*** INTRODUCTION ***

## Overview

The purpose of the communications infrastructure standards and specifications is to ensure:

1. Communications infrastructure is capable of meeting the current and future operational and technical performance requirements and needs of BCIT.
2. Reliability, functionality and serviceability of systems and components
3. Reduction of lifecycle cost of ownership, operation and maintenance.
4. Efficiency of energy and resources.
5. Flexibility to accommodate growth and changes.
6. Security and safety.
7. A good value investment.

The BCIT communications infrastructure technical standards and specifications highlight the importance of:

1. Following best practices for design and installation of cabling systems.
2. The impacts of multiple technologies on the cabling infrastructure design.
3. Reducing the impact of moves, adds and changes and upgrades.

### Intent

BCIT has 5 campuses that are spread out across the Lower Mainland, including Burnaby, Downtown Vancouver, Annacis Island in Delta, Marine Campus in North Vancouver, and Aerospace Campus in Richmond, as well as satellite sites at various Secondary Schools in the Lower Mainland and Kelowna, BC. They are inter-connected via a complex network of private and service provider links. There is a reliable existing system of redundancy that ensures service is maintained to all campus facilities. The various sites are all different and unique in their own right, whether due to their age, installed products or location. An existing campus or building may have Category 5E, Category 6, Category 6A or other Cabling System installed. They cannot all be served by a single uniform standard for network cabling. The consultant will need to have site-specific, accurate information for an existing campus, in order to prepare the specifications and documentation for any new or renovation projects there.

The BCIT standards and specifications are provided to consultants as part of the consultant agreement and apply to all types of construction projects for all new or renovation/upgrade projects. Any deviation from these standards must first be approved in writing by BCIT throughout all stages of the design and construction. The consultant is to prescribe minimum mandatory requirements for contractors installing Communications and Security Systems infrastructure within buildings and between buildings to the extent of a local campus within a region wide environment.

The Standards and Specifications are intended for use by:

1. Consultants and professional engineers.
2. Facilities Management, Maintenance and Operations.
3. Suppliers and contractors.

Consultants and professional engineers are expected to use the BCIT Standards and specifications to develop their own project specific specifications and drawings. The lead consultant shall be responsible to provide a BICSI certified RCDD (Registered Communications Distribution Designer) to work with the BCIT representative who will be leading the project. The RCDD shall have expertise in all the current and applicable codes and ANSI/TIA/BICSI standards.
The BCIT standards and specifications will be the highest authority at all times unless communicated otherwise. The RCDD will communicate directly with the BCIT lead resource on the project for clarification and guidance for any items not covered by the standards. The RCDD must abide by the responsibility and duties noted in the BCIT standards.

Contractors that are engaged directly by BCIT shall refer to the standards and specifications for all their installation work. Contractors that are engaged directly by BCIT Facilities Maintenance and Operations shall refer to the standards and specifications for all their installation work as they may require connection to the BCIT data network (e.g. BMS, Lighting Control, Access Control, and various other applications).

The Communications and Security Systems Contractors will supply, furnish, and install: all material, labour, apparatus, tools, equipment and services required for construction and put into regular operation the complete technology systems, as shown on the Technical Drawings, described in the specifications and any attached appendices.

There are administrative and documentation requirements such as product shop drawings, test results and warranties in the specifications sections that apply to all BCIT projects. At substantial completion deliverables such as as-built drawings, maintenance manuals, warranties and commissioning reports are required.

Not all renovation, moves, adds and changes work is tendered to contractors. Some work is completed by BCIT Operations technical staff, as deemed necessary by BCIT – IT Services.

Codes and Standards.
There are mandatory codes which must be strictly followed as well as industry accepted standards which provide guidance for best practices and manufacturer's recommendations. These are listed in detail in the "Common Works" specifications section 27 05 00 and 28 05 00.
BCIT also has specific operational requirements which need to be incorporated in the project documentation.

Grounding and Bonding for Communications Systems.
Grounding of equipment and infrastructure is a matter of safety for all occupants in BCIT facilities and is necessary for protection of electrical or electronic equipment. It is mandated in the Canadian Electrical Code and is described in detail in the specifications section 27 05 26 and associated project drawings. Materials and methods are detailed in these specifications. The standard prescribing telecommunications bonding and grounding is ANSI/TIA-607 (current version).

Communications Cabling Pathways.
Pathways for communications cabling are crucial to new buildings and should be designed with adequate initial capacity as well as planning for future requirements, as prescribed by the current ANSI/TIA-569 Standard. If redundancy is a requirement in critical facilities, then additional pathways must be considered. Pathways in buildings are typically metallic cable trays or conduit

systems. There may be a requirement for wall mounted surface raceways in Lab type learning spaces. Seismic support of trays, conduits and raceways is a requirement. Specifications section 27 05 28 deals with pathway requirements in greater detail. Coordination between the electrical and communications installation contractors is always recommended prior to start of work due to the overlap of some of their responsibilities.

Firestopping.
All penetrations of cable trays, conduits, sleeves and such through walls and floors shall be fire-stopped using an approved fire stop system from an approved manufacturer. Detailed instructions for fire stopping methods and products will be found in 27 05 29.

Communications Rooms.
Communications rooms are crucial spaces in a building that are sometimes afforded less priority by project architects, and this can result in rooms that are either too small to accommodate the quantity of equipment racks required or fail to provide the necessary clearances around equipment. Wall equipment layout should include efficient use of space to accommodate equipment required to enable the operation of the room. Coordination between the architect, mechanical, electrical, communications, audio visual and security consultants is vital. This will ensure that communications rooms are adequately sized, environmentally controlled to protect equipment, and that rack power needs are met for initial and future requirements. Communications rooms are featured throughout every building from the service entry point (Entrance Facility Room) to the main communications room (MCR) and the satellite telecommunications rooms (TR) to distribute backbone and horizontal cabling throughout the building. The Data Centres are the main server rooms such as the MER in the Burnaby campus and serves other campus facilities. Communications rooms are strategically located to adhere to cable length limitations which are set by the industry standards like the current ANSI/TIA-569 and BICSI. Detailed information regarding the design of communications rooms is found in specifications section 27 11 00.

Cabling Infrastructure
All communications rooms are connected via intra-building backbone cabling which can be copper or fibre optic or both. Buildings within a campus layout are connected via inter-building backbone cables. Backbone cables within buildings are riser-rated if not installed in a plenum air space. Inter-building backbone cables are outdoor rated to have added protection against water or moisture ingress when installed in underground cable pathways. Backbone cabling information can be found in greater detail in specifications section 27 13 13 and 27 13 23.
Horizontal cabling is distributed from a communication room to user outlets on the same floor. The overall length limit for horizontal cabling is a maximum of 90 metres from the serving communications room. If a floorplan is larger then a second communications room must be added. The Performance Category of the structured Cabling system will be Category 6A for new buildings and may be Category 6 or 5E for adds and changes in existing sites. The solution provided must match the existing structured cabling on the site. Further requirements and information can be found in section 27 15 00.

Wireless
Wireless access to the BCIT network is distributed throughout all campuses and is required by both faculty and students, as well as visitors. Specific instructions to contractors for the installation of wireless access points in all campus environments can be found in section 27 21 33.

Testing
All installed cabling infrastructure shall be tested by the contractor using an appropriate cable certifier instrument such as manufactured by the FLUKE company or alternate as approved by BCIT IT. Detailed testing instructions are mandated in 27 08 11 and 27 08 21.

Administration and Identification
All installed structured cabling components, racks, bonding, pull boxes, wireless access points, etc. shall be labeled as per the requirements of the current ANSI/TIA 606 Standard. Requirements are stipulated in 27 05 53.

Products
BCIT has standardized with CommScope/ Uniprise products for all their campus structured wiring infrastructure. No other manufacturer's products may be installed without prior approval of the BCIT IT Department. Contractors and technicians must have proof of manufacturer's training and certification for approval to perform work on BCIT campuses.

*** END OF **INSTRUCTIONS TO CONSULTANTS** ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 All of Division 27 specifications.

.2 Division 28:

.1 28 13 00 Access Control.

.2 28 16 00 Security and Access Control Systems.

.3 28 23 00 Video Surveillance Systems.

.4 28 25 01 Panic and Emergency Phone Devices.

### .2 List of Abbreviations

.1 The following abbreviations may be used within this specification document and in the drawings:

.1 AHJ: Authority Having Jurisdiction.

.2 ANSI: American National Standards Institute.

.3 ASTM: American Society for Testing and Materials.

.4 BCIT: British Columbia Institute of Technology.

.5 BICSI: Building Industry Consulting Service International.

.6 CATV: Cable TV.

.7 CP: Consolidation Point.

.8 CSA: Canadian Standards Association – equipment safety approvals and testing for Canada.

.9 EF: Entrance Facility.

.10 EGB: Electrical Ground Breaker.

.11 ETL: ETL Testing Laboratories – product testing laboratory for U.S. and Canada.

.12 FDC: Fiber Distribution Centre (Fiber splice tray or termination tray).

.13 IDF: Intermediate Distribution Frame.

.14 IEEE: Institute of Electrical and Electronic Engineers.

.15 ISO: International Standards Organization.

.16 MEGB: Main Electrical Ground Busbar.

.17 NEMA: National Electrical Manufacturer's Association.

.18 PBB: Primary Bonding Busbar.

.19 MER: Main Equipment Room (Typical location of Network Core Switches).

.20 EF: Entrance Facility.

.21 TR: Local Telecommunications Room.

.22 SBB: Secondary Bonding Busbar.

.23 TO: Telecommunications Outlet.

.24 ULC: Underwriters Laboratories of Canada – testing laboratory for Canada (see C- UL and UL).

.25 UTP: Unshielded Twisted Pair.

.26 WA: Work Area.

**.3 Overview**

.1 These standards and specifications prescribe minimum mandatory requirements for communications infrastructure within all buildings, up to and including the Telecommunications outlet, and between buildings to the extent of a region and province wide environment. Requirements in existing buildings may differ and specific project specifications may be required for moves, additions and changes, to match installed cabling solutions. Coordination with BCIT IT Services will be required.

.2 A structured approach is specified which will ensure a flexible distribution system that will minimize the future costs of moves, additions and changes.

.3 Communications Systems Contractor will supply, furnish, and install: all material, labour, apparatus, tools, equipment and services required for construction and put into regular operation the complete Communications system, as shown on the Telecommunications Drawings, described in the specifications and any attached appendices.

.4 There are administrative and documentation requirements in this section that also apply to electronic security systems in Division 28.

**.4 Referenced Codes and Standards**

.1 Comply with the latest British Columbia Building Code, and Canadian Electrical Code, including all provincial and other amendments, any local by-laws or rules and regulations requirements of the Owner.

.2 Equipment and materials shall bear the approval of the Canadian Standards Association and where applicable, the Underwriters Laboratories of Canada or alternately shall bear local approval from the Electrical Inspection Department having jurisdiction. Include in the contract all costs associated with obtaining local approvals.

.3 If there is a conflict between the Drawings and Specifications and the above noted codes, by-laws, rule and orders, the codes, by-laws, rules and orders shall govern. In no instance, however, shall the standards established by the Contract Documents be reduced by any of these codes or regulations.

.4 Install and test telecommunications cabling networks as per the latest manufacturer's requirements and in accordance with the following industry standards:

.1 ANSI/TIA Standards:

.2 ANSI/TIA 568-D.1-2015 Generic Telecommunications Cabling for Customer Premises standard.

.3 ANSI/TIA -568-0-D-2015 Commercial Building Telecommunications Cabling Standard.

.4 ANSI/TIA-568-C.2-2009 Commercial Building Telecommunications Cabling Standard – Balanced Twisted Pair Cabling Components.

.5 ANSI/TIA-568-C.3-2008 Optical Fiber Cabling Components Standard.

.6 ANSI/TIA-569-D-2015 Commercial Building Standard for Telecommunications Pathways and Spaces.

.7 ANSI/TIA/EIA-606-C-2017 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.8 J-STD-607-C-2015 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.9 ANSI/TIA-570-C-2012 Residential Telecommunications Cabling Standard.

.10 ANSI/TIA-758-B-2012 Customer Owned Outside Plant Telecommunications Cabling Standard.

.11 ANSI/TIA-4966-2014 Telecommunications Infrastructure Standard for Educational Facilities.

.12 ANSI/TIA-942-A-2012 Telecommunications Infrastructure Standard for Data Centers.

.13 ANSI/TIA-TSB-162-2013 Telecommunications Cabling Guidelines for wireless Access Points.

.14 The Canadian Electrical Code Part 1, C22.1-18 edition.

.15 BC Amendments to the CEC and associated bulletins.

.16 IEEE 802.3 series of Ethernet Standards.

.17 IEEE 802.11 series of Wireless Standards.

.18 ISO 8802-3 series of Standards.

.19 BICSI latest technical manuals:

.1 ANSI/BICSI 002-2014, Data Centers Design and Implementation Best Practices.

.2 ANSI/BICSI 003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems.

.3 ANSI/BICSI 004-2012, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities.

.4 ANSI/BICSI 005-2013, Electronic Safety and Security (ESS) System Design and Implementation Best Practices.

.5 ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling.

.6 NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.

.7 Information Technology Systems Installation Methods Manual.

.8 Network Systems and Commissioning (NSC) reference.

.9 Outside Plant Design Reference Manual 5th Edition.

.10 Telecommunications Distribution Methods Manual 13th Edition.

.11 Electronic Safety and Security Design Reference Manual.

.5 Conform to current safety and security standards, codes, and practices in effect at Health Authorities including, but not limited to:

.1 Workers Compensation Act – Part 3 – Occupational Health & Safety.

.2 BC Electrical Safety Act.

.3 The British Columbia Building Code with Amendments.

.6 If there is conflict between any of the ANSI/TIA or BISCI referenced standards, ANSI/TIA takes precedence.

**.5 Application Standards**

.1 The Certified Structured Cabling System shall be guaranteed to operate the applications which the System was originally designed to support, as well as any new applications. New applications are defined as any application introduced in the future by recognized standards organizations or user forums that use the TIA-568-C or ISO/IEC IS 11801 component and link/channel specifications for cabling.

**.6 Manufacturer's Cabling System Application Warranty**

.1 An applications Warranty shall be issued to guarantee that the Telecommunications Wiring Infrastructure shall support up to, but not limited to 1000Base-T applications or 10GBASE T (10GbE) over twisted-pair copper cabling) for Cat.6A solutions, dependent on category of system being installed.

.2 All cabling products and workmanship must include coverage as follows:

.1 System Application Warranty from Manufacturer.

.2 System Performance Warranty Certificate must be provided by the Subject Warranty Manufacturer.

.3 The System Application Warranty term must be a minimum of 25 years provided by the Warranty Underwriting Manufacturer, from the date of final acceptance of the project.

.4 The name and address of the building/facility and location of site must appear on the warranty document.

.5 The Communications Systems Contractor must be fully approved and certified by the proposed Warranty Underwriting Manufacturer prior to responding to the bid as a pre-qualification.

.6 Testing shall be performed by Telecommunications Technicians who are qualified to perform related tests as required by the manufacturer in accordance with the manufacturer's methods. The successful Contractor shall also provide proof of competency for the installers that will be working on the system on site.

.7 The original 25 Year Warranty Certificate from the Manufacturer's shall be submitted to the Owner.

**.7 Drawings**

.1 The location of various items indicated in drawings, are approximate except where specifically mentioned.

.2 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work.

.3 The Communications Systems Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions.

.4 The Communications Systems Contractor will coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final user outlet locations.

.5 If any discrepancies or omissions are found in the drawings, or if the intent is not clear, the Communications Systems Contractor will obtain clarification from the Consultant.

**.8 Shop Drawings, Submittals and Construction Documents**

.1 The Communications Systems Contractor will submit to the Consultant for review all product data (including cut sheets and catalogue information) and shop drawings for the project noting long lead-time items and providing samples and mock-ups if required by the Contract Documents.

.2 The Communications Systems Contractor will submit a sample binder and contents of the Manual of Operations for approval at time of shop drawings submission. Refer to Substantial Performance for further details.

.3 The Communications Systems Contractor will also present the following submittals to the Consultant for review:

.1 Manufacturer's catalogue sheets and specifications for fiber optic field- test instruments including optical loss test sets (OLTS; power meter and source), optical time domain reflectometer (OTDR) and inspection scope.

.2 Sample test reports.

.3 Backbone cable routing or location changes.

.4 Commissioning Plan.

.4 All above submittals must be forwarded promptly, and in such sequence as to cause no delay in the work or in the activities of the other trades.

.5 The Consultant will indicate approval of shop drawings, product data, and samples submitted by stamping such submittals with the word: "REVIEWED".

.6 Submitted shop drawings will be signed by the Communications Systems Contractor, imprinted with the date submitted, and will bear the Communications Systems Contractor's legitimate Company name.

.7 By submitting shop drawings, product data, and samples, the Communications Systems Contractor signifies that he, or she has carefully reviewed and verified materials, quantities, field measurements, and related field construction criteria. It also signifies the Communications Systems Contractor has checked, coordinated, and verified that all information contained in shop drawings, product data, and samples conforms to the requirements of the Work and of the Contract Documents.

.8 The Communications Systems Contractor will perform no portion of the Work requiring submittal and review of shop drawings, product data, or samples until the Consultant has reviewed the respective submittal.

.9 The Communications Systems Contractor will submit shop drawings, product data, and samples to the Consultant;

.1 For initial and re-submission for approval, the Communications Systems Contractor will submit a soft copy of the proposal that is electronically stamped to the Consultant.

.2 The Communications Systems Contractor will highlight relevant products on the shop drawings.

.3 The Consultant will not accept illegible submittals.

.10 Shop Drawings shall be provided for:

.1 Copper Cabling.

.2 Fiber Cabling.

.3 Coaxial Cabling.

.4 Fiber Connector Housings.

.5 Faceplates.

.6 Ceiling boxes.

.7 Floor boxes.

.8 Jacks/Inserts.

.9 Patch Panels.

.10 110 Impact Termination System (Gigabix).

.11 Fiber Connectors.

.12 Equipment Racks, Cabinets and Enclosures.

.13 Vertical and Horizontal Cable Management.

.14 Cable Tray.

.15 Telecommunications Bonding and Grounding System Materials.

.16 ePDUs.

.11 The submittals shall be reviewed for general compliance and not for dimensions, quantities, etc. The submittals that are returned shall be used for procurement. The responsibility of correct procurement remains solely with the Communications Systems Contractor. The submittal review shall not relieve the Communications Systems Contractor of responsibility for errors or omissions and deviations from the Contract requirements.

