City & Guilds Level 3 Certificate in Communications Cabling (3668-03)

March 2022 version 1.0

Qualification Handbook

Qualification at a glance

Subject area	Digital and IT
City & Guilds number	3668-03
Age group approved	16+
Entry requirements	None
Assessment	Assignment
Approvals	Qualification Approval
Support materials	Qualifications Handbook; Assessment pack
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Accreditation number
Level 3 Certificate in Communications Cabling	3668-03	610/0379/7

Version and date	Change detail	Section
V1.0 March 2022	Document created	n/a

Contents

1   Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	This qualification is aimed at learners aged 16 and above who would like to gain the knowledge and skills required during their initial training within the network infrastructure (communications cabling) industry for specific job roles.
	It is also for those who work within the telecoms industry and wish to further develop their knowledge and skills.
	Additionally, it is also aimed at new entrants looking to start a career in this sector.
What does the qualification cover?	Learners will be introduced to the scope and opportunities offered within the network infrastructure (communications cabling) and telecoms industry.
	This qualification will cover communications cabling processes and principles including safe working practices and telecom behaviours. Learners will gain an insight into the communications cabling industry, including an understanding of the range of services offered, the terminology used and the health, safety and environmental rules and regulations.
	Learners will be introduced to the principles of communications cabling systems and supporting network infrastructure.
	Learners will develop skills on how to install, e.g. fibre optic, copper and/or air blown fibre cables and micro-ducts.
	All the above will enable learners to progress into further training to take on various supervisor and management roles within this sector.
What opportunities for progression are there?	Upon successful completion of this qualification, learners will be equipped with the knowledge, skills and behaviours required for progression towards new job roles within the industry.
	This Certificate will enable learners to learn, develop and practise the skills required for employment and career progression in the network infrastructure (communications cabling) and telecoms industry. Specialist knowledge and skills will be developed.

Who did we develop the qualification with?	This qualification has been developed in collaboration with the Training and Qualification Committee for the Fibreoptics Industry Association which is led by CTTS (chair), Lucid Optical Service and Total Comms Training. Further collaboration involved BT Openreach, CityFibre, Hyperoptic, PQMS, TBN, Virgin Media and White Associates.
Is it part of an apprenticeship standard or initiative?	This Level 3 Certificate in Communications Cabling is not an apprenticeship, but it could be taken as an optional "on programme" qualification within an apprenticeship.
	This qualification will develop knowledge, skills and behaviours which can link into apprenticeships such as Telecoms Fields Operative (level 2) and Network Cable Installer (level 3).
	This Level 3 Certificate in Communications Cabling will form a vital part of the City & Guilds' updated offer to support the Communications Cabling sector and are intended to meet the requirements of the ECS Network Infrastructure Installation Assistant and Network Infrastructure Installer (Level 3) cards respectively.

Structure

To gain the **Level 3 Certificate in Communications Cabling** learners must complete **two** mandatory units (301 and 302) plus **one** unit from the **nine** optional units (303 – 311). A total of **three** units are required to achieve this qualification, which can be completed in any order.

City & Guilds unit number	Unit title	GLH
Level 3 Certificate in Communications Cabling		
Mandatory		
301	Safe working practices and behaviours	40
302	Telecoms fundamentals	50
Optional		
303	Fibre optic cabling	50
304	Air blown fibre technologies	45
305	Passive optical networks (PON)	40
306	Structured cabling and enterprise networks	50
307	Fibre fault finding and diagnostics	30
308	Copper fault finding and diagnostics	30
309	Design and planning external enterprise networks	50
310	Design and planning internal enterprise networks	50
311	Wireless and cellular	50

Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the Certificate of a qualification.

TQT is comprised of the following two elements:
- The number of hours which a certificating organisation has assigned to a qualification for Guided Learning
- An estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the immediate guidance or supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training

The table below shows the minimum GLH and TQT due to the optionality of units:

Title and level	GLH	TQT
Level 3 Certificate in Communications Cabling	120	150

2   Centre requirements

Approval

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the *City & Guilds Centre Manual* for further information.

To offer the new 3668-03 Certificate in Communications Cabling existing centres who deliver the 3667-02 Award in Communications Cabling will be fast tracked.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Resource requirements

Resources

The Level 3 Certificate in Communications Cabling includes units which can be taken individually for those new to the industry and those learners who are experienced for Continuing Professional Development.

This qualification should be delivered in the workshops and classrooms of a centre with full facilities for communications cabling activities, with all the equipment, machines, relevant tools and consumables for working safely with materials appropriate to each unit.

Centre staffing

Staff delivering and quality assuring this qualification must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training

Centre staff may undertake more than one role, e.g. tutor and assessor or internal quality assurer, but cannot internally quality assure their own assessments.

Assessors and Internal Quality Assurers

Registered centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualification. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. Assessor/Verifier (A/V) units are valued as qualification for centre, but they are not currently a requirement for the qualification.

Learner entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that learners have the potential and opportunity to gain the qualification successfully.

Age restrictions

City & Guilds cannot accept any registrations for learners under 16 as this qualification is not approved for under 16s.

3   Delivering the qualification

Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific training needs
- support and guidance they may need when working towards their qualification
- any units they have already completed, or credit they have accumulated which is relevant to the qualification
- the appropriate type and level of qualification

We recommend that centres provide an induction programme, so learners fully understand the requirements of the qualification their responsibilities as a learner, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for this qualification:

Description	How to access
Assessment pack	www.cityandguilds.com

Recording documents

Learners and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds' endorses ePortfolio system, **Learning Assistant**, is an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualification. Further details are available at **www.cityandguilds.com/eportfolios**.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. *Recording forms* are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external quality assurer, before they are used by learners and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4   Assessment

Summary of assessment methods

Assessment Types – Certificate in Communications cabling			
Unit	Title	Assessment method	Where to obtain assessment materials
301	Safe working practices and behaviours	Assignment	www.cityandguilds.com
302	Telecoms fundamentals	Assignment	www.cityandguilds.com
303	Fibre optic cabling	Assignment	www.cityandguilds.com
304	Air blown fibre technologies	Assignment	www.cityandguilds.com
305	Passive optical networks (PON)	Assignment	www.cityandguilds.com
306	Structured cabling and enterprise networks	Assignment	www.cityandguilds.com
307	Fibre fault finding and diagnostics	Assignment	www.cityandguilds.com
308	Copper fault finding and diagnostics	Assignment	www.cityandguilds.com
309	Design and planning external enterprise networks	Assignment	www.cityandguilds.com
310	Design and planning internal enterprise networks	Assignment	www.cityandguilds.com
311	Wireless and cellular	Assignment	www.cityandguilds.com

This qualification is graded Pass/Fail only. To pass the qualification learners must pass all the assessments relating to each selected unit.

Time constraints

The following must be applied to the assessment of this qualification:

- All assessments must be completed within the learners' period of registration.

Assessment strategy

Practical assessments

Learners are required to successfully complete practical assessments to be assessed in the City & Guilds approved centre. The Assessment Pack which includes specific guidance, information and instructions can be located at www.cityandguilds.com.

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience or qualification which have already been achieved to contribute to a new qualification.

For this qualification, RPL is allowed and is not sector specific.

Unless specifically stated, any previous experience or qualification gained may reduce the amount of learning hours required. However, all the assessments must be completed successfully in order to achieve this qualification.

5   Grading

Grading of individual assessments

Individual assessments will be graded Pass/Fail.

For the units to be achieved, learners must achieve a minimum of Pass in each assessment, as per the marking scheme provided for each assessment.

Pass reflects the minimum requirements that are expressed in the unit.

Grading of qualification

The Communications Cabling Employer Group has taken the decision to grade this qualification Pass/Fail.

All assessments must be achieved at a minimum of Pass for the qualification to be certificated. All assessments graded Pass contribute equally to the overall qualification grade. For full details on how to grade the qualification, refer to the Assessment Pack available on the qualification page of www.cityandguilds.com.

