to the Project Engineer who will then arrange to provide this power at one point in the PTTS Plant room from the Suitable Power Supply Source in the Hospital.

Determine Secondary Power Supply requirements along the PTTS Transport Tube Network installation. Provide this information to the Project Engineer who will then arrange to provide this power at required points.

Determine UPS Power Supply requirements for the PTTS central Control Station. Provide this information to the Project Engineer who will then arrange to provide adequate power at required point for recharging the Unit(s). Supply of the UPS Power Supply will be in the scope of PTTS Installer.

Determine the requirements for the PTTS Control Station integration with Hospital's HIT Systems. Provide this information to the Project Engineer who will then arrange to provide TCP/IP integration switches at the required points.

Prepare the PTTS Installation drawings, get these approved from the Project Engineer, workout all interface requirements, pass through conduits and sign out the co-ordinated Layout Drawings. These drawings should also bring out all requirements for core cutting and wall cut-outs.

2.3 PERFORMANCE REQUIREMENTS

2.3.1 BLOWER CAPACITY

Exhauster/blower capacity should be established by the system designer and should be sufficient for transporting the carriers through the local zone at the agreed velocity and, if required, across to other zones connected in the network.

2.3.2 TUBING

The installation should normally be carried out using 160mm or 110mm diameter hard PVC-U tubing to DIN8061/62 Group B1 specification with all joints solvent welded. If certain sections of the system need to be protected, steel tubing should be used. If the option to specify 160mm tubing is taken, the need and ability to accommodate large radius bends will require careful consideration.

2.3.2.1 A smooth internal bore must be retained throughout the system.

2.3.2.2 Where tubing passes through a wall, floor, ceiling or other barrier, the contractor should ensure that the fire rating of the barrier is not reduced. This can be achieved by installing crushing type intumescent fire sleeves or collars. The system will require to be designed to take account of 'Cause and Effect' issues raised by Fire and Rescue

Services in relation to shut-downs of zones local to the sources of fire alarm activation. Reference should be made to NHS Scotland Fire code Guidance (SHTMs 81-86) for further information.

2.3.2.3 All tubing pipework should be labelled at regular intervals and each side of penetrations through walls, ceilings and floors to indicate its purpose.

2.3.3 CARRIER VELOCITY

The normal system speed is 5 m/s. System velocity should be agreed timeously with the pathology and pharmacy departments. The system should gradually accelerate and then slow down the carrier on arrival at the destination station.

2.3.4 RETURN CARRIER VELOCITY

The majority of systems should operate satisfactorily using a velocity of 5 m/s having a network capacity or design for traffic to run at a safe speed for both send and return carriers. Systems do offer selectable carrier speeds at individual stations should this be seen as essential for special applications.

2.3.5 CARRIER SIZE

The carrier sizes available for a 110mm diameter tube usually having minimum bend radii of 800mm or as follows. The use of 650mm bends for 110mm tubing should be a last resort dictated by severe space limitations.

Carrier description			Transmission		Internal capacity	
Size	Type	Lid style	Nominal tube In mm	C/line bend radius mm	Diameter mm	Length mm
110	Short	Swivel top	110	800	80	228
110	Long	Swivel top	110	800	72	326
160	Short	Swivel top	160	800	116	350
160	Long	Swivel top	160	1200	116	420

Note: Long carriers (420mm long) require bends with centre line radius of 1200 mm.

2.3.6 SYSTEM AUTOMATIC PURGE

The system should be capable of carrying out an initial automatic purge, in an attempt to clear a blockage or sticking carrier, with the sticking carrier being purged to the source station. If the purging operation fails to deliver the carrier to the assigned destination, the carrier may be diverted to a designated station. If the automatic purge is not successful the system will require to be reset manually. In addition to this, a Volt-free contact may be provided to allow connection to the hospital building energy management system (BEMS) to indicate an alarm condition.

2.3.7 FIRE ALARM INTERFACE

The system's central control should be equipped with a fire alarm interface which, in the event of a fire, will suspend its operation and reinstate the operation of carrier movement automatically on clearance of the alarm condition. The choice of the local authority or fire officer may be to use manual intervention.

2.4 VALIDATION AND VERIFICATION

(a) The Physical Plant of PTTS installation will be validated against the approved design of the PTTS plant and its operations will be verified as meeting the employer's objectives.

(b) Detailed validated Tests are provided in SHTM 08-04 which shall be customised and carried out.

(c) The hospital authorities, department and a factory-authorized Service Representative of OEM who has supplied major components of the PTTS installation, will inspect all major areas where the Pneumatic Tube Transport System and all sub-systems are installed, to ensure that these are operationally ready for proof of performance testing. All Validation Tests shall be witnessed by the Project Engineer and the designated Responsible Officer (PTTS installation).

(d) All OEM and other test reports of the Equipment in the PTTS installation shall be verified.

(e) The testing shall be carried out in three stages as under and as listed in detail above.

(i) Testing of the integrity of the PTTS Transport Tubing Installation.

(ii) Testing of the integrity of the PTTS Stations & Air Blower Units for safety, intended performance and physical integration with the Transport Tubing.

(iii) Then the Centralised Controller will be tested.

(f) The results of all tests must form part of the permanent records of the Hospital and should show details of the services and areas tested.

(g) A system inventory including available spare parts will be taken over at this time.

(h) Each item of installed equipment shall be checked to ensure appropriate Test certification labels are affixed or provided.

(i) All samples, as submitted shall be tested as per various standards and test reports reviewed. Testing will be done in NABL Certified Laboratories, which are recommended or approved by CPWD.

(j) The Project Engineer will certify that all work related to making up the cutting, fitting, repainting, patching and finishing of all associated and accessory works has been carried out.

(k) All PTTS Carriers (and Carrier Inserts) will be validated for being leak proof.

(l) Any failure of Installation Requirements shall be noted, and further testing aborted, till it is rectified.

(m) The System Diagrams, Record Drawings, Equipment Manuals, Operational Manual, Maintenance Manual, intermediate, and pre-test results shall be formally inventoried and reviewed.

(n) All PTTS carriers used in preliminary testing shall be inspected for nicks, cuts, and other marks which indicate a faulty installation.

(o) Always, the designated Responsible Officer of the Hospital (PTTS installation) is responsible for the day-to-day management of the PTTS, after commissioning of this PTTS Installation. All works including maintenance works and repair works, modification works, addition or deletion of terminal units, etc. must be authorised before these works are carried out. This shall be included in the O&M contract agreement.

(p) The PTTS Technician/operators, whether in house or third party, will always work under the designated Responsible Officer (PTTS installation).

(q) For Verification, carry out the following: -

(i) Verify that the plant is physically complete, and all pipework has been identified as specified, and the installations is in accordance with the design specification and drawings.

(ii) Manual Operation of equipment, static measurements and functional tests of individual components. This should be carried out prior to setting the system to work and undertaking the dynamic commissioning process.

(iii) Certify that all components function correctly.
(iv) Certify that the interlocks are operative and in accordance with specification.
(v) Certify that the electric circuits are completed, tested and energised.
(vi) Check the CVT, UPS for supply current fluctuation and low voltage conditions.
(vii) Certify that electric motors have been checked for correct direction of rotation.
(viii) Certify that access to all parts of the system is safe and satisfactory.

(r) Quality Evaluation of PTTS Plant is facilitated by availability and understanding of critical performance indices. These indices include the following;

(i) **Delivery Time:** The time from the instant that the user presses the send button until the carrier arrives at the destination station.

(ii) **Send Wait Time:** The time from the instant that the user presses the send button until the carrier leaves the send station. This time is the wait to capture the blower, and if needed, an inter zone storage pipe.

(iii) **Buffer Wait Time:** The time the carrier spends in an inter zone storage pipe waiting to capture the blower in the destination zone.

(iv) **Blower Utilization Time:** Fraction of time blower spent actively moving carriers.

(v) **Transaction Volume:** Number of carriers delivered from a source station to a destination station, compiled per installed station.

(vi) **Move Volume:** Number of total moves made by carriers from station to station (intra-zone transactions), source station to storage pipe (first part of Central Interchange Unit), and storage pipe to destination station (second part of Central Interchange Unit).

(s) These performance indices are compared against performance indices set compiled over a number of similar installations to establish Performance Quality of the PTTS installation. For this comparison, compile the performance tables separately for performance at the PTTS Station Level, at the Zone level and at the System Level (For Inter zone evaluation)

(i) Station Level evaluation determines effectiveness of the PTTS layout.

(ii) Zonal Level evaluation determines effectiveness of the priority assignment and Carrier turnaround time and its impact on Carrier Inventory. It also helps to evaluate Hospital SOPs for PTTS linked performance which facilitates PTTS Station assignments in Departments.

(iii) System Level evaluation determines PTTS Structure, addition or deletion of Point-to-Point Zones, provision of High Traffic Routes and management of additional Carrier Storage & Distribution Units.