.12 Equipment and material substitutions are prohibited. If the submittal shows variations from the requirements of the Contract Documents for any reason, the Communications Systems Contractor shall provide written detail of each variation in the letter of transmittal.

.13 All approved equivalent products shall be submitted prior to tender closing.

.14 Shop Drawings shall be submitted in an electronic format. The file format shall be Adobe portable data file (.pdf).

**.9 As-Built Documentation**

.1 The as-built drawing package shall have all elements in all floor plan, elevations, sections, and isometric views updated to as-built conditions by the Communications Systems Contractor. In addition, all schematics and risers shall be updated by the Communications Systems Contractor.

.2 The Communications Systems Contractor will provide Maintenance Manual containing the following:

.1 Set of final reviewed Shop Drawings.

.2 Full size set of As-Built drawings.

.3 (3) USB Memory Keys of As-Built drawings in PDF format (all files combined into a single document).

.4 Digital photos of all Communications Rooms showing each wall and rack elevations.

.5 Digital photos of all Electronic Security System equipment installed in racks or cabinets.

.6 Circuit Spreadsheets for horizontal cabling and fiber backbone.

.7 Manufacturer Warranty documents for equipment and workmanship.

.8 Copper Warranty Certification test result printouts.

.9 Optical fiber power meter/light source test result.

.10 Electronics Security Systems Testing and Commissioning Results.

.11 Manufacturer's installation and operation manuals for all components, application software and any associated cables shall be left on-site with support documentation for future reference.

.12 Names, addresses, phone numbers, facsimile numbers and email addresses of the Communications Systems Contractor, Communications Systems Contractor's BICSI RCDD, sub-Communications Systems Contractors and suppliers used on the Work together with a specification reference of the portion of the Work they undertook.

.3 In addition to the applicable requirements in this Section, the Communications Systems Contractor will submit the following:

.1 Full size set of As-Built drawings.

.2 (3) USB Memory Keys of As-Built drawings.

.3 PDF (all files combined into a single document).

.4 Maintenance Manual will be in a suitably labelled, hard back, D-Ring type commercial binders, each complete with an index and tabbed title sheets for each section;

.1 All binder pages will have self-adhesive reinforcing rings at each binder ring.

.2 All maintenance manual data will be printed on 8 1/2" x 11" heavy bond, indexed, tabbed, punched and bound in the binders. Drawings will be printed on 11" x 17". Each manual will have a title sheet which is labelled "Operation & Maintenance Manual with an associated Table of Contents for each volume. If a manual exceeds 75 mm in thickness, provide additional manuals as required.

.3 Soft copy of the Maintenance Manual in PDF format on a separate USB Memory Key.

**.10 Communications Systems Contractor Qualifications**

.1 Certified Personnel:

.1 Communications Systems Contractor shall be approved by BCIT and structured cabling system manufacturer.

.2 All Technicians performing cable system installation work shall meet current technician training certifications. All Technician certification cards shall be checked prior to work start up. Technicians must be current employees of the Communications Systems Contractor. No sub-contracting shall be allowed.

.3 The Communications Systems Contractor shall assign a Supervisor with current BICSI RCDD certification to provide Quality Control based on the "Communications Infrastructure Standards and Specifications," and to provide weekly report to the Contractor.

.4 The Communications Systems Contractor shall have worked satisfactorily for a minimum of five (5) years on structured cabling solutions.

.5 Upon request of the Consultant, the Communications Systems Contractor will supply a list of references with specific information regarding type of project and involvement in supplying and installing equipment and systems.

**.11 Communications Systems Contractor Responsibilities**

.1 In the event that the certified system ceases to support the required application(s), whether at the time of cutover, during normal use or when upgrading, the manufacturer and vendor will commit to promptly implement corrective action.

.2 The Communications Systems Contractor will use qualified service personnel to conduct all work and at any time will show manufacturer's certification and/or submit references upon request of the Consultant.

.3 The maintenance on site of one complete set of white prints to be used exclusively for purposes of recording changes, deviations, and revisions from the original contract.

.4 Scheduling the Work in a manner acceptable to the Contractor.

.5 The Communications Systems Contractor has the responsibility to ensure that all provisions of these Standards are met and to specifically advise the Consultant in writing of any contemplated exceptions and obtain approval in writing for these changes.

.6 The complete scope of all work is fully described in Division 27 drawings and technical specifications described herein.

.7 The words “provide, “supply”, “furnish”, and “install” will imply that the Communications Systems Contractor will provide all necessary labour, materials, and equipment to complete the installation and where applicable, to the approval of the Consultant.

.8 Unless otherwise noted or specified, the Communications Systems Contractor will provide all equipment and / or materials shown on the drawings and defined in the specifications.

.9 Any apparatus, appliances, materials, or work not shown on the drawings, but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, will be furnished, delivered, and installed by the Communications Systems Contractor, without additional expense.

.10 Establishment and verification of dimensions, elevations, grades, boundaries shown on drawings and, reporting of any errors or inconsistencies to the Consultant and or the Contractor before starting Work. Starting Work will imply that the Communications Systems Contractor has verified all items and found them to be correct. Additional costs arising out of any subsequent rectifications will be borne by the Communications Systems Contractor.

.11 The maintenance of discipline and general orderliness of work areas throughout the duration of the Project.

.12 Take steps to prevent dust from escaping the immediate work zone and from settling on or contaminating communications equipment and terminal hardware, as well as furniture and equipment.

**.12 Communications Systems Contractor’s Foreman**

.1 The Communications Systems Contractor will designate a Foreman to remain on the job site from the time construction commences until final completion and acceptance of the Work.

.2 The Foreman will not be changed unless satisfactory reasons are given in writing to the Contractor.

**.13 Sequence and Scheduling**

.1 The Communications Systems Contractor will submit a complete Construction Schedule for the installation of equipment (if specified), and cabling.

.2 The Construction Schedule will indicate delivery, installation, and testing dates for each component of the project. A typical project schedule submitted by the Communications Systems Contractor will provide the following key milestone dates:

.1 Contract Award.

.2 Submittal and Approval of Shop Drawings.

.3 Key Material Procurement Date.

.4 Horizontal Cabling;

.1 Cable Rough-in.

.2 Cable Termination.

.3 Testing.

.4 Labelling.

.5 Backbone Cabling:

.1 Cable Rough-in.

.2 Cable Termination.

.3 Testing.

.4 Labelling.

.6 Telecommunication Grounding Backbone:

.1 Bonding Conductor Rough-in.

.2 Busbar Installation.

.3 Bonding Conductor Termination.

.4 Labelling.

.7 Communications Room Make Ready:

.1 Racks/Cabinets/Cable Management Installed.

.2 Grounding and Bonding Complete.

.3 Cable Termination Equipment Installed.

.4 Labelling.

.5 Final (Equipment Ready) Clean.

.6 Room is secure.

.8 Equipment Installation Dates.

.9 Submission of As-Built Documentation Package.

.10 Substantial Performance.

.11 Communications Consultant and or the Contractor Acceptance.

.3 The Communications Systems Contractor will ensure their schedule aligns to and is coordinated as well as the schedules of other sub-trades (electrical, mechanical, etc.), the Authority and other third parties whose tasks impact either the start and/or completion of the Communications Systems Contractor's tasks.

.4 The Communications Systems Contractor will submit a separate demolition time schedule with applicable cut-over in areas that have existing users. This applies to any areas where systems will need to be taken off-line.

**.14 Materials**

.1 Materials not approved or not conforming to the Contract Documents will be rejected.

.2 The Communications Systems Contractor will identify materials with long delivery times immediately upon submittal of shop drawings and will order such materials as soon the shop drawings are reviewed by the Consultant.

.3 Materials will be delivered on site in original containers and packages with labels and seals intact. Use in strict accordance with manufacturer's latest printed directions and instructions unless otherwise specified.

.4 Material deliveries to the site will be the responsibility of the Communications Systems Contractor. After delivery, the Communications Systems Contractor will take responsibility to protect material during storage and handling to prevent damage and theft. Do not store equipment or materials where conditions fall outside manufacturer's recommendations for environmental conditions. Do not install damaged material or equipment. Material or equipment damaged during installation will be replaced.

**.15 Communications Rooms – Dust Containment and Access**

.1 Dust Containment:

.1 ANSI/TIA-569-D Commercial Building Standard for Telecommunications Pathways and Spaces:

.1 To mitigate dust containment, Communications rooms e.g. main and local communications rooms, (excluding data centres which have more stringent requirements) will not be used as storage areas to store cardboard boxes, ladders and other materials as they tend to accumulate dust particles. This ensures Communications rooms are kept generally clean.

.2 Communications rooms will be protected from contaminants and pollutants that affect the operation and material integrity of the installed equipment and connecting hardware.

.3 The Contractor will effectively protect the Communications rooms, equipment, connecting hardware and materials from dust, dirt and damage during construction.

.4 Dust containment measures such as vapour barrier, positive room pressure and absolute filters will be provided.

.5 Precautionary measures will be taken to ensure dust containment measures taken to protect equipment will not cause the equipment to overheat.

.6 Any dust or particulates that may have resulted from the work will be mitigated from spreading by placing the nozzle of a vacuum close to the point of drilling, cutting, grinding, sanding and the like that create dust.

.7 The work area will be cleaned up and vacuumed on a daily basis. Communications rooms, the outside of equipment racks, cabinets and panels, the inside of power panels, connecting hardware, Communications outlets and the like will be vacuumed.

.8 Prior to receiving any network equipment from the Owner to install, the Contractor shall conduct air quality testing and provide the Consultant with a report and analysis of particle counts before and after the cleaning of TR's.

.9 The Contractor will provide clean room sticky mats, booties, curtains and plastic strip doors and air scrubbers as required to keep the TR's clean until target Substantial Completion of the Facility is achieved.

.2 After room turn-over, all un-authorized people must have prior approval from the Owner and be granted access before entering Communications rooms. Timing of each room turn-over to be coordinated by Contractor with the Owner.

.3 Equipment cannot be added or removed from the racks unless specifically stated within the project's scope of work or authorized by the Contractor and the Owner. This includes power cables, network cables and fiber cables.

.4 Failure to comply with these rules will result in the removal of access to the Communications rooms.

.5 Network equipment and switches provided to the Contractor for the interior of the Facility will not be installed until the Facility is enclosed, weather tight, temperature and humidity conditions are approximately the same as final conditions expected, fiber backbone is installed and tested, most construction activities are completed and surfaces have been swept and treated for dust control. The Contractor will not be allowed to install wireless and wired network hardware until the Owner has inspected the interior conditions of the Facility and provided written approval to proceed with the installation.

.6 Prior to receipt of network equipment and switches, the Contractor is required to provide the Owner with as-built documentation and the test results for the intra-building fiber backbone system. Upon receipt of network equipment and switches, the Contractor will be financially responsible for any damage or disappearance of Owner's provided material due to improper handling and storage, negligence, fire, theft and environmental conditions during construction.

**.16 Pre-Installation Site Survey**

.1 Prior to start of systems installation, the Communications Systems Contractor will meet at the project site with the Contractor and Representatives of trades performing related work to co-ordinate efforts.

.2 The Communications Systems Contractor will review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with other trades will be necessary to meet critical deadlines for completion of Communications Rooms and Closets.

.3 Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

**.17 Project Meetings**

.1 The Communications Systems Contractor's Project Manager and Foreman will attend all meetings that may be requested by the Contractor.

**.18 Inspections**

.1 The Communications Systems Contractor will request and coordinate representation from the Consultant for inspection of cabling system during, but not limited to the following stages of construction:

.1 Communications room construction.

.2 Wall layout of various low voltage systems, entrance copper cables, grounding system, system panels, connecting hardware and GigaBIX mount.

.3 Floor layout of equipment racks and double-sided finger-type vertical cable managers on both sides of each rack.

.4 Ceiling layout of cable tray, and cable dropouts over side of tray (clip-on Cablofil 115mm deep) into vertical cable managers and GigaBIX mounts. This is to provide unrestricted access of cables from the tray into the vertical managers, and to avoid cutting the bottom of tray.

.5 Proper positioning of lighting and mechanical ducting layout in relation to ceiling tray, racks and sprinkler head.

.6 Layout of equipment on racks – horizontal cable manager, fiber patch panels, analog voice patch panels, horizontal cable patch panels in relation to switches, etc.

.2 Cable rough-in, dressing and termination (workmanship).

.3 Labelling.

.4 Testing and documentation.

.5 Completion and acceptance.

**.19 Project Closeout**

.1 In addition to the requirements stated elsewhere in the specifications, the Communications Systems Contractor will not issue a final Deficiencies Inspection request until the following work has been completed and specified documentation forwarded to the Contractor:

.1 As-built record (soft copy) documentation has been provided.

.2 All systems have been tested and are ready for operation.

.3 Record of completed verification of Communications system has been provided.

.4 Fire-stop installation is performed as per Fire-stop Section 27 05 29.

.5 The clean-up is finished in all respects.

.6 All inspection certificates have been furnished including final low voltage and or Electrical inspection certificate.

.7 As-built drawing package will confirm location and identification of all:

.1 Communications Outlets and jack numbers with serving Communications Room ID.

.2 Communications Rooms.

.3 Communications Room boundary lines.

.4 Backbone Cable Runs.

.5 Communications Room floor and ceiling layouts (rack, GigaBIX mount, wall-mount system panels, vertical & horizontal conduit sleeves, ceiling tray, etc.).

.6 Fiber, Copper and Grounding schematics.

*** END OF **COMMON WORKS for COMMUNICATIONS SYSTEMS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts. Related sections:

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 28 – Pathways for Communications Systems.

.3 Section 27 05 53 – Identification for Communications Systems.

.4 Section 27 11 00 – Communication Room Fittings.

### .2 References

.1 CEC, CSA C22.1-15 “Canadian Electrical Code” Part 1.

.2 ANSI/TIA J-STD-607-C standard.

### .3 Statutory Authority – Electrical Safety

.1 Canadian Electrical Code, Part 1, Twenty-Third Edition.

.2 Safety Standard for Electrical Installations.

.3 Canadian Standards Association Standard C22.1-18 is adopted in whole, including any errata and with the changes set out in schedule, as the B.C. Electrical Code Regulation, is in force.

### .4 Definitions

.1 Define the following list of terms, as used in this specifications as follows:

.1 “CM”: Circular Mil.

.2 “MBRGB”: Main Building Reference Grounding Busbar.

.3 “TBB”: Telecommunications Bonding Backbone.

.4 “TBC”: Telecommunications Bonding Conductor.

.5 “PBB”: Primary Bonding Busbar.

**.6** “SBB”: Secondary Bonding Busbar.

### .5 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

### .6 As-Built Documentation

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

**.7 System Description**

.1 Telecommunications Grounding as described on the drawings are to be referred to as a minimum requirement using a dedicated ground.

.2 The Telecommunications Grounding Backbone system contains grounding busbars, grounding conductors, connecting devices (including but not limited to compression lugs, taps, ground bushings, clamps, or exothermic welds). These components provide a low impedance path to ground for stray voltages or spurious signals present on telecommunications media and equipment.

.3 Grounding and bonding practices will comply with all applicable codes.

## 2.0 PRODUCTS

**.1 Grounding and Bonding Conductors**

.1 TBB:

.1 Conductor: Class I stranded copper.

.2 Insulation: Flex EPR/Hypalon LS, green in colour.

.3 The cable will have the insulation grade, the conductor gauge, and applicable UL jacket listings printed on the insulation.

.4 Where conductors with green insulation are not commercially available, provide a minimum of 100 mm long colour band with green, non-aging, plastic tape in accordance with CEC. This band will occur at both ends of the conductor, and at all connections between.

.5 Gauge: #4/0.

.2 TBC:

.1 Bonding conductor will be green jacketed, stranded copper, soft conductor, unless otherwise noted.

.2 Conductor:

.1 Class I stranded copper.

.2 Insulation: Flex EPR/Hypalon LS, green in colour. The cable will have the insulation grade, the conductor gauge, and applicable UL jacket listings printed on the insulation.

.3 Gauge: Per the Canadian Electrical Code.

.3 All bonding conductors will be approved as defined in CSA C22.1-15.

**.2 Grounding Busbars**

.1 PBB:

.1 Material: Tin plated copper.

.2 Minimum dimension of 100 mm wide X 500 mm long X 6 mm thick.

.3 Holes: Predrilled, with standard NEMA bolt hole sizing & spacing for this type of connectors used.

.4 Mounting: Utilize insulated standoffs.

.5 Manufacturer: Panduit.

.2 SBB:

.1 Material: Tin plated copper.

.2 Minimum dimension of 70 mm wide X 305 mm long X 6 mm thick.

.3 Holes: Predrilled, with standard NEMA bolt hole sizing & spacing for the type of connectors used.

.4 Mounting: Utilize insulated standoffs.

.5 Manufacturer: Panduit.

**.3 Connectors**

.1 General: All connectors will be ULC listed.

.2 Connectors shall be intended for the application.

.3 Acceptable connector types include: Two Hole Compression Lug, H-Tap, C-Tap, Post Burndy, Split-bolt Burndy, Ground bushings, Pedestal Clamps.

## 3.0 EXECUTION

**.1 General**

.1 Install a complete, permanent, and continuous bonding and grounding system for Communications infrastructure and, equipment including all necessary conductors, connectors and accessories, as indicated on drawings and this document, in order to conform to requirements of the referenced Codes and Standards.

**.2 Identification**

.1 Refer to Section 27 05 53 Identification for Communications Systems for labelling requirements.

**.3 Grounding and Bonding Conductors**

.1 Bonding conductors placed in metallic conduits longer than one metre must be bonded at each end of the conduit with the appropriate bonding bushing.

.2 Where the Communications rooms are stacked, the bonding conductor will be a common riser bonding conductor for connection to the stacked Communications rooms.

.3 Where practicable, all bonding conductors will be installed without a splice. Where a splice is necessary, it will be accessible and located within a Communications room. Conductors will be spliced using irreversible compression-type connectors, exothermic welding, or equivalent. All joints will be adequately supported and protected.

.4 Bonding conductors shall be as short as possible and routed with a minimum of bends. All bends made on the conductor shall be sweeping bends. Minimum bending radius is 200 mm (8”) bonding conductors will be fixed to the walls and neatly formed around the perimeter of the room.

.5 Install a bare #6 AWG copper stranded conductor, in the entire length of surface raceway or cable tray and bond to the telecommunications grounding system.

.6 The cable tray bonding conductor will be bonded to cable tray by a bonding clamp at each straight length of tray regardless of length and each elbow and T- fittings.

.7 All splices of bonding conductors will be outside of the cable trays.