6   Units

Structure of the units

These units each have the following:
- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Unit aim
- Assessment type
- Learning outcomes, which are comprised of a number of assessment criteria

Centres must deliver the full breadth of the range. Specialist equipment or commodities may not be available to all centres, so centres should ensure that their delivery covers their use. This may be covered by a practical demonstration (e.g. video). For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task but are not required to use all the equipment or commodities in the range.

Unit 301   Safe working practices and behaviours

Level:	Level 3
GLH:	40
Aim:	The purpose of this unit is for learners to develop the required safe working practices and behaviours to work in the public highway, underground, overhead and internal networks to the safety standards as laid out by legislation and industry standards. It will also develop the learner's communication skills and behaviours with customers, peers and hierarchy.
Assessment type:	Assignment

Learning outcome

The learner will:

1.   Apply legislations and regulations relevant to the telecommunications industry including key factors relating to legislation and regulations, health and wellbeing and risk assessment.

Assessment criteria

The learner can:

1.1   Describe **legislation and regulations** relevant to the telecommunications industry.
1.2   Describe key factors of **health and wellbeing**.
1.3   Describe comprehensive **risk assessments**, method statement and permit to work in all aspects of underground, overhead and internal networks.

Range

(AC 1.1)
Legislation and regulations:
- Health and Safety at Work Act 1974
- Management of Health and Safety at Work Regulations 1999
- Personal Protective Equipment Legislation at Work 1992
- Provision and Use of Work Equipment Regulations 1998
- Lifting Operations and Lifting equipment regulations 1998
- Manual Handling Regulations 1998
- Working at Height Regulations 2005
- Confined Spaces Regulations 1995
- New Roads and Street Works Act 1991
- Construction Design and Management Regulations 2015
- The Electricity at work regulations 1989
- Gas safety management regulations 1996
- The Pipelines Safety Regulations 1996

- Reporting of diseases and dangerous occurrence regulations 2013
- Control of asbestos regulations 2012
- Control of substances hazardous to health 2002
- Building regulations (2020 Update)
- The Data Protection Act 1998 and GDPR

(AC 1.2)
Health and wellbeing:
- identifying changes in personality, character and behaviours
- support and guidance

(AC 1.3)
Risk assessment:

- types of risk
- hazard identification
- risk matrix
- safe systems of work
- permits to work

Learning outcome

The learner will:

2.   Prepare a site survey and plan which demonstrates the correct setup of road works guarding in the public highway safely.

Assessment criteria

The learner can:

2.1   Conduct a **site survey**.
2.2   Produce a **plan** for a road works guarding set up.
2.3   Deploy **road works guarding** in accordance with their plan.

Range

(AC 2.1)
Site survey:
- reviewing the appropriate PPE requirements
- risk assessing tools and equipment required to survey
- conduct an onsite risk assessment
- conduct a survey capturing the required information to be able to effectively plan a road works guarding set up

(AC 2.2)
Plan:
- produce a clear, safe and effective plan considering road users, pedestrians, and colleagues
- effectively communicate the plan with other team members

(AC 2.3)

Road works guarding:
- monitor the deployment of road works guarding
- conduct a site survey
- monitor action to protect pedestrians, vehicular traffic and site personnel
- monitor provision of portable traffic signals
- react to changes, problems and emergencies
- supervise the recovery of road works guarding safely

Learning outcome

The learner will:

3. Demonstrate the correct techniques to safely access and work in an underground chamber taking emergencies into account.

Assessment criteria

The learner can:

3.1 Safely **access** an underground chamber.
3.2 React promptly and appropriately to **emergencies**.

Range

(AC 3.1)
Access:
- risk assessment for a confined space team entry
- set-up of the site (supervising or monitoring)
- inspect equipment (to Include LOLOR and escape equipment)
- complete gas testing pre-entry tests
- cover lifting of both footway and carriageway type covers
- operate tripods and winches

(AC 3.2)
Emergencies:

- gas alarms
- flooding
- injured and unconscious causalities

Learning outcome

The learner will:

4. Employ safe working methods in the overhead network using ladders and stepladders at premises and on a pole using the required equipment and climbing techniques within the vicinity of overhead power.

Assessment criteria

The learner can:

4.1 Demonstrate **safe working methods in overhead network** using ladders and step ladders at premises within the vicinity of overhead power.

4.2 **Assess poles for safe access** using required equipment and climbing techniques within the vicinity of overhead power.

Safe working methods in overhead networks:
- ladder types and selection
- ladder pre use checks and inspection
- ladder stability (top and bottom)
- ascending and descending safely
- different types of OH power and cable types
- safe sector method of working
- correct power separation for both HV & LV cable types
- actions to be taken in an emergency

(AC 4.2)
Assess poles for safe access:
- conduct an onsite risk assessment (Pre climb checks)
- inspect a harness and fit it correctly
- use work restraint and fall arrest equipment appropriately
- secure a ladder against a pole
- ascend and descend a pole safely
- lift and lower tools and equipment safely
- climb past obstacles safely
- turning on a pole safely

Learning outcome

The learner will:

5. Evaluate the safe working practices in a customer's premises relating to hazards in asbestos, fire stopping, voltage, metal and stud detection requirements in accordance with legal requirements.

Assessment criteria

The learner can:

5.1 Identify **asbestos hazards** and legal requirements
5.2 Identify the correct **fire stopping** materials
5.3 Follow the safe system of work for **voltage/metal/stud detection** to identify hidden service and the selection of a safe place to drill

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Range

(AC 5.1)
Asbestos hazards:
- types of asbestos
- asbestos containing materials (ACM)
- reporting procedures and respond to emergencies

(AC 5.2)
Fire stopping:
- intumescent materials
- use of fire stopping materials/fire breaks

(AC 5.3)
Voltage/metal/stud detection:
- risk assessment
- inspection of tools and equipment
- correct drilling in walls for installation of cables up to 25mm
- correct sealing of cable entry points
- verify hidden electricity
- verify hidden stud work
- verify hidden metal work

Learning outcome

The learner will:

6. Demonstrate effective communication with customers, peers and management.

Assessment criteria

The learner can:

6.1 Carry out effective **communication with customers** appropriately and courteously using telephony, digital platforms and face to face.
6.2 Conduct effective **communication with peers**.
6.3 Conduct effective **communication with manager**.

Range

(AC 6.1)
Communication with customers:
- contact customers in advance of arrival
- keep customers informed
- dealing with irate customers
- correct demonstrations/documentation at the point of commissioning

(AC 6.2)
Communication with peers:
- correct hand over for tasks requiring second line support (updating job notes clearly and concisely to prevent customer delay and associated costs)
- clearly brief all peers onsite of the risk assessment, safe systems of work and work requirements

(AC 6.3)
Communication with manager:
- discuss health & safety (accidents & near misses) clearly and in a timely manner with hierarchy
- discuss any Issues that may affect safety at work

Unit 302   Telecoms fundamentals

Level:	Level 3
GLH:	50
Aim:	The purpose of this unit is for learners to develop their knowledge and understand of methods of delivering communications networks within the telecommunications industry. This will provide learners with the underpinning knowledge and skills required to progress within the sector in a variety of job functions. The concepts will be relevant to both wired and wireless components of data and telecommunications networks. Learners will be expected to explore issues such as enterprise cabling and telecoms utilities. Learners will develop an awareness of the concepts that provide the underpinning knowledge required in the other units that are delivered as part of this qualification.
Assessment type:	Assignment

Learning outcome

The learner will:

1. Evaluate the characteristics of transmission technologies as applied in digital networks.

Assessment criteria

The learner can:

1.1   Describe the characteristics of **transmission technologies**.
1.2   Describe the applications in **digital networks**.

