

City & Guilds Level 2 Award in Communications Cabling (3668-02)

March 2022 Version 1.0

Qualification Handbook

Qualification at a glance

Subject area	Digital and IT
City & Guilds number	3668-02
Age group approved	16+
Entry requirements	None
Assessment	Multiple Choice; Assignment
Approvals	Qualification Approval
Support materials	Qualification handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Accreditation number
Level 2 Award in Communications Cabling	3668-02	610/0378/5

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

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1 Introduction

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

Area	Description
Who is the qualification for?	<p>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. It is also aimed at new entrants looking to start a career in this sector.</p>
What does the qualification cover?	<p>Learners will be introduced to the scope and opportunities offered within the network infrastructure (communications cabling) and telecoms industry.</p> <p>This qualification will cover communications cabling processes and principles. 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.</p> <p>Learners will be introduced to the principles of communications cabling systems and supporting network infrastructure.</p> <p>Learners will develop skills on how to install, e.g. fibre optic, copper and/or air blown fibre cables and micro-ducts.</p> <p>All the above will enable learners to progress into further training to take on various job roles.</p>
What opportunities for progression are there?	<p>Upon successful completion of this qualification, learners will be equipped with the knowledge, skills and behaviours required for progression towards a Level 3 Certificate in Communications Cabling qualification, with the goal of becoming a qualified technician. This award 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.</p>
Who did we develop the qualification with?	<p>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,</p>

	Hyperoptic, PQMS, TBN, Virgin Media and White Associates.
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Is it part of an apprenticeship standard or initiative?

This Level 2 Award 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 qualifications and the 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.

Level 2 Award in Communications Cabling

City & Guilds unit number	Unit title	GLH
Mandatory		
201	Principles of communications cabling	30
Optional		
202	Fibre optic cabling	50
203	Structured cabling and enterprise networks	50
204	Air blown fibre	45

Structure

To gain the **Level 2 Award in Communications Cabling** learners will complete **one** mandatory unit (201) plus **one** from the **three** optional units (202 – 204). A total of **two** units are required to achieve the award, which can be completed in any order.

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 award of a qualification.

TQT is comprised of the following two elements:

- The number of hours which an awarding 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 2 Award in Communications Cabling	75	91

2 Centre requirements

Approval

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

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 2 Award in Communications Cabling can be taken to complete the group award but it also 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, eg, 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 are 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 the learner fully understands the requirements of the qualification[s], 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' ePortfolio **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

City & Guilds has written the following assessments to use with this qualification:

- multiple-choice tests to be delivered online for 201, 202 and 203
- externally set, internally marked short-answer questions for unit 204
- guidance for centre-devised assignments including example assignments and short-answer questions for units 202 and 203
- sample multiple-choice tests are available for units 201, 202 and 203

Assessment Types – Award in Communications cabling			
Unit	Title	Assessment method	Where to obtain assessment materials
201	Principles of communications cabling	Evolve - Multiple-choice online test	Evolve
202	Fibre optic cabling	Evolve - Multiple-choice online test Plus Assignment	Evolve www.cityandguilds.com
203	Structured cabling and enterprise networks	Evolve - Multiple-choice online test Plus Assignment	Evolve www.cityandguilds.com
204	Air blown fibre	Assignment (no Multiple-choice online test)	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 learner's period of registration

Assessment strategy

Test specifications for the Evolve multiple choice online tests

The way the knowledge is covered by **each** test is laid out in the tables below:

Assessment title: Principles of communications cabling.

Assessment type: Evolve - Multiple-choice online test.

Assessment conditions: Invigilated examination conditions.

Grading: X/P.

Unit	Duration: 60 minutes		
201	Learning Outcome	Number of questions	%
	1. Identify safe working practices in communications systems.	6	20
	2. Describe the basic principles of SI units, symbols and wave types/motion.	9	30
	3. Explain the basic systems and principles of communications methods.	9	30
	4. Describe the basic principles of data networks, digital signals and types of communication systems.	6	20
Total		30	100

The grade boundaries for this test will be:

Pass: **70%** (21/30).

This boundary may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

Assessment title: Fibre optic cabling.

Assessment type: Evolve - Multiple-choice online test.