.8 Conduits for individual outlets will be bonded using a #12 AWG stranded insulated copper conductor from the conduit bonding bushing to the cable tray bonding conductor.

.9 The metallic jacket of metallic shielded & interlocking armoured backbone cables will be bonded with a #6 AWG green jacketed stranded copper conductor at the jacket opening at both ends of the cable, using a Grounding Bushing on an armoured cable connector designed for the cable being used.

.10 Metallic cable protectors will be bonded with a #6 AWG green jacketed stranded copper bonding conductor.

.11 Equipment racks and Communications equipment will be bonded with a #6 AWG green. Each rack will be bonded with a #6 AWG green directly to the PBB or SBB. (Star-wired. Daisy-chaining is no longer acceptable).

.12 Metal parts (including non-electrical equipment, i.e. duct work) in the Communications rooms will be bonded to the appropriate ground busbar.

.13 Power panels in Communications rooms will be bonded to the PBB or SBB with ground cable sized as per the requirements of the CEC.

.14 Bond Primary Protector.

.15 Bond Static Dissipative Flooring.

.16 Bond aisle containment systems.

.17 All Communications EMT conduit and tray leaving the Communications room will be bonded.

.18 Bond the metal frame of the building to the PBB/SBB; cable sized as per the CEC.

.19 All Communications outlet boxes will be bonded.

.20 Install #12 AWG insulated stranded copper bonding conductor to metal Wiremold surface raceway, and bond to the building and telecommunications grounding systems for joint- use power and Communications applications. Bond to telecommunications grounding system if the raceway is dedicated only for Communications use.

.21 Protect exposed bonding conductors from mechanical damage.

**.4 Grounding Busbars**

.1 The PBB will be connected to the building main Electrical ground busbar with a #4/0 AWG green jacketed stranded copper conductor.

.2 The size of the TBB is a minimum size of 4/0 AWG.

.3 All SBB's will be connected to the PBB with a minimum #4/0 AWG green jacketed copper conductor FT rated as per the AHJ or installed in conduit.

.4 A grounding busbar will be placed below the ceiling cable tray at 2300 mm AFF near the corner of the wall that adjoins another wall where the conduit sleeves are located. It will be mounted to the wall with insulating stand-offs.

**.5 Connectors**

.1 All connections to the TBB will be accessible and located in a Communications room.

.2 Compression Taps:

.1 TBB will bond the PBB with each SBB (star configuration – individual TBBs) or;

.2 TBB will bond the PBB to the farthest SBB (riser configuration – one main TBB where SBBs between PBB and farthest SBB are tapped off).

.3 Compression Connectors (Lugs):

.1 General: Compression connectors will be used as a connection device from TBCs to SBBs.

.2 Bonding connections will be made with star-washers, dual bolts, triple crimp connectors, clamps, or lugs specifically designed for the purpose.

.3 A lug will be crimped to each end of the bonding conductor. Bonding conductors will be bolted on the appropriate ground busbar with a 6 mm copper alloy bolts and nuts.

.4 Leave 6 spare connectors in the MER and 4 spare connectors in each TR Communications Room.

.5 Prior to attaching a lug to a painted or galvanized surface, the paint will be scraped off to bare metal, to provide maximum contact. Paint Piercing washers will be used with the bolts.

.6 Install two-hole connectors in accordance with manufacturer's instructions.

.7 Copper lug for #6 AWG conductor, with two 6 mm bolt holes, or approved equivalent.

.8 Copper lug for 4/0 AWG conductor, with two 8 mm bolt holes, or approved equivalent.

.4 Connections to Conduits:

.1 Entrance Conduits: For connecting bonding conductor to all 103 mm rigid steel entrance conduits, use threaded insulated throat grounding bushings.

.5 Connections to Busbar:

.1 General: Compression connectors will be used as a connection device for TBC to SBBs.

.2 Standard barrel copper lug for #6 AWG conductor, with two 6 mm bolt hole.

.3 Standard barrel copper lug for 4/0 AWG conductor, with two 8 mm bolt holes.

.4 Two 8 mm lugholes, for all conductors between #4 AWG to 4/0 AWG conductors.

.5 Two 6 mm lugholes, for #6 AWG conductors.

.6 Connections to Communications Racks and Cabinets:

.1 General: Connectors will be used as a connection device for TBC’s to equipment racks. Paint will be removed from the rack location where the connector is attached to ensure metal to metal contact. Star washers will be used.

.2 Each rack will have a dedicated #6AWG bonding conductor homerun to the busbar. The racks will not be daisy-chained with a single bonding conductor back to the busbar.

.7 Connections to Structural Steel:

.1 Where shown on the Drawings, connect grounding conductors to structural steel using exothermic welds. Each particular type of weld will use a kit unique to that type of weld.

.8 Connections to Interlocking Armoured Fiber Optic Cable:

.1 Bond the armour of the cable at both ends of the cable with armoured flex connector’s c/w grounding bushings sized to suit the cable.

.2 Provide a #6 AWG green insulated ground cable and bond the TMG or PBB.

.9 Connections in Entrance Facility:

.1 Provide a Telecommunication grounding system as per drawings.

.2 Provide SBB.

*** END OF **GROUNDING and BONDING for COMMUNICATIONS SYSTEMS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 08 31 13 – Access Doors and Frames.

.2 Section 27 05 00 – Common Works for Communications Systems.

.3 Section 27 05 26 – Grounding and Bonding for Communications Systems.

.4 Section 27 05 53 – Identification for Communications Systems.

.5 Section 27 11 00 – Communication Rooms Fittings.

.6 Section 27 13 13 – Communications Copper Backbone Cabling.

.7 Section 27 13 23 – Communications Fiber Backbone Cabling

### .2 Documents

.1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

### .3 System Description

.1 The Communications Pathways consist of the following subsystems:

.1 Cable Tray System and various fittings – overhead (within the ceiling space) from the building entrance rooms, equipment rooms, and TRs throughout the building space.

.2 Conduit and fittings.

.3 Miscellaneous conduit fittings and products.

.4 Conduit sleeves, Firestop sleeves, Conduits.

.5 Wall outlet boxes.

.6 Floor boxes.

.7 Pull and junction boxes.

.8 Access Panels.

.2 Pathway design and space assignment will be coordinated with the mechanical, electrical, plumbing, and pneumatic tube systems designs.

.3 The work under this section will also include the planning and coordination with General Contractor (and other trades) of Communications system pathways, the furnishing of necessary materials, and the labour & associated services required to install Communications pathways.

### .4 Submittals

.1 General: Conform to Submittal requirements as described in Section 27 05 00 Common Works for Communications Systems.

## 2.0 PRODUCTS

### .1 Cable Tray

.1 Basket Tray:

.1 Application: Suitable for the support & management of Communications cables, either overhead or mounted vertically on a wall.

.2 Description: Cable basket will be made of steel wires and formed into a standard 50-mm by 100-mm or 50-mm by 50-mm wire mesh pattern. Wire intersections will be welded. Wire ends along sides (flanges) will be rounded during manufacturing for safety of installers and to prevent damage to cables.

.3 Material: Carbon steel wire, ASTM A510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

.4 CabloFil or Flextray is the approved basket tray.

.5 Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.

.6 Size: The minimum size tray in communication spaces is 457 mm wide x 152 mm deep unless specifically noted otherwise.

.7 Accessories: Corner, intersection, cable drop out, and attachment bracket fittings as indicated on drawings.

.8 Grounding: Terminal support and cable support for attachment on tray of continuous #6 AWG ground conductor fixing system.

.9 Electro-plated zinc: Support accessories and miscellaneous hardware will be coated in accordance with ASTM B633 SC3.

.10 Cable Label Clips: Mark and identify specific cable runs, electro-zinc plated steel.

.2 Ladder Tray:

.1 For the Corridors, provide 457 mm wide with a fill depth of 152 mm as shown on drawings. Use manufacturer accessory corner bracket kits for radius bends for all directional changes to the cable tray.

.2 Legrand is the approved manufacturer.

### .2 Electrical Metallic Tubing (EMT) and Fittings

.1 Per Division 26 specification.

.2 Minimum size 32mm. Provide 1x 32mm conduits to every outlet box. Increase conduit size based on 40% cable fill capacity.

.3 Conduit: Will be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication.

.4 Set Screw Steel type couplings: Electroplate steel or cast malleable iron; concrete tight, with insulated throat, using gland.

.5 Compression type connectors: Electroplated steel or cast malleable iron, concrete tight, with insulated throat.

**.3 PVC Conduit and Fittings**

.1 Per Division 26 specification.

.2 Bend radius, box size, conduit fill per reference standards.

**.4 Pull Boxes**

.1 Unless otherwise specified, the minimum size of a pull box will be 610 mm x 610 mm x 305 mm deep. Refer to Section 27 05 53 for labelling requirements.

**.5 Liquidtight Flexible Metallic Conduit (LFMC)**

.1 Conduit: Will be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquid tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.

.2 Fittings: Connector body and gland nut will be of cadmium plated steel or cast malleable iron, with tapered, male, threaded; insulated throat and neoprene “O” ring gasket recessed into the face of the stop nut. The clamping gland will be of moulded nylon with an integral brass push-in ferrule.

.3 Application: Suitable for an indoor installation for the support of Communications cables from a feed pathway to furniture systems or similar.

**.6 Communications System Outlet Boxes**

.1 A Communications outlet is the point at which the Communications equipment is connected to the network. The outlet consists of an outlet box and cover plate, connecting conduit, several jacks, and its connecting cables.

.2 Outlet boxes will be specified on drawing.

.3 Flush-Mount Box:

.1 Provide one-piece die formed or drawn steel, knockout type box of size and configuration as indicated on the Electrical Drawings. No sectional boxes.

.2 103 mm square by 103 mm deep will be minimum box size.

.3 Mud ring will be used on top of the electrical box to receive single gang outlet faceplate.

.4 Surface-Mount Box:

.1 Manufacturer:

.1 Wiremold:

.1 5500 or 5500A (in-line or offset with 5500 series surface raceway).

.2 V5744-2 (dual-gang for use with conduits).

.2 Panduit:

.1 JBP2D1W (132 mm x 132 mm x 70 mm dual-gang for use with Panduit).

**.7 Communications System Outlet Plates**

.1 Unless specified to the contrary, all outlet plates will be plastic with appropriate cut-outs and permanently marked designations, as specified in the outlet specifications of the related sections.

.2 Plastic plates will be the same colour as determined for the jack inserts. The architect's decision is final.

.3 Ensure that total depth of raceway and outlet plate is sufficient for terminating Horizontal cable and jacks.

**.8 Surface Raceways Products**

.1 Refer to Division 26 specifications.

**.9 Floor Boxes**

.1 Refer to Section 26 05 32 Outlet Boxes.

## 3.0 EXECUTION

**.1 General**

.1 The Contractor will supply and install a system of cable raceways consisting of a combination of cable tray and conduit. The cable trays extend horizontally from the Communications Rooms, down the hallways or corridors to become the backbone or main highway to support communications cables.

.2 Each communications outlet will be stubbed out to the nearest corridor onto the cable tray. If the cable tray is greater than 300mm from the stub out location, non-continuous open supports (J-hooks) are permitted.

.3 Install conduit and sleeves where required prior to pouring concrete. Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure to keep furring to a minimum.

.4 All raceway will be installed parallel to building lines, keeping cable run length at an absolute minimum.

.5 Where raceway size is not specified, the raceway will be sized to not exceed a 28% fill ratio after all the cables are installed.

.6 Mule tape will be left in all backbone raceways after installation of the cables.

.7 Mule tape will be Greenlee 4435 or approved equal for backbone conduits.

.8 The Contractor will ensure adequate support for raceways and cables dropping vertically to equipment where there is no wall support. Do not use wire lashing or perforated strap to support or secure raceways or cables.

.9 Explosive drive pins will not be allowed on the works without prior approval of the Communications Consultant. All fixings to be metal expansion type in pre-drilled holes. The Contractor will not use plastic expansion inserts or fittings. The Contractor will use coach screws, lag screws or wood screws, minimum 27 mm long, in wood construction.

.10 The Contractor will provide supports for equipment and materials supplied. The Contractor will provide all anchor bolts and other fastenings, where shown on or in tile walls or wall inadequate to support the equipment, provide angle or channel iron supports to bear the equipment, independent of the wall or conduit. All hangers, supports and brackets will be provided and installed to be consistent with the requirements of the B.C. Building Code.

.11 The Contractor will provide seismic bracing of tray. Following installation of all equipment and fixings, the Contractors will provide a seismic restraint structural review of the fixings of all devices which form part of the Communications infrastructure installation. The Contractor will provide a structural engineer registered as a Professional Engineer in the Province of British Columbia to sign and seal the report. The Contractor will reinstall, if necessary, supports for the equipment and fixings to the satisfaction of the structural engineer, at no additional cost.

.12 Cutting and Coring:

.1 It is expected that tradesmen skilled in their trades will do the work of that trade. Electricians performing painting, dry-walling or carpentry work will not be accepted.

.2 Ensure that all penetrations through floors or walls are patched to match adjoining finish. Penetrations through concrete are to be sealed with approved fire-stop material.

.3 Cutting and patching are to be done to architectural standards and will be inspected by the architect. Refer to the architectural specifications.

.4 Refer to Firestop Systems Section 27 05 29.

.5 Carpet at core locations is to be carefully cut out with a knife to the exact diameter of the pipe prior to coring if the pipe is to be exposed. Fire-stop from below at these locations.

**.2 Backbone Conduits and Sleeves**

.1 Backbone conduits and sleeves in Communications rooms will be shown on the drawings.

.2 Ducts will protrude 100 mm above finished floor level and will be encased in concrete.

.3 Riser ducts connecting vertically stacked Communications rooms may consist of sleeves that protrude 50 mm through the ceiling and or 100 mm through the floor. Vertically mounted mesh cable tray must be installed on walls to support backbone riser cables with VELCRO ties.

.4 After installation of the inter-building cables, the ducts will be closed with an approved re- enterable sealing material.

.5 Refer to Section 3.3 for further details concerning backbone sleeve requirements.

**.3 Pathways through Barriers**

.1 All communications cable trays that need penetrate through walls and where there is an accessible ceiling on both sides of the wall; will terminate on both sides of the wall and the following rated assembly will be installed:

.1 Provide a rated assembly through a gypsum wall penetration based on a HILTI Speed Sleeve Gang Plate assembly using 103 mm HILTI Speed sleeves.

.1 Provide 6 speed sleeves for a 457 mm cable tray.

.2 Provide a rated assembly through a concrete wall penetration based on a HILTI Speed Sleeve Gang Plate assembly using 103mm HILTI Speed sleeves.

.1 Provide 6 speed sleeves through concrete (cored holes) for a 457 mm cable tray.

.2 The installation of HILTI Speed sleeves in combination with HILTI Cast-in- place sleeves are acceptable provided a HILTI system drawing is provided during the shop drawing submittal phase.

.2 For communications riser sleeves penetrating a concrete floor inside communication rooms.

.1 Provide a rated assembly through a concrete floor penetration based on using 103 mm HILTI Speed sleeves through HILTI Cast-in-Place sleeves.

.3 For the installation of all other communication conduit pathways through fire rated barriers, refer to Firestop Section 27 05 29.

**.4 Cable Tray System**

.1 Provide cable tray in approximate location and general routing as shown on drawings.

.2 Cable trays are usually installed in the false ceiling space of hallways and located to keep conduit lengths to a minimum. When raceway is not installed in a readily accessible false ceiling space, access hatches will be installed at a nominal spacing of 9m.

.3 Do not route cable tray through Electrical room and Mechanical room spaces.

.4 Cable tray may require installation of risers, bends, etc. to adjust tray up or down as well as sideways for the tray routing to fit within limits of space available, and to clear other services, ducts, pipes etc. along the route. Routing may be adjusted somewhat as necessary to enable installation of services under other trades. Installation work planning and coordination will be required.

.5 Provide communication cable trays with depth and width as specified. Install 100 mm radius minimum inside bend kits and all manufacturer fittings required for a complete cable tray system. Provide an allowance for all changes in direction or elevation of the cable tray.

.6 Do not cut the basket tray for cable exit, instead use manufacturer dropout that is designed to be attached to the tray side with the dropout hanging over the tray. Adjust the tray layout such that the dropout enables the cables to be routed directly and fully into entire cross sectional area of the vertical cable managers, GigaBIX cable management modules or false wall. Perimeter basket tray inside the Communications room will be offset at about 250 mm from the wall to the near side of the tray for attachment of tray dropouts to deliver cables into GigaBIX cable termination field and management modules and any other low voltage wall-mount panels.

.7 Sharp metal edges in cable trays which could cut the cable will be smoothed and the cable dressed away from these edges. Manufacturer surface imperfections will be touched up with a cold galvanizing coating before installing cable.

.8 Connect the new cable tray system to the existing cable tray (if exists). Re-work existing tray ends to suit tie-in.

.9 Cable Tray Installation:

.1 The fill ratio for cable tray is 50% at substantial completion of the project. The remaining 50% is reserved for future growth capacity.

.2 Install cable system in accordance with manufacturer’s instructions and recognized industry practices, and ensure that the installed system complies with requirements of the “Manufacturer’s Cable Tray Installation Guidelines” pertaining to general electrical installation practices. Install cable system using splice connectors, support components, and other accessories by the same manufacturer.

.3 Provide supports for cable tray system at a maximum 1220 mm on centre and at both sides of each tray transition per a given route. Supports will be dual support hangers, trapeze hangers or wall brackets. Trapeze hangers will be supported by structurally approved anchoring system, and will consist of 9.5

mm (maximum size) threaded rod with appropriate hardware (nuts, washers, etc.).

.4 Provide materials necessary to properly support system from existing building structure per manufacturer's instructions and meeting or exceeding recognized industry practices, and as appropriate for this project. Provide special accessories as required to protect, support and install a cable tray system.

.5 Interface with Other Work:

.1 Field verify route prior to installation.

.2 Coordinate the installation of the cable tray system with other trades.

.3 Do not support from ductwork, piping, or other equipment hangers.

.6 Installation Clearances:

.1 Install system a minimum of 1220 mm from any motor.

.2 Install system a minimum of 150 mm from fluorescent light fixtures, or other EMI sources.

.3 Install system to allow a minimum of 305 mm above, 600 mm in front, and 75mm below of clearance from piping, conduits, ductwork, etc.

.7 Provide cable tray hangers between 150 mm and 305 mm above ceiling grid.

.8 Install tray support hangers between 150 mm and 305 mm above ceiling grid.

