



External Civil Network Infrastructure Specification.

Specification for the Provision of New works & Comprehensive
Maintenance & repair services to University of Warwick.

Document Control.

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Appendix 1 as applicable, accompanies this document.

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4. Technical Requirements.

4.1 Specification Overview - General

To provide specialist services ranging from New Civil works through to Underground Utility Maintenance and Surveying Services.

And offer project management support for large projects through complementary services such as GIS and live web hosting packages.

The following paragraphs describe and details the requirements for contractors working on the UoW Underground Duct Network.

This document is meant to be used by appropriately trained and competent personnel who have good experience of working below and under ground



4.2 Capital Build Network Extension requirements.

4.2.1 Existing Records and Mapping.

The Estates Office shall supply all available existing underground plant utility records.

The Estates Office shall supply any Ordnance Survey base mapping needed to satisfy the requirements of the Supplier.

Where the Order does not include Topographical Surveying Services, the Estates Office will supply any existing Topographical Survey data needed to satisfy the requirements of the Order.

All GML Data supplied by Ordnance Survey (<http://www.ordnancesurvey.co.uk/oswebsite/>)

Under Licence 100033685 will be converted to AutoCAD (DWG) by the supplier @ no cost.

4.2.1 New Installation Design Criteria for Manholes Details.

Also note Chapter 4.4

Unless otherwise specified in the Order:

4.2.1.1 SPECIFICATIONS.

Where British Standards, or other specifications, are quoted these will be current issues adopted by the British Standard Institution or relevant Authority. Where equivalent European Standards, to those quoted, exist, then the European Standards must be adhered to insofar as they are deemed to apply.

4.2.1.1.1 DESIGN CRITERIA.

1) Design Standards

The structures are to be designed in accordance with the following:

BS 4449	-	- Steel for reinforcement of concrete
BS 5400	Part 1	- General Statement.
BS 5400	Part 2	- Specification for loads.
BS 5400	Part 4	- Code of Practice for design of concrete bridges.
BS 8110	Part 1	Structural Use of Concrete Code of Practice for design and construction.

Department of Transport Standards

- BD 15/92 - General principles - use of BS 5400 Part 1.
- BD 24/92 - Design of concrete bridges - Use of BS 5400 Part 4.
- BD 31/01 - Buried concrete box type structures. (Excluding clauses 5.5 and 5.6).
- BD 37/01 - Loads for highway bridges.

2) Live Loading.

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Full HA loading, to BS5400: Part 2 as revised and amended by

Department of Transport Standard BD37/01 - Loads for Highway Bridges - must be applied.

45 Units of HB loading, to BS5400: Part 2 and as defined by Department of Transport Standard BD 37/01 - Loads for highway Bridges - must be applied.

3) Span and Articulation arrangements.

All Roof, Wall and Floor arrangements must be single way spanning.

All Roof to Wall connections are to be fixed. Pinned connections are not accepted.

4) Concrete.

The Characteristic strength of concrete fcu is 40 N/mm². minimum. Where in situ conditions require the use of higher Characteristic strength concrete approval must be obtained from the Estates Network Engineer & the minimum thickness of Roof, Wall and Floor slab units shall be 200mm.

5) Reinforcement.

All main tension reinforcement must be Type 2 to BS 4449 with a specified characteristic strength (fy) of 500 N/ mm².

All main tension reinforcement shall have a minimum diameter of 16mm and be spaced at 150mm across centres. Where the bars occur on the internal faces of the structure they shall be located in a square grid format and extend the full length and breadth of the Roof, Wall and Floor slab units.

All external faces of the structures Roof, Wall and Floor slabs shall have secondary reinforcement, in addition to tension reinforcement in place, located in a square grid format extending the full length and breadth of the Roof, Wall and Floor slab units. In locations where tension reinforcement provides a suitable square grid then the requirement for secondary reinforcement can be waived. All secondary reinforcement shall be plain round steel bars to BS 4482, BS EN 10025-1 or BS EN 13877-3 (ref. item 203.reinforcement, para.1) with a specified characteristic strength (fy) of 250 N/mm²., have a minimum diameter of 8mm and be spaced at 300mm across centres.

All bar shape codes to refer to BS 8666, Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete.

6) Water table.