Assessment conditions: Invigilated examination conditions.

Grading: X/P.

Unit	Duration: 60 minutes		
202	Learning Outcome	Number of questions	%
	1. Carry out a risk assessment and work safely with optical fibres in internal and external environments.	6	20
	2. Carry out an installation following recommended procedures.	6	20
	3. Prepare fibre optic cables using cable cutting and stripping tools for splicing.	6	20
	4. Splice together optical fibre.	6	20
	5. Test fibre optic links.	6	20
Total		30	100

The grade boundaries for this test will be:

Pass: **70%** (21/30).

This boundary may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

Assessment title: Structured cabling and enterprise networks.

Assessment type: Evolve - Multiple-choice online test.

Assessment conditions: Invigilated examination conditions.

Grading: X/P.

Unit	Duration: 60 minutes		
203	Learning Outcome	Number of questions	%
	1. Conduct a risk assessment in order to work safely with copper cabling in an internal environment.	3	10
	2. Apply basic electrical theory in data communications cabling.	9	30
	3. Install copper cabling in accordance with current applicable standards.	6	20
	4. Use copper communications cabling techniques to terminate cables, terminate modules, keystones, modular plug onto appropriate cabling.	6	20
	5. Test and measure FTP and UTP links.	6	20
Total		30	100

The grade boundaries for this test will be:

Pass: **70%** (21/30).

This boundary may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

Practical assessments

Learner are required to successfully complete one practical assignments for units 202, 203 and 204 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 through the aggregation of the individual assessments graded.

All assessments must be achieved at a minimum of Pass for the qualification to be awarded. 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)
- 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 (eg 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.

Level:	Level 2
GLH:	30
Aim:	The purpose of this mandatory unit is for learners to develop their knowledge and understand of safe working practices including basic principles required to work in the telecommunications industry.
Assessment type:	Evolve – Multiple choice test.

Learning outcome

The learner will:

1. Identify safe working practices in communications systems.

Assessment criteria

The learner can:

- 1.1 Describe the rules for safe working when undertaking an **installation**.
- 1.2 Describe the rules for safe working when carrying out **preparation**.
- 1.3 Describe the rules for safe working and any special **precautions** when carrying out a communications installation.
- 1.4 Describe the rules for safe working and any special precautions to be observed when **terminating** cables.

Range

(AC 1.1)

Installation:

- Statutory requirements - Health and Safety at Work Act (HASAWA)/Control of Substances Hazardous to Health (COSHH) or relevant national safety standards
- Working in confined spaces
- Overhead cable routes – heights/ladders
- Electrical safety including grounding/bonding
- Fire stopping
- Asbestos awareness

(AC 1.2)

Preparation:

- Safe use of cutting and stripping tools
- Safe handling and containment of cleaning materials
- The disposal of waste material

(AC 1.3)

Precautions:

- Identification of hazardous working conditions
- Selection and use of tools and materials

(AC 1.4)

Terminating:

- Correct and safe use of tools and equipment
 - Storage of tools
 - Safe working when handling cable
 - Care in using chemicals for cleaning
 - Care in use of resins and adhesives
 - Correct waste disposal
-

Learning outcome

The learner will:

2. Describe the basic principles of **SI units, symbols, wave types/motion**.

Assessment criteria

The learner can:

- 2.1 Identify basic **SI units**.
 - 2.2 Identify names and **symbols** for preferred SI prefixes.
 - 2.3 Identify **wave types/motion**.
-

Range

(AC 2.1)

SI units:

- metre (m)
- kilogram (kg)
- second (s)
- ampere (A)
- kelvin (K)

(AC 2.2)

Symbols:

- tera (T)
- giga (G)
- mega (M)
- kilo (k)
- milli (m)
- micro (μ)
- nano (n)
- pico (p)

(AC 2.3)

Waves types/motion:

- sound waves
 - electromagnetic waves
 - amplitude
 - decibel (dB)
 - wavelength (λ)
 - frequency (f)
 - the unit of frequency (Hertz)
 - velocity, frequency and wavelength ($v = f\lambda$)
-

Learning outcome

The learner will:

3. Explain the basic **systems and principles** of communications **methods**.

Assessment criteria

The learner can:

- 3.1 Identify the basic communications **systems and principles** of cable systems.
 - 3.2 Describe communication **methods**.
-

Range

(AC 3.1)

Systems and principles:

- information source (transmitter)
- information destination (receiver)
- transmission/transfer link (communications channel)
- basic principles of cable systems: eg the source is directly connected to the receiver by means of cable links; attenuation is directly proportional to the distance travelled
- sources of interference: e.g. electromagnetic radiation and unwanted signals
- sources of distortion: e.g. non-linearity, harmonics
- properties of differing types of transmission links (channels)
- properties: typical attenuation in dB, normalised attenuation in dB/km, susceptibility to interference, unwanted radiation of signals, crosstalk
- fixed links: wired (shielded and unshielded copper multipair, shielded and unshielded copper twisted pairs, copper coaxial), optical fibre

(AC 3.2)

Methods:

- simplex (one-way communication)
- duplex (two-way communication)
- half/semi-duplex (two-way communication but only one-way at any one time)
- broadcast
- serial
- parallel
- types of information carried eg, sound, picture or data
- systems available for communication eg, internet, telephone, radio and television
- signals into audio, video and data types
- difference between ac and dc signals
- ac signals: frequency, amplitude, phase, wavelength, period, velocity, harmonics
- differences between analogue and digital signals
- bandwidth
- baseband of complex signals
- baseband and broadband
- analogue to digital signals and vice versa
- variation of the amplitude, frequency or phase of a carrier wave can be used to convey information
- gain and attenuation
- multiplexing
- optical fibre compared to copper
- measuring in decibels (dBs)
- relationship for the power ratio expressed in dBs for the following ratios and vice versa:
 - 2 (3dB)

- 4 (6dB)
- 8 (9dB)
- 10 (10dB)
- 100 (20dB)
- 1000 (30dB)
- 1000000 (60dB)
- 1/2 (-3db)
- 1/4 (-6dB)
- 1/8 (-9dB)
- 1/10 (-10dB)
- 1/100 (-20dB) etc

Learning outcome

The learner will:

4. Describe the basic principles of **data networks**, **digital signals** and **types of communication systems**.

Assessment criteria

The learner can:

- 4.1 Understand **data networks**.
 - 4.2 Understand **digital signals**.
 - 4.3 Understand different **types of communication systems**.
-

Range

(AC 4.1)

Data networks:

- Data networks allow computers or other data terminals to exchange information
- Advantages and disadvantages of digital communication
- Advantages and disadvantages of analogue communications

(AC 4.2)

Digital signals:

- Identify analogue and digital signals
- Binary encoding is typically used on digital networks
- Distinguishing between 'bits' (b) and 'bytes' (B)
- Bit error rate (BER) and give typical figures for copper and optical fibre systems

(AC 4.3)

Types of communications systems:

- Transmitting data: serial using a single transmission line and parallel using multiple lines
- Advantages of transmitting data by these two methods:
 - Serial: can be used over longer distances
 - Parallel: can send higher data rates over shorter distances
 - applications for serial data communication and parallel data communication
 - applications for serial data communication and parallel data communication
 - 'Modems' are required for computer communication
- main categories of computer networks:
 - Local area networks (LAN)
 - Metropolitan area networks (MAN)
 - Wide area networks (WAN)
 - Storage area network (SAN)
 - Basic topologies of computer networks: e.g. star, bus, ring

Unit 202

Fibre optic cabling

Level:	Level 2
GLH:	50
Aim:	This unit aims to provide the learner with the knowledge and understanding of installation, splicing, termination and testing of fibre optic cable in patch panels/equipment racks. This would usually take place in an indoor/external environment involving multimode and single-mode end to end cabling.
Assessment type:	Evolve - Multiple choice test Assignment

Learning outcome

The learner will:

1. Carry out a **risk assessment** and **work safely** with optical fibres in internal and external environments.

Assessment criteria

The learner can:

- 1.1 Conduct a **risk assessment** prior to installation of optical fibres in internal and external environments.
- 1.2 **Work safely** when installing, splicing, terminating, and testing optical fibre in internal and external environments.