**.5 Conduit**

.1 All conduits will have sweeping bends with inside radius being no less than six (6) times the internal diameter of the conduit. For conduit 50mm or larger, the bend radius will be no less than ten (10) times the internal conduit diameter. Fittings such as LB type joints are not acceptable.

.2 Provide sweeping 90º bends for conduits where conduits are above cable trays and cables are running from the conduits to cable trays to create a water fall effect to reduce the strain on cables.

.3 When cable trays are used, conduit will be attached to the edge of the tray with a conduit bracket designed for this purpose. If this is not possible, conduit will be stubbed within 150 mm above the tray and terminate in a bonding type bushing.

.4 Install conduits and cables within new walls.

.5 All conduit will be fixed to or hung from building structure and will not be fixed to or hung from building services, i.e. ducts, pipes, electrical conduits, sprinkler pipes, etc. Install fastenings and supports at regular intervals as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations. Provide and correctly locate all hangers and clips for the installation of all work under this Division. They will be firmly secured to the structure.

.6 The Contractor will use rigid conduit for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade.

.7 Electrical Metallic Tubing (EMT) and Fittings:

.1 Electrical metallic tubing (EMT): Will be used to conceal interior low voltage cables where runs are concealed above suspended ceilings, in walls, furred spaces and crawl spaces.

.2 Preparation:

.1 Locations of conduit runs will be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and will not unnecessarily cross other conduits or pipe, nor block access to mechanical or electrical equipment.

.2 Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.

.3 All conduits will be run parallel or at right angles to the centrelines of columns and beams.

.4 Conduits will not be placed closer than 305 mm to a flue, parallel hot water, steam line or other heat producing source or 75 mm from such lines when crossing perpendicular to the runs.

.5 Exposed conduit installation will not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.

.6 In long runs of conduit provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 30 m. Support pull boxes from structure independent of conduit supports. Not all pull boxes are not indicated on the Drawings.

.7 Provide all reasonably inferred standard conduit fittings and products required to complete conduit installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not.

.3 Installation:

.1 Install conduit as indicated on Drawings and as specified herein.

.2 Install conduits in complete runs before pulling in cables or wires.

.3 Install conduit free from dents, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.

.4 Conduits will be well protected and tightly covered during construction using metallic bushings and bushing “pennies” to seal open ends.

.5 Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.

.6 Conduit systems will be mechanically and electrically continuous throughout.

.7 Metallic conduit will not be in contact with other dissimilar metal pipes (i.e. plumbing).

.8 Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.

.9 A run of conduit between terminations at wire pulling points will not contain more than the equivalent of two quarter bends (180 deg. total).

.4 Penetrations:

.1 Cutting of Holes:

.1 Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space. Obtain the approval of the Structural Engineer prior to drilling through structural sections.

.2 Firestop: Where conduits pass through fire rated partitions, walls, smoke partitions or floor; install a UL classified firestop material to provide an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the firestop material. Refer to Firestop Systems 27 05 29.

.3 Waterproofing: At floor, exterior wall and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

.4 For roof penetrations furnish and install roof flashing, counter flashing and pitch-pockets.

.5 Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane. Conduits that horizontally penetrate a waterproof membrane will fall away from and below the penetration on the exterior side a minimum of two times the conduit diameter.

.5 Termination and Joints:

.1 Use raceway fittings that are of types compatible with the associated raceway and suitable for use at the location.

.2 Raceways will be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.

.3 Conduits will be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

.4 Conduit terminations exposed at weatherproof enclosures and cast outlet boxes will be made watertight using specified connectors and hubs.

.6 Supports:

.1 All raceways systems will be secured to building structures using specified fasteners, clamps and hangers spaced according to the CEC.

.2 Support single runs of conduit using one-hole pipe straps. Where run horizontally on walls in damp or wet locations, install “clamp backs” to space conduit off the surface.

.3 Multiple conduit runs will be supported using “trapeze” hangers fabricated from specified construction channel, mounted to 9.5 mm diameter and threaded steel rods secured to building structures. Fasten conduit to construction channel with standard one-hole pipe clamps or the equivalent. Provide lateral seismic bracing for hangers.

.4 Fasteners and supports in solid masonry and concrete:

.1 Use steel or malleable iron concrete inserts set in place prior to placing the concrete.

.5 After concrete installation:

.1 Steel expansion anchors not less than 6 mm bolt size and not less than 28 mm embedment.

.2 Power set fasteners not less than 6 mm diameter with depth of penetration not less than 75 mm.

.3 Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

.6 Hollow masonry: Toggle bolts are permitted. Bolts supported only by masonry block are not acceptable.

.7 Metal structures: Use stainless steel machine screw fasteners or other devices specifically designed and approved for the application.

### .6 Outlet Boxes

.1 Preparation:

.1 Locate pull boxes and junction boxes in accessible locations.

.2 Install outlet boxes at the locations and elevations indicated on the Drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of construction conditions.

.2 Installation:

.1 Install boxes as indicated on Drawings and as specified herein.

.2 Do not install outlets back-to-back in wall; and allow a minimum of 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, provided distance does not exceed 3 m, and information is given before installation.

.4 Locate electrical boxes as indicated on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.

.5 Install junction or pull boxes where required to limit bends in conduit runs to not more than 180 degrees or where pulling tension achieved will exceed the maximum allowable for the cable to be installed. Note that these boxes are not indicated on the Drawings.

.6 Leave no unused openings in any box. Install close-up plugs as required to seal openings.

.7 Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations or located in hazardous areas.

.8 Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit directions only. Do not make splices in conduit outlet bodies.

.9 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.10 If mounting height of equipment is not specified or indicated, verify with Communications Consultant before proceeding with the installation.

.11 Communications Outlets:

.1 Above finished floors – match mounting height of power receptacles.

.2 Above counters splash backs – match mounting height of power receptacles.

.3 Supports:

.1 Support boxes independently of conduit system.

.2 Support boxes, mounted above suspended acoustical tile ceilings, directly from the structure above.

**.7 Access Panel**

.1 Install access panel per specification section 08 31 13 Access Doors and Frames.

**.8 Pull Boxes**

.1 Pull boxes installed inside accessible ceilings will be within 600 mm of T-bar ceiling grid for ease of access in future.

**.9 Surface Raceways Installation**

.1 Install Wiremold raceway where indicated on the drawings for power and Communications outlets.

.2 The surface raceway will parallel building lines and hug ceilings, baseboards, and corners. Raceway length will be kept to a minimum.

.3 The surface raceway base will be mechanically fastened to walls and supporting structures. Use of double-sided tape alone is not acceptable. For non-metallic surface raceway the maximum spacing of fastener is 400 mm. The recommended fasteners are as follow:

.1 Masonry surface – Tapcon masonry type fastener, 6 mm dia.

.2 Dry wall with no stud – Toggler AF “Alligator type” anchor. AF8 or AFG6.

.3 Dry wall with stud – Dry wall screw.

.4 The surface raceway will maintain its integrity when passing through a wall or supporting structure. The raceway cover will be cut 100 mm from either side of the penetration.

.5 Surface raceway extending into the ceiling will connect to the conduit extending from the cable tray with the appropriate fitting or pull box.

.6 When installing surface raceway, manufactured bends and fittings must be used.

.7 Installation will be in accordance with the manufacturer's instructions.

.8 Wire clips will be installed in two-piece surface raceway installations at 450 mm centres.

.9 Additional wire clips will be used when the raceway is secured to a ceiling or large amounts of cables are installed.

.10 When installing cable in surface raceway, cable fill will not exceed 28%.

.11 Provide lockable access panels at location of all pull boxes.

*** END OF **PATHWAYS for COMMUNICATIONS SYSTEMS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts;

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 28 – Pathways for Communications Systems.

.3 Section 27 11 00 – Communication Rooms Fitting.

### .2 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 The Contractor will submit to Consultant for approval, the following items relating to the fire-stop system:

.1 HILTI Speed Sleeve manufacturer, or approved alternative, technical data for each product intended to be used on site including product description, specifications and storage requirements.

.3 Firestop design documentation will include a schedule indicating:

.1 Listed firestop system tested to ULC-S115.

.2 Number of firestop locations.

.3 Type of penetration.

.4 Type of building construction at point of penetration.

.5 Hourly fire-rating of floors and walls.

.6 Firestop device or system proposed.

.7 Installation Procedures and Material Safety Data Sheets will be included with products delivered to the job site.

.8 Maintenance manuals and maintenance data that may be published by Manufacturer.

### .3 As-Built Documentation

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

### .4 References

.1 CAN/ULC-S115-11, Standard Method of Fire Tests of Through Penetration Firestops.

.2 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E814, Standard Method of Fire Tests of Through-Penetration Firestops.

.4 UL 1479, Fire Tests of Through-Penetration Firestops.

.5 UL Fire Resistance Directory: Through Penetration Firestop Devices (XHCR) and Through Penetration Firestop Systems (XNEZ).

.6 ASTM E119, Fire Tests of Building Construction and Materials (for fire-rated architectural barriers).

.7 ASTM G-21, Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.8 BICSI - Current Edition, Telecommunications Distribution Methods Manual (TDMM), Chapter 11, Firestopping.

.9 Factory Mutual Approval Guide.

.10 ULC List of Equipment and Materials, VOL. II.

.11 Current Canadian Electrical Code.

.12 Current BC Building Code.

.13 Installed firestopping systems will meet approval of Local Authorities having jurisdiction.

**.5 Quality Assurance**

.1 A manufacturer's direct representative (account manager, fire protection specialist, not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

.2 For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's firestop custom detail derived from similar UL system designs or other tests will be submitted to the Owner for their review and approval prior to installation. Firestop custom detail drawings must follow requirements set forth by the International Firestop Council.

.3 Manufacturer’s fire protection specialist to provide site walk-through report detailing visual review of a random sampling of applications.

**.6 Training**

.1 The Contractor must receive training through the Firestop University program offered from HILTI, or approved alternative, and possess current certification prior to installing firestop products.

## 2.0 PRODUCTS

### .1 General

.1 Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

.2 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.

.2 T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.

.3 W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

.3 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

.4 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.2.

### .2 Specific Requirement

.1 For communications rooms, provide the Hilti CP-653-4” speed sleeves in the walls. For riser sleeves, use a combination of Hilti CP 680 cast-in-place firestop devices c/w CP- 653- 4” speed sleeves inserted into them. Refer to the Hilti Systems drawing.

.2 Refer to Hilti FL3060 system drawing and C-STD-033.3 Cast-in place/Speed sleeve firestop drawing.

.3 Use the Hilti ganging wall plate when installing 2 or more Hilti Speed sleeves.

### .3 Acceptable Manufacturers

.1 Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

.1 Hilti, Inc., Tulsa, Oklahoma 800-879-8000 www.us.hilti.com

.2 Provide products from the above acceptable manufacturer; only reviewed and approved alternates can be used as substitutions.

### .4 Materials

.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.2 Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire- rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.3 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:

.1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.

.2 Hilti Firestop Sleeve (CFS-SL SK).

.3 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.

.4 Hilti Cable Collar (CFS-CC).

.5 Hilti Gang plate (CFS-SL GP) for use with multiple cable management devices.

.6 Hilti Gang plate Cap (CFS-SL GP CAP) for use at blank openings in gang plate for future penetrations.

.4 Pre-formed, round firestop devices with integrated intumescent strips for use with non-combustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls, the following products are acceptable:

.1 Hilti Cast-In Place Firestop Device (CP 680-P) for use with combustible penetrants.

.2 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non- combustible penetrants.

.3 Hilti Speed Sleeve (CP 653) for use with cable penetrations.

.4 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.

.5 Sealants, foams or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

.1 Hilti Intumescent Firestop Sealant (FS-ONE).

.2 Hilti Fire Foam (CP 620).

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG).

.6 Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles, and plastic pipe, the following products are acceptable:

.1 Hilti Intumescent Firestop Sealant (FS-ONE).

.7 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti Intumescent Firestop Sealant (FS-ONE).

.2 Hilti Fire Foam (CP 620).

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG).

.8 Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti Firestop Putty Stick (CP 618).

.2 Hilti Firestop Plug (CFS-PL).

.9 Wall opening protective materials for use with U.L. listed metallic and specified non-metallic outlet boxes, the following products are acceptable:

.1 Hilti Firestop Putty Pad (CFS-P PA).

.2 Hilti Firestop Box Insert.

.10 Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

.1 Hilti Firestop Mortar (CP 637).

.2 Hilti Firestop Block (CFS-BL).

.3 Hilti Fire Foam (CP 620).

.4 Hilti Firestop Board (CP 675T).

.11 Non-curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Firestop Board (CP 675T).

.12 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Firestop Plug (CFS-PL).

.13 The Contractor will use firestop materials that have no irritating or objectionable odours, when firestopping occupied areas of existing buildings.

.14 Firestop products used in cross-sectional areas of pathway such as inside sleeves, or cable tray penetrations of fire barriers will be of re-enterable and reusable type to enable future Moves, Additions, or Changes.

## 3.0 EXECUTION

### .1 Coordination

.1 Firestop systems installed by the Contractor will meet the requirements of all applicable codes and ULC standards.

.2 The Contractor will firestop new Communication pathway and/or cable penetrations of building fire barriers with an approved firestop system, following cable installation.

.3 The Contractor will firestop with an approved firestop system, any holes created by the Work of this Contract.

.4 The Contractor will coordinate all Work with Division 26 and the site's Facilities Maintenance and Operations department.

.5 The Contractor will obtain inspection approval from local Authority Having Jurisdiction (AHJ) and the site's Facilities Maintenance and Operations department and will be responsible for all associated costs.

.6 The Contractor will provide equipment, materials, labour, and services not specifically mentioned or shown which may be necessary to complete or perfect all parts of this installation and in compliance with requirements stated or reasonably inferred by the Contract Documents.

### .2 Installation

.1 The Contractor will select appropriate firestop assembly to suit the type of penetration and base the selection on criteria specified herein.

.2 Selected firestop systems will not be less than the hourly fire-ratings indicated in the Contract Documents for each respective penetration through fire-rated floor, wall, or other partition of building construction.

.3 Firestop for each type of penetration will conform to manufacturer's firestop design drawings or approved modifications and meet requirements of an independent testing laboratory.

.4 The Contractor will perform all necessary coordination with trades constructing floors, walls, or other partitions with respect to size and shape of each opening, device, or

firestop system approved for use in each instance. Also, the Contractor will resolve any feasibility or obstruction issues.

.5 In areas accessible to public and other "finished" areas, the Contractor will prepare the surface area surrounding firestop penetrations to match finished quality of adjoining surfaces.

.6 The Contractor will provide damming materials, plates, wires, restricting collars, and devices necessary for proper installation of a firestop system.

.7 The Contractor will remove combustible installation aids after firestopping material has cured.

.8 All Firestop assemblies will be installed in accordance with the manufacturer instructions in order to maintain the specific rating assigned by the independent testing laboratory.

.9 The Contractor will remove excess materials and debris and clean adjacent surfaces immediately after application.

**.3 Existing Penetrations**

.1 In existing buildings, the Contractor will firestop any gaps or cavities between penetrating cable tray, ducts, or sleeves and surrounding surface area.

.2 The Contractor will firestop with an approved firestop system, the following existing penetrations of building fire barriers:

.1 Existing Communication pathway, cables, or penetrations that are not fire-stopped and are within 1 m (3') of new Communication pathway, or cable penetrations of fire barriers.

.2 Existing Communication cables abandoned by the Work of this Contract.

.3 Firestop assemblies consisting of wrap around individual steel collar sections complete with intumescent putty material that completely surround penetrations, will be used for non- metallic pipes.

**.4 Masonry Pointing Pattern**

.1 Where firestop systems penetrate masonry barriers, the Contractor will make good surrounding area by replicating original pointing pattern and matching in quality of workmanship.

**.5 Inspecting Authorities**

.1 The Contractor will remove and expose firestop systems to the extent directed by Inspecting Authority for the purpose of carrying out the inspection.

.2 The Contractor will re-install firestop system and restore any affected building components removed for inspection, at no cost design.

*** END OF **FIRESTOP SYSTEMS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 28 – Pathways for Communications Systems.

.3 Section 27 11 00 – Communication Room Fittings.

.4 Section 27 13 13 – Communications Copper Backbone Cabling.

.5 Section 27 13 23 – Communications Fiber Backbone Cabling.

.6 Section 27 21 33 – Data Communications Wireless Access Points.

### .2 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Submit shop drawings for:

.1 Samples of methods of labelling and materials.

.2 Sample database sheet for cable identification.

## 2.0 PRODUCTS

### .1 Labels

.1 Labels for GigaBIX termination hardware.

.1 Labels are supplied in coloured sheets:

.1 White - LAN, PBX, Multiplexer.

.2 Green label - Entry connect.

.3 Blue label – Horizontal.

.4 Purple label - 1st level Backbone.

.5 Grey label - 2nd level Backbone.

.6 Brown label - Inter-building.

.2 Substitutes are not accepted.

.2 Colour scheme for jack inserts in patch panel is black.

.3 Colour scheme for jack inserts in faceplates is <Table A, Work Area Jack Insert Colour>.

.4 Colour scheme for faceplates:

.1 Faceplates will be the same colour as determined for the jack inserts.

.5 Cable label for indoor cable and indoor/outdoor Interlocking armoured type fiber optic cables,

.1 Label type for cable labels: Labels will be pre-cut for quick and easy application.

.2 Labels will be in self-adhesive polyester or non-adhesive polyester (depending on label type).

.3 Product: Panduit S050X-xxx-VAC or approved equal.

.6 Fiber Optic Cable label for marking cables inside outdoor pull-pits and manholes.

.1 Self-Laminating Rigid Vinyl equal to Panduit PST-FO or approved equal.

.2 Labels shall include the cable ID and the text “BCIT FIBRE”.

## 3.0 EXECUTION

### .1 Installation

.1 Unless specified otherwise, designation labels on outlet plates will be machine- printed on tape and inserted in the top label windows of faceplates, as detailed in these and related specifications. Alternate methods must be submitted to the Communications Consultant for approval. Lamacoid labels will not be accepted.

.2 After terminating and identifying a Communications cable, each cable will be identified with a unique cable number, as detailed in these and related specifications. The Contractor will populate cable information without any modification to a cable database and provide database file in .xlsx and .pdf formats.

.3 All backbone fiber optic cables after exiting conduits will be labelled at each end as well as within 1 meter of each side of a wall or floor slab the cable passes through. Identify destination and originating Communications room number on each wrap around cable label, as detailed in these and related specifications.

.4 Labelling will conform to standard faceplate detail on the drawings.

.5 Label strips or equal will be approved by the Consultant. The Communications Contractor will label each outlet with 9 mm high black on white mechanical label.