2.5 COMMISSIONING & HANDING OVER

(a) Before commissioning the PTTS, make sure that the area around the Air Blower Unit's air intake, is free of dust, waste, rubbish, builder's debris or any other possible source of contamination.

(b) First act of commissioning will be "System Purge" where the PTTS Tubing network is cleared of any dirt, dust or debris accumulated during construction.

(c) Then all filters shall be inspected and installed for operation in the system.

(d) The Air Blower Unit, their direction of rotation, speed and current drawn should be set in accordance with their manufacturer's instructions.

(e) The Central Control System would be the first part to be commissioned after which each system would be commissioned progressively from the plant room outward.

(f) Operational Tests:

(i) Carry out preliminary testing to determine if the Operational Criteria listed in System Operations are functioning satisfactorily, without limitations.

(ii) Test Dispatch/receive sequencing for every PTTS Station installed

(iii) Test Central Control functions

(iv) Carry out deliberate interruption and synthesizing of malfunctions to test safety features, all alarm conditions, and system monitoring including tracking capabilities.

(v) Each of these shall be repeated at least Seven (7) times or as per Project Engineer's Directives.

(g) Review Sound controls and noise levels, as generated in Equipment Rooms and in sensitive IPD zone of PTTS paths.

(h) Then the Central Control Centre shall be tasked with all possible system routines to verify that it meets all performance requirements. The system routines will be taken from the System Operation Manual. The Central Control Centre Functions which shall specifically be tested are;

(i) All System Control Functions

(ii) All System Monitoring Functions

(iii) All System Transaction Recording Functions. It will include recording of Secure Transactions, and Priority assignments.

(iv) All System Diagnostic and Fault locating Functions.

(v) Empty Carrier redistribution Functions

(vi) Switch off a loop and check if all other loops continue to operate normally. Repeat it for all installed loops.

(vii) Through keyboard input, set or reset electro-mechanical or pneumatic devices which are under Software control and analyse the impact on system operations.

(i) Then the PTTS will be operated and checked to ensure there are no signal distortions in the control circuit and all its devices, for any function.

(j) Test each installed PTTS Station functionality to simultaneously and randomly, dispatch a carrier to every other system station until all dispatches/receives are complete. “Simultaneous” for the purposes of this test is construed to mean an interval not over 5 minutes between the time a carrier leaves the dispatcher, and another carrier is entered into the dispatch sequence. Record the number of transactions to accomplish total test, start/completion time, number of transactions, and summary/number of malfunctions/ alarms.

(k) Once the sub-systems have been tested, PTTS will be tested as a whole by deploying multiple carriers at multiple stations (30% of total) in a randomised order and results recorded with station numbers.

(l) When reliability of the system has been demonstrated for a period of 30 consecutive days of operation, in which the total mechanical/ electrical failures due to equipment malfunction do not exceed one for every thousand transactions and the total downtime due to equipment malfunction does not exceed one hour in every thousand operating hours for the number of stations in the system, or both, further testing for handing over shall be done.

(m) After successful completion of these tests and compilation of all documents, the Pneumatic Tube Transport System shall be handed over.

2.6 DEFINITIONS

Exhauster/blower: the prime air mover providing air flow to transport carriers through the system, normally one exhauster/blower per zone. However, in a large zone additional blowers may be required to ensure the correct level of air flow in long tube runs. The exhauster/blower drive should preferably be driven by a 3-phase electrical supply.

Station: the user interface at which carriers are loaded or received; incorporates a key pad and visual display screen which are used to enter destination addresses and receive messages on the availability of the system/station.

Diverter unit: provides the facility to change direction of the carrier through the network between sending and receiving station under the control of the central control unit. Diverters may be two-way, three-way or six-way depending on the design requirements of the system. Most are now either three- or six-way.

System interchange unit: provides the facility to move carriers between systems. Simple interchange units would consist of Diverters or Linear Transfer units while Linear Couplers would comprise more comprehensive carrier servers.

Point-to-point system: comprises a single continuous pipe network.

Multi-point system: provides communication between all stations on a multi tube network utilising diverters to change the tube and direction of the carrier between stations.

Management: management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable for the safe operation of premises.

System manager: a person intending to fulfil any of the staff functions specified below should be able to prove possession of sufficient skills, knowledge and experience to be able to perform the designated tasks safely.

Maintenance person: a member of the maintenance staff, pneumatic tube equipment manufacturer or maintenance organisation employed by the general manager to carry out maintenance duties on pneumatic tube installations.

Infection control officer: or consultant microbiologist, if not the same person, nominated by the management to advise on monitoring infection control policy and microbiological performance of the systems. Major policy decisions, however, should be made through an infection control committee.

Sample inventory table given below for guidance of NIT authority. This table is to be modified as per site requirement and design of PTT system.

Location wise Quantity of Front Load Stations					
	OPD BLOCK	HOSPITAL BLOCK	DIAGNOSTIC BLOCK	BIO BANK BLOCK	Total
PHASE I					
BASEMENT		1			
GROUND FLOOR	2	2	1		
FIRST FLOOR	1	2	1		
SECOND FLOOR	1	4			
THIRD FLOOR	1	5			
Total – Phase I	5	14	2		21
PHASE II					
BASEMENT				1	
GROUND FLOOR			1		
FIRST FLOOR			1		
SECOND FLOOR			1		
THIRD FLOOR			1		
FOURTH FLOOR	3	5	1		
FIFTH FLOOR		4	1		
SIXTH FLOOR		4			
SEVENTH FLOOR		4			
EIGHTH FLOOR		4			
Total – Phase II	**3**	**21**	**6**	**1**	**31**
TOTAL	**8**	**35**	**8**	**1**	**52**
AUTO UNLOAD STATION			**1**		**1**

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CHAPTER 3

TECHNICAL SPECIFICATION OF PNEUMATIC TUBE TRANSPORT SYSTEM (PTTS)

3.1 SCOPE OF WORK:

The Pneumatic Tube Transport System (PTTS) includes the following turnkey jobs:

a. Control PC with Peripherals

b. Compact Automatic Linear Multi-zone Transfer unit

c. Control software (pre-loaded on Control PC)

d. Side Channel Blowers

e. Standard or Compact Stations

f. Horizontal lab receiving Station

g. Diverter Units

h. System Tube Network

i. System Forwarding Bends

j. System Control Cable

k. Optical sensor

l. Power booster pack

m. Carriers or Capsules

n. Electrical Installations

o. Distribution Board

p. Online UPSs

3.2 CONTROL PC WITH PERIPHERALS

- PC with CPU with INTEL I7 with SMPS Cabinet
- 3.4GHz/8GB RAM
- 500GB HDD
- RS232 Ports
- USB Ports
- PCI Slot for ISDN/Modem Card
- Data Port
- Ethernet 100/1000 Lan Card
- Standard Keyboard
- Standard Optical mouse
- 19”-22” flat LCD/LED Monitor
- Standard Mono laser A4 printer
- Original licensed MS-Office and Windows 10 64-bit OS.

NOTE: LINUX based system with matching hardware details satisfying the performance parameters of the PTTS shall also be acceptable.

3.3 COMPACT AUTOMATIC LINEAR MULTI-ZONE TRANSFER UNIT

This unit is used for connecting and inter changing of all zones and power lines as specified:

(i) Conforming to DIN 6663, EU Directive Electromagnetic tolerance 2004/108/EC, EEC Directive for Low Voltage Device 93/68/EEC, EEC Directive Machine Director 98/37/EEC;

(ii) Should be linear automatic compact transfer unit for space saving and integration of all zones;

(iii) Each zone should be capable of storing multiple carriers in each line with priority by-pass; with power line & power train capabilities for sending multiple carriers in runs.

(iv) The movements of mechanism should be using low-noise gear mechanism.

(v) With capabilities of carrier cradle moving from zone to zone at very high speeds

(vi) Each receiving line of the standard zone should be capable of mandatory multiple carrier stacking for optimized carrier traffic management and enabling the zone blower to be free to take up the next carrier transport.

(vii) The zone transfer unit should have individual 'X' receiving line and individual 'Y' sending line. Same line should not be used for sending or receiving enabling increase of multiple transports.

(viii) The Zone transfer unit's each zone must have individual motorized carrier stopper slide gates and carrier holder / cradle activated or deactivated with linear motor & aligned with proximity sensors to handle multiple carrier storage and management.