Range

(AC 1.1)
 Transmission technologies:
- analogue signals, i.e. phase, frequency, amplitude, harmonics
- digital signals, i.e. data rates, band width

(AC 1.2)
Digital networks:
- Quadrature Amplitude Modulation (QAM)
- Quadrature Phase Shift Keying (QPSK)
- Polarisation Division Multiplexing (PDM)
- Orthogonal Frequency Division Multiplexing (OFDM)
- Time Division Multiple Access (TDMA)

The learner will:

2.   Analyse the media, characteristics and transmission methods used as part of data and telecommunications networks.

Assessment criteria

The learner can:

2.1   Describe the uses of different types of **media** associated with data and telecommunications networks.

2.2   Explain the **characteristics** of different media that are used as part of data and telecommunications networks.

2.3   Demonstrate the data **transmission methods** used as part of data and telecommunications networks.

Range

(AC 2.1)
Media:
- wired:
    o   twisted pair cable
    o   coaxial cable
    o   fibre optic cables (i.e. multimode, singlemode)
- wireless:
    o   microwave
    o   satellite
    o   Bluetooth
    o   Wi-fi/WiMax
    o   Cellular

(AC 2.2)
Characteristics:
- baseband
- broadband:
    o   Digital Subscriber Line (DSL)
    o   Synchronous Digital Hierarchy (SDH)
    o   Asynchronous Transfer Mode (ATM)
    o   carrier ethernet
- bandwidth/data rate
- attenuation
- gain

(AC 2.3)
Transmission methods:
- circuit switching
- packet switching
- software defined networks (SDN)
- low powered wide area network (LoRaWAN)

- disaggregated central office (DCO)
- cellular

Learning outcome

The learner will:

3. Evaluate the **telecoms and data network standards**, **the OSI model**, **purpose of standards** and **protocols** associated with data and telecommunications networks and apply these to practical situations.

Assessment criteria

The learner can:

3.1 Explain the **role of the organisations** that are responsible for establishing telecoms and data network standards.
3.2 Describe the layers of the **OSI model** and function of each layer, referencing this against the TCP/IP model.
3.3 Describe the **purpose of standards** associated with data and telecommunications networks.
3.4 Describe the role of **protocols** in data and telecommunications networks.

Range

(AC 3.1)

Role of organisations:

- European Telecommunications Standards Institute (ETSI)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Standards Organisation (ISO)
- American National Standards Institute (ANSI)
- International Telecommunications Union (ITU)

(AC 3.2)

OSI model:

- TCP
- IP

(AC 3.3)

Purpose of standards:

- interoperability
- quality assurance
- consistency
- data and telecommunications:
  - Ethernet
  - VoIP
  - PoE
  - PPP
  - SDN
- mobile:

- o ETSI EN 301 893 broadband radio access networks (BRAN)
  - o Code Division Multiple Access (CDMA)
  - o Global System for Mobile Communications (GSM)
  - o General packet radio service (GPRS)
  - o Universal Mobile Telecommunications System (UMTS)
  - o High Speed Packet Access (HSPA)
  - o IEEE 802.11
  - o IEEE 802.12
  - o Software defined radio (SDR)
  - o Common public radio interface
- Error handling:
  - o Cyclic Redundancy Checking (CRC)
  - o Forward Error Correction (FEC)

(AC 3.4)

Protocols:

- IP
- TCP
- X25
- E.163 and 164
- PPP
- PPPoE
- SLIP
- High-level Data Link Control (HDLC)
- Quality of Service (QoS)
- VoIP
- Real time transport protocol (RTP)
- Real time streaming protocol (RTSP)

Unit 303   Fibre optic cabling

Level:	Level 3
GLH:	50
Aim:	This unit aims to provide the learner with the opportunity to evaluate the most appropriate fibre optic cabling that are commonly available in the communications cabling industry. Learners will develop their knowledge and understanding of different types of fibre, their uses and some of the standards associated with them. Learners will also build upon their knowledge of fibre testing techniques and when these are applied.
Assessment type:	Assessment

Learning outcome

The learner will:

1.   Evaluate the advantages and disadvantages of fibre optic types cabling

Assessment criteria

The learner can:

1.1   Explain the advantages and disadvantages of different **fibre optic types** according to their specifications.

1.2   Describe the different **transmitting characteristics** for different types of cabling.

Range

(AC 1.1)

fibre optic types:
- single-mode – OS cable types
- multimode – OM cable types
- types of single-mode fibre:
    - ITU G.655
    - G.657
- special purpose fibre:
    - erbium doped
    - non-dispersion
    - dispersion shifted

(AC 1.2)

transmitting characteristics:
- LEDs (Light Emitting Diodes)
- Fabry Perot (FP) Lasers

- Distributed Feedback (DFB)Lasers
- vertical Cavity Surface emitting Laser (VCSL)

Learning outcome

The learner will:

2.   Evaluate the characteristics of fibre optic cables and their appropriate uses.

Assessment criteria

The learner can:

2.1   Identify the different **characteristics** of fibre optic cables.
2.2   Use fibre optics cable and show their various **appropriate uses**.

Range

(AC 2.1)

characteristics:
- transmission distance
- appropriate transmission methods
- power levels
- non-linear effects

(AC 2.2)

appropriate uses:

- micro bend
- macro bend
- bandwidth and dispersion
- chromatic dispersion (CD)
- polarisation mode dispersion (PMD)

Learning outcome

The learner will:

3.   Apply fibre optic cabling standards by selecting appropriate testing methods.

Assessment criteria

The learner can:

3.1   Apply appropriate **fibre optic cabling standards**.
3.2   Select appropriate **testing methods** in fibre optic cabling.

Range

(AC 3.1)

Fibre optic cabling standards:
- Fibre types:
  - ITU G.651
  - ITU G.652

- o ITU G.654
- o ITU G.655
- o ITU G.657
- single-Mode – OS cable types
- multimode – OM cable types
- fire safety
- environmental

(AC 3.2)

Testing methods:
- visible light source
- light source and power meter
- Optical Time Domain Reflectometer (OTDR)
- Chromatic dispersion test set
- Polarisation Mode Dispersion tester (PMD)
- power meter and channel power tester
- Optical spectrum analyser (OSA)

Unit 304   Air blown fibre Technologies

Level:	Level 3
GLH:	45
Aim:	The purpose of this unit is for learners to develop an insight into the concepts involved with the installation of micro ducts and sub ducts, pre-blowing checks, blowing in fibre bundles, e.g. 1.10mm – 2.05mm 2, 4, 8, 12, 24 fibre units and micro cables containing many hundreds of fibres, e.g. 3 – 10mm using a variety of blowing machines. The fibres will be blown into a variety of nodes and termination closures. This would usually take place in a workshop environment and outside ducted networks with blowing tracks and micro trenches.
Assessment type:	Assignment

Learning outcome

The learner will:

1.   Carry out a risk assessment and safety checks when using hydraulic equipment.

Assessment criteria

The learner can:

1.1   Conduct a **risk assessment** prior to working with air compressors and hydraulic equipment and installation of micro ducts.
1.2   Carry out **safety checks** when operating compressors and electrical and hydraulic driven blowing machines.
1.3   **Work safely** with cable drum rolling dispensing devices.

Range
(AC 1.1)
Risk assessment:

- task/operation defined
- arranging essential personnel for consultation
- likelihood and severity (grading risks and hazards)
- stating which task/operation is being assessed
- stating which group or employees, contractors, service users or members of the public are affected
- carrying our risk assessment process
- stating the hazards
- consequences of exposure to the hazards

- stating the expected likelihood of the hazard being present assuming no control measures are in place
- stating the expected severity of the harm/damage following exposure to the hazard, assuming no control measures are in place
- carrying our risk rating. Multiply the likelihood by the severity. (This figure is used to determine the level of risk with the higher number showing the higher the risk level).
- using the hierarchy of control measures
- expected likelihood of the hazard being present assuming that control measures are or will be put into place
- severity of the expected harm/damage assuming that control measures are or will be put into place
- risk ratings
- information for employees
- monitoring and reviewing – legislation requires the assessment to be monitored
- near miss/dangerous occurrence or accident has taken place

(AC 1.2)
Safety checks:
- demonstrating understanding of Bar and PSI air pressure
- select correct compressor with pressure (Bar, Pa) air flow (l/min, cuft/min) for the micro duct and size of fibre unit/cable being blown in being used
- pre user checks on air-hoses
- pre user checks on pressure gauge lenses clear and easy to read not cracked or damaged in any way.
- user handbook, start-up guide, and local operating registers available
- physical check on portability of machine, wheels, handles extension and storage.
- pre user checks on all isolating / vent valves prior to switch on followed by a functional check after switch on.
- note the hours run indicator if fitted, check any servicing dates.
- ensure only trained / qualified personnel iaw PUWER 1998 regulations operate machine
- clean all safety labels and replace any that are missing or damaged

(AC 1.3)
Work safely:

- safe manual handling of cabling drums up to 2.5m
- carry out the daily/ weekly checks on a CDT
- capacity and limitations of the current CDT
- safe manual handling of the CDT
- couple, uncouple and position the trailers in a safe and competent manner
- load and couple/uncouple the trailer to a suitable towing vehicle
- positioning of the CDT
- dispense tubing from the CDT whilst observing all the relevant precautions
- pre-use safety checks of winches
- inspection
- rollers and guides
- ropes and knots

Learning outcome

The learner will:

2. Interpret network diagrams when installing a micro ducted link prior to blowing in fibres in with micro duct and sub duct assemblies and interconnecting devices ensuring safe storage and handling.