.6 Unless specified otherwise, all labels will be machine-printed. Brother "P-touch" electronic labelling system, or approved equal by the Consultant. Hand-lettered labels will not be accepted.

.7 Distribution terminals will use standard TIA colour coding on all terminations as follows:

.1 Green = Termination of network connection on the customer side of the demarcation point.

.2 White/Silver = Termination of cables originating from common equipment (PBXs, computers, LANs and multiplexers).

.3 Brown = Inter-building Backbone.

.4 Purple = First-level Backbone. Riser/Backbone and between Communications rooms.

.5 Blue = Stations served directly from closets, i.e. horizontal wiring.

.6 Grey = Second-level Backbone.

.8 Faceplate Work Area,

.1 Faceplates will have the following labels:

.1 <Table A, Faceplate Labels>.

.9 Patch Cable and Icon Colours,

.1 Jacket colour for all Copper patch cables shall be <Table A, Patch Cable Colour>.

.10 Communications Racks,

.1 Communications racks will be labelled at the top middle of the rack frame on the front as R1. The second rack will be labelled as R2 and so on towards the inside of the room.

.2 The numbers and not the background will be 50 mm high x 40 mm wide engraved on lamacoid in permanent White on Black background.

.11 UTP Horizontal Cable

.1 Communications horizontal cables will be identified at each termination end with a unique number at the faceplate (outlet jack), at the patch panel and on both ends of the cable jacket, <Table A, Horizontal Cable Labels>.

.12 Backbone Fibre Cabling,

.1 Provide a cable label at each end as well as within 1 m of both sides of any wall and floor penetrations. Use wrap around labels inside a building. Label can be arranged in two line with the following format, e.g. 48 strands OS2 SM from NW04-1003 to NW04-3003:

.1 48 strands - Represents strand count.

.2 OS2 SM - Represents type.

.3 NW04 - Represents originating building number.

.4 1003 - Represents originating room number.

.5 NW04 - Represents destination building number.

.6 3003 - Represents destination room number.

.2 Size of font is to be as maximum as possible, depending on the diameter of the cable.

.13 Backbone Copper Cabling,

.1 The first GigaBIX mount on the lower half of the GigaBIX frame will be reserved for Entrance cables.

.2 Backbone Copper cable will be identified at both ends. Example: RM1003/RM3003.

.1 RM1003 - Represents origin room number.

.2 RM3003 - Represents destination room number.

.3 Backbone Copper cables from the GigaBIX mount to the racks (CAT5e) will be terminated on 24-port patch panels that are labelled as VP1, VP2, etc. in the rack. On the GigaBIX frame, mounts will appear sequentially starting at the top frame.

.4 GigaBIX designation strips will identify the origin, destination and pair counts.

.14 Fibre Patch Panel Lablel,

.1 Add Alpha Numeric ID on each patch panel. First patch panel starts with “FP1”, then “FP2” and so on sequentially for each rack. Restart counter for adjacent rack.

.2 Size of font is to be as maximum as possible.

.15 Copper Patch Panel Label,

.1 <Table A, Patch Panel Labels>.

.16 Telecommunications Ground,

.1 Bonding conductors will be identified on both ends of the conductors, with data plate cable marker completed with double straps, to indicate where the destination end of the conductor is located.

.2 Telecommunications Bonding Backbone (TBB) Label example:

.1 CM1003-PBB/CM2003-SBB.

.3 Bonding Conductor from Busbar to and Object Example:

.1 CM1003-PBB/Object e.g. building steel, cable trays, etc. at both ends prior to conductor routed into its termination.

.4 Label TBB every 6 m and within 1 m of both sides of any wall and floor penetrations with the description: “Communications Ground Only” The lettering size is 6 mm white on green background.

.5 Examples of Telecommunications Ground Bar Labelling PBB Busbar Label:

.1 CM1003-PBB.

.2 CM2003-SBB.

.17 Communications Pull Boxes and Junction Boxes,

.1 Identify all pull boxes and junction boxes using spray paint on the cover. Neatly identify the relevant system and circuit ID using permanent marker pen. Utilize green for communications colour bands.

.18 Wireless Access Points (WAPs),

.1 <Table A, Wireless Access Points Labels>.

.2 Contractor shall supply a WAPs schedule indicating the location (room name and number), MAC address, serial number and data drop number for each owner-supplied, contractor-installed WAP.

*** END OF **IDENTIFICATION for COMMUNICATIONS SYSTEMS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 11 00 – Communication Room Fittings.

.3 Section 27 15 00 – Horizontal Cabling.

### .2 Work Included

.1 Provide all labour, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of a Horizontal Cat5E/6/6A cabling system.

.2 The Communications Contractor will survey the work areas and coordinate cabling testing with other applicable trades.

.3 In addition to the tests detailed in this document, the contractor will notify the Consultant of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor will carry out and record any additional measurement results at no additional charge.

### .3 Scope

.1 This Section includes the minimum requirements for the test certification of horizontal Category 5e/6/6A balanced twisted pair cabling.

.2 This Section includes minimum requirements for:

.1 Copper cabling test instruments.

.2 Copper cabling testing.

.3 Administration;

.1 Test results documentation.

.2 As-built drawings.

.3 Testing will be carried out in accordance with this document.

.4 Testing will be performed on each cabling link. (100% testing).

.5 All tests will be documented.

### .4 Quality Assurance

.1 All testing procedures and field-test instruments will comply with applicable requirements of:

.1 ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.

.2 ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.

.3 ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard.

.4 ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

.5 ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the Owner.

.2 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof will execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

.1 Manufacturer of the connectors or cable.

.2 Manufacturer of the test equipment used for the field certification.

.3 Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida).

.3 The Consultant will be invited to witness and/or review field-testing.

.1 The Communications Consultant will be notified of the start date of the testing phase five (5) business days before testing commences.

.2 The Communications Consultant may select a random sample of up to 5% of the installed links. The Communications Consultant will witness the testing of these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained will be compared to the original data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Communications Consultant will repeat 100% testing at no cost to the Owner.

**.5 Acceptance of Test Results**

.1 Unless otherwise specified by the Owner or the Owners representative, each Category 5E/6/6A cabling link will be in tested for:

.1 Wire Map.

.2 Length.

.3 Propagation Delay.

.4 Delay Skew.

.5 DC Loop Resistance – recorded for information only.

.6 DC Resistance Unbalance – recorded for information only.

.7 Insertion Loss.

.8 NEXT (Near-End Crosstalk).

.9 PS NEXT (Power Sum Near-End Crosstalk).

.10 ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only.

.11 PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only.

.12 ACR-F (Attenuation to Crosstalk Ratio Far-End).

.13 PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End).

.14 Return Loss.

.15 TCL (Transverse Conversion Loss) – recorded for information only.

.16 ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only.

.17 PS ANEXT (Power Sum Alien Near-End Crosstalk) – sampled per section 3.2 (Cat.6A).

.18 Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk) – sampled per section 3.2 (Cat.6A).

.19 PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) - sampled per section 3.2 (Cat.6A).

.20 Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.2 (Cat.6A).

.2 All installed cabling Permanent Links will be field-tested and pass the test requirements and analysis as described in Part 3. Any Permanent Link that fails these requirements will be diagnosed and corrected. Any corrective action that must take place will be documented and followed with a new test to prove that the corrected Permanent Link meets performance requirements. The final and passing result of the tests for all Permanent Links will be provided in the test results documentation in accordance with Part 3.

.3 Acceptance of the test results will be given in writing after the project is fully completed and tested to the satisfaction of the Consultant.

## 2.0 PRODUCTS

### .1 Products

Consultants are to provide complete specifications, and review these Technical Standards documents to include BCIT requirements within the specifications as applicable to the project.

.1 Balanced twisted-pair Cable Testers;

.1 The field-test instrument will be within the calibration as minimum of 12 month period or as recommended by the manufacturer.

.2 Certification tester;

.1 Accuracy;

.1 Level III accuracy in accordance with ANSI/TIA-1152.

.2 Independent verification of accuracy.

.3 Acceptable manufacturers:

.1 Fluke Networks.

.2 Permanent Link Adapters;

.1 RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568-C.2 Annex C.

.2 Twisted pair Category 5e, 6 or 6A cords are not permitted as their performance degrades with use and can cause false Return Loss failures.

.3 Results Storage;

.1 Must be capable of storing > 10,000 results for all measurements found in 2.1.B.4 below.

.4 Measurement Capabilities;

.1 Wire Map.

.2 Length.

.3 Propagation Delay.

.4 Delay Skew.

.5 DC Loop Resistance.

.6 DC Resistance Unbalance.

.7 Insertion Loss.

.8 NEXT (Near-End Crosstalk).

.9 PS NEXT (Power Sum Near-End Crosstalk).

.10 ACR-N (Attenuation to Crosstalk Ratio Near-End).

.11 PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End).

.12 ACR-F (Attenuation to Crosstalk Ratio Far-End).

.13 PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far- End).

.14 Return Loss.

.15 TCL (Transverse Conversion Loss).

.16 ELTCTL (Equal Level Transverse Conversion Transfer Loss).

.17 Time Domain Reflectometer.

.18 Time Domain Xtalk Analyser.

.19 PS ANEXT (Power Sum Alien Near-End Crosstalk) (Cat.6A).

.20 Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk) (Cat.6A).

.21 PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) (Cat.6A).

.22 Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End) (Cat.6A).

.5 PC Software;

.1 Windows® based.

.2 Must show when 3 dB and 4 dB rules are applied.

.3 Re-certification capability, where results must have their Cable IDs suffixed with (RC).

.4 Built in PDF export – no additional third party software permitted.

.5 Built-in statistical analysis.

## 2.0 EXECUTION

### .1 General

.1 All outlets, cables, patch panels and associated components shall be fully assembled and labelled prior to field-testing. Any testing performed on incomplete systems will be redone on completion of the work.

### .2 Category 5E/6/6A Balanced Twisted Pair Cable Testing

.1 Field-test instruments will have the latest software and firmware installed.

.2 Permanent Link test results including the individual frequency measurements from the tester will be recorded in the test instrument upon completion of each test for

subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

.3 Permanent Link testing will be performed on each cabling segment (connector to connector). Sampling is not acceptable.

.4 Alien Crosstalk testing will be performed using a sampling plan. An acceptance quality level (AQL) of 0,4 %, normal inspection, general inspection level I as defined in ISO 2859- 1 for populations of up to 500,000 links will be used. The following table represents this sampling level. (Cat6A).

.5 Disturbed (Victim) links chosen for Alien Crosstalk testing will be an equal combination of short, medium and long links. (Cat.6A).

.6 Permanent Link adapters made from twisted pair Category 5e, 6 or 6A cords are not permitted as their performance degrades with use and can cause false Return Loss failures.

.7 The installer will build a reference link. All components will be anchored so it is not possible to disturb them. The technician is to conduct a Category 6A Permanent Link test each day to ensure no degradation of the tester or its Permanent Link adapters.

.8 Wire Map Measurement:

.1 The wire map test is intended to verify pin-to-pin termination at each end and check for installation connectivity errors. For each of the 8 conductors in the cabling, the wire map indicates:

.1 Continuity to the remote end.

.2 Shorts between any two or more conductors.

.3 Reversed pairs.

.4 Split pairs.

.5 Transposed pairs.

.6 Distance to open on shield.

.7 Any other miss-wiring.

.2 The correct connectivity of telecommunications outlets/connectors is defined in ANSI/TIA-568-C.2. T568A will be used. The field tester will use this colour scheme.

.9 Length Measurement;

.1 The length of each balanced twisted pair will be recorded.

.2 Since physical length is determined from electrical length, the physical length of the link calculated using the pair with the shortest electrical delay will be reported and used for making the pass or fail determination.

.3 The pass or fail criteria is based on the maximum length allowed for the Permanent Link as specified in ANSI/TIA-568-C.2 plus the nominal velocity of propagation (NVP) uncertainty of 10%. For a Permanent Link, the length measurement can be 325 ft. (99 m) before a fail is reported.

.10 Propagation Delay measurement is the time it takes for a signal to reach the end of the link.

.1 The measurement will be made at 10 MHz per ANSI/TIA-1152.

.2 The propagation delay of each balanced twisted pair will be recorded.

.3 Is not to exceed 498 ns per ANSI/TIA-568-C.2 Section 6.3.18.

.11 Delay Skew measurement is the difference in propagation delay @ 10 MHz between the shortest delay and the delays of the other wire pairs.

.1 The delay skew of each balanced twisted pair will be recorded.

.2 Is not to exceed 44 ns per ANSI/TIA-568-C.2 Section 6.3.19.

.12 DC Resistance;

.1 Often reported as Resistance, is the loop resistance of both conductors in the pair.

.2 Is not specified in ANSI/TIA-1152, but will be recorded for all four pairs.

.13 DC Resistance Unbalance;

.1 Often reported as Resistance Unbalance, is the difference in resistance of the two wires within the pair.

.2 Is not specified in ANSI/TIA-1152 for a Permanent Link, but will be recorded for all four pairs.

.14 Insertion Loss is the loss of signal strength over the cabling (in dB);

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Worst case will be reported for all four pairs in one direction only.

.3 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.4 Is not to exceed the Category 5e/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.7.

.15 NEXT (Near-End Crosstalk) is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other wire pairs at the same end of the cabling.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions. (12 pair to pair possible combinations).

.3 Both worst case and worst margins will be reported.

.4 Is not to exceed the Category 5e/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.8.

.5 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.6 The Time Domain Xtalk data will be stored for any marginal or failing NEXT results.

.16 PS NEXT (Power Sum Near-End Crosstalk) is the difference (in dB) between the test signal and the crosstalk from the other pairs received at the same end of the cabling.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions. (8 pair possible combinations).

.3 Both worst case and worst margins will be reported.

.4 Is not to exceed the Category 5E/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.9.

.5 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.6 The Time Domain Xtalk data will be stored for any marginal or failing PS NEXT results.

.17 ACR-N (Attenuation Crosstalk Ratio Near-End) is a calculation of NEXT minus Insertion Loss of the disturbed pair in dB.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be calculated in both directions.

.3 Is not specified in ANSI/TIA-1152, but will be recorded for all 12 possible combinations.

.18 PS ACR-N (Power Sum Attenuation Crosstalk Ratio Near-End) is a calculation of PS NEXT minus Insertion Loss of the disturbed pair in dB.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be calculated in both directions.

.3 Is not specified in ANSI/TIA-1152, but will be recorded for all 8 possible combinations.

.19 ACR-F (Attenuation Crosstalk Ratio Far-End) is a calculation of FEXT minus Insertion Loss of the disturbed pair in dB.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions. (24 pair to pair possible combinations).

.3 Both worst case and worst margins will be reported.

.4 Is not to exceed the Category 5E/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.11.

.5 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.20 PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End) is a calculation of PS FEXT minus Insertion Loss of the disturbed pair in dB.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions. (8 pair possible combinations).

.3 Both worst case and worst margins will be reported.

.4 Is not to exceed the Category 5E/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.13.

.5 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.21 Return Loss is the difference (in dB) between the power of a transmitted signal and the power of the signals reflected back.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions. (8 pair possible combinations).

.3 Both worst case and worst margins will be reported.

.4 Will be ignored at all frequencies where the Insertion Loss is less than 3 dB for that pair.

.5 Is not to exceed the Category 5E/6/6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.6.

.6 Reported margins found to be within the accuracy of the field tester will be marked with an asterisk (*).

.7 The Time Domain Reflectometer data will be stored for any marginal or failing Return Loss results.

.22 TCL (Transverse Conversion Loss) is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the near-end on the same wire pair.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions.

.3 Is not specified in ANSI/TIA-1152 for a Permanent Link, but will be recorded for all 8 possible combinations.

.23 ELTCTL (Equal Level Transverse Conversion Transfer Loss) is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the far end on the same wire pair minus the Insertion Loss of that pair.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz (Cat.6/6A).

.4 250 – 500 MHz: 1000 kHz (Cat.6A).

.2 Will be measured in both directions.

.3 Is not specified in ANSI/TIA-1152 for a Permanent Link, but will be recorded for all 8 possible combinations.

.24 PS ANEXT (Power Sum Alien Near-End Crosstalk) (Category 6A).

.1 Takes into account the combined alien crosstalk (statistical) on a receive pair from all external near-end disturbers operating simultaneously.

.2 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz.

.4 250 – 500 MHz: 1000 kHz.

.3 The disturbed (victim) link will have links to the left and right of it and if present, links above and below it.

.4 Disturber cables will include all links within the same bundle as the disturbed (victim) link and adjacent links.

.5 Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it will be measured from the patch panel end only.

.6 Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.21.

.25 Average PS ANEXT (Power Sum Alien Near-End Crosstalk) (Category 6A) is calculated by averaging the individual PSANEXT loss values, in dB, for all four pairs in the disturbed (victim) link.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz.

.4 250 – 500 MHz: 1000 kHz.

.2 Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.22.

.26 PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) (Category 6A).

.1 AFEXT loss is the coupling of crosstalk at the far-end from external link pairs into a disturbed (victim) pair of the 4-pair link under test. PS AACR- F is the calculated power sum from all external pairs into the disturbed (victim) pair.

.2 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz.

.4 250 – 500 MHz: 1000 kHz.

.3 The disturbed (victim) link will have links to the left and right of it and if present, links above and below it.

.4 Disturber cables will include all links within the same bundle as the disturbed (victim) link and adjacent links.

.5 Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it will be measured from the patch panel end only.

.6 Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.25.

.27 Average PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) (Category 6A) is calculated by averaging the individual PS AACR-F values, in dB, for all four pairs in the disturbed (victim) link.

.1 The frequency resolution will be:

.1 1 – 31.25 MHz: 150 kHz.

.2 31.25 – 100 MHz: 250 kHz.

.3 100 – 250 MHz: 500 kHz.

.4 250 – 500 MHz: 1000 kHz.

.2 The disturbed (victim) link will have links to the left and right of it and if present, links above and below it.

.3 Disturber cables will include all links within the same bundle as the disturbed (victim) link and adjacent links.

.4 Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it will be measured from the patch panel end only.

.5 Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.26.

**.3 Administration**

.1 Test results documentation;

.1 Test results saved within the field-test instrument will be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records will be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”. The file format, CSV (comma separated value), does not provide adequate protection of these records and will not be used.

.2 Alien Crosstalk measurements will be stored to a PC upon completion of the test.

.3 The test results documentation will be available for inspection by the Communications Consultant during the installation period and will be passed to the Communications Consultant within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer will retain a copy to aid preparation of as- built information.