Range

(AC 1.1)

Risk assessment:

- statutory requirements eg, HASAWA/COSHH/NRSWA or relevant national safety standards
- laser safety and the Optical Radiation Directive (ORD)
- safe use of cutting and stripping tools
- safe handling and containment of cleaning materials
- proper disposal of waste materials

(AC 1.2)

Work safely:

- identification of hazardous working conditions including gas detection
- understanding the dangers of high voltage systems employed in fusion splicing machines
- use of tools and equipment
- disposal of waste material
- handling fibre cable
- use of chemicals for cleaning
- use of resins and adhesives

Learning outcome

The learner will:

2. Carry out an installation following recommended procedures.

Assessment criteria

The learner can:

- 2.1. **Check cable** components before installation.
 - 2.2. Ensure **appropriate cable installation** procedures are followed.
 - 2.3. **Test** laid cable before jointing/termination.
 - 2.4. Follow verbal/written work **plans** and instructions.
-

Range

(AC 2.1)

Check cable:

- use of fibre optics in LANs
- distinguishing between types of optical fibre eg, single-mode, multimode, graded-index, stepped-index

(AC 2.2)

Cable installation:

- component parts of optical fibre
- glands/couplings/mountings/fibre management tray/grounding/bonding
- connectors
- pre-terminated cable assemblies
- types of equipment used for installation eg rods, pulling ropes, fuse link protectors, socks, grips, fused connectors and swivels
- cable tensile strength
- minimum bend radius (MBR)
- adequate protection and support
- correct identification and labelling
- provision of spare cable
- fibre specifications and parameters:
 - core/cladding diameters
 - buffer or secondary (buffer) and primary coating diameters
 - refractive index
 - attenuation
 - operational wavelengths
 - operational characteristics of LEDs and lasers
 - laser enhanced fibres eg, principles of reduced attenuation and increased bandwidth for restricted mode launch conditions in multi-mode fibres

(AC2.3)

Test:

- visual checks
- optical continuity
- point defects
- length certification
- component documentation and insertion loss and return loss
- return loss and reflectance

- component parts of an optical fibre
- glands/couplings/mountings/fibre management tray/grounding/bonding
- connectors
- pre-terminated cable assemblies

(AC 2.4)

Plan:

- main types of equipment used for cable installation eg, rods, pulling ropes, fuse link protectors, socks, grips, fused connectors and swivels
- cable installation and fibre management in terms of:
 - cable tensile strength
 - minimum bend radius (MBR)
 - adequate protection and support
 - correct identification and labelling
 - provision of spare cable
 - testing laid cable before jointing/termination in relation to point defects and fibre continuity

Learning outcome

The learner will:

3. Prepare **fibre optic cables** using **cable cutting and stripping tools** for **splicing**.

Assessment criteria

The learner can:

- 3.1. Identify characteristics of **fibre optic cables** for splicing.
- 3.2. Select and use **cable cutting and stripping tools**.
- 3.3. Prepare coated fibre for **splicing**.

Range

(AC 3.1)

Fibre optic cables:

- indoor/outdoor/universal eg, breakout, distribution, loose tube, singled ruggedised, single-fibre cable
- fibre optic cable and coating in relation to fibre size, fibre coating and material combinations

(AC 3.2)

Cable cutting and stripping tools:

- kevlar cutters
- jacket stripper
- sheath remover
- primary stripper
- secondary strippers

(AC 3.3)

Splicing:

- fibre cleaning materials
- techniques involving degreasing solvents and solvent application
- special precautions to be observed

- correct use of cutting, stripping tools and cleaning materials
 - care in handling fibre optical cable
-

Learning outcome

The learner will:

4. Splice together optical fibres.

Assessment criteria

The learner can:

- 4.1 Splice optical fibres using **splicing machine**.
 - 4.2 Splice optical fibres using **mechanical splices**.
-

Range

(AC 4.1)

Splicing machine:

- fibre preparation
- cleaving
- splicing methods
- splicing on pigtails
- using fibre cleaving tools
- causes of faults eg, incorrect cleave angle, hackle, burrs, ingress of dirt, inadequate fibre length, problems with fibre coatings
- mismatch fibres
- application of splice equipment eg, fusion splice machines (automatic and manual) and selection of splicing program for multi-mode and single-mode fibre