Assessment criteria

The learner can:

1.1 Interpret **network diagrams** and draw up a bill of materials to complete an end to end blowing link for the size of the fibre unit or cable being blown in.
1.2 Understand differing types of micro duct and sub **duct assemblies and interconnecting devices**.
1.3 **Storage and handle** micro duct and sub duct assemblies.

Range
(AC 2.1)
Network diagrams:
*   Global system for mobile communication (GSM)
*   Symbols & Keys
*   GIS systems
*   GeoHub
*   Product maps
*   Industry diagrams

(AC 2.2)
Duct assemblies and interconnecting devices:
*   direct buried
*   direct installed
*   indoor installation LFH
*   tight protected micro duct
*   loose protected micro duct
*   pulling tensions
*   thermal relaxation
*   tensile relaxation

(AC 2.3)
Storage and handling:
*   drum and coil
*   offloading
*   authorisation
*   stacking
*   conditions
*   security

Learning outcome

The learner will:

3. Demonstrate direct buried installation techniques and backfill trenches.

Assessment criteria

The learner can:

3.1 Carry out **direct buried installation**.
3.2 **Backfill** trenches to manufactures standards.

Range

(AC 3.1)
Direct buried installation:
- slot trench
- micro trenching
- mole plough
- excavation

(AC3.2)
Backfill trenches:

- blinding
- granular
- back-fill
- sub-base
- base/binder course
- marker tape
- Bitumen tarmac

Learning outcome

The learner will:

4. Demonstrate methods of installation and troubleshooting techniques used for direct installation into ducts.

Assessment criteria

The learner can:

4.1 Follow **methods of installation**.
4.2 Conduct **troubleshooting**.

Range

(AC 4.1)
Methods of installation:
- rodding and roping techniques
- use of mechanical machines and aids, i.e. hand or machine rodding
- pull socks

- end caps
- fused swivels
- pulling ropes
- lubricants
- protection of tub assemblies during installation

(AC 4.2)
Troubleshooting:
- blockages
- congested ducts

Learning outcome

The learner will:

5. Connect micro ducts **tube bundles assemblies** and interconnecting tube distribution closures (TDC).

Assessment criteria

The learner can:

5.1 Identify and number tube bundle assemblies.
5.2 Fit **interconnecting tube distribution closures (TDC)**.

Range

(AC 5.1)
tube bundle assemblies:
- 1 DB, DI ,LFH – 24 DB, DI, LFH tube assemblies
- 25mm sub duct mono bore
- select a range of tube connectors
- straight connectors
- closedown connectors
- reducers
- end caps
- Excess Fibre Length (EFL)- fibre locking fibre systems for cabinets
- super seal end caps
- use of collet locking tools
- gas block connectors
- water block connectors
- sizes of micro duct tubes internal and external diameters
- collect locking tools
- rounding tools
- cutting tools
- cable end sealing
- building entry kits
- numbering of tube assemblies
- bend radii

(AC 5.2)

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interconnecting tube distribution closures (TDC):
- fit manufacturer's TDC and wrapped closure (at least one)
- fit fibre optic nodes
- manage tubes into outside plant closures
- assemblies' preparation
- window cut entry methods
- tube distribution manifolds
- Y branches
- H branches
- Multi Dwelling Units (MDU) basement closures
- customer lead in closures
- gas and water blocking techniques

Learning outcome

The learner will:

6. Use air flow charts for pre-blowing tests to include **pressure testing**, **continuity testing** and air flow.

Assessment criteria

The learner can:

6.1 Carry out **pressure testing**.
6.2 Conduct **continuity testing** and air flow.

Range

(AC 6.1)
Pressure testing:
- use an air flow meter kit
- air flow checks at the appropriate pressure 10 bar 15 bar
- air pressure/ air speed L/min
- seal the chosen link
- pressure test

(AC 6.2)
Continuity testing:
- fit air stone
- continuity device and blow in at lower pressure than operational requirements typically 4 bar

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Learning outcome

The learner will:

7. Operate blowing machines using appropriate control box mechanism to blow in fibre units and cables.

Assessment criteria

The learner can:

7.1 Operate **blowing machines**.
7.2 Connect to appropriate **control box mechanisms**.
7.3 blow in **fibre units and cables**.

Range

(AC 7.1)
Blowing machines:
- fibre unit blowing 1.10mm-2.05mm 2 -24 fu
- fibre micro cables 3-10mm containing many hundreds of fibres
- select air dispenser devices

(AC 7.2)
C**ontrol box mechanisms**:
- fit the correct size collars and seals for the size of the fibres being blown in
- fit machine fittings guide's and plates for the size of the fibre being blown in
- seal the chosen link
- conduct a pressure test

(AC 7.3)
fibre units and cables:
- operate control boxes
- set distances indicators
- regulate blowing speeds as required
- function of buckle detectors
- select the correct size drive wheels for the fibre being blown in.
- fitting of seals
- setting up of blowing machines for the size of fibre unit/cable (Fu/C) being blown in
- fit blowing beads onto fibre units as required
- strip and prepare specialist air blown fibre bundles
- strip and prepare specialist micro cables for subsequent terminations

Unit 305   Passive Optical Networks (PON)

Level:	3
GLH:	40
Aim:	The aim of this unit is to give learners the opportunity to evaluate passive optical network technology and become competent to a professional standard when installing a passive optical network system.

Learners will develop their knowledge and understanding of the recent global deployment of fibre to the home/office between central office/telephone exchange/head-end and its subscribers using passive optical networks.

Learners will have the opportunity to recognise and evaluate passive optical network architectures.

Learners will also study the passive components employed in network implementation. Practical aspects of this unit will cover the installation and testing of outside plant.

Learners will also build upon their knowledge of passive optical networks and understand their applications. |
| Assessment type: | Assignment |

Learning outcome

The learner will:

1.   Evaluate the benefits of passive optical networks technologies, last mile limitations and features.

Assessment criteria

The learner can:

1.1   Use passive optical **network technologies**
1.2   Describe the impact of **last mile limitations**
1.3   Describe the **features** of passive optical networks

Range

(AC 1.1)
Network technologies:
- broadband
- bandwidth
- data bit rate
- baseband
- time division multiplexing

- time division multiple access
- wavelength division multiplexing
- triple play
- quadruple play

(AC 1.2)
Last mile limitations:
- Asynchronous Digital Subscriber Line (ADSL), e.g. twisted copper pair cabling
- Cable Television (CATV), e.g. coaxial cabling
- loss
- noise/crosstalk
- attenuation
- power requirements
- bandwidth reduction

(AC 1.3)
Features:

- attributes
- advantages
- architectural variants
- fibre to the everything (FTTX)
- fibre to the curb (FTTC)
- fibre to the cabinet (FTTCab)
- fibre to the home (FTTH)
- fibre to the premises (FTTP)
- fibre to the office (FTTO)
- fibre to the user (FTTU)
- fibre to the antenna (FTTA)

Learning outcome

The learner will:

2. Use passive optical technologies.

Assessment criteria

The learner can:

2.1 Describe passive optical **network technologies**.
2.2 Describe the purpose of **fibre to home** technology.
2.3 Identify the fibre to **home wavelengths**.
2.4 Describe the passive optical network **topologies**.
2.5 Describe the purpose of **time division multiple access**.