.4 The database for the complete project, including twisted-pair copper cabling links, if applicable, will be stored and delivered via Aconex to Consultant acceptance of the building. The Communications Contractor will include the software tools required to view, inspect, and print any selection of the test reports.

.5 Circuit IDs reported by the test instrument shall match the specified label ID. For Permanent Link testing, the detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and will contain the following information:

.1 The overall Pass/Fail evaluation of the link-under-test.

.2 The date and time the test results were saved in the memory of the tester.

.3 The identification of the customer site as specified by the end-user.

.4 The name of the test limit selected to execute the stored test results.

.5 The name of the personnel performing the test.

.6 The version of the test software and the version of the test limit database held within the test instrument.

.7 The manufacturer, model and serial number of the field-test instrument.

.8 The adapters used.

.9 The factory calibration date.

.10 Wire Map.

.11 Propagation Delay values, for all four pairs.

.12 Delay Skew values, for all four pairs.

.13 DC Resistance values, for all four pairs.

.14 DC Resistance Unbalance, values for all four pairs.

.15 Insertion Loss, worst case values for all four pairs.

.16 NEXT, worst case margin and worst case values, both directions.

.17 PS NEXT, worst case margin and worst case values, both directions.

.18 ACR-F, worst case margin and worst case values, both directions.

.19 PS ACR-F, worst case margin and worst case values, both directions.

.20 Return Loss, worst case margin and worst case values, both directions.

.21 TCL, worst case values both directions.

.22 ELTCTL, worst case values, both directions.

.23 Time Domain Crosstalk data if the link is marginal or fails.

.24 Time Domain Reflectometer data if the link is marginal or fails.

.2 For Alien Crosstalk testing (Category 6A), the detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and will contain the following information:

.1 The overall Pass/Fail evaluation of the link-under-test.

.2 The date and time the measurements were made.

.3 The identification of the customer site as specified by the end-user.

.4 The name of the test limit selected to execute the stored test results.

.5 The name of the personnel performing the test.

.6 The version of the test software.

.7 PS ANEXT, worst case margin for all four pairs.

.8 Average PS ANEXT, worst case margin.

.9 PS AACR-F, worst case margin for all four pairs.

.10 Average PS AACR-F, worst case margin.

**.4 Category 5E Backbone Cable Installation Testing**

.1 Multi-pair Category 5e backbone cable testing will consist of testing each cable pair for opens, shorts, grounds, crosses and pair reversal. Examine any faulty pairs and correct the problem if it is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets. Replace any damaged or faulty cables, or connectors at no cost.

.2 Category 5e Inter backbone cable testing will consist of testing each cable pair for opens, shorts, grounds and pair reversal. Examine any open and shorted pairs to determine if the problem is caused by improper termination. If termination is improper, tag bad pairs at both ends and note on termination sheets.

.3 The test results will be submitted to the Consultant upon completion of testing the installed cables.

*** END OF **TESTING for COMMUNICATIONS SYSTEMS - COPPER** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 11 00 – Communication Room Fittings.

.3 Section 28 23 00 – Video Surveillance System.

### .2 Overview

.1 Test equipment will be approved by the Consultant in writing before it can be used to test the structured cabling systems.

.2 Final details of all test parameters, scope, and methodology to be performed by the Contractor, as described in this section, will be verified with the Consultant.

.3 All terminations will be completed and all Communications equipment installed before the tests are performed.

.4 The installation will be tested in the presence of the Consultant when requested by the Consultant.

### .3 Testing

.1 Correct improper splices and replace damaged cables or connectors at no cost to the Owner.

.2 Optical Loss Testing – Contractor shall set up their Fluke OLTS in custom settings with the maximum loss parameters identified in these specifications for MP, LC and Fiber cable. Tester Pass or Fail results shall be based on the Project Specifications for maximum dB loss which is 0.50 dB per mated pair of connectors, not the Industry Standards of maximum 0.75 dB loss for mated pairs.

### .4 Test Results Documentation

.1 Test results saved within the field-test instrument will be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records will be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”. For the purposes of review only, the contractor will transfer field test results into a spreadsheet. The connector loss at both ends of the fiber link along with the fiber strand loss will be used by the Communications Consultant to determine pass or fail. The OTDR test results will be used to determine whether each connector of a fiber link is within the maximum of 0.5 dB loss level.

.2 The database for the complete project, including twisted-pair copper cabling links will be delivered prior to Consultant acceptance of the results. The Communications Contractor will upload the software tools required to view, inspect, and print any selection of the test reports.

.3 Circuit IDs reported by the test instrument will match the specified label ID.

.4 The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and will contain the following information:

.1 The identification of the customer site as specified by the end-user.

.2 The name of the test limit selected to execute the stored test results.

.3 The name of the personnel performing the test.

.4 The date and time the test results were saved in the tester's memory.

.5 The manufacturer, model and serial number of the field-test instrument.

.6 The version of the test software and the version of the test limit database held within the test instrument.

.7 The fiber identification number.

.8 The length for each optical fiber.

.9 Optionally the index of refraction used for length calculation when using a length capable OLTS.

.10 Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).

.11 Test results to include OTDR link and channel traces, tables at the appropriate wavelength(s).

.12 The length for each optical fiber as calculated by the OTDR.

.13 The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

## .5 Work Included

.1 Provide all labour, materials, tools; field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

.2 In order to conform to the overall project event schedule, the Communications Contractor will monitor work progress and coordinate cable testing with other applicable trades.

.3 In addition to the tests detailed in this document, the Communications Contractor will notify the Consultant of any additional tests that are deemed necessary to guarantee a fully functional system. The Communications Contractor will carry out and record any additional test results at no additional charge.

## .6 Fiber Quality Assurance

.1 All testing procedures and field-test instruments will comply with applicable requirements of:

.1 ANSI Z136.2, (2012 Edition) ANS for Safe Use of Optical Fiber Communications Systems Utilizing Laser Diode and LED Sources.

.2 TIA-455-78 Measurement Methods and Test Procedures – Attenuation.

.3 TIA-455-78 Measurement Methods and Test Procedures – Attenuation.

.4 TIA-455-133-A Measurement Methods and Test Procedures – Length Measurement.

.5 TIA-455-78 Measurement Methods and Test Procedures – Attenuation.

.6 ANSI/TIA-526-7A, Optical Power Loss Measurements of Installed Single- mode Fiber Cable Plant.

.7 ANSI/TIA-526-14C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

.8 ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard, Part 1, General Requirements.

.9 ANSI/TIA-568.3-D, Optical Fiber Cabling Components Standard.

.10 ANSI/TIA-606C, Administration Standard for Commercial Telecommunications Infrastructure, including labelling requirements.

.2 Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof will be allowed to execute the tests. These must be issued by any of the following organizations or an equivalent organization:

.1 Manufacturer of the Fiber optic cable and/or the Fiber optic connectors.

.2 Manufacturer of the test equipment used for the field certification.

.3 BICSI and its authorized training partners.

.3 The Consultant shall be invited to witness ad/or review field-testing;

.1 The Communications Consultant will be notified of the start date of the testing phase five (5) business days before testing commences.

.2 The Communications Consultant may select a random sample of up to 5% of the installed links. The Consultant will witness the testing of these randomly selected links and the results are to be stored in accordance with this document. The results obtained will be compared to the original data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Consultant will repeat 100% testing at no cost to the Owner.

## 2.0 PRODUCTS

### .1 Optical Fiber Cable Testers

.1 The field-test instrument will be within the calibration period as minimum of 12 months or as recommended by the manufacturer. Contractor shall provide proof of the last date the equipment was calibrated.

.2 Optical loss test set (OLTS);

.1 Singlemode optical fiber light source;

.1 Provide dual laser light sources with central wavelengths of 1310 nm (+/- 20 nm) and 1550 nm (+/-20 nm).

.2 Output power of –10 dBm minimum.

.3 Acceptable manufacturers:

.1 Fluke Networks.

.2 Power Meter;

.1 Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.

.2 Power measurement uncertainty of +/- 0.25 dB.

.3 Store reference power measurement.

.4 Save at least 100 results in internal memory.

.5 PC interface (serial or USB).

.6 Acceptable manufacturers:

.1 Fluke Networks.

### .2 Optical Time Domain Reflectometer (OTDR)

.1 Singlemode OTDR;

.1 Wavelengths of 1310 nm (+/- 25 nm) and 1550 nm (+/- 30 nm).

.2 Event dead zones of 0.6 m maximum at 1310 nm and 1550 nm.

.3 Attenuation dead zones of 4 m typical at 1310 nm and 1550 nm.

.4 Distance range not less than 130 km at 1550 nm and 80 km at 1310 nm.

.5 Dynamic range 30 dB typical at 1310 nm and 1550 nm.

.6 Acceptable manufacturers:

.1 Fluke Networks.

.2 Fiber Microscope;

.1 Magnification of 200X or 400X for end-face inspection.

.2 Acceptable manufacturers:

.1 Fluke Networks.

## 3.0 EXECUTION

### .1 Fiber Testing Scope

.1 Initially test every fiber strand within the Fiber optic cable with a light source and power- meter utilizing procedures as stated in ANSI/TIA -526-14-C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant, and ANSI/TIA-526-7 (currently Standard Proposal Number 2974-B): OFSTP-7 Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant. Measured results will be within manufacturers' cable and specified loss budget calculations. If loss figures are outside this range, test cable again with Optical Time Domain Reflectometer (OTDR) to determine cause of variation. Correct improper splices and replace damaged cables or connectors at no cost.

.1 This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber end faces will also be verified.

.2 Testing will be performed on each cabling link (connector to connector).

.3 Testing will be performed on each cabling channel (equipment to equipment) that is identified by the Consultant where required.

.4 Testing will not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

.5 All tests will be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and tables for multimode and singlemode links and channels.

.6 Field-test instruments will have the latest software and firmware installed.

.7 Link and channel test results from the OLTS and OTDR will be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative (reports) may be generated.

.8 Fiber end faces will be inspected at 250X or 400 X magnifications. 250X magnification will be used for inspecting multimode and single-mode fibers. 400X magnification will be used for detailed examination of single-mode fibers. Scratched, pitted or dirty connectors will be diagnosed and replaced at no cost to the Owner.

.9 It is mandatory that the end face images be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.

.10 Testing of the cabling will be performed using high-quality test cords of the same Fiber type as the cabling under test. The test cords for OLTS testing will be between 1 m and 5 m length. The test cords for OTDR testing will be approximately 100 m for the launch cable and at least 25 m for the receive cable.

.11 All tests performed on optical fiber cabling that use a laser or LED in a test set will be carried out with safety precautions in accordance with ANSI Z136.2.

.12 All outlets, cables, patch panels and associated components will be fully assembled and labelled prior to field-testing. Any testing performed on incomplete systems will be redone on completion of the work. The following test parameters will be adhered to:

.1 Single-mode fiber optic cables will be tested at 1310 nm and 1550 nm.

.1 Testing procedures will utilize “Method B” – one jumper reference.

.2 Bi-directional testing of optical Fibers is required.

.3 Test every strand of fiber with an OTDR.

.4 Fiber links will be tested with test equipment based on laser light sources categorized by a Coupled Power Ratio (CPR) of Category 2, under filled, as per IEC 60825-2.

.5 This rule will be followed to support Gigabit Ethernet applications. Gigabit Ethernet only specifies laser light sources and not LED (light emitting diode) light sources. Field test equipment based on LED light sources is a Category 1 device as per IEC 60825-2 and typically yields high attenuation results.

.6 For Gigabit Ethernet compliant certification (IEEE std 802.3z application), use Test equipment which uses a VCSEL (Vertical Cavity Surface Emitting Laser) at 850 nm (compliant with 1000BASE-SX) and an FP laser at 1310 nm (compliant with 1000BASELX).

**.2 Acceptance of Fiber Test Results**

.1 Unless otherwise specified by the Consultant, each cabling link will be in compliance with the following test limits:

.1 Optical loss testing;

.1 Multimode and singlemode links;

.1 The link attenuation will be calculated by the following formulas as specified in ANSI/TIA-568-C.0.,

.1 Link Attenuation (dB) = Cable_Attn (dB) + Connector_Attn (dB) + Splice_Attn (dB).

.2 Cable_Attn (dB) = Attenuation_Coefficient (dB/km).

.3 Length (Km).

.4 Connector_Attn (dB) = number_of_connector_pairs.

.5 Connector_loss (dB).

.6 Maximum allowable connector loss = 0.50 dB.

.7 Splice_Attn (dB) = number_of_splices * splice_loss (dB).

.8 Maximum allowable splice_loss = 0.3 dB.

.9 The values for the Attenuation_Coefficient (dB/km) are listed in the table below.

.2 OTDR Testing;

.1 Reflective events (connections) will not exceed 0.5 dB.

.2 Non-reflective events (splices) will not exceed 0.1 dB. A maximum of 10% of all splices in the project can have an allowable splice loss of 0.3 dB.

.3 Fiber links will be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

.4 Singlemode: 1310 nm and 1550 nm.

.5 Each fiber link and channel will be tested in both directions.

.6 A launch cord will be installed between the OTDR and the first link connection.

.7 A tail cord will be installed after the last link connection.

.3 Magnified end-face inspection;

.1 Fiber connections will be visually inspected for end-face quality.

.2 Scratched, pitted or dirty connectors will be diagnosed and corrected.

.4 All installed cabling links and channels will be field-tested and pass the test requirements and analysis. Any link or channel that fails these requirements will be diagnosed and corrected. Any corrective action that must take place will be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels will be provided in the test results documentation.

.5 Acceptance of the test results will be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Consultant.

*** END OF **TESTING for COMMUNICATIONS SYSTEMS - FIBER** SECTION ***

## 1.0 GENERAL

### .1 Communications Rooms Overview

.1 EF (Entrance Facility) – The EF is an environmentally controlled space consisting of the pathways(s), space(s), cables, connecting hardware, protection devices and other passive and active equipment that support the access and service provider. The functions of the EF are:

.1 Demarcation point between the access and service provider cabling and equipment and the facility's network infrastructure.

.2 Electrical protection for inter-building campus backbone and access and service provider cabling. Electrical protection is governed by local electrical codes.

.3 Connection point between outside plant cabling and building cabling that is accomplished by splicing or other means.

.4 The Cellular Distributed Antenna System (DAS) head end location.

.2 Main Equipment Room (MER) – The MER is an environmentally controlled space that is typically located on level 01. The MER houses:

.1 The intermediate cross-connect.

.2 Core equipment for building systems such systems as Building Automation and Management, Security, Access Control, Audio Visual and Video Conferencing.

.3 The MER is also used as the local Telecommunications Room for level 01 horizontal cabling that does not exceed 90m.

.3 TR (local Telecommunications Room) – The TR is an environmentally controlled space that provides a common access point for pathways, backbone cabling and horizontal cabling. The TR may also contain cabling used for cross-connection. The horizontal cross-connect (HC) is located in the TR. The TR houses:

.1 Horizontal and backbone cables to connecting hardware.

.2 Telecommunication equipment, connecting hardware and splice closures serving a portion of the building. The TR will not house PBX, Servers, Core Equipment, Network Storage equipment, etc.

.3 Provide for the administration and routing of equipment cords from the HC to the telecommunications equipment.

.4 IT racks will be alternate between passive and active infrastructure (e.g. rack 1 is dedicated for passive infrastructure, rack 2 is dedicated for active equipment, and so on).

### .2 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

### .3 As-Built Documentation

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

## 2.0 PRODUCTS

Note: Due to supply chain shortages some products may be unavailable. Check with BCIT IT for acceptable product alternatives.

### .1 Equipment Racks/Cabinets

.1 Two Post Equipment Rack (passive infrastructure);

.1 Free standing 2135 mm high (44 rack units).

.2 2-post racks c/w RU markings (RU1 at top & RU44 at bottom) on front and rear posts and rails.

.3 Seismic Zone 4 NEBS Telcordia GR-63-CORE certified.

.4 Must provide 482.6 mm (19”) rack mount capability for rack mountable components.

.5 Must provide 44 rack units of vertical mounting space.

.6 Must have 10-32 tapped mounting holes front and rear.

.7 Will be black in colour.

.8 Racks will be 610 mm wide.

.9 Product: Electron Metal RKZFR2-194400 or approved equal.

.2 Four Post Equipment Rack (active infrastructure);

.1 EIA compliant 482.6 mm (19”) gangable equipment rack.

.2 Overall dimensions of rack shall be 2112 mm H x 616 mm W x 829 mm D.

.3 Useable height shall be 44 rackspaces, useable depth shall be 749 mm.

.4 Fully welded construction shall provide a UL Listed 2,500 lb. weight capacity.

.5 Rack shall be constructed of the following materials: top and bottom shall be 14-gauge steel, horizontal braces shall be 16-gauge steel welded to integral structural side panels of 16-gauge steel giving an 1/ 8” thick structure, all structural elements shall be finished in a durable black powder coat.

.6 Rack shall come equipped with two pairs of 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing. Finished in black e-coat with numbered rackspaces.

.7 Rack shall have removable split rear knockout panels with 1/ 2”, 3/ 4”, 1”, and 1-1/ 2” electrical knockouts installed in base, and removable split rear knockout panels with 1/ 2”, 3/ 4”, 1”, and 1-1/ 2” electrical knockouts, and BNC knockouts for UHF/ VHF antennae installed in top.

.8 Grounding and bonding stud shall be 1/ 4-20 threaded, installed in base of enclosure.

.9 Enclosures shall satisfy the 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) “D” with lateral force requirements for protecting 900 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with WRKZ4 seismic floor anchor bracket.

.10 Rack shall be UL Listed in the US and Canada.

.11 Rack shall be GREENGUARD Gold Certified. Rack shall be manufactured by an ISO 9001 and ISO 14001 registered company.

.12 Rack shall be warrantied to be free from defects in material or workmanship under normal use and conditions for the lifetime of the rack.

.13 Product: Legrand Middle Atlantic WRK-44-32LRD with WRK-Z4 seismic option or approved equal.

.3 Wall Mount Brackets;

.1 Minimum Depth: 146mm (3 rack units).

.2 Product: Electron Metal WMBVER 190305 or approved equal.

**.2 Cable Management Systems (CMS)**

.1 Vertical Cable Management System;

.1 Double Sided.

.2 Front Channel;

.1 305mm wide between racks; 152mm wide at end unit. 254mm deep.

.3 Rear Channel;

.1 305mm wide between racks; 152mm wide at end unit. 254mm deep.

.4 Must be equipped with removable doors and straps, removable side fingers, access cut-outs at the back, and 3 sets of removable spools per front channel to take up patch cable slacks.