(AC 4.2)

Mechanical splicing:

- mechanical splices, accessories, and splice protection housings
 - splice protection systems for working within patch panels
 - potential problems when undertaking splicing and possible causes
 - performance requirements of splices according to standards
 - connector types and patch cords
-

Learning outcome

The learner will:

5. Test fibre optic links.

Assessment criteria

The learner can:

- 5.1 Identify fibre **continuity and power budgets**.
 - 5.2 Measuring **insertion loss**.
 - 5.3 **Test performance links**.
 - 5.4 **Document results**.
-

Range

(AC 5.1)

Continuity and power budgets:

- performance loss calculations
- test methods
- testing to measure cable performance in relation to:
 - fibre and connector insertion loss/individual component loss/fibre continuity/fibre and system lengths
 - test equipment eg, visible light source, light source and power meter, OTDR

(AC 5.2)

Insertion loss:

- testing equipment and procedures to measure link insertion loss
- features of an OTDR trace eg, fault location of breaks and ends, measurement of fibre loss, splice loss, connector insertion and return loss, distance measurements

(AC 5.3)

Test performance links:

- procedures eg, terminated fibre, unterminated fibre and test directions
- applying and operation test equipment to prevent sources of error by calibration:
 - launch stability
 - test lead connection
 - spatial resolution
 - elimination of ghosting
 - fibre mismatch
 - minimisation of dead zone

(AC 5.4)

Document results:

- test results/OTDR reports
- compare link against acceptable budget
- component performance
- connector end face inspection
- criteria defined in current BSEN standards
- insertion loss measurement

Unit 203

Structured cabling and enterprise networks

Level:	Level 2
GLH:	50
Aim:	This unit aims to provide the learner with the knowledge and understanding of health and safety, standards, installation procedures and testing of copper communication cables in an internal environment.
Assessment type:	Evolve - Multiple choice test Assignment

Learning outcome

The learner will:

1. Conduct a **risk assessment** in order to **work safely** with copper cabling in an internal environment.

Assessment criteria

The learner can:

- 1.1 Conduct a **risk assessment** prior to the installation of copper cables in an internal environment.
- 1.2 **Work safely** when installing, terminating, and testing copper cables in an internal environment.

Range

(AC 1.1)

Risk assessment:

- copper cabling when undertaking installation eg, statutory requirements HASAWA/COSHH or relevant national safety standards working in confined spaces
- copper cabling when carrying preparation in terms of use of tools and equipment, personal safety requirements
- identification of hazardous work conditions
- electrical safety eg, compliance with BS7671 or relevant national standard
- requirement for fire stopping
- correct use of grounding and bonding
- battery/corded test equipment and power leads

(AC 1.1)

Work safely:

- electrical safety - compliance with BS7671 or relevant national standard
- correct use of grounding and bonding
- use of battery/corded test equipment
- power leads

Learning outcome

The learner will:

2. Apply basic electrical theory in data communications cabling.

Assessment criteria

The learner can:

- 2.1 Use a **multi-meter** to measure voltage and resistance.
 - 2.2 Use Ohm's law and transmission characteristics to identify and solve simple **electrical circuit issues**.
-

Range

(AC 2.1)

Multi-meter:

- distinguish between different electrical conductors and different insulators
- relationship between AWG and properties of resistance
- materials that make up electrical conductors and insulators
- capacitance, inductance and characteristic impedance in relationship to an AC signal
- international standard symbols for electrical components
- effects of an electric current eg, heating, chemical, magnetic
- SI units of current (ampere), potential difference (volt) and resistance (ohm)

(AC 2.2)

Electrical circuit issues:

- solving simple electrical circuit problems
- relationship between MHz and Mbits
- test parameters:
 - wire map
 - nominal velocity of propagation (NVP)
 - delay skew and propagation delay
 - length
 - near end cross talk (NEXT) and ACR-N
 - equal level far end cross talk (ELFEXT) and ACR-F
 - attenuation-to-crosstalk ratio (ACR)
 - return loss
 - insertion loss (attenuation)
 - powersum calculations
 - dc loop resistance
 - frequency (bandwidth)
- the importance of good installation practice when using copper communications cables with respect to:
 - maintaining the twist in copper pairs and their effect on the cable's characteristic impedance
 - maintaining the cable's characteristic impedance eg, the potential impact of not complying with minimum bend radius
 - potential impact of applying excessive pull tension
- rules for copper cable installation and management in terms of compliance with European and International standards eg, BSEN, ISO, TIA/EIA
- cable wiring diagrams and construction drawings