Range

(AC 2.1)
Network technologies:
- Broadband Passive Optical Networks (BPON)

- Asynchronous Transfer Mode Passive Optical Networks (APON)
- Gigabit Passive Optical Networks (GPON)
- Ethernet (EPON)
- Gigabits (GPON)
- 10G (XGPON)
- symmetrical (XGSPON)
- protocol
- architecture
- services
- fibre type
- maximum physical distance
- split ratio
- wavelengths
- bandwidth
- data rate

(AC 2.2)
Fibre to home:
- Optical Line Terminal (OLT)
- optical splitter
- optical network terminal (ONT)
- optical network unit (ONU)
- fibre distribution hub (FDH)
- video transmitter
- erbium doped fibre amplifier (EDFA)

(AC 2.3)
Home wavelengths:
- upstream optical wavelengths
- downstream optical wavelengths
- type of data carried, e.g. video, voice, data
- out of band test wavelength

(AC 2.4)
Topologies:
- star
- bus
- ring
- passive splitters

(AC 2.5)
Time Division Multiple Access (TDMA):
- data collision avoidance
- upstream data support

Learning outcome

The learner will:

3. Analyse components of PON topologies in both overhead and underground environments.

Assessment criteria

The learner can:

3.1   Demonstrate **overhead** delivery when using components of PON topologies.
3.2   Demonstrate **underground** delivery when using components of PON topologies.

Range

(AC 3.1)
Overhead:
- safe working practices at height
- telegraph poles Carrier, DP Poles, hollow poles, joint user poles
- OH support structures
- clearances and Heights
- anti-creep devices - External Locking Mechanism (ELM)
- hardened connectorized components
- connector block terminals
- nodes
- Ofcom Physical Infrastructure Access (PIA)
- customer premises equipment

(AC 3.2)
Underground:

- safe working practices underground
- ducted and subducted networks
- micro ducts and air blown fibre tubing
- manholes and cabling chambers including entry methods
- large, medium and small nodes
- street side cabinets
- building entry methods
- customer premises equipment

Learning outcome

The learner will:

4. Work to standards using proof connectivity technologies to calculate the optical loss budget for a network architecture.

Assessment criteria

The learner can:

4.1   Explain **standards** affecting network performance.
4.2   Use **proof connectivity** technologies.

4.3   Calculate a **loss budget** for a fibre to home.

(AC 4.1)
Standards:
- Fibre ITU-G 652 recommended fibre
- fibre attenuation values at selected wavelengths, e.g. single mode at 1270 nm, 1310 nm, 1490 nm, 1550 nm and 1577 nm

(AC 4.2)
 Proof connectivity:
- passive optical network (PON) connector types, e.g. subscriber connector (SC)
- angled physical contact (APC)
- insertion loss values
- optical return loss values
- wavelength division multiplexing (WDM) coupler
- attenuators, e.g. location, matching to system wavelengths
- optical splitters, e.g. branching (downstream), combining (upstream)
- splitter insertion loss values for different splitters, e.g. 2-way, 4-way, 8-way, 16-way, 32-way
- overall power loss for cascaded examples of splitters
- absolute power levels (dBm)
- PON optic class

(AC 4.3)
Loss budget:
- fibre length
- attenuation
- Tx power
- Rx sensitivity
- number of splices
- splitter loss
- link margin
- wavelength
- WDM coupler loss

Learning outcome

The learner will:

5.   Carry out tests to establish accurate equipment location, installation methods and testing methods of optical network distribution.

Assessment criteria

The learner can:

5.1   Describe the importance of **equipment location**.
5.2   Demonstrate different **installation methods**.
5.3   Describe the purpose of **optical network distribution**.

5.4 Use **testing methods**.

5.5 Demonstrate the use of **test equipment**.

Range

(AC 5.1)

Importance of **equipment location**:

- outside plant
- beyond exchange
- before customer's premises
- types of components used

(AC 5.2)

Installation methods:

- direct burial
- duct installation
- aerial installation
- influencing factors

(AC 5.3)

Optical network distribution:

- fibre optic cables
- WDM coupler
- patch cords
- splices
- connectors
- splitters
- drop terminals
- attenuators
- non-optical hardware e.g. pedestals, splice enclosures, patch panels

(AC 5.4)

Testing methods:

- bi-directional optical return loss measurement
- bi-directional end-to-end loss measurement
- bi-directional end-to-end link characterisation

(AC 5.5)

Test equipment:

- Live Fibre Detector (LFD)
- optical loss test set
- PON power meter
- Optical Time Distance Reflectometer (OTDR)
- visual fault locator
- remote Optical Test Heads (OTH)
- High Reflectance Demarcation (HRD)

Unit 306   Structured cabling and enterprise networks

Level:	Level 3
GLH:	50
Aim:	The aim of this unit is to give learners the skills to analyse the equipment, standards and protocols used in data networks. With businesses and organisations now more dependent on cloud-based technologies there is an imperative for an enhanced knowledge of network cabling and other supportive elements of the infrastructure. These elements will be comprehensively covered within this unit. Learners will be able to apply their knowledge of theories, models and structures gained from this unit and other units to implement a data network including internal and external infrastructure.
Assessment type:	Assignment

Learning outcome

The learner will:

1. Interpret and select the **cable types** based on **categories and rating**, taking into account the **environment**.

Assessment criteria

The learner can:

1.1 Select different **cable types**, connectors and their associated specifications.
1.2 Describe **categories and ratings** of data network cabling.
1.3 Select cable types depending on the **environment**.

Range

(AC 1.1)
Cable types:
- unshielded Twisted Pair (UTP)
- shielded Twisted Pair (STP)
- shielded/Foil Twisted Pair (S/FTW)
- construction Products Regulations (CPR)/United Kingdom Accreditation Service (UKAS)
- coaxial
- fibre optic
- Power over ethernet (PoE)

(AC 1.2)

Categories and ratings:
- category/classes, e.g. 5e/6/6a/8 – class D/class E/ class Ea/ class F/ class Fa
- frequency
- capacity, e.g. bits, bytes
- permanent link/channel/extended reach
- limitations of function, e.g. other issues not related to cabling

(AC 1.3)
Environment:
- buildings – public and private
- special locations
- food/pharmaceutical manufacturing facilities (hygiene considerations)
- industrial premises
- data centres/edge computing facilities

Learning outcome

The learner will:

2. Analyse the associated national and international protocols and standards for network cabling and other supportive networks including building regulations and fire performance.

Assessment criteria

The learner can:

2.1 Apply current national and international **protocols and standards** in data networks.
2.2 Demonstrate knowledge and understanding of **building regulations**.
2.3 Demonstrate knowledge and understanding of **fire performance**.

Range

(AC 2.1)
Protocols and standards:
- ISO
- IEC
- CENELEC
- TIA
- Data networking standards/protocols:
  - IEEE 802.1 – 802.12
  - 802.3 Ethernet
  - 802.11 Wireless LAN & Mesh (wi-fi certification)
  - 802.15 Wireless PAN
  - 802.15.4 Low-Rate Wireless PAN

(AC 2.2)
Building regulations:
- approved document R – physical infrastructure for high-speed electronic communication networks
- legislative directives

- regulatory directives

(AC 2.3)
Fire performance:
- CPR and UKAS
- firestopping
- passive fire protection
- active fire suppressants

The learner will:

3. Explain the physical components of a network infrastructure.

Assessment criteria

The learner can:

3.1 Describe the purpose and function of **cable components** used in data networks.
3.2 Describe the purpose of **hardware** used in data networks.

Range

(AC 3.1)
Cable components:
- switches (including PoE)
- patch panels
- routers
- servers/storage
- VLANS
- wireless access points
- end user devices
- LAN/WAN/VLAN
- end user devices
- UPS
- media converter

(AC 3.2)
Hardware:
- cabinets
- racks
- cable containment

Learning outcome

The learner will:

4. Interpret power separation guidance, grounding/bonding and other technical considerations.

Assessment criteria

The learner can:

4.1 Describe **power and data segregation** in a variety of environments.
4.2 Describe **grounding and bonding** in a variety of environments.