3.4 CONTROL SOFTWARE (PRE-LOADED ON CONTROL PC)

3.4.1 The software has basic features that enable to Supervision with Real time monitoring for viewing and maintenance of system as follows:

- Priority settings
- Network viewing
- System access and controls for each device on the network;
- Traffic flow analysis
- Delay analysis
- Logging of each transaction and error; with transaction ID, Carrier ID, send station ID, Receive Station ID, start time and End / Receive time with dates.
- Inventory controls
- Location of carriers,

- Password controls
- Carrier re-distribution
- Pro-remote accessibility
- Automatic Return feature of carriers to origin or to station with highest deficit
- Programmable timetable for recurring functions
- Divert Carrier function in case of absence, job rotation or vacation
- Various Priority Settings for urgent and emergency transports
- Optimisation of pathways with intelligent alternate routing of carriers
- Mechanical and electrical Control of all devices
- System configuration
- Access and timetable features
- User Groups and group conditions and functions
- Carrier Management
- Power Line and Powertrain for multi-carrier transports for optimized frequency and over long distances
- Print module for reports and statistics, analysis reports
- User profiles and rights
- System graphic visualizations
- Reports editing

3.4.2 System Parameter Settings for Management and Maintenance Flexibility: Runtime configuration sets the transport time between the different devices with alarm notification if a runtime is being exceeded. Automatic targeting allocates a specific destination to one carrier or a group of carrier. Variation of the transport speed depending on the carrier content.

3.4.3 Access Features for Security and Safety: Different authorization levels via PIN code, ID card transponder; designated stations in departments where security and safety are of paramount importance.

3.4.4 Timetable Features for Guaranteed Delivery: Priority settings configure the priority of the transport of goods from and/or to designated stations: carriers with priority have right of way in the system and will optionally bypass other carriers at diverters. Absent feature sets station on absence mode either by the administrator for recurrent absence or by user via entry on station keypad for sporadic absence. This feature should not affect the rest of the system. When carriers are addressed to an absent station, the sender is informed by an audible alarm and a text message at the sending station.

3.4.5 Grouping with conditions for carrier distribution with Total Carrier Management for Process Optimization with RFID transponder technology & Dedicated carrier slow speed for transport of sensitive goods; Tracking & Tracing for real-time location of carriers and transaction history; Stock control and empty carrier management, balancing the stock of carriers at the station and in the system in a logical way, sending empty carriers to the

station with the highest deficit; Carrier maintenance schedules facilitate washing and inspection after a predetermined number of transport or specific usage.

3.4.6 Power Line for High-Traffic Frequency to enable automated transports of upto 8 carrier at a given point of time over long distances several floors, between buildings or floors.

3.4.7 User Profiles and Rights: User profiles determine the access level to data and devices in the system. User rights are permissions granted to users according to their user profile. They define what data and devices a user profile can read or modify.

3.4.8 System Visualization for remote Monitoring, Controlling, and Maintenance Remote assistance from anywhere on-site and/or off-site.

3.4.9 Topographic view of the system offers a detailed, accurate diagram in real time, displaying movement of the carriers on the monitor.

3.4.10 Track & Trace tools for information and Analysis: Trans info generates a basic view of every realized transport whereas info Log generates a detailed view. Log Book records chronologically many kinds of information that user might want to record manually.

3.4.11 Reporting and editing with wide range of standard reports with system editor to customise reports and changes the settings if charts and diagrams; providing statistics to analyze system usage and optimization.

3.4.12 The system should show real time communication speeds of minimum 70 dps.

3.4.13 The Software should be operable & system should be accessible via License Dongle Key only to prevent unauthorized access to the control software.

3.5 SIDE CHANNEL BLOWERS

3.5.1 The low maintenance unidirectional side channel blower with automatic device to convert air / suction mode (air switch diverter) complete with silencer, carrier damper and accessories. The blower should confirm to EC machines directives 98/37/EC and low voltage director 73/23/EEC; DIN EN292 for safety of machines; EN60034-1 / DIN VDE 0530 Part 1 for rotating electrical machines; EN 60034-5 / DIN VDE 0530-5 classification of degree of protection DIN EN 60204 for safety of machine electrical equipment of machine Part 1 of Electric Motors and DIN VDE 0110-1 insulation coordination for equipment within low voltage systems. The blower should conform to following specifications (these specification can be modified by the NIT approving authority as per site / energy efficiency requirements):

i. Volumetric flow rate (m^3/min): Upto 11.0 (With variable control as required satisfying the performance parameters of the system.

ii. Total pressure difference (mbar): 300 ± 25

iii. Maximum blower speed (rpm): 3000

iv. Voltage (V): 400

v. Frequency (Hz): 50/60

vi. Current consumption (A): 12.5/ As per OEM

vii. Motor output (Kw): 5.5/ as per OEM.

viii. Weight (kg): 75/ as per OEM

ix. Rating plate should have details of data which should also include the model number as per OEM.

x. The side channel blower should have high degree of safety and should produce powerful suction effect.

xi. The blower should be provided with safeguard with motor circuit-breaker.

xii. The maximum permissible temperature of the conveyed medium should be - 30°C to +40°C.

xiii. Solid particles or contaminants must be withheld using the filters before entering the side channel blower.

xiv. Maximum ambient temperature must not exceed 60°C and minimum should not be below -20°C.

xv. The blower should produce below 85db of noise levels at peak volumetric airflow of $9m^3$/min.

xvi. The open intake and discharge ports should be protected by wire guards in accordance to DIN EN 294 standards.

3.5.2 Should be supplied Complete with silencer, filters, dampers & installation accessories and air switch device.

3.5.3 The blower should be based on unidirectional rotation and equipped with unique electronic air-switch to switch between compressed air and vacuum reducing air and energy losses. The electronic air switch is equipped with state-of-art maintenance free linear gear drive mechanism and electronic modular optical sensor switch for activation and deactivation of the air switch.

3.5.4 The blower should be automatically activated through centralized control system

3.5.5 The turbine is with independent power control module with automatic protection / VFD / inverter which is interfaced with centralized control system. The VFD or variable frequency / inverter device should be installed for green building / environment enabling

low energy consumption / conservation of energy while maintaining optimal speeds and should conform to the following specifications / features:

i. Should conform to EMC director 2003/108/EC for MX2 inverter and use dedicated EMC filter

ii. Carrier frequency of 15kHz with shielded motor cable

iii. 3-phase AC 200/400 V class with appropriate Amps filter

iv. With input cable to comply with EMC directive for harmonic distortion IEC 61000-3-2 and 4

v. Should conform to safety norms of ISO 13849-1 with safe stop according to EN60204-1, stop category 0; PL=d.

3.6 STANDARD OR COMPACT STATIONS

3.6.1 The Station screens have the capability to show all send and receive log of their own stations. Send List with display of Carrier No, Device No, Address, Start Time and End (Delivery) Time and Receiving List with display of Carrier No, Device No, Address, Start Time and End (Delivery) Time.

3.6.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

3.6.3 The equipment Station is constructed using steel & standards minimizing electro-magnetic and electro-static interference.

3.6.4 The device is wall mountable; each device is equipped with state-of-art maintenance free gear drive mechanism & self-adjusting optical seals for moving parts for noise- less operations.

3.6.5 Stations are equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc.

3.6.6 Each station has capability / option for unlimited remote arrival messaging via (optional) Net Client on to user's PC.

3.6.7 Integrated carrier damping arrangement; no air waste while sending or receiving a carrier;

3.6.8 LEDs for notice;

3.6.9 Automatic energy-saving mode;

3.6.10 Juddering circuit; with modular replaceable control cards Configurable; Comfortable read of the digital LCD screen with Graphic Monitor 240 x 64 pixel & 4 lines – 30

3.6.11 The station display LCD screen should display following information with navigating menus:

- Destination Address with Name. The address name should be shown during input of address key using number keys
- Guiding Instructions
- View Log
- View Station List
- Send List
- Receive List
- View Signal
- Directory / Address Book with Station Address No and Name
- Absence /log off device or log on device possibility
- Divert To Address
- Service Mode

3.6.12 Characters each line with Clear text in station display for various messages & servicing and backlit; Possibility to enter pin-codes / access code; Speed-dial button for direct dialing of the receiver.

3.6.13 Telephone type soft membrane key pad/ touch screen panel.

3.6.14 Each device is supplied with receiving basket with upholstery and carrier holding rack.

3.6.15 Each station device is provided with four carriers. These special carriers are with caps for secure use; fully integrated rubber seal; payload up to 3 kg; Impact resistant and crystal-clear polycarbonate middle body;

3.6.16 The device is with integrated radio-frequency identification system.

3.7 HORIZONTAL LAB RECEIVING STATION

3.7.1 The station Device for installation in laboratories with much reduced space capacity and always taking in consideration the ergonomically aspect.

3.7.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

3.7.3 Motorised Receiving area with 1.5mtr length; the device should compact size and connected to dedicated and independent power lines.

3.7.4 The device should be wall / table top mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self-adjusting optical seals for moving parts for noise-less operations.

3.7.5 Stations should be equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc.

3.7.6 Should be connected to the network with control cable of high grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication.