Learning outcome

The learner will:

3. Install copper cabling in accordance with current applicable standards.

Assessment criteria

The learner can:

- 3.1 Understand **cable components and topologies** before installation.
 - 3.2 Undertake a **site survey** prior to commencing work.
 - 3.3 Follow correct cable **installation procedures**.
-

Range

(AC 3.1)

Cable components and topologies:

- cable topologies available for the installation of copper cables eg:
 - point to point
 - star
 - branching tree
 - bus
 - ring
 - grid
 - mesh
- cable types available for use in copper networks eg:
 - coaxial cables
 - unshielded twisted pair (UTP)
 - shielded twisted pair (STP)
 - foil screen twisted pair (FTP)
 - supplementary/secondary shielded TP cable types
- state the relevant classes, standards and categories of cabling including categories 5e, 6, 6a, 8; class D, E, Ea, F and Fa

(AC 3.2)

Site survey:

- interpreting wiring diagrams and construction drawings
- fixing cabling communication racks/cabinets
- providing cable supports and wall fastening systems
- fixing horizontal and vertical cables onto appropriate cable support systems
- interpreting cable labelling and identification
- compliance with appropriate building and fire compliance regulations

(AC 3.3)

Installation procedures:

- carrying out installations
- conducting site surveys
- work to appropriate standards and regulations

Learning outcome

The learner will:

4. Use copper communications cabling techniques to **terminate cables, terminate modules, keystones, modular plug** onto appropriate cabling.

Assessment criteria

The learner can:

- 4.1 **Terminate cables** and hardware to mount into patch panels/wall/floor boxes/cabinets and frames.
- 4.2 **Terminate modules, keystone, modular plug** onto appropriate cabling eg, UTP, FTP, S/FTP cabling.

Range

(AC 4.1)

Terminate cables:

- use cable preparation and termination tools.
- insulation displacement connection (IDC) methods of terminating, twisted-pair onto Krone LSA/110/ coax, within appropriate wiring systems.

(AC 4.2)

Terminate modules/keystone/modular plug:

- rules and any special precautions for termination in terms of:
 - problems with incorrect cable termination
 - selection and use of tools and connectors
- situations/environments to use stranded and solid core cables

Learning outcome

The learner will:

5. **Test and measure** FTP and UTP links.

Assessment criteria

The learner can:

- 5.1 Use a range of commercially available cable **testing** equipment.
- 5.2 **Measure** cable parameters using the correct test methods.

Range

(AC 5.1)

Testing:

- cabling plant installations
- national and international testing standards
- application and use of continuity and loop testing equipment
- wiremapping:
 - split pairs
 - transposed/crossed pairs
 - reversed pairs
 - mixed pairs

(AC 5.2)

Measure:

- wire map
- nominal velocity of propagation (NVP)
- delay skew and propagation delay
- length
- near end cross talk (NEXT) and ACR-N
- alien cross talk
- equal level far end cross talk (ELFEXT) and ACR-F
- attenuation-to-crosstalk ratio (ACR)
- return loss
- insertion loss (attenuation)
- powersum calculations
- dc loop resistance
- frequency (bandwidth)
- UTP, FTP and S/FTP cable permanent links
- MPTL (modular plug terminated link)
- installations to relevant performance standards eg, categories 5e, 6, 6a and 8; classes D, E, Ea, F and Fa

Unit 204

Air blown fibre

Level:	Level 2
GLH:	45
Aim:	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 (approximately 1mm – 2.5mm 2, 4, 8, 12,24 fibre units). This would usually take place in a workshop environment.
Assessment type:	Assignment

Learning outcome

The learner will:

1. Carry out risk assessments and safety checks when using air blown fibre machines.

Assessment criteria

The learner can:

- 1.1 Conduct a **risk assessment** prior to working with air compressors and installation of micro ducts.
- 1.2 Conduct **safety checks** when operating compressors, electrical and hydraulic driven blowing machines.