.5 The back of the cable trough must have stances to provide fastening for Horizontal cabling to the back of the trough.

.6 CMS must be gang-able.

.7 Will be black in colour (including doors).

.8 Product (305mm wide): CommScope 760089375 | VCM-DS-84-12B or approved equal.

.9 Product (152mm wide): CommScope 760089342 | VCM-DS-84-6B or approved equal.

.2 Horizontal Cable Management;

.1 Horizontal cable manager at the top of each rack and between every 2RU of patch panel as indicated on the drawings.

.2 The horizontal cable manager will be a finger-type, single-sided, and compatible with the finger-type vertical manager.

.3 Product: CommScope 760072942 | HTK-19-SS-1U or approved equal.

**.3 UTP Patch Panels**

.1 Patch panels for UTP horizontal cabling will be a flat 1U modular 24-port unit or 2U modular 48-port unit, suitable for mounting on 482.6mm (19”) racks. Refer to rack elevations on drawings.

.2 All ports shall be populated with RJ45 Modular Jack, in accordance with Section 27 15 00.

.3 Product: CommScope 760237041 | CPP-UDDM-SL-2U-48 or approved equal. **Optical**

**.4 Fibre Patch Panels**

.1 Patch panels for Fiber Optic cabling will be a modular, sliding tray, suitable for mounting on 482.6mm (19”) racks. Refer to rack elevations on drawings.

.2 All slots will be populated with bulkheads, in accordance with Section 27 13 23.

.3 The specified fiber patch panel will have the ability to house Single Mode / Multi Mode fiber, fusion splice, pre-terminated fiber assemblies with MPO cassettes / bulkhead terminations simultaneously.

.4 Equip with 24-fiber Duplex LC splice cassettes.

.5 Product (1U-unit): CommScope 760231449 | SD-1U or approved equal.

.6 Product (2U-unit): CommScope 760231456 | SD-2U or approved equal.

.7 Product (4U-unit): CommScope 760231464 | SD-4U or approved equal.

**.5 Fibre Splice Enclosures**

.1 Wall Mount Enclosure with spooling area.

.2 Accommodates a minimum of 24 fibre strands.

.3 Product: CommScope, or approved equal.

**.6 Power Distribution Units**

.1 Provide 3-phase 208V, 30A power distribution units (PDU) with alternating-phase outlets down the length of the unit and network monitoring.

.2 Minimum C13 outlet count: 24.

.3 Minimum Cx outlet (dual C13 and C19 outlet) count: 12.

.4 Minimum 5-20R outlet count: 3.

.5 Quantities:

.1 Not used.

.1 Not used.

.2 Active IT Racks;

.1 One master PDU for every active IT rack as indicated on the drawings.

.2 One link PDU for every active IT rack as indicated on the drawings.

.3 One (1) spare master PDU and one (1) spare link PDU for the entire project.

.6 Product(s):

.1 Master PDU: Server Technology C2WG36TE-YCMFAM66 or approved equal.

.2 Link PDU: Server Technology C2XG36TE-YCMFAM66 or approved equal.

**.7 IDC Termination Blocks**

.1 Will be Belden, GigaBIX Mount, GigaBIX Connector, 25-pair, to terminate voice multi pair (25 pair) backbone cables.

.2 Belden GigaBIX Wire Guard.

.3 Belden GigaBIX Designation Strip.

.4 Belden GigaBIX Management Ring.

.5 Belden GigaBIX cable management module (installed behind GigaBIX mount to facilitate cable routing).

.6 Belden GigaBIX horizontal channel plate.

## 3.0 EXECUTION

### .1 Communications Room Finishes

.1 Penetrations through walls, floors and ceilings will be fire-stopped using products based on the requirements of Firestop Systems 27 05 29 and in accordance with Section 27 05 28 Pathways for Communications Systems.

.2 All walls will be to underside of slab. All walls will be lined with rigidly installed 20 mm (3/4"), AAA G1S plywood. The plywood panels will extend from floor level to a height of 2438mm. Expose certified stamped mark. Refer to Interiors Finishes list for coordination.

.3 The only access from adjacent ceiling spaces will be by cable tray via Hilti Speed Sleeves or conduit in accordance with Section 27 05 28 Pathways for Communications Systems to allow connection to the horizontal and backbone pathways. Hallway cable tray will access the Communications room on the same floor by cable tray only.

.4 The use of a pull pit in Communications Rooms will not be acceptable.

.5 All floors will require anti-static dissipative flooring. Refer to Interiors Finishes list and Section 09 65 00 for coordination. Bond flooring per manufacturer's recommendations and TIA -J-STD-607B.

### .2 Cleaning

.1 Prior to installing network equipment and switches, the Contractor will have the TRs professionally cleaned at the sub-micron level by a company that is specialized in cleaning critical environments. The cleaning will remove all construction related dust and debris from all surfaces including equipment racks and all components installed within them.

.1 Prior to receiving any network equipment from the Authority to install, the Contractor shall conduct air quality testing and provide the Consultant with a report and analysis of particle counts before and after the cleaning of TR's.

.2 The Contractor will provide clean room sticky mats and air scrubbers as required to keep the TR's clean until target substantial completion of the Facility is achieved.

### .3 Security

.1 Access Control:

.1 The Contractor will coordinate and arrange for installation of Communications Room's card access system prior to the installation of network equipment, with Communications Consultant and Owner.

.2 All entry doors to communication rooms will be equipped with a network access control card reader.

.3 Manual punch code locks are not permitted on any Communications Room doors.

.2 Keys:

.1 Key will be cut to fit all the TR's within the same building.

.2 A copy of the key will be given to the Owner.

.3 If the TR is equipped with a supplementary door, no keys will be issued for these doors in order to ensure the audit trail through the access control system remains intact. Keys issued for the main entry doors that bypass the card reader should be limited for emergency access only.

.4 Refer to Section 08 71 00 for keying system.

.3 All TR's will be equipped with CCTV camera(s). CCTV camera(s) will be used to identify people entering the room and general activity within the room in accordance to Section 28 23 00. Refer to drawings for the location of devices.

.4 All TR's will be equipped with Intrusion Detection in accordance to Section 28 16 00.

.5 Refer to drawings for the location of devices.

**.4 Equipment Racks/Cabinets (Refer to Drawings for Sizing)**

.1 Each rack / cabinet will be plumbed and levelled, and solidly bolted to the floor with bolts, washers and brackets. Bonding of rack to ground per TIA -J-STD- 607C and Section 27 05 26.

.2 Equipment racks / cabinets will be seismically restrained and approved per Seismic Engineer of record.

.3 Where two or more racks are mounted side by side, the racks will have a double sided 12" vertical manager installed in between and ganged with metal bolts and washers.

.4 Both side ends of a row of one or more racks will have a double sided 6" vertical manager installed and ganged with metal bolts and washers.

*** END OF **COMMUNICATIONS ROOM FITTINGS** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 11 00 – Communication Room Fittings.

.3 Section 27 13 13 – Communications Copper Backbone Cabling.

### .2 List of Terms as Used in this Specification

.1 “ISP”: Inside Plant cabling.

.2 “OSP” Outside Plant cabling.

.3 “PIC”: Plastic Insulated Conductor.

.4 “PVC”: Polyvinyl Chloride.

.5 “PE”: Polyethylene.

.6 “CMP”: Communications Media Plenum rating.

.7 “CMR”: Communications Media Riser rating.

.8 “TR”: Telecommunications Room.

### .3 Scope

.1 The Communications Contractor will, supply, install, test and certify a multi- conductor twisted pair backbone cabling system (including all patch panels, termination blocks, patch cords and cross connect wire) that will connect the MER to each Telecommunications Room/Closet/Enclosure in the Facility.

.2 The backbone configuration will be a hierarchical star structure with separate dedicated cables from the MER to each Telecommunications Room.

.3 In a TR and MER, Horizontal cables will be bundled separately from Intra- Building Backbone cables.

.4 No backbone cables will be left un-terminated in a Telecommunications Room.

.5 Copper Intra-Building Backbone Cables;

.1 Copper backbone cabling consisting of Category 5e (4-pair) unshielded twisted-pair will be installed by the Communications Contractor, from the MER to each TR as shown on the drawings. Provide six (6) CAT5e cables to each TR.

.2 Multi-pair cable bundles entering GigaBIX mounts and the hinging of connectors will be on the jumper side of the mount.

.3 Backbone copper cables from the same Telecommunications Room must be grouped together and terminated sequentially on the GigaBIX connectors; group the cables from each Telecommunications Room together. Once the first riser is terminated and numbered, every other riser in its group continues the number sequence.

.6 The Communications Contractor will supply, install, test and certify a multi- conductor twisted pair inter-building cabling run that will connect the new building. Cable routing and existing pathways are noted on the drawings. Terminate Category 5e cable 2 x 25-pair cable on the BIX frame at either end.

**.4 Submittals**

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Submit shop drawings for:

.1 Cabling.

.2 IDC termination (GigaBix).

**.5 As-Built Documentation**

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Provide:

.1 Circuit Spreadsheet.

## 2.0 PRODUCTS

**.1 Multipair Unshielded Twisted Pair Cable**

.1 Conductors:

.1 Conductors of 24 AWG annealed solid copper.

.2 Conductors fully insulated, consisting of an inner layer of expanded polyolefin, covered with an outer layer (skin) of solid PVC.

.3 Twisted pair conductors, stranded into 25-pair bundles and into units.

.4 Colour Coding: Twisted pairs and units individually color-coded to industry standards (ANSI/ICEA Publications S-80-576, and TIA-230).

.2 Core & Sheath:

.1 Cable sheath consisting of an overall flame-retardant PVDF or equivalent jacket.

.2 Cable that is CEC rated as CMP as required by the authority having jurisdiction, and UL listed as such.

.3 Performance:

.1 Electrical performance of the twisted pairs and overall cable that complies with TIA- 568-C requirements for Category 5e UTP cabling.

.4 Inter-Building Application:

.1 Product(s): CommScope CS24P 25PR WHITE CMP REEL

**.2 Category 5E 4-Pair Cable**

.1 Intra-Building Application:

.1 Cable suitable for indoor installation, between floors in vertical riser system, utility tunnels, under access flooring, and through overhead ceiling space (in cable tray, conduit & hangers).

.2 Each and every cable run will have a continuous single cable, homogenous in nature. Splices are not permitted anywhere.

.3 Twisted pair PIC type, air core cable for intra-building cabling.

.4 Accepted Manufacturers: CommScope CS27P BLU C5E 4/24 U/UTP

**.3 Termination Equipment**

.1 GigaBIX suitable for installation within a telecommunications facility for the termination of the backbone twisted pair cables and suitable for either wall or rack installations, vertically oriented for a wall mounted column configuration.

.2 “GigaBIX” type.

.3 GigaBIX accompanied by the quantity of management equipment, for both horizontal and vertical routing of cords and cross connect wires.

.1 GigaBIX kit, 300 pair, 5-pair based.

.2 Vertical management panel.

.3 Cable management module will be provided behind each GigaBIX mount.

**.4 Cross-connect Wire**

.1 Cross Connect Wire, 1-Pair;

.1 Cross connect wire suitable for installation within a telecommunications facility and fully compatible with the GigaBIX. Each and every cross connect wire manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere.

.2 Factory splices of insulated conductors are expressly prohibited.

.3 Conductors:

.1 Insulated Conductors: 24 AWG conductors of solid copper. Fully insulated conductors with a flame retardant thermoplastic material (such as PVC, or equivalent).

.2 Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), individually color-coded.

## 3.0 EXECUTION

### .1 Installation

.1 Backbone Cable:

.1 Cable runs will have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.

.2 Placement:

.1 Maintain a minimum bend radius of 20 times the cable diameter and 10 times the cable diameter after installation.

.2 Maintain pulling tension within manufacturer’s limits.

.3 Place cables within designated pathways.

.4 Place and suspend cables in a manner to protect them from physical interferences or damage. Replace cables if damaged during installation.

.5 Place cables with no kinks, twists, or impact damage to the sheath.

.6 Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.

.3 Routing:

.1 When routing horizontally within Communications rooms, utilize the overhead cable support. When routing vertically within Communications rooms, utilize the vertical cable support (vertical basket tray) and provide cable ties every 610mm (24”) on centre.

.2 Route cables a minimum of 150mm (6”) away from power sources to reduce interferences from EMI.

.3 Provide minimum 7 meters sheathed cable slack loop at each end of the run. Coil and place the slack on wall outside and above the overhead cable tray.

.4 Termination:

.1 Properly strain-relieve cables at termination points per manufacturer’s instructions.

.2 Terminate twisted pairs onto the GigaBIX in accordance with manufacturer's latest instructions and TIA-568 standard installation practices.

.3 Perform post-installation testing as described in the Testing for Communications specification.

.2 GigaBIX:

.1 Provide accessories required for a complete installation.

.2 Install cable management module layout such that the 1st cable management module starts at 203mm (8") from the wall and 457mm (18") from the floor.

.3 Mount GigaBIX plumb and square.

.3 GigaBIX Distribution for Voice Tie Cables:

.1 Install patch panels in data rack as per drawings.

.2 Provide 2x25 pair from the GigaBIX mount in the MER to a rack mounted patch panel in TR on Level 1.

.3 Provide 6x Category 5e cables from TR on Level 1 to a rack mounted patch panel on each floor.

.4 At the Main Cross-connect, provide one 1-pair cross connect to length from the equipment field to the backbone.

.5 Refer to drawings for details.

.6 Utilize the horizontal and vertical management components to properly route the cross connect wire.

.7 Splices in cross connect wire are prohibited.

*** END OF **COMMUNICATIONS COPPER BACKBONE CABLING** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 53 – Identification for Communication Systems.

.3 Section 27 08 11.01 – Testing for Communications Fiber.

.4 Section 27 11 00 – Communication Room Fittings.

.5 Section 27 11 30 – Campus Communications Hub Fittings.

.6 Section 28 23 00 – Video Surveillance System.

### .2 Scope

.1 The Communications Contractor shall supply, install, test and certify an intra- building fiber backbone cabling system that will connect the MER to each Telecommunications Room and AV/IT room in the Facility.

.2 The Communications Contractor shall supply, install, test and certify an inter-building fiber entrance cabling system that will connect the new building to the building specified (primary path) and also provide alternate (diverse path). Cable routing and existing pathways are noted on the drawings.

.3 The Communications Contractor shall supply, install, test and certify an inter-building fiber link. Cable routing and existing pathways are noted on the drawings.

.4 The Communications Contractor shall supply, install, test and certify fiber optical patch hardware and cables within Telecommunication Room and Campus Communications Hub.

### .3 List of Terms as Used in this Specification

.1 In addition, define the following list of terms as used in this specification as follows:

.1 “MM”: Multimode (Fiber type OM5).

.2 “OFNP”: Optical Fiber Non-conductive, plenum rated.

.3 “OFNR”: Optical Fiber Non-conductive, riser rated.

.4 “OFCP”: Optical Fiber Conductive, plenum rated.

.5 “OFCR”: Optical Fiber Conductive, riser rated.

.6 “PVC”: Polyvinyl Chloride.

.7 “SM”: Single mode (fiber type OS2).

.8 “MER”: Main Equipment Room.

.9 “TR”: Telecommunications Rooms.

.10 “ER”: Entrance Room.

.11 “AV/IT”: Audio-Visual/Information Technology Rooms.

### .4 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Submit shop drawings for:

.1 Fiber Cabling (including patch cables and pre-term trunk cables),

.2 Cassettes,

.3 Patch panels,

.4 Fiber Management Components.

### .5 As-Built Documentation

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Provide:

.1 Circuit Spreadsheet.

.2 Optical Fiber test results.

.3 Pre-terminated Factory Test Results for each Component (with unique identifier).

## 2.0 PRODUCTS

### .1 Fiber Cabling

.1 Fiber Optic Intra-building (Indoor) Backbone Cables;

.1 Between MER and each TR & AV/IT room:

.1 Indoor/outdoor, plenum distribution cable, interlocking aluminum armored with plenum jacket.

.2 Product(s): CommScope 760127837 | P-048-DZ-8W-FMUYL. Fiber Optic

.2 Inter-building (Indoor/Outdoor) Entrance Cables;

.1 Product(s): CommScope 760149724 | P-072-LZ-8W-F12BK/25D.

.3 Fiber strand count is identified on the drawings.

**.2 Patch Cables**

.1 Cord assembled from a single, continuous length of cordage, homogenous in nature; Splices are not permitted.

.2 Cords terminated at both ends via specified connector type.

.3 Patch Cables:

.1 LC/UPC to LC/UPC:

.1 Single-mode: CommScope FEWLCLC42.

.2 LC/UPC to SC/UPC:

.1 Single-mode: CommScope FEWLCSC42.

.4 Quantity:

.1 The Communications Contractor will provide and, where required, install single mode patch cords of the correct length for all end-use and telecommunications equipment in sufficient quantity to make each device and system in the Facility fully operational.

.2 The Communications Contractor will additional spare multimode and single mode patch cords. The amount will be equal to six (6) spare single mode patch cords for each fiber patch panel installed in the Facility.

.5 Patch cable lengths to be confirmed with Owner prior to ordering.

**.3 Termination Equipment**

.1 Provide sliding tray panels in accordance to Section 27 11 00.

**.4 Splice Cassettes**

.1 LC, OS2 fiber cassette with pigtails.

.2 Fiber strand count per bulkhead: 12.

.3 Product(s): CommScope | PNL-CS-12LCW-PT.

**.5 Fiber Management Components**

.1 Velcro Cable Ties;

.1 Width: 19mm (0.75”).

## 3.0 EXECUTION

**.1 Installation**

.1 Fiber Optic Installation:

.1 The following requirements must be met to gain system acceptance.

.1 Run the cable along the route identified on the plan drawings.

.2 Install materials and equipment in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturer's printed instructions.

.3 Adhere to manufacturers' published specifications for pulling tension, minimum bend radii and sidewall pressure when installing cables.

.4 Any scoring or pitting within the fiber core (regardless of test result) will result in re-termination by the Contractor using a new connector.

.5 Provide a minimum of 7 meters of fiber optic cable slack at both ends of all cables, unless otherwise noted on the drawings (the greater of 7 metres or length indicated on drawings shall be provided).

.6 All single-mode fiber will be fusion spliced utilizing 900 micron pigtails supplied by the Contractor. The fusion splicer used must be fully automated with full X and Y alignment and will employ fusion splice loss estimation. Fiber splice protection will be via 3M heat shrink sleeves.

.7 Signal attenuation:

.1 Any splice loss must not exceed 0.3 dB.

.2 Any connector loss must not exceed 0.5 dB.