3.8 DIVERTER UNITS

3.8.1 The diverter units are switching device used at branching points in the system to direct the path of the carrier from a single tube at one end to three selectable tubes at the other end. The ends of the diverters should be attached with forwarding tube network using steel clamps that are easily removable during servicing.

3.8.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

3.8.3 Should be fitted with optical sensor to detect passage of the carrier.

3.8.4 Should be fitted with moveable tube that gently guides the carrier through the diverter in pre and auto-selected direction. The tube is positioned precisely at the selected port using proximity sensor built-in.

3.8.5 The diverter should have enclosed rigid metal box frame with removable side covers for services with minimized electrostatic interference and alignment to X-Y-Z ports should be via digital proximity sensors and not mechanical or relay sensors.

3.1.6 The device should be wall/ceiling mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self-adjusting optical seals for moving parts for noise-less operations.

3.8.7 The units should be equipped with state-of-art maintenance free linear gear drive mechanism & self-adjusting proximity digital sensors & noise-less operations.

3.8.8 Should be fitted with wear resistant gear driven s-section for switching lines; and the diverter unit.

3.8.9 The unit should have automatic operations as well as via Centralized control centre for smooth receipt of material.

3.8.10 Should be connected to the network with control cable of high grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication.

3.9 SYSTEM TUBE NETWORK

3.9.1 The network should be of special Imported tubes and U-PVC forwarding bends conforming to DIN6660 for characteristics; Tubes and bends should be smoothly connected with PVC sleeves welded together with special PVC welding glue after cleaning with PVC cleaner. The Tubes and bends should be mounted at site using thread rods & tube clips at every 2 to 3 meter distance.

3.9.2 Should be touch with low elastic distortion, high abrasive resistance,

3.9.3 Should be difficult to inflame in accordance to DIN4102 – should only burn when it is decomposed by very high temperatures constantly of more than 180 degrees Celsius – once removed from source of fire the polyvinylchloride extinguishes again.

3.9.4 The tubes and bends in the network should conform to following specifications:

(a)	Physical tensile strength	: 55 N/mm^3 (minimum)
(b)	E-module	: 3000 N/mm^3
(c)	Resistance to impact	: High resistance at 20^{o}C without breaking
(d)	Thermal Coefficient of Linea Expansion	: 80 x 10-6 K-1
(e)	Heat conductivity	: 0.16 W/meter-kelvin
(f)	Inherent stability up to	: 60^o C
(g)	Electric surface resistance	: -1012
(h)	General average density	: 1.38 g/cm^3
(i)	Absorption of water during 24 hours	: 0.03%
(j)	Combustibility: Self-extinguishing B1	: Difficult to inflame
(k)	Tolerance of Diameter	: +0.35 mm – 0.50 mm

3.10 SYSTEM FORWARDING BENDS

Wall thickness 3.2mm, Radius 800 mm. Special Imported U-PVC forwarding bends conforming to DIN6660 for characteristics, ; with following features - Physical tensile strength: 55 N/mm^3; Emodule:3000 N/mm^3; Resistance to impact: High resistance at 20^o C without breaking Thermal Coefficient of Linear Expansion: 80 x 10-6 K-1; Heat conductivity:0.16 W/meter-kelvin; Inhere stability up to: 60^o C; Electric surface resistance: -1012; General average density:1.38 g/cm^3; Absorption of water during 24 hours:0.03%; Combustibility: Self-extinguishing; Difficult to inflame; Tolerance of Diameter: +0.35 mm– 0.50 mm along with necessary accessories Tube clips, tube clamps, special Glue, Special Cleaner, PVC sleeves.

3.11 SYSTEM CONTROL CABLE

3.11.1 The system should have single control cable of high grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference.

Instrumentation wire type 2 x 2 x 0.22 x 1.9^2, Compatible with system on low voltage supply of 36V for human protection.

3.11.2 All devices should be connected with LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication to all stations and devices in the network and hence are digital in nature and maintaining a real time live connectivity speed of minimum 70 –120 devices per second which can be constantly monitored Live and Real Time on the PC monitor. The control cable of high-grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2x2x0.22 x 1.9^2 conforming to CE or EN standards.

3.12 OPTICAL SENSOR

Switch should be modular and provided with built-in various devices. Should be portable in nature & easily replaceable. Should be com-connectable to various devices through the system. Should have single control cable of high-grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2 x 2 x 0.22 x 1.9^2, Compatible with system on low voltage supply of 36V for human protection.

3.13 POWER BOOSTER PACK

The system should be with integrated power pack at strategic points; made of plastic/ strong metal case as per IP66/67 rating; 200VA. The power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L connection. Each Power pack should be supplied with a separate UPS backup of 500VA (power point of 6A with supply will be provided by the Institute / Customer).

3.14 CARRIERS OR CAPSULES

These special carriers are with caps for secure use; payload up to 3 kg; Impact resistant and crystal clear polycarbonate middle body; With Loading Dimensions of 330mmH x 120mm ID or as per OEM; with Swivel caps for secure use; Metal-free design through rotation welding procedure; There should be 4 carriers supplied per station.

3.15 ELECTRICAL INSTALLATIONS

3.15.1 Power distribution within the Pneumatic Tube Transport System shall be provided from distribution panels placed locally in each station. Sub mains power to these panels shall be provided by the general electrical contractor. From these panels all distribution services within the Pneumatic Tube Transport System shall be executed by the Pneumatic Tube Transport System firm as per CPWD Specifications.

3.15.2 Earthed equipment bonding of all exposed metal work shall be provided.

3.15.3 All Power sockets within the Operating Theatre & ancillary areas shall be matched to the rest of the hospital and provided with anti-microbial coated, flushed to the wall at a height of 1.2m-1.5 m above FFL.

3.15.4 Pneumatic Tube Transport System shall have minimum 02 number 6A/16A hybrid switch sockets. One 32A industrial socket shall also be provided at any two walls as per IEC standard.

3.15.5 Light fittings within the clinical areas shall be recessed LED type with control gear.

3.15.6 Fittings shall conform to IP65 regulations.

3.15.7 All equipment shall be fully and permanently label led to identify and describe the function, operation and voltage of the apparatus concerned. Upon completion of the electrical installation, tests in accordance with relevant sections of the local wiring regulations shall be carried out and the results recorded.

3.15.8 All the electrical fittings shall be flushed in the wall /Ceilings.

3.16 DISTRIBUTION BOARD

3.16.1 All high voltage equipment shall be installed in a separate enclosure. The Pneumatic Tube Transport System firm shall provide two DBs for each Pneumatic Tube Transport System to be installed with suitable wiring (one DB dedicated for UPS power supplies and other for raw power supplies to Pneumatic Tube Transport System equipment)

3.16.2 The Pneumatic Tube Transport System firm shall provide a remote cabinet which shall house the mains failure relays, MCB, MCCB, electrical distribution equipment and circuit protection equipment for all circuits within the operation.

3.16.3 All internal wiring shall terminate in connectors with screw and clamp spring.

3.16.4 Connections of the clip on type mounted on a rail and labelled with indelible proprietary labels shall be provided.

3.16.5 Individual fuses or miniature circuit breakers shall protect all internal circuits.

3.16.6 Complete schematic drawing with description shall be enclosed with the equipment.

3.16.7 DBs shall have minimum two number 32A/16A (as per requirement) extra circuits with MCCB /MCB for future usage like integration equipment etc.

3.17 ONLINE UPS

3.17.1 Backup shall be minimum 30 min.

3.17.2 The room for the central UPS will be provided by the respective institute/hospital preferably at same floor and one point electric supply will be provided to the UPS room by the respective institute /hospital (Applicable only for standalone Pneumatic Tube Transport System work to be executed in existing building).

3.17.3 The Pneumatic Tube Transport System firm shall provide required electrical wiring from UPS to all Pneumatic Tube Transport System IEC/International standard.

3.17.4 Electrical control panel complete with MCCB, switchgears etc. shall be provided for distribution of power.

3.17.5 UPS load per Pneumatic Tube Transport System shall be minimum as per requirement and backup for all system and redundancy (n+1) shall switch automatically. The battery bank may be common for all the UPSs.

3.18 MAKE IN INDIA POLICY

The Pneumatic Tube Transport System work shall fully comply to Public Procurement (preference to make in India) Order (PPP-MII order) 2017 issued by DPIIT and corresponding notifications issued by concerned nodal ministry/department as amended up to the last date of receipt of tenders.