Range

(AC 4.1)

Power and data separation and segregation:
- EN50174 – power and data separation guidance
- EN50174 and BS7671-power and data segregation guidance
- Technical considerations in respect of other electrical services

(AC 4.2)

Grounding and bonding:
- IEC/BSEN 62305

Learning outcome

The learner will:

5. Interpret the graphical test parameters in accordance with protocols and standards by following appropriate processes relating to fault-finding, troubleshooting and rectification.

Assessment criteria

The learner can:

5.1 Apply **test parameters** using graphical data to two protocols and standards

5.2 Follow appropriate **processes** to find faults, trouble-shoot and rectify.

Range

(AC 5.1)

Test parameters:
- graphical test data
- certification
- Modular Plug Terminated Link (MPTL) testing
- compliance
- further information to support inspection e.g. photographic evidence

(AC 5.2)

Processes:
- fault finding
- standard fault-finding procedures
- common fault identification
- troubleshooting
- rectification

Learning outcome

The learner will:

6.   Review and evaluate supporting documentation for handover.

Assessment criteria

The learner can:

6.1   Use proprietary **cloud-based platforms** for data storage/projects.
6.2   Supply supporting **documentation**.
6.3   Handover **submission and completion** work.

Range
(AC 6.1)
Cloud based platforms:
- create projects
- storage

(AC 6.2)
Documentation:
- full plot data
- photographic evidence
- signed documentation

(AC 6.3)
Submission and completion:
- completion handover documents
- maintenance records (as appropriate)

Unit 307   Fibre fault finding and diagnostics

Level:	Level 3
GLH:	30
Aim:	This unit aims to provide learners with an understanding of the fault-finding methodologies, tools and processes involved when determining faults on a communications network. Learners will apply this understanding by demonstrating the appropriate use and selection of tools when undertaking troubleshooting of faults on a network.
Assessment type:	Assignment

Learning outcome

The learner will:

1. Demonstrate physical and logical **fault location** and **fault-finding** methodologies.

Assessment criteria

The learner can:

1.1 use visual and physical methodologies for fibre **fault location**.
1.2 use logical methodologies for fibre **fault finding**.

Range

(AC 1.1)
Fault location:
- continuity
- micro/macro bends

(AC 1.2)
Fault finding:
- decibel theory
- non-disruptive/intrusive testing
- half split/bracketing
- flow charts
- decision trees

Learning outcome

The learner will:

2. Demonstrate fault location and use a range of tools and carry out troubleshooting.

Assessment criteria

The learner can:

2.1   use physical tools for **fault location**.
2.2   describe fault locations using appropriate logical **tools**.
2.3   Carry out **troubleshooting** visually.

Range

(AC 2.1)

Fault location:
- visible light source
- insertion loss measurement (ILM)
- OTDR
- live fibre detector
- return loss measurement

(AC 2.2)

Tools:
- remote optical test heads (OTH)
- high reflectance demarcation (HRD)
- computer based test systems
- software and smart applications

(AC 2.3)

Troubleshooting:
- damage
- physical connection
- end face inspection
- optical distribution frame
- optical consolidation rack
- primary nodes
- splitter nodes
- aerial fibre nodes/connectorized block terminals
- patch panels
- underground closures
- customer service points
- optical termination equipment

Learning outcome

The learner will:

3.   Evaluate documentation issues and implement fault resolution methodologies while calculating associated costs.

Assessment criteria

The learner can:

3.1   Describe reasons for maintaining **documentation** relating to troubleshooting.

3.2   Use **fault resolution** methodologies.

3.3   Work out associated **costs**.

Range

(AC 3.1)

Documentation:

- record Issues
- fault logs
- cable records
- defect reporting/proactive repair
- record tests
- help desk software

(AC 3.2)

Fault resolution:

- temporary repair
- permanent repair
- service level guarantee
- Planned Engineering Work (PEW)

(AC 3.3)

Costs:

- compensatory (outages)

Unit 308   Copper fault finding and diagnostics

Level:	Level 3
GLH:	30
Aim:	This unit aims to provide learners with an understanding of the fault-finding methodologies, tools and processes involved when determining faults within a copper communications network. Learners will apply this understanding by demonstrating the appropriate use and selection of tools when undertaking troubleshooting of faults on a network.
Assessment type:	Assignment

Learning outcome

The learner will:

1. Demonstrate fault location and fault-finding methodologies relating to copper cabling communications network.

Assessment criteria

The learner can:

1.1   Use visual and physical methodologies for copper **fault location**.
1.2   Use of logical methodologies for copper **fault finding**.

Range

(AC 1.1)
Fault location:
- continuity
- disconnection
- high resistance
- short circuit
- rectified Loop
- battery contact
- earth contact
- spilt pair

(AC 1.2)
Fault finding:
- Ohms Law
- non-disruptive/intrusive testing
- half split/Bracketing
- flow charts
- decision trees

Learning outcome

The learner will:

2.   use a range of **tools** to determine **fault locations** and manage troubleshooting.

Assessment criteria

The learner can:

2.1   Identify appropriate **tools** for fault location.
2.2   Carry out **fault location**.
2.3   Carry out **troubleshooting**.

Range

(AC 2.1)

Tools:
- Cable Tester
- Multi-meter
- Signal Generator
- TDR

(AC 2.2)

Fault location:
- MDF test heads
- computer based test systems
- software & smart applications

(AC 2.3)

Troubleshooting:
- damage
- physical connection
- HDF/MDF
- primary connection points
- secondary Connection points
- distribution points
- joint closures
- overhead closures and block terminals
- network termination equipment

Learning outcome

The learner will:

3.   Evaluate documentation relating to troubleshooting, deal with fault resolution, associated costs, findings and issues.

Assessment criteria

The learner can:

3.1   Describe the reasons for maintaining **documentation relating to troubleshooting**.

3.2   Carry out **fault resolution** and calculate **associated costs**.

(AC 3.1)
Documentation relating to troubleshooting:
- record Issues
- fault logs
- cable records
- defect reporting/proactive repair
- record tests
- help desk

(AC 3.2)
Fault resolution and associated costs:
- temporary repair
- permanent repair
- service level guarantee
- service level agreements (SLA)
- associated compensatory costs

Unit 309   Design and planning external enterprise networks

Level:	3
GLH:	50
Aim:	The aim of this unit is to provide learners with an understanding of the industry standards and requirements when designing and planning external fibre networks. Learners will develop knowledge and practical understanding of the various techniques, skills and documentation that are necessary for planning external fibre networks. In addition, the learner will develop an understanding of the Health and Safety practices and relevant legislation which are the pre-requisites for conducting any on-site surveys and assessments. As part of the planning process the learner will gain an understanding of the correct procedures when designing a network using other licensed operators' infrastructure including distribution network operator (DNO) overhead networks and Physical Infrastructure Access (PIA).
Assessment type:	Assignment

Learning outcome

The learner will:

1.   Evaluate network architecture and topological designs in fibre optic networks.

Assessment criteria

The learner can:

1.1   Interpret **topological designs** for fibre optic networks.
1.2   Understand network planning decisions when scoping work.

Range

(AC 1.1)
topological designs:
- Passive Optical Networks (PON)
- Gigabit Passive Optical Networks (GPON)
- direct fibre to premises
- overhead networks (OH)
- underground networks (UG)
- Point of Presence (POP)

- customer lead-in
- buried routes

(AC 1.2)
Network planning decisions:
- PON
- overhead network POPs
- GPONs
- underground networks
- FTTP
- direct buried routes

Learning outcome

The learner will:

2. Demonstrate how to prepare for network surveying by classifying predesigned network routes for topological fibre cable optimisation.

Assessment criteria

The learner can:

2.1 Plan and prepare a preliminary **site survey** using route plans for both underground and overhead networks.
2.2 Identify predesigned **network routes** including the placement of network furniture.
2.3 Identify **network dimensioning** to ensure efficient fibre distribution and network coverage.