.3 The loss along the length of the cable must not exceed 0.5dB/km.

.4 If test results show attenuation out of specification limits, then the Contractor is responsible to troubleshoot the link and determine corrective procedures.

.8 No manual fusion splicing will be performed.

.9 Fiber cable preparation, pigtail routing, and forming within the splice or distribution panel will be as per manufacturer's training and printed instructions.

.10 Prior to installation, the Contractor shall test the fiber optic cable with an OTDR instrument to verify that the cable has not been damaged during shipment. Readings obtained shall be used later for comparison with test acceptance data and included in the as- built documentation. Refer to Section 27 08 11 for testing requirements.

.11 All cabling shall be labelled in accordance to Section 27 05 53.

.2 Patch Cables, Termination Equipment, Cassettes & Panels, Connectors;

.1 Per industry standards and modified per manufacturer's recommended practices, and

.2 Modified by the requirements of Sections:

.1 27 11 00 – Communication Room Fittings.

*** END OF **COMMUNICATIONS FIBER BACKBONE CABLING** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 28 – Pathways for Communications Systems.

.3 Section 27 05 53 – Identification for Communications Systems.

.4 Section 27 08 12 – Testing for Horizontal Category 6A.

.5 Section 27 11 00 – Communication Room Fittings.

.6 Section 27 21 33 – Communications Wireless Access Points.

### .2 System Description

.1 The Communications Contractor will supply, install, test and certify a horizontal structured cabling subsystem for the Facility.

.2 Horizontal cable forms part of the structured cabling system and shall be run from each workstation, data point, telephone, and wireless access point location to the communication room designated for the zone. The cable shall be terminated and tested on both ends in accordance with the project specifications and the most recent TIA-568-C standard.

.3 This section also describes any cords, cross-connect wire, devices, and adapters required to connect the OSP, riser, and horizontal cabling as called for in these specifications and related drawings.

### .3 Submittals

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Submit shop drawings for:

.1 Cabling.

.2 Faceplates.

.3 Patch panels.

.4 Patch cords.

.5 Jacks/inserts.

### .4 As-Built Documentation

.1 To be furnished as specified in Specification Section 27 05 00 Common Works for Communications Systems.

.2 Provide:

.1 Circuit Spreadsheet.

## 2.0 PRODUCTS

### .1 Category 6A Horizontal Cable

.1 All horizontal cable and associated jacks, connectors, patch panels and faceplates will be CommScope, Category6A.

.2 The installed system shall utilize a cable no larger than 0.285” O.D. while supporting IEEE proposed Type 4 PoE performance (100W) over the full channel length.

.3 The installed system shall utilize a cable design supportive of heat dissipation such that no more than 9.5C of temperature rise occurs inside a 100-cable bundle as PSE power reaches 90W over 100 meters.

.4 Horizontal cable shall include 4 conductor pairs with a minimum wire gauge of 23 AWG.

.5 All cabling shall be CMP plenum rated.

.6 Cable jacket colour shall be blue

.7 Product: CommScope CS44P BLU C6A 4/23 U/UTP

### .2 Communications Room Copper Category 6A Patch Cords

.1 Provide one (1) patch cord per horizontal cable installed at the communications room.

.2 All patch cords shall be counted and provided to the Owner prior to the commencement of any work on site.

.3 Patch cable jacket colour shall be black.

.4 Lengths:

.1 Minimum patch cord cable to patch between the panel jacks and the switch ports shall be 2538mm (8’). However, other lengths will be required for this application.

.2 Patch cord lengths to be confirmed with Owner prior to ordering.

.5 Product: CommScope CO199K2-01 | MiNo6A-BK

### .3 Work Area Copper Category 6A Equipment Cords

.1 Provide one (1) Category 6A equipment cord per horizontal cable installed at the communications room.

.2 All equipment cords shall be counted and provided to the Owner prior to the commencement of any work on site.

.3 Patch cable jacket colour shall be black.

.4 Lengths:

.1 Minimum patch cord cable to patch between the panel jacks and the switch ports shall be 3048mm (10'). However, other lengths will be required for this application.

.5 Provide plenum rated equipment cords for any horizontal cable terminated in the plenum ceiling space. This includes, but not limited to:

.1 AV communication outlets.

.2 WAP outlets.

.3 CCTV outlets.

.6 Product: CommScope UC1AA22-01 | UNC10G-BK.

**.4 Cross-Connect Wire**

.1 Contractor will supply and install cross connection wires. All voice cross connections will be neatly routed via D-rings and bundled with Velcro wraps.

.2 Wires will be 24 AWG solid tinned copper, 1-pair Category 5E. Conductors will be insulated with semi-rigid PVC. One insulated conductor in a pair will be white and the other in visibly distinct solid colour. Pair-untwist will not exceed 75mm from the point of termination.

.3 The quantity of cross connection wires will be 24 pairs per 24 port voice tie cable patch panel, plus 10% spare.

**.5 Communications Connectors (Jack Inserts)**

.1 Category 6A, UTP connectors shall be unshielded, with strain relief, 8-pin modular jacks (RJ-45-style) terminated in T568A Wire Map configuration. The Jacks must accept RJ-45 modular plugs without causing any damage or degradation to the connectors or pins.

.2 Approved colour for 8-pin modular jacks is alpine white (work area) and black (patch panel).

.3 Product (work area): CommScope 760241147 | USL10G-A.WHT.

.4 Product (patch panel): CommScope 760241138 | USL10G-BK.

**.6 Surface Mount Boxes**

.1 Surface Mount boxes will be used for Wireless Access Point and Video Surveillance Camera termination.

.2 Product CommScope Surface Mount Box 1-1116698-3 and 1-1116697-3.

**.7 Device Plates**

.1 Each outlet shall be finished with a Faceplate kit, non-labeled, 1-gang, 6-port coupled with RJ45 Modular Jacks in accordance with this Section.

.2 Ports with no cable terminated shall have matching colour blank inserts.

.3 Approved Colour: Alpine White.

.4 Faceplate kit product: CommScope 1-2111025-3.

.5 Blanking insert product: CommScope 1-1116412-3.

**.8 Outdoor-Rated Category 6A Horizontal Cable**

.1 Product: CommScope 760178129 | 1592A BLK C6A 4/24 F/UTP R1000

**.9 Surge Protective Device**

.1 Product: Approved Category 6A Surge Protective Device

## 3.0 EXECUTION

**.1 Overview**

.1 The horizontal configuration will be a star topology with separate dedicated continuous cables run from the servicing zone Communications Room to the outlets on the same floor.

.2 The maximum length of horizontal cable will not exceed 90m.

.3 Where there is more than one Communications Room on the same floor, boundary limit lines are to be indicated on drawings. Horizontal cables shall not cross the lines to another zone to be served by another Communications room.

.4 In a Communications Room, horizontal cables will be bundled separately from Inter and Intra backbone cables.

.5 CMP rated Velcro straps will be used to support the cables depending on location requirement. The straps will be loosely tightened in such a manner that it can slide around cable bundle. Zip ties are not permitted.

.6 Each cable will be terminated at workstation outlets on eight-position modular jacks with pin/pair assignment wired to T568A scheme.

.7 The Communications Contractor will leave slack in the cable at the outlet box following termination. Too much slack at the point of termination may result in testing failures and too little slack can compromise future maintenance. Minimum cable slack for CAT6A cabling is as follows:

.1 3000mm (10’) in the communications room.

.2 300mm (1’) at the work area.

.8 The Communications Contractor will neatly dress all cables within the Communications Room to follow building lines, the objective being to provide a reasonable amount of slack into each cable run, while at the same time provide neatness and promote order as the cables migrate from the point-of-entry to the termination point.

.9 The cable pair untwist must be maintained as per the Manufacturer specifications at the point of termination.

.10 Refer to the following documents for guidelines on installation:

.1 Manufacturer Installation Guideline Documentation.

.2 TIA-568-C and C.1, as well as Drawings for installation.

**.2 Horizontal Cable Installation**

.1 Faceplate Configuration;

.1 Communications Outlet;

.1 A typical Communications outlet will have two 4-pair cables (Jacks 1 and 2 on a 6-port faceplate). Populate jack inserts on faceplate starting at the top and move sequentially down once the first row is full.

.2 All UTP cable system work completed by the Communications Contractor must be inspected by the Consultant.

.3 Install materials in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturer printed instructions.

.4 Adhere to manufacturer published specifications for pulling tension, minimum bend radii and sidewall pressure when installing cables.

.5 When installing, ensure cable is not subjected to stress due to contact with tray/conduit support mechanisms, bonding lugs or any metal burrs within the support structure. Conduit must have insulated throat connectors installed prior to pulling any cable.

.6 Particular care must be taken when working around corners and offsets.

.7 Cable dressing and termination procedures will comply with the following requirements:

.1 All cable installation will be done in a neat and tidy fashion. All cable dressing within the entrance facility and communications rooms will follow building lines.

.2 Cable will be neatly dressed with no crossovers within the bundle. The Consultant will have final approval of cable dressing quality and any workmanship issues. Bundles will be dressed using Velcro fasteners. Cables must not exhibit sheath deformation due to poor installation or bundle over-tightening. If cable dressing is not performed to the satisfaction of the

Consultant, the Communications Contractor will be responsible to re-install or re-dress the bundles at no cost. Termination practices must strictly comply with manufacturer recommendations and all referenced wiring installation standards.

.3 Particular care must be taken to limit sheath removal length and pair untwisting at point of termination.

.4 Cables will be terminated in sequential order.

.5 At each Communications outlet follow the same termination practices as stipulated for the Communications Room.

.6 In Communications Room, horizontal cables will be bundled and terminated on patch panels. Refer to Drawings.

.7 Horizontal distribution cables will be loosely bundled in quantities of no more than 24 cables.

.8 Any cable damaged or exceeding recommended installation parameters during installation will be replaced by the Communications Contractor prior to final acceptance at no cost.

.9 All cables will be terminated in Communications Rooms and at Communications outlets. Leave no cables un-terminated unless specified in drawings or as directed by the Consultant.

**.3 Accessibility**

.1 Install all work in a manner that allows easy access for adjustment, operation and maintenance. Provide access panels in inaccessible ceiling areas where required to allow access to junction boxes and devices for maintenance purposes.

.2 Locate access panels in service areas wherever possible. Do not locate in finished walls.

**.4 Miscellaneous Cables**

.1 The Owner does not accept hybrid or under-carpet cabling.

**.5 Lightning Protection**

.1 Primary Protectors for PoE equipment installed inside Communication Rooms:

.1 Provide Surge protectors on each Horizontal cable run entering the building.

.2 Provide a #6 AWG Green Insulated Bonding Conductor from either the Electrical Grounding Busbar or the Communications Grounding Busbar (whichever is closer).

.3 Daisy Chain the #6 ground between each Horizontal Protector.

.4 Bond the metallic conduit used for running the Horizontal 4-pair Circuits.

.5 Note: the 65V Solid State modules are necessary for pass-through of PoE+ voltage. Surge Protector Installation is based on current CEC Code Section 60 and ANSI/TIA 607.

*** END OF **HORIZONTAL CABLING** SECTION ***

## 1.0 GENERAL

### .1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 27 05 00 – Common Works for Communications Systems.

.2 Section 27 05 53 – Identification for Communications Systems.

.3 Section 27 15 00 – Horizontal Cabling.

### .2 Scope

.1 The Owner is responsible for:

.1 The procurement, configuration and commissioning of all hardware and software related to wireless network management systems and tools.

.2 The procurement of all standard vendor supplied access point mounting brackets, lighting arrestors and accessories required to install wireless hardware.

.3 Supplying the Contractor with wireless access points, antennas, mounting brackets, specialty mounting brackets and other standardized hardware based upon a mutually agreed to schedule.

.2 The Contractor is responsible for:

.1 Installation of Owner supplied wireless access points and accessories.

.2 Providing horizontal cabling, patch cords between access points and outlets, cable terminations and designated WAP outlets.

.3 Cable testing and certification.

.4 Labelling the wireless access points.

.5 Showing outlet locations on as-built drawings.

## 2.0 PRODUCTS

### .1 Cabling

.1 See Section 27 15 00 - Horizontal Cabling Section.

### .2 Enclosures

.1 Provide per Section 08 31 00 - Access Doors and Panels.

## 3.0 EXECUTION

**.1 Wireless Installation**

.1 The responsibility of the Communications Contractor in the deployment of a wireless infrastructure are as follows:

.1 Supplying, installing, testing and certifying a horizontal cabling throughout the facility's ceiling spaces or walls to connect wireless access points.

.2 Installing all access points, antennas and associated accessories and hardware as prescribed by Consultant's wireless design.

.1 Wireless network hardware provided to the Contractor for the interior of the Facility will not be installed until the building is enclosed, weather tight, temperature and humidity conditions are approximately the same as final conditions expected, wireless cabling grid is installed and tested, most construction activities are complete and surfaces have been swept and treated for dust control. The Contractor will not be allowed to install wireless and wired network hardware until the Owner has inspected the interior building conditions and provided written approval to proceed with the installation.

.2 Prior to receipt of wireless network hardware and components for installation, the Communications Contractor is required to provide the Consultant with as-built documentation of the wireless cabling identifying the cable IDs associated with each wireless communication outlet.

.3 Upon receipt of wireless and wired network hardware and components, the Contractor will be financially responsible for any damage or disappearance of the Owner provided material due to improper handling and storage, negligence, fire, theft and environmental conditions during construction.

.3 Moving wireless network hardware within 5 metres of telecommunications outlet as prescribed by the Owner after completion of post occupancy wireless surveys conducted by Owner. In addition to labour and equipment, the Contractor is required to cover all costs associated with moving access points such as replacement of ceiling tiles and the installation of sleeves through walls.

.4 Installing two patch cords between each access point and its designated wireless outlet as specified. If required due to the ceiling type, the Contractor will install conduit to run the patch cords between the wireless communication outlet and the access point. In the Communications Room, the Contractor must also install two patch cords to connect the access point to the switch ports designated by the Owner.

.5 Installing surge protectors in the Communications room and associated grounding for all outdoor access point locations.

.6 If the mounting of wireless hardware requires the procurement of non- standard or specialty mounts, brackets, vanity skins or covers or the fabrication of custom solutions, the Contractor will be expected to bear all associated design, fabrication, procurement and installation costs.

.7 Furthermore, if alterations in the design, fabrication and installation of components provided by others are needed to install any aspect of the wireless infrastructure then the Contractor will be expected to bear the full cost of all such customization.

**.2 Installation (Indoor)**

.1 Regardless of the location and mounting method of the wireless access point, maximum permanent link length is 90 meters.

.2 Two horizontal cables will be installed to each wireless Communications outlet.

.3 Terminate two horizontal cables on jack.

.4 Mounting Scenarios:

.1 Solid (drywall) ceiling:

.1 The dual horizontal cable runs are to be installed in conduit between the ceiling Communications outlet box and the nearest cable tray.

.2 Patch cords are to be fished across solid ceilings between the ceiling Communications outlet box and the wireless access point location.

.3 The standard patch cord length used to connect to the wireless access point is 20’ / 6.1m. Store and support any slack length in the ceiling above the access point.

.4 The ceiling Communications outlet box to be mounted above ceiling for the termination of horizontal runs.

.1 Ceiling Communications outlet box is a 100mm x 100mm x 100mm with a 100mm x 100mm shoe box steel cover for a decora strap.

.2 The ceiling Communications outlet box will be fastened directly to the ceiling’s structural support member with a Caddy clip and/or screws no more than 305mm above the access hatch opening.

.5 An access panel (305mm x 305mm) will be installed at the ceiling Communications outlet box location (painting is by the contractor).

.6 Wireless access point installation (directly) to ceiling using vendor supplied mounting bracket.

.7 All access points must be seismically restrained.

.8 Label the faceplate, patch cords and the access hatch.

.2 Exposed ceiling (parkade, utility spaces, stairwells, etc.):

.1 The dual horizontal cable runs are to be installed in conduit between the ceiling Communications outlet box and the nearest zone box.

.2 Mount wireless access point to the box using mounting bracket or wireless enclosure.

.3 Ceiling Communications outlet box to be mounted to the ceiling for the termination of horizontal runs.

.1 Ceiling Communications outlet box is a 200mm x 200mm x 100mm with a solid cover plate. Locate a 2-port Surface jack Assembly inside the JB.

.2 The standard patch cord length used to connect to the wireless access point is 2' / 0.6m. Coil patch cord slack inside outlet box.

.4 All access points must be seismically restrained.

.5 Label the ceiling Communications outlet box, surface jack assembly and patch cords.

.3 Accessible Ceiling (T-bar or wooden slats):

.1 The dual horizontal cable runs are to be installed in conduit or non-continuous open supports (J-hooks) between the ceiling Communications outlet box and the nearest cable tray.

.2 Patch cords are to be fished across ceilings between the ceiling Communications outlet box and the wireless access point location.

.3 The standard patch cord length used to connect to the wireless access point is 20' / 6.1m. Store and support any slack length in the ceiling above the access point.

.4 The ceiling Communications outlet box to be mounted above ceiling for the termination of horizontal runs.

.1 Ceiling Communications outlet box is a 100mm x 100mm x 100mm with a 100mm x 100mm shoe box steel cover for a decora strap.

.2 The ceiling Communications outlet box will be fastened directly to the ceiling's structural support member with a Caddy clip.

.5 Wireless access point installation (directly) to ceiling Main Tee using vendor supplied mounting bracket.

.6 All access points must be seismically restrained.

.7 Label the faceplate and patch cords.

.4 Solid (drywall) wall:

.1 The dual horizontal cable runs are to be installed in conduit between the ceiling Communications outlet box and the nearest cable tray.

.2 Mount wireless access point below the box using horizontal mounting bracket or wireless enclosure.

.3 Ceiling Communications outlet box to be finished with faceplate.

.1 Ceiling Communications outlet box is a 100mm x 100mm x 100mm. Mud ring will be used on top of the electrical box to receive single gang outlet faceplate.

.2 The standard patch cord length used to connect to the wireless access point is 2' / 0.6m. Coil patch cord slack inside outlet box.

.4 All access points must be seismically restrained.

.5 Label the ceiling Communications outlet box, surface jack assembly and patch cords.

.5 In mounting scenarios that don't meet with the examples above, the Consultant is to be consulted.

.6 At the communications room end, the wireless cabling from the same drop location shall be distributed evenly across patch panels for patching to different switches.

.7 For all outdoor wireless access point installation, the applicable CEC and BC codes will govern the location, mounting, grounding and type of service cable and enclosures used.

*** END OF **COMMUNICATIONS WIRELESS ACCESS POINTS** SECTION ***