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CHAPTER 4

COMPREHENSIVE MAINTENANCE OF PNEUMATIC TUBE TRANSPORT SYSTEM

4.1 The contractor shall be responsible for comprehensive maintenance of Pneumatic Tube Transport System installations for 5 (five) years after completion of Defect Liability Period/Warranty Period of 5 (five) years from the date of completion of the work through the same Pneumatic Tube Transport System firm. The Pneumatic Tube Transport System firm shall be approved on the basis of work experience as per provisions of eligibility described in the CPWD Works Manual/ Chapter 1 para 4 of this specification. The comprehensive maintenance of Pneumatic Tube Transport System installations includes complete Pneumatic Tube Transport System installations, labour, spares, all consumables and filters etc. as required including the following:

(a) Control PC with peripherals
(b) Compact Automatic Linear Multi-zone Transfer unit
(c) Control software (pre-loaded on Control PC)
(d) Side Channel Blowers
(e) Standard or Compact Stations
(f) Horizontal lab receiving Station
(g) Diverter Units
(h) System Tube Network
(i) System Forwarding Bends
(j) System Control Cable
(k) Optical sensor
(l) Power booster pack
(m) Carriers or Capsules
(n) Electrical Installations
(o) Distribution Board

4.1.1 All Pneumatic Tube Transport System.

4.1.2 Plastic and glass parts against any manufacturing defects.

4.1.3 All kinds of sensors.

4.1.4 All kind of coils, probes and transducers.

4.1.5 Printers and imagers including laser and thermal printers with all parts.

4.1.6 UPS including the replacement of batteries.

4.1.7 Preventive maintenance including testing & calibration as per technical / service / operational manual of the manufacturer.

4.1.8 In the case of Pneumatic Tube Transport System equipment, the comprehensive maintenance shall be done with back-to-back support from OEM. In such cases, authorized agent of OEM should reach the site within 8 hours of raising a service call.

4.1.9 The Pneumatic Tube Transport System firm should ensure uninterrupted service without compromising functioning of Pneumatic Tube Transport System.

4.1.10 The Pneumatic Tube Transport System firm should set-up a maintenance base in the vicinity of the hospital, to provide maintenance service of the entire Pneumatic Tube Transport System installations.

4.1.11 If the performance of any individual equipment or system is not satisfactory, the same shall be replaced free of cost.

4.1.12 If it is found that to meet the performance criteria, any extra equipment is required, the same shall be provided free of cost.

4.1.13 Any lacunae noticed in the functioning of the installation as a result of any design fault the same shall be rectified free of cost.

4.1.14 Proper marking has to be made for all spares for identification like printing of installation and repair dates.

4.1.15 On receipt of any complaint, the Pneumatic Tube Transport System firm should, within 8 hours on a 24(hours) X 7 (days) X 365 (days) basis respond to take action to repair or replace the defective goods or parts thereof free of cost. The Pneumatic Tube Transport System firm shall take over the replaced parts/goods after providing their replacements and no claim, whatsoever shall lie on the hospital/institute for such replaced parts/goods thereafter.

4.1.16 Upon failure of the Pneumatic Tube Transport System firm to respond to take action to repair or replace the defect(s) within 8 hours on a 24(hours) X 7 (days) X 365 (days) basis, the hospital/institute may proceed to take such remedial action(s) as deemed fit by the department/ hospital/ institute, at the risk and cost of the contractor without prejudice to the Right of Government to take other remedial actions under the agreement.

4.1.17 If the Pneumatic Tube Transport System firm fails to attend the complaint within 8 hours, a penalty of Rs.2000/hour will be charged from the firm and recovery made accordingly. The decision of the Engineer-in-Charge shall be final and binding on the firm with respect to the imposition of overall penalty decision taking into view overall circumstances of the case.

4.1.18 The payment of comprehensive maintenance will be made on six monthly basis after satisfactory completion of said period duly certified by end user.

4.1.19 The contractor shall ensure regular updates of newer technology as and when evolved during warranty period for all the equipment.

4.1.20 The contractor shall deposit performance guarantee @ 3% of the value of the comprehensive maintenance contract before commencement of comprehensive maintenance, which shall be held by the hospital/institute/ department till completion of comprehensive maintenance period. Supplementary agreement can be drawn for the purpose of CAMC, after completion of the defect liability.

4.1.21 There shall be no extra cost for software upgradation/ supply and installation of security patches/ lifetime license fee for system. The software upgradation including security patches shall be provided free of cost during the CAMC period. Bidder should submit OEM certificate to the effect that the software as well as security patches etc. shall be made available for enabling free upgradation of the system till the expiry of the defect liability period and CAMC period. The software validity shall be till the end of the CAMC period and will be got done by the OEM/through their authorised channel partners within the tendered cost.

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CHAPTER 5

SAMPLE BOQ OF PNEUMATIC TUBE TRANSPORT SYSTEM (PTTS)

Following is the Sample BOQ for Pneumatic Tube Transport System. However, itemsand quantities of BOQ may be derived as per individual site requirements:

Sl. No.	Description	Unit	Qty	Unit Rate	Amount
1	Supplying Installation Testing and Commissioning of Control PC with CPU with INTEL I7 with SMPS Cabinet, 3.4GHz/8GB RAM, 1 TB HDD, RS232 Ports, USB Ports, PCI Slot for ISDN/Modem Card, Data Port, Ethernet 100/1000 LAN Card, Standard Keyboard, Standard Optical mouse, 19"-22" flat LCD/LED Monitor, Standard Mono laser A4 printer etc. complete as required. *NOTE: LINUX based system with matching hardware details satisfying the performance parameters of the PTTS shall also be acceptable.*	Nos.			
2	Supplying Installation Testing and Commissioning of **Compact Automatic Linear Multi-zone Transfer unit** Conforming to DIN 6663, EU Directive Electromagnetic tolerance 2004/108/EC, EEC Directive for Low Voltage Device 93/68/EEC, EEC Directive Machine Director 98/37/EEC; automatic compact transfer unit for space saving and integration of all zones; using low-noise gear mechanism. With capabilities of carrier cradle moving from zone to zone at very high speeds etc. complete as required.	Nos.			
3	Supplying Installation Testing and Commissioning of **Control software (pre-loaded on Control PC)with** Network viewing; System access and controls for each device on the network; Traffic flow analysis; Delay analysis; Logging of each transaction and error; with transaction ID, Carrier ID send station ID, Receive Station ID, start time and End / Receive time with dates including, Inventory controls; Location of carriers, Password controls, Carrier re-distribution; Pro-remote accessibility; Automatic Return feature of carriers to origin or to station with highest deficit, Programmable timetable for recurring functions etc complete as required.	Nos.			
4	Supplying Installation Testing and Commissioning of **Side Channel Blowers** conforming to EC machines directives 98/37/EC	Nos.			

	and low voltage director 73/23/EEC; DIN EN292 for safety of machines; EN60034-1 / DIN VDE 0530 Part 1 for rotating electrical machines; EN 60034-5 / DIN VDE 0530-5 classification of degree of protection DIN EN 60204 for safety of machine electrical equipment of machine etc. complete as required.				
5	Supplying, installation, testing & commissioning of **Standard or Compact Stations** conforming to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC. Stations are equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc. complete as required.	Nos.			
6	Supplying, installation, testing & commissioning of **Horizontal lab receiving Station** conforming to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC. Motorised Receiving area with 1.5mtr length; the device should compact size and connected to dedicated and independent power lines. Stations should be equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc. as required	Nos			
7	Supplying, installation, testing & commissioning of **Diverter Units** conforming to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC. And fitted with optical sensor to detect passage of the carrier with moveable tube that gently guides the carrier through the diverter in pre and auto-selected direction and Electromagnetic radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication. etc. as required.	Nos.			

8	Supplying, installation, testing & commissioning of **System Tube Network** which should be of special Imported tubes and U-PVC forwarding bends conforming to DIN6660. Tubes and bends should be smoothly connected with PVC sleeves welded together with special PVC welding glue after cleaning with PVC cleaner. The Tubes and bends should be mounted at site using thread rods & tube clips at every 2 to 3 meter distance and should be touch with low elastic distortion, high abrasive resistance difficult to inflame in accordance to DIN4102 – should only burn when it is decomposed by very high temperatures constantly of more than 180 degrees Celsius – once removed from source of fire the polyvinylchloride extinguishes again complete as required.	Mtr.			
9	Supplying, installation, testing & commissioning of **System Forwarding Bends of** Wall thickness 3.2mm, Radius 800mm. Special Imported U-PVC forwarding bends conforming to DIN6660 along with necessary accessories like Tube clips, tube clamps, special Glue, Special Cleaner, Pvc sleeves. etc. as required.	Nos.			
10	Supplying, installation, testing & commissioning of **System Control Cable** of high-grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference complete as required.	mtr.			
11	Supplying, installation, testing & commissioning of **Optical sensor** which should be portable in nature, easily replaceable and connectable to various devices through the system. Should have single control cable of high-grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference. Compatible with system on low voltage supply of 36V for human protection etc. complete as required.	Nos.			
12	Supplying, installation, testing & commissioning of **Power booster pack** at strategic points; made of plastic case as per IP66/67 rating; 200VA. The power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L connection complete as required.	Nos.			