Range

(AC 2.1)
Site survey:
- Health & Safety in overhead and underground environments when conducting surveys
  - Existing Health & Safety site information:
    - risk Assessments
    - specific site safety statements
    - Reporting of Injuries Diseases and Dangerous occurrences (RIDDOR)
    - utility companies' documentation
- traffic management, i.e. road closures, traffic control locations
- network rail, pipeline (gas/oil), high voltage locations, hot spots
- location and avoidance
- preliminary site survey

(AC 2.2)
Network routes:
- underground routes (duct and direct buried)
- overhead cabling routes
- network chambers, pits and manholes
- cabinets or POP locations
- distribution nodes

- splitter nodes
- connectorised block terminals/drop nodes (CBT/DN)
- duct space
- pole capacity (wooden/metallic/hollow)
- loading and envelopes

(AC 2.3)
Network dimensioning:
- preliminary identification
- aggregate nodes (DIST)
- splitter nodes (PON/GPON)
- connectorised block terminals/drop nodes (CBT/DN)
- Physical Infrastructure Access (PIA) specification

Learning outcome

The learner will:

3. Evaluate **hazards**, risk assessment and environmental conditions related to surveying for networks.

Assessment criteria

The learner can:

3.1 State the **hazards and controls** associated with various environmental conditions.
3.2 Describe the **standards, legislation and regulations** which apply when undertaking site surveys.

Range

(AC 3.1)
Hazards and controls:
- Hazards:
  o working at height
  o ladders/use of hoist
  o working in confined spaces
  o working near overhead power
  o working near railway crossings
  o manual handling
  o hazardous substances/diseases
  o use of Mobile Elevated Work Platforms (MEWP)
  o use of Power Elevated Work Platforms (PEWP)
- Risks:
  o risk assessments
  o risk assessment methods statement (RAMS)
  o likelihood of harm
  o risk matrix (RIDDOR).
- Environmental conditions:
  o weather
  o wind

- o rain
- o animal / bird habitats
- o flora and fauna hazards
- o wastewater
- Control Measures :
  - o signing
  - o lighting
  - o guarding
  - o PPE
  - o gas detection
  - o confined spaces
  - o NRSWA
  - o GDU
  - o location avoidance
  - o linesearch

(AC3.2)
Standards, legislation and regulations:

- Health and Safety at Work Act (1974)
- New Roads and Streetworks Act (1991)
- Control of Substances Hazardous to Health Regulations 2002
- Electricity at Work Regulations (1989)
- Control of Asbestos Regulations (2012)
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013
- Physical infrastructure access (PIA)
- ITU Telecoms standards
- Communications Act (2003)
- Telecommunications Act (1984)
- Interconnection Regulations (1997)
- Highways Act (1980)
- Environmental Health Act (1990)
- Traffic Management Act (2006)
- Town and Country Planning Act (1990).

Learning outcome

The learner will:

4. Produce preliminary designs for the provision of telecoms infrastructure (overhead and external underground).

Assessment criteria

The learner can:

4.1 Gather sufficient technical and regulatory information to be able to identify availability and feasibility of proposed routes.
4.2 Plan the collection of information in a time scale suitable for achieving demand.
4.3 Interpret information, access, and import evidence into an equivalent Generic Network Mapping System (GNMS).

(AC 4.1)

Gather information:

- design tools that are suitable for the purpose
- Generic Mapping Software (GMS)
- Geographic Information System (GIS)
- premises to connected
- route availability
- existing Overhead and Underground Capacity
- build plan

(AC 4.2)

Plan:

- route
- resource allocation
- timescales
- manpower

(AC 4.3)

GNMS:

- mapping software route plan
- point of presence
- ducts
- duct chambers
- access chambers/manholes
- telegraph poles

Learning outcome

The learner will:

5. Develop detailed planning and documentation based on the network operator's specifications using appropriate tools.

Assessment criteria

The learner can:

5.1 Prepare planning documentation in accordance with standards and demand.
5.2 Produce planning documentation in accordance with standards and demand.

Range

(AC 5.1)

Preparation:

- mapping software
- preliminary site survey
- risk assessment forms
- route plans
- materials

(AC 5.2)
Producing:

- fibre cable selection
- clients' specification (within demand)
- clients topological and architecture specifications
- secondary site survey
- timescales of events
- timescale of Installation
- equipment and material lists
- optimisation and use of resources
- processes and instructions to be followed

Unit 310   Design and planning internal enterprise networks

Level:	3
GLH:	50
Aim:	The aim of this unit is to provide learners with an understanding of the industry standards and requirements when design and planning internal enterprise networks.

Learners will develop knowledge and practical understanding of the various techniques, skills and documentation that are necessary for planning local area and enterprise networks.

In addition, the learner will develop an understanding of the Health and Safety practices and relevant legislation which are the pre-requisites for conducting any on-site surveys and assessments as part of the design and planning process. |
| **Assessment type:** | Assignment |

Learning outcome

The learner will:

1. Evaluate the available information sources relating to building an internal enterprise network.

Assessment criteria

The learner can:

1.1 Describe information that can be obtained from **as built records/site plans**.
1.2 Describe information that can be obtained from **utility duct/riser/cable containment site plans**.
1.3 Describe information that can be obtained from **cable and rack layout diagrams**.

Range

(AC 1.1)
As built records/site plans:
- commonly used diagram symbols on Legends:
  - o door
  - o window
  - o fire exit
  - o utilities locations
  - o telecommunication:
    - ▪ mains distribution cabinets
    - ▪ telecom points
- security systems/CCTV camera locations

- LAN area networking:
  - ethernet protocols
  - fibre optic cabling (multi-mode, single-mode)
  - copper cabling media
  - wireless/Wi-Fi access points
  - comms rooms/datacentres
  - cable assured pathways
- Environmental:
  - asbestos building survey reports
  - airflow (plenum)
  - fire stopping
  - cooling of equipment

(AC 1.2)
Utility duct/riser/cable containment site plans:
- internal cable assured pathways/cable ducts and conduits
- external assured pathways
  - above ground/catenary cable support
  - underground/cable ducts/access chambers

(AC 1.3)
Cable and rack layout diagrams:

- comms rooms (campus, building distribution)
- racks
- power provision
- devices:
  - routers
  - switches
  - PSU
  - patch panels
  - UPS

Learning outcome

The learner will:

2.   Analyse the requirements for preparing a preliminary internal enterprise network survey.

Assessment criteria

The learner can:

2.1   Describe the requirements which should be considered when undertaking a **preliminary internal survey**.
2.2   Identify **existing cable infrastructure** that must be included as part of a survey.

Range
(AC 2.1)
Internal preliminary survey:

- Health & Safety when conducting surveys
  - existing Health & Safety site information:
    - risk assessments
    - control measures
    - site safety statements
    - RIDDOR
    - liaison with site safety personnel
- Internal:
  - physical internal boundaries
  - physical internal structures
  - wireless coverage – heat maps
  - heating and ventilation systems
  - noisy environments – electro-magnetic interference (EMI)
  - power outlets
  - utilities:
    - telecoms/data
    - electricity
    - water
- External:
  - boundaries (wayleaves)
  - planning documentation
  - utility companies' documentation
  - underground subducts
  - external comms cabinets
  - service providers access

(AC 2.2)

Existing cabling infrastructure:
- existing cabling (categories, classes future use)
- cable pathways (types, space requirements)
- network interface
- diverse routing (pathway selection)
- end user devices
- device locations (floor boxes, building lines, power poles):
  - wireless access points (locations, coverage area)
  - EMI/RFI (issues, distances).

Learning outcome

The learner will:

3. Analyse **hazards and risks** taking account of environmental conditions as well as standards, legislation and regulations when surveying for internal enterprise networks.

Assessment criteria

The learner can:

3.1 Describe **hazards and risk** associated with environmental conditions which should be included in site surveys.

3.2   Describe the **standards**, **legislation and regulations** which apply when undertaking site surveys.

(AC 3.1)
Hazards and risks:

- hazards
    - working at height
    - ladder/podium/hydraulic lifting equipment/access platforms
    - working in confined spaces
    - working near live equipment
    - manual Handling
    - hazardous substances (asbestos, chemical, biological)
- risks
    - risk assessments
    - likelihood of harm
    - risk matrix
- environmental conditions
- control Measures
    - temporary
    - permanent
    - PPE

(AC 3.2)
Standards, legislation and regulations:

- Standards:
    - building regulations
    - cabling standards
    - applicable protocols, e.g. PoE, Wi-Fi
    - fire regulations (fire stopping)
- Safe Health and Safety at Work Act 1974
- The Control of Substances Hazardous to Health Regulations 2002
- The Electricity at Work Regulations 1989
- Control of Asbestos Regulations 2012
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013

Learning outcome

The learner will:

4.   Utilise a range of generic digital software to develop planning documentation in the design and plan of internal enterprise networks.