Range

(AC 1.1)

Risk assessment:

- identifying the task/operation
- arranging for the essential personnel to be available for consultation
- grading risks and hazards in terms of likelihood and severity
- task/operation being assessed
- group or employees, contractors, service users or members of the public are affected
- carrying our risk assessment process
- stating the hazards
- stating the 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
- stating the expected likelihood of the hazard being present assuming that control measures are or will be put into place

- stating the 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
- a near miss/dangerous occurrence or accident has taken place

(AC 1.2)

Safety checks:

- Bar and PSI air pressure
- 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

Learning outcome

The learner will:

2. Construct a micro ducted link prior to blowing fibres.

Assessment criteria

The learner can:

- 2.1 Build an end to end **blowing link** for the size of the fibre unit being blown in.
- 2.2 Use differing types of **micro duct and sub duct assemblies** and interconnecting devices.
- 2.3 **Store and handle** micro duct and sub duct assemblies.

Range

(AC 2.1)

Blowing link:

- product maps
- industry diagrams

(AC 2.2)

Micro duct and sub duct assemblies:

- 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. Use direct buried **methods of trenching** to manufacturer's recommendations.

Assessment criteria

The learner can:

- 3.1 Identify **methods of trenching**.
 - 3.2 **Back-fill trenches** to manufacturer's recommendations.
-

Range

(AC 3.1)

Methods of trenching:

- slot trench
- micro trenching
- mole plough
- excavation

(AC 3.2)

Back-fill trenches:

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

Learning outcome

The learner will:

4. Use various **methods of installation** and **troubleshooting measures** for directly installing into ducts.

Assessment criteria

The learner can:

- 4.1 Carry out **methods of installation**.
 - 4.2 Use **troubleshooting measures** when carrying out direct installation into ducts.
-

Range

(AC 4.1)

Methods of installation:

- rodding, roping and winching techniques
- use of mechanical machines and aids eg, hand or machine rodding
- pull socks
- end caps
- fused swivels
- pulling ropes
- lubricants
- protection of tub assemblies during installation

(AC 4.2)

Troubleshooting measures:

- blockages
 - congested ducts
-

Learning outcome

The learner will:

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

Assessment criteria

The learner can:

- 5.1 Select **tube bundles assemblies**.
 - 5.2 **Connect microducts into tube bundles assemblies**.
 - 5.3 **Interconnect tube distribution closures (TDC)**.
-

Range

(AC 5.1)

Tube bundles 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
 - EFL- fibre locking fibre systems for cabinets
 - super seal end caps
 - 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
-

(AC 5.2)

Tube distribution closures (TDC):

- fit manufacturer's TDC and wrapped closures
 - 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. Conduct pre-blowing pressure and continuity testing.

Assessment criteria

The learner can:

- 6.1 Carry out **airflow and pressure testing**.
 - 6.2 Conduct **continuity testing**.
-

Range

(AC 6.1)

Air flow and pressure testing:

- use an air flow meter kit
- carry out air flow checks at the appropriate pressure 10 bar 15 bar
- air pressure/ air speed L/min
- seal the chosen link
- conduct a pressure test to manufactures specification

(AC 6.2)

Continuity test:

- fit air stone
 - insert continuity device and blow in at lower pressure than operational requirements typically 4 bar
-

Learning outcome

The learner will:

7. Install blown fibre bundles into tubes.

Assessment criteria

The learner can:

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

Range

(AC 7.1)

Blowing machines:

- fibre unit blowing 1.10mm-2.05mm 2 -24 fu
- air dispenser devices (hoses)

(AC 7.2)

Connect to appropriate control box:

- 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)

Blow in fibre (eg1-12 fibres/up to 3mm diameter):

- 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

Links to other qualification

This qualification has connections to the:

- Level 3 Certificate in Communications Cabling

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 on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments.

Centre Guide – Delivering International Qualification 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. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of learners
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions

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Useful contacts

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General qualification information

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General qualification information

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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 awards

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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

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