13	Supplying, installation, testing & commissioning of **Carriers or Capsules** for secure use; payload up to 3 kg; Impact resistant and crystal-clear polycarbonate middle body; With Loading Dimensions of 330mmH x 120mm ID /as per OEM; with Swivel caps for secure use; Metal-free design through rotation welding procedure etc. complete as required.	Nos.			
14	Comprehensive maintenance of the complete Pneumatic Tube Transport System installation for 5 years after completion of Defect Liability Period/Warranty Period of five years as per terms and conditions of comprehensive maintenance described in the NIT as per following:				
	1st year	Job			
	2nd year	Job			
	3rd year	Job			
	4th year	Job			
	5th year	Job			

Note : ***NIT issuing authority shall put the suitable clause to safeguard the Govt. interest against front loading of bid by the contractor***

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CHAPTER 6

SAMPLE COMPLIANCE SHEET OF PNEUMATIC TUBE TRANSPORT SYSTEM (PTTS)

NOTE :

- The compliance sheet as given below has to be submitted by the firm at appropriate stage prior to placing of orders for the supply of goods/equipment and execution of work and has to be submitted to the department for approval.
- The firm will submit the compliance sheet in detail for each of the item along with the relevant catalogues and technical literature confirming compliance to NIT.
- The deviations, if any, to be categorically brought out.
- In case of non compliance of specification, the firm will be bound to offer alternate item of required specification.
- Only after approval of the same by the department, the firm will place the order and take execution of work.

S.No.	Item of PTTS	As per NIT	As offered by firm	Deviation if any/Remarks
1	**Control PC with peripherals**	Make /Model/Country of origin		
		PC with CPU with INTEL I7 with SMPS Cabinet		
		3.4GHz/8GB RAM		
		1 TB HDD		
		RS232 Ports		
		USB Ports		
		PCI Slot for ISDN/Modem Card		
		Data Port		
		Ethernet 100/1000 Lan Card		
		Standard Keyboard		
		Standard Optical mouse;		
		19”-22” flat LCD/LED Monitor		
		Standard Mono laser A4 printer		
		Original licensed MS-Office and Windows 10 64-bit OS.		

2	**Compact Automatic Linear Multi-zone Transfer unit**	Make /Model/Country of origin		
		Conforming to DIN 6663		
		EU Directive Electromagnetic tolerance 2004/108/EC		
		Low Voltage Device 93/68/EEC		
		EEC Directive Machine Director 98/37/EEC		
		linear automatic compact transfer unit		
		capable of storing multiple carriers		
3	**Control software (pre-loaded on Control PC)**	Make /Model/Country of origin		
		Traffic flow analysis;		
		Delay analysis;		
		Logging of each transaction and error; with transaction ID, Carrier ID send station ID, Receive Station ID, start time and End / Receive time with dates.		
		Inventory controls;		
		Location of carriers		
		Password controls,		
		Carrier re-distribution;		
		Pro-remote accessibility;		
		Automatic Return feature of carriers to origin or to station with highest deficit		
		Programmable timetable for recurring functions		
4	**Side Channel Blowers**	Make /Model/Country of origin		
		confirm to EC machines directives 98/37/EC		
		low voltage director 73/23/EEC		
		DIN EN292 for safety of machines		
		EN60034-1 / DIN VDE 0530		
		Volumetric flow rate (m^3/min): 11.0		
		Voltage (V): 400		
		Total pressure difference (mbar): 300		
		Maximum blower speed (rpm): 3000+		
		Frequency (Hz): 50/60		

		Current consumption (A): 12.5		
		Motor output (Kw): 5.5		
		Weight (kg): 75		
		maximum permissible temperature of the conveyed medium should be -30°C to + 40°C.		
5	**Standard or Compact Stations**	Make /Model/Country of origin		
		conforming to EU Director for Electromagnetic tolerance 2004/108/EC		
		EEC directive for low voltage devices 93/68/EEC		
		EEC machines directors 98/37/EEC		
		Stations are equipped with RFID readers		
		Digital LCD screen with Graphic Monitor 240 x 64 pixel & 4 lines – 30		
		Display LCD screen should display: • Guiding Instructions • View Log • View Station List • Send List • Receive List • View Signal • Directory / Address Book with Station Address No and Name • Absence /log off device or log on device possibility • Divert To Address • Service Mode		
6	**Horizontal lab receiving Station**	Make /Model/Country of origin		
		Conforming to EU Director for Electromagnetic tolerance 2004/108/EC		
		EEC directive for low voltage devices 93/68/EEC		
		EEC machines directors 98/37/EEC		
		Motorised Receiving area with 1.5mtr length		
7	**Diverter Units**	Make /Model/Country of origin		
		Conforming to EU Director for Electromagnetic tolerance 2004/108/EC		
		EEC directive for low voltage devices 93/68/EEC		

		EEC machines directors 98/37/EEC		
		radio-frequency interference for LVDC 36V using RS232 to RS485		
		Provides composite LV power supply		
8	**System Tube Network**	Make /Model/Country of origin		
		U-PVC forwarding bends conforming to DIN6660		
		Thread rods & tube clips at every 2 to 3 meter distance		
		The tubes and bends in the network should conform to following specification:		
		Physical tensile strength: 55N/mm^3s		
		E module : 300m^3		
		Resistance to impact: High resistance at 20°C without breaking		
		Thermal Coefficient of Linea Expansion: 80 x 10-6 K-1		
		Heat conductivity: 0.16 W/meter-kelvin		
		Inherent stability up to: 60^0C		
		Electric surface resistance: -1012		
		General average density: 1.38 g/cm^3		
		Absorption of water during 24 hours: 0.03%		
		Combustibility: Self-extinguishing B1: Difficult to inflame		
		Tolerance of Diameter: +0.35 mm – 0.50 mm		
9	**System Forwarding Bends**	Make /Model/Country of origin		
		Wall thickness 3.2 mm		
		Radius 800 mm		
		Conforming to DIN6660		
		- Physical tensile strength: 55N/mm^3;		
		Emodule:3000N/mm^3;		
		Resistance to impact: High resistance at 20°C without breaking Thermal		
		Coefficient of Linea Expansion: 80 x 10-6 K-1;		
		Heat conductivity:0.16 W/mk;		
		Inhere stability up to: 60°C;		
		Electric surface resistance: -1012;		
		General average density:1.38 g/cm^3; Absorption of water during 24 hours:0.03%;		
		Combustibility: Self-extinguishing;		

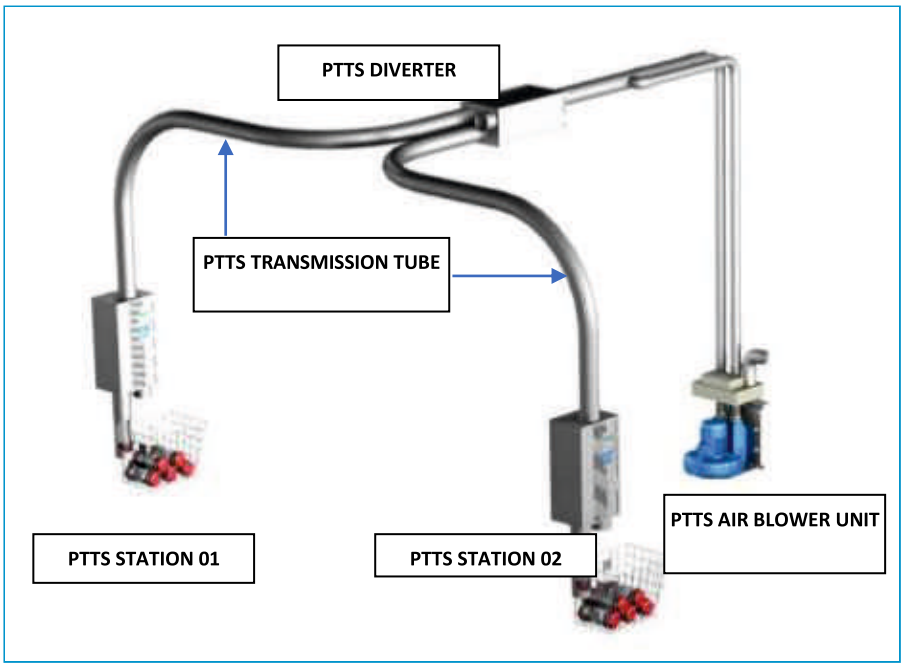
		Difficult to inflame; Tolerance of Diameter: +0.35 mm-0.50 mm		
10	**System Control Cable**	Make /Model/Country of origin		
		Single control cable of high-grade		
		Wire type 2 x 2 x 0.22 x 1.9^2,		
		Low voltage supply of 36V for human protection.		
		Connected with LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity		
		Real time live connectivity speed of minimum 70 –120 devices per second		
		Monitored Live and Real Time on the PC monitor		
11	**Optical sensor**	Make /Model/Country of origin		
		Be portable in nature, easily replaceable		
		Instrumentation wire type 2 x 2 x 0.22 x 1.9^2,		
		Low voltage supply of 36V for human protection		
		Single control cable of high-grade composite with grounding, power and data combined all three in one and should be fully screened and use grounded system concept to minimize electromagnetic and radio-frequency interference.		
12	**Power booster pack**	Make /Model/Country of origin		
		Integrated power pack at strategic points		
		As per IP66/67 rating; 200VA		
		Separate UPS backup of 500VA		
		Power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L connection.		
13	**Carriers or Capsules**	Make /Model/Country of origin		
		Payload up to 3 kg;		
		Loading Dimensions of 330 mm H x 120mm ID		
		Swivel caps for secure use		
		Metal-free design through rotation welding procedure		
		Should be 4 carriers supplied per station.		