Assessment criteria

The learner can:

4.1   Use a range of digital software in **design and planning**.
4.2   Produce planning **documentation to meet specified client requirements**.

(AC 4.1)

Design and planning:
- scope (blueprints, floorplans)
- requirements
- preliminary site surveys
- timescales/critical path analysis/PERT
- project management software
- resources
- floor plans
- implementation of initial plan/initial acceptance by client

(AC 4.2)

Documentation to meet specified client requirements:
- fibre cable selection
- clients' specification (within demand)
- clients topological and architecture specifications
- secondary site survey
- timescales of events (critical pathways)
- timescale of Installation (PERT/GANT charts)
- equipment and material lists
- optimisation and use of resources
- processes and instructions to be followed
- Implementation of plan/acceptance by client

Unit 311   Wireless and cellular

Level:	Level 3
GLH:	50
Aim:	The purpose of this unit is for learners to develop an insight into the concepts involved in using mobile and wireless networks to communicate both in a business and personal environment. This unit provides the underpinning knowledge to be able to understand the technologies used in the Public Communication Network (PCN), Mobile and Wireless Industry. This will involve the physical layer components including antenna theory, RF feeders and FTTA, and higher layers to give the learner an understanding of the networks they support and the traffic carried.
Assessment type:	Assignment

Learning outcome

The learner will:

1.   Analyse wireless **technology**, **architecture** and **components** associated with data communications.

Assessment criteria

The learner can:

1.1   Describe wireless **technology**.
1.2   Describe wireless network **architecture**.
1.3   Identify the **components** required to implement a wireless LAN.

Range

(AC 1.1)
Technology:
- wireless communication technologies:
    o   Near Field Communications (NFC)
    o   IEEE 802.11
    o   IEEE 802.15 (Bluetooth)
- microwave (WiMax – Worldwide Interoperability for Microwave Access)
- free space optics (FSO)
- direct broadcast Satellite (DBS)
- mobile phone networks:
    o   Global system for mobile communication (GSM)
    o   General packet radio service (GPRS)

- o   Global Positioning System (GPS)
- o   Short messaging service (SMS)
- o   Multimedia messaging service (MMS)
- o   3G
- o   4G
- o   5G
- o   Long Term Evolution (LTE).

(AC 1.2)
Architecture:

- Ad-hoc mode
- infrastructure mode
- Cell Structure
- frequency recycling and cell repeat patterns
- cell structure and cell splitting
- System Identification Codes (SID)
- multiple access schemes
- registration, roaming and handover.
- traffic capacity
- Base Transceiver Station (BTS)/ Base Station Subsystem (BSS)
- Radio Network Controller (RNC)
- Servicing General Packet Radio Support Node (SGSN)
- Mobile Switch Centre (MSC)
- Visitor Location Register (VLR)
- Home Location Register (HLRs)
- FDMA/TDMA Air Interface
- antenna types

(AC 1.3)
Components:

- routers (wired and wireless)
- wireless access points
- network interface cards/devices
- End user devices
- Network security
  - o   WPA
    - ▪   Broadcasting SSID

Learning outcome

The learner will:

2.   Understand the operation and construction of **antenna systems** used in wireless and mobile networks and the **propagation** of radio frequencies and **testing** PCN systems.

The learner can:

2.1 Describe **antenna systems** used in wireless and mobile networks.
2.2 Explain the **propagation** in modern networks.
2.3 **Understand testing** PCN antenna systems.

Range

(AC 2.1)
Antenna systems:
- dBi unit and basic radiation patterns.
- feeder systems
- Antenna system power budget in decibels
- Antenna Types
- MIMO Antenna configurations

(AC 2.2)
propagation:
- Radio Frequency Propagation
- Common frequency
- Multipath propagation
- Fresnal zones
- Weather conditions and refraction on radio communications

(AC 2.3)
testing:
- Passive Intermodulation Testing (PIM)
- sweep
- feeder attenuation testing
- FTTA Testing
- Remote Radio Head
- Connector inspection
- Insertion Loss, Optical Return Loss, Optical Time Domain Reflectometry and CPRI analysis
- RF safety when testing Antenna Systems

Learning outcome

The learner will:

3. Understand wireless techniques (WiFi and WiMax) for **Local Area Networking (LAN)** and **Wide Area Networking (WAN)**.

Assessment criteria

The learner can:

3.1 Learn the principles of wireless access used in **Local Area Networking (LAN)**.
3.2 Describe **Wide Area Networking (WAN)** for Broadband provision.

Range

(AC 3.1)

Local Area Networking (LAN):

- frequency bands and propagation
- modulation techniques
- security, SSPA and WPA
- wireless coexistence
- Wifi Standards
- IEEE 802 Standards, WPAN, IoT supporting Technologies
- Routers and gateway Devices

(AC 3.2)

Wide Area Networking (WAN):

- frequency bands and propagation
- modulation techniques
- Security, SSPA and WPA
- Wireless Coexistence
- WiMax Standards
- IEEE 802 Standards
- WPAN, IoT supporting technologies
- routers and gateway devices

Learning outcome

The learner will:

4. Understand the **technology** and **implementation** of 5G and LTE.

Assessment criteria

The learner can:
4.1 Describe the **technology** for 5G and LTE.
4.2 Describe the **implementation** of 5G and LTE.

Range

(AC 4.1)

 technology:

- all IP Networks
- Evolved Packet Core (EPC)
- Frequency Spectrum and Millimetre Wave Propagation
- Core Network Architecture

(AC 4.2)

 implementation:

- Small Cells
- Distributed Antenna Systems (DAS)
- Air Interface and Protocol Stack
- Data handling of Transmitted and Received Traffic

- Interoperability's with other technologies

Learning outcome

The learner will:

5.   Evaluate **Microwave Point to Point techniques** and **radio link planning**.

Assessment criteria

The learner can:

5.1   Describe **Microwave Point to Point techniques**.
5.2   Describe **radio link planning**.

Range

(AC 5.1)
 Microwave Point to Point techniques
- antenna systems and configuration
- Frequency Bands and Modulation
- applications to support other networks

(AC 5.2)
radio link planning:
- Path Profile Analysis (PPA)
- Radio Link Budget calculation
- Fading, Signal to Noise ratio (SNR) and Bit Error Rates (BER)
- antenna siting

Appendix 1   **Relationships to other qualification**

Links to other qualifications

This qualification has connections to the:
- Level 2 Award in Communications Cabling

Appendix 2   **Sources of general information**

The following documents contain essential information for centres delivering City & Guilds qualification. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on **www.cityandguilds.com**.

City & Guilds Centre Manual contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:
- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of Learners
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Access to Assessment & Qualification provides full details of the arrangements that may be made to facilitate access to assessments and qualification for Learners who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information on such things as:
- **Walled Garden**: how to register and certificate Learners online
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

Linking to this document from web pages
We regularly update the name of documents on our website, therefore in order to prevent broken links we recommend that you link to our web page that the document resides upon, rather than linking to the document itself.

Useful contacts

UK learners General qualification information	**E: learnersupport@cityandguilds.com**
International learners General qualification information	**E: intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	**E: centresupport@cityandguilds.com**
Single subject qualification Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	**E: singlesubjects@cityandguilds.com**
International Certificates Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	**E: intops@cityandguilds.com**
Walled Garden Re-issue of password or username, technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	**E: walledgarden@cityandguilds.com**
Employer Employer solutions including, Employer Recognition: Endorsement, Accreditation and Quality Mark, Consultancy, Mapping and Specialist Training Delivery	**E: business@cityandguilds.com**

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