Where exact information is not available the water table shall be assumed to occur at .5mt below existing ground level.

7) Buried depth.

For the purposes of analysis the structure should be designed for buried depths of 500mm and the actual in-situ or planned depths.

The maximum buried depth to the top of the roof level (inclusive of the frame and cover), for any structure, must not exceed 3.0m.

8) Internal height.

The maximum internal height of the structure is to be 2.7m. and the minimum internal height is to be 2.0m. Any deviation from this requirement must be approved by the UofW Agent.

Where in-situ parameters are not compatible to the above requirement then the use of a two tier, or multi-tier, structure should be considered. Prior to the design of any multi-tier structure approval must be obtained from the UofW Agent.

9) Design Calculations and Drawings.

Each non-standard structure must be supported by design calculations and construction drawings.

Design calculations must be approved by a Chartered Civil or Structural Engineer, who is a member of the British Institution of Civil or Structural Engineers or other professional body recognised by the Institutions, and has sign off responsibility for the company.

Each non-standard structure must have a general arrangement drawing supported by reinforcement detail drawings to ensure construction is carried out in accordance with the requirements of the design calculations. The general arrangement drawing must clearly indicate the positions of all duct entry points, cable bearers, sump, and anchor irons, manhole steps and manhole entry point. A typical example of a general arrangement drawing is shown on drawing CN 14103.

The access shaft to the chamber is to be in accordance with drawing CN 1153.

Submissions.

One copy of all design calculations and two prints of all drawings must be submitted to:

Underground Networks Group (Estates TAA)
Estates Office
Argent Court
Coventry
CV4 7EZ

Phone No. 024 76 5 24688

Fax No. 024 76 5 24444

4.3.1 As Built Records.

Unless otherwise specified in the Order:

All existing Chambers / Manholes have had their elements recorded and stored in an asset register.
The data for all new installations of chambers and ducting are to be recorded.
This will be provided by our resident Digital Surveying Supplier.

Data will be made available to the contractor @ no cost in electronic format for their use during the contract to assist them in meeting their contractual requirements.

4.3.2 Schedule of works.

Unless otherwise specified in the Order:

All new installations will be scheduled in compliance with the needs of the University of Warwick.
The Network manager will approve all schedules prior to order confirmation.

4.3.3 Paragraph Omitted.

4.3.4 Underground Services Reporting.

The Supplier shall prepare for each Project / Task a survey report which includes the following:

- Manhole record cards.
- Details of the equipment and methods used to locate and survey plant in the different areas of the site.
- Identification of any discrepancies between Plant Owners records and the findings of the survey.
- Confirmation of actual accuracies achieved.
- Details of plant not located together with justification.
- Details of access covers not lifted together with justification.
- Details of any unidentified plant or suspicious signals encountered together with the surveyor's comment Supporting Photographs / Data.

This information is to be obtained via the UofW Current Digital Surveying supplier.

The CAD drawing supplied shall be supplied in hard and soft copy all utilities shown over a grey coloured base. The final data shall also be made available to the client in DWG format for further integration and interrogation.



4.4 Detailed Technical Specification.

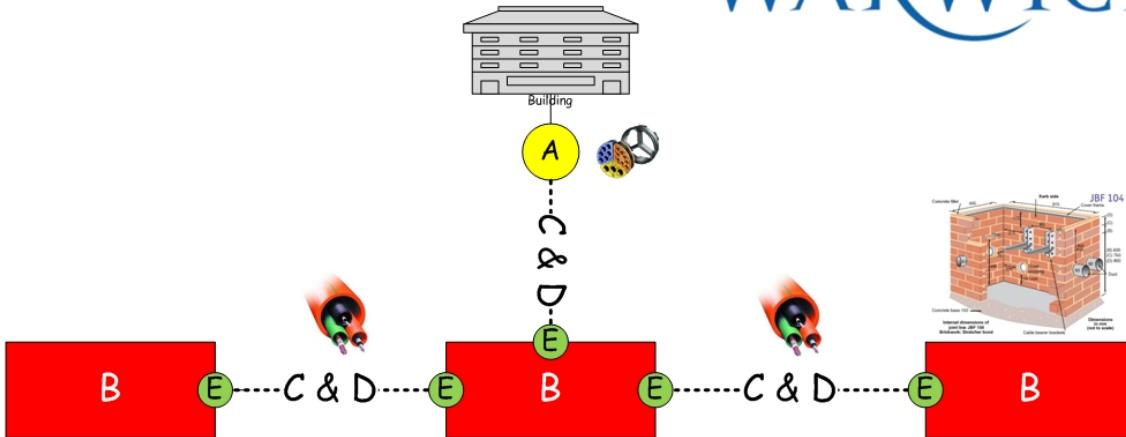
Building Entry & Lead ins (A) Para 4.4.1 Refers. [4.4.1 Building Entry - Lead In \(A\)](#)