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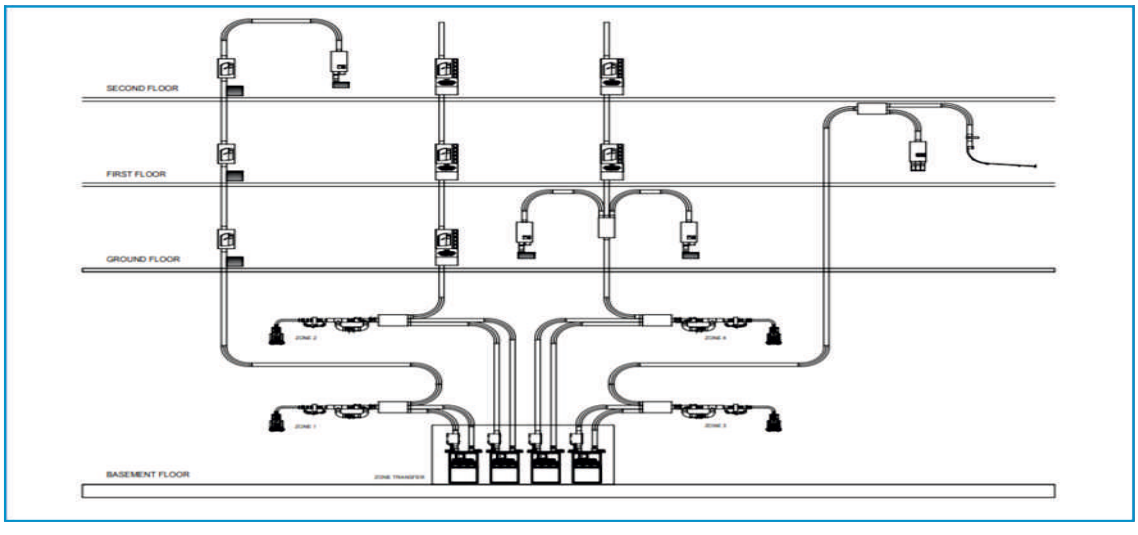
CHAPTER 7

SKETCH OF PNEUMATIC TUBE TRANSPORT SYSTEM (PTTS)

SIMPLIFIED PTTS FLOW DIAGRAM (POINT TO POINT)



SIMPLIFIED PTTS FLOW DIAGRAM (MULTIPOINT)



PTTS CARRIERS







PTTS STATIONS

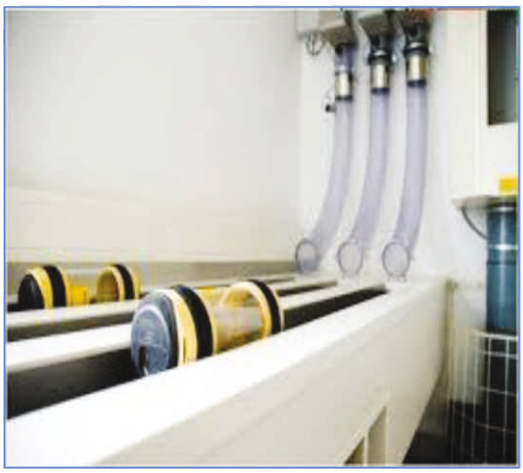






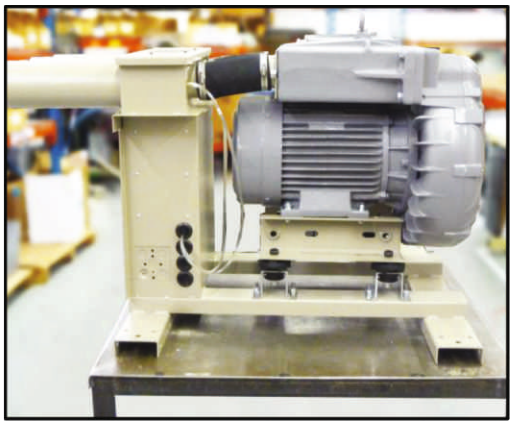
SLIDE BEND ATTACHMENT FOR LABORATORY PTTS STATION





PTTS AIR BLOWER UNIT



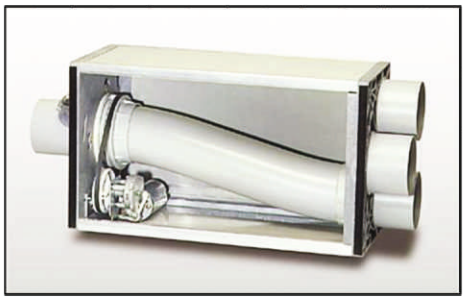


PTTS MULTIPLE BLOWER UNIT SETS INSTALLED TOGATHER

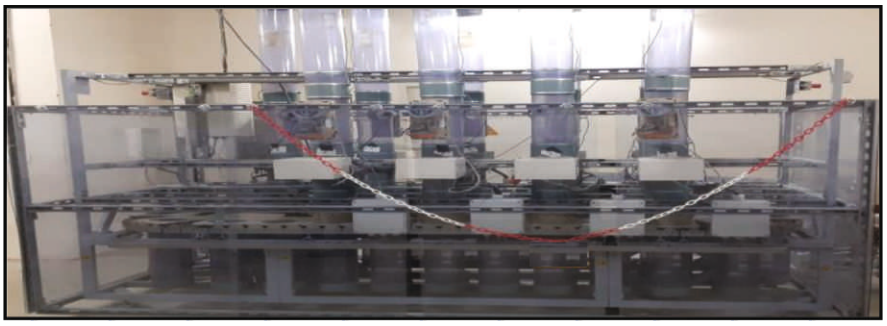


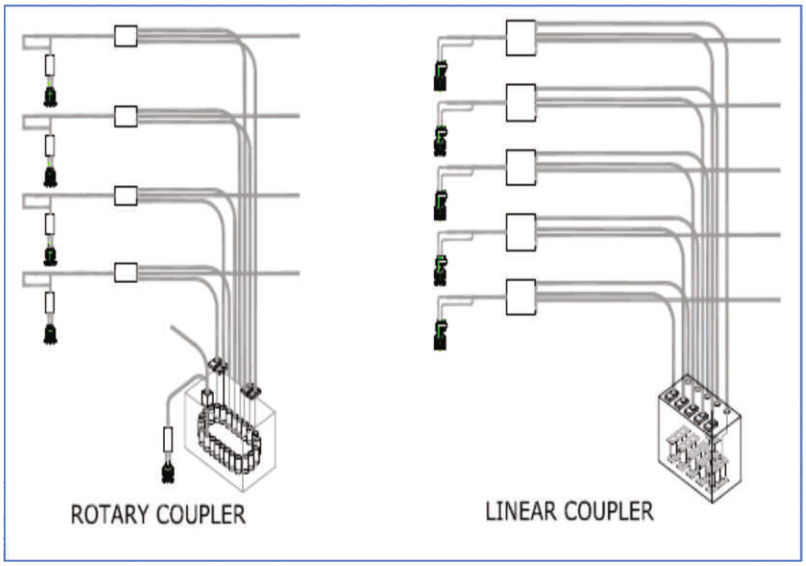
PTTS LINE DIVERTER (1:3 REPRESENTATIVE ONLY)





CENTRAL INTERCHANGE UNIT





CHAPTER 8

CODES & GUIDELINES FOR SERVICES IN HOSPITALS

- ASHRAE 170-2017 covers patient care areas of Healthcare facilities in new buildings, additions to existing buildings, and alterations to existing buildings. It provides a guideline for Healthcare facility safety and dictates the air changes per hour required in Healthcare settings, pressure relationship requirements, exhaust requirements, filtration and air distribution requirements, humidity and temperature requirements, etc.
- ASHRAE 189.3 Construction, and Operation of Sustainable High-Performance Healthcare Facilities
- Bio-Medical Waste Management Rules, 2016,for Treatment and Disposal of Hospital generated waste.
- FGI Guidelines 2018, Guidelines for Design and Construction of Healthcare Facilities, provides minimum design requirements for Hospitals and its environment.
- IS/ISO 7396 for Medical Gases Pipeline Systems
- ISO 13485, Quality Management System, Medical Devices, Key Standard for installation and servicing of medical devices and related engineering services
- ISO 20017, RFID Standard for Healthcare
- NABH,Hospital Accreditation Standards
- NABL,Hospital Laboratories Accreditation Standards
- **NBC 2016** provides Guidance for all services. Its part 4 provides specific Fire & Life Safety guidance and part 9 provides Plumbing & Drainage Guidelines.
- **NEC 2011** provides Guidance for all Electrical Services and Lighting Services.
- **NFPA 92,** A group of Standard on Smoke Control & Management Systems
- **NFPA 99, 2018,** Healthcare Facilities Code provides comprehensive Guidance for mitigating the hazards of fire, explosion, and electricity.
- **NFPA 101,** Life Safety Code provides building requirements necessary to protect Hospital Building Occupants from dangers caused by fire, smoke, and toxic fumes.
- Occupational Safety and Health Administration (OSHA) standards for Use of construction materials in Hospital Engineering Services
- The regulations for Radiation safety of **International Atomic Energy Agency and Atomic Energy Regulatory Body of India.**

- **The Rights of Persons with Disabilities Act, 2016** provides for the design of products, environments and services to be usable by all people including Persons with Disabilities to the greatest extent possible.
- **Whole Building Design Guide, Hospitals, 2017**, design Criteria for Public Hospital buildings in USA
- **ANSI/TIA/EIA-569** Telecommunications Pathways and Spaces
- **MIL-HDBK-419A** Grounding, Bonding, and Shielding for Electronic Equipment and Facilities, Basics, Volume 1 of 2
- MIL-HDBK-419A Grounding, Bonding, and Shielding for Electronic Equipment and Facilities, Application, Volume 2 of 2
- CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) 2017.
- CPWD General Specifications for Electrical Works Part I Internal -2013.
- CPWD General Specifications for Electrical Works Part IV Sub-Station -2013.
- CPWD General Specifications for Electrical Works Part V Wet Riser & Sprinkler System -2013.
- CPWD General Specifications for Electrical Works Part VI Fire Detection and Alarm System -2013.
- CPWD Compendium of Norms for Designing of Hospitals and Medical Institutions
- In addition, now Green Building Council Guidelines and Energy Audits and preliminary Audits of Gas Services are also applied at pre-construction stage.
- Scottish Health Technical Memorandum 08-04: Specialist services Pneumatic tube transport systems Part A: Overview and management responsibilities
- Scottish Health Technical Memorandum 08-04: Specialist services Pneumatic tube transport systems Part B: Design considerations and good practice guide

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CHAPTER 9

LICENSES, PERMITS & STATUTORY OBLIGATIONS FOR HOSPITALS IN INDIA

- Air (Prevention and Control of Pollution) Act, 1981 along with Rules, 1982
- Atomic Energy Regulatory Board
- Bio-Medical Waste Rules, 2016
- Boilers Act 1923
- Building Permit (Completion Certificate)
- Child Labour (Prohibition and Regulation) Act 1986 along with Rules, 1988 and Children (Pledging of Labour) Act 1933.
- Consumer Protection Act, 1986 along with Rules, 1987 amended in 1998
- Delhi Nursing Home Registration Act 1953
- Delhi Private Medical Establishment (Regulations) Act 1956
- Drugs & Cosmetics Act, 1940
- Explosive Act, 1884 along with The Explosive Substance Act 1908 and The Explosives Rules, 1983
- Govt. Order No. 73231/SS B4/92/Home dated 29.09.1993 - Section 304 not applicable in Hospital deaths.
- Indian Lifts and Escalators Act
- National Building Code
- National Electrical Code
- National Commission Acts [Containing 4 Acts -Women Act ,1990 Safai Karamcharies Act, 1993 and Allied Information]
- National Environmental Tribunal Act, 1995
- No Objection Certificate from the Chief Fire Officer
- No Objection Certificate under Bio-medical Waste Rules, 1998
- No Objection Certificate under Pollution Control Act
- Pre-Natal Diagnostic Techniques (Regulation & Prevention of Misuse) Act, 1994 along with Rules, 1996

- Radiation Protection Certificate in respect of All X-Ray Equipment from BARC
- Radiation Protection Rules under BARC Act
- The Blood Bank Permit under Drugs Act
- The Excise Permit to store Spirit
- The Permit to Operate Lifts under the Indian Lifts and Escalators Act

INDIAN/INTERNATIONAL STANDARD FOLLOWED IN WORK OF HOSPITAL SERVICES SYSTEM

Indian Standard	International Standard	
IS/ISO 7396 :Part 1	ISO 7396-1:2016	Medical Gas Pipelines Systems : Part 1 Pipelines Systems for Compressed Medical Gases and Vacuum
IS/ISO 7396 :Part 2	ISO 7396-2:2007	Medical Gas Pipeline Systems : Part 2 Anaesthetic Gas Scavenging Disposal Systems
NIL	ISO 3746:2010	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane
NIL	ISO 5359:2014	Anaesthetic and respiratory equipment — Low-pressure hose assemblies for use with medical gases
NIL	ISO 8573-1:2010	Compressed air — Part 1: Contaminants and purity classes
IS/ISO 9170 :Part 1	ISO 9170-1:2008	Terminal units for medical gas pipeline systems — Part 1: Terminal units for use with compressed medical gases and vacuum
IS/ISO 9170 :Part 2	ISO 9170-2:2008	Terminal Units for Medical Gas Pipeline Systems, Part 2 Terminal Units for Anaesthetic Gas Scavenging Systems
IS/ISO 10524 :Part 1	ISO 10524-1:	Pressure Regulators For Use with Medical Gases Part 1 Pressure Regulators and Pressure Regulators with Flow-Metering Devices
IS/ISO 10524 :Part 2	ISO 10524-2:2005	Pressure regulators for use with medical gases — Part 2: Manifold and line pressure regulators
IS/ISO 10524 :Part 3	ISO 10524-3:	Pressure Regulators for Use with Medical Gases Part 3 Pressure Regulators Integrated with Cylinder Valves
IS/ISO 10524 :Part 4	ISO 10524-4	Pressure Regulators for Use with Medical Gases Part 4 Low-pressure Regulators
NIL	ISO 11197:2004	Medical supply units
NIL	ISO 14644-1:1999	Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness
NIL	ISO 14971:2007	Medical devices — Application of risk management to medical devices
IS/ISO 15001	ISO 15001:2010	Anaesthetic and respiratory equipment — Compatibility with oxygen
IS/ISO 15002	ISO 15002:2018	Flow-Metering Devices for Connection to Terminal Units of Medical Gas Pipeline Systems
NIL	ISO 17672:2010	Brazing — Filler metals
NIL	ISO 18082:2014	Anaesthetic and respiratory equipment — Dimensions of non-interchangeable screw threaded (NIST) low-pressure connectors for medical gases
NIL	ISO 21969:2009	High-pressure flexible connections for use with medical gas systems

NIL	ISO 29463-1:2011	High-efficiency filters and filter media for removing particles in air — Part 1: Classification, performance testing and marking
NIL	ISO 80601-2-69:2014	Medical electrical equipment — Part 2-69: Particular requirements for basic safety and essential performance of oxygen concentrator equipment
IS 11478:2018	IEC 60601-1-8:2006	Medical electrical equipment — Part 1-8: General requirements for basic safety and essential performance — Collateral standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
IS 2825:1969	EN 286-1:1998	Simple unfired pressure vessels designed to contain air or nitrogen — Part 1: Pressure vessels for general purposes
IS/ISO 15223 :Part 1	ISO 15223-1:2016	Medical Devices - Symbols to be used with Medical Device Labels, Labelling and Information to be Supplied Part 1 General Requirements
NIL	EN 1254-1:1998	Copper and copper alloys - Plumbing fittings - Fittings with ends for capillary soldering or capillary brazing to copper tubes
NIL	EN 1254-4:1998	Copper and copper alloys - Plumbing fittings - Fittings combining other end connections with capillary or compression ends
NIL	EN 13348:2008	Copper and copper alloys — Seamless, round copper tubes for medical gases or vacuum
IS/ISO 10079 :Part 2	ISO 10079-2:2014	Medical Suction Equipment Part 2 Manually Powered Suction Equipment
IS/ISO 10079 :Part 3	ISO 10079-3:2014	Medical Suction Equipment Part 3 Suction Equipment from a Vacuum or Pressure source
IS 8382:1977		Pressure Regulators, Pre-set Used with Medical Gas Cylinders
IS 5355		Oxygen flowmeter (dry bobbin type for Therapy purposes)
IS 6207		Trolleys for Oxygen Cylinders
IS 3624		Pressure and Vacuum Gauges
IS 2379:1990		Colour code for identification of pipe lines

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