Manholes Pits/ Jointing Chambers (B) Para 4.4.2 Refers. [4.4.2 Manholes / Access Pits / Jointing Chambers & Refurbishment. \(B\)](#)

Excavations / Trench (C) Para 4.4.3 Refers. [4.4.3 Excavation / Trench Specification. \(C\)](#)

Ducting & Cable Laying (D) Para 4.4.4 Refers. [4.4.4 Ducting & Cable Laying. \(D\)](#)

Duct Seals (E) Para 4.4.5 Refers. [4.4.5 Duct sealing. \(E\)](#)



Chapter 4.4.1 A. Building Entry (A)

Chapter 4.4.2 B. Pits/ Chambers

Chapter 4.4.3 C. Excavations/Trench

Chapter 4.4.4 D. Ducting & Cabling Laying

Chapter 4.4.5 E. Duct Sealing (E)



4.4.1 Building Entry - Lead In (A)

All building Entry Points & Lead ins shall use a minimum Joint Box No 23 (LN 550 Diagram No CU 14113) with cast iron lid.

In existing buildings an aperture shall be made in the building fabric by core drilling or other vibration free means.

Any aperture shall allow for a minimum of 25 mm of resin mortar to be applied around the entire circumference of any duct.

The surface of any aperture created by core drilling shall be roughened to give a good bonding surface for the resin mortar.

The core-drilled aperture shall slope away from the building to prevent any ingress of water.

Core drilling shall only commence after authorisation from the Estates Network Engineer has been given / authorized.

In buildings that have less than 1.5m of headroom below finished floor level, the lead-in ducts shall be brought into the building from below.

The ducts shall be sited as close as possible to the wall of the building and shall extend to a minimum of 300mm up from the surface of the finished floor.

Bends having a minimum radius of 900mm shall be used to achieve this lead-in.

In buildings that have greater than 1.5 of headroom below finished floor level the lead-in ducts shall be brought into the building horizontally through a wall.

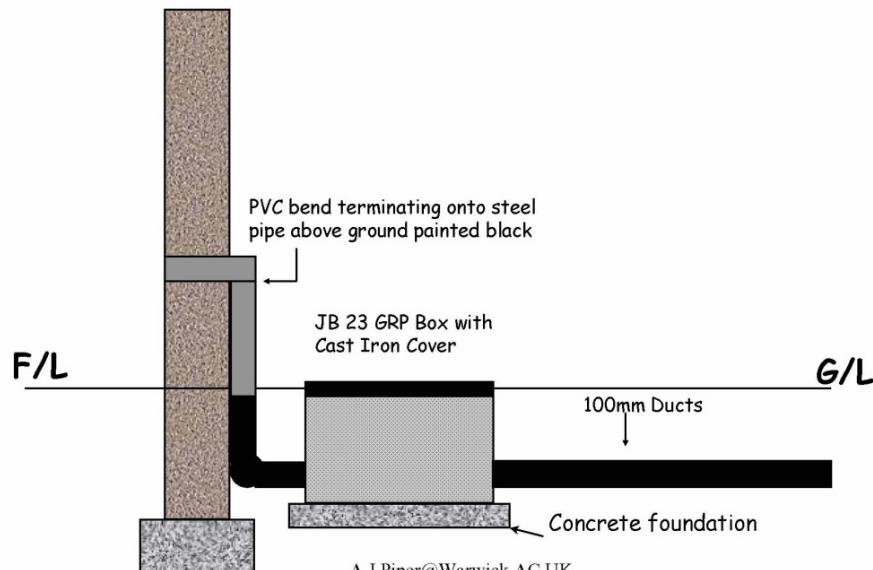


Figure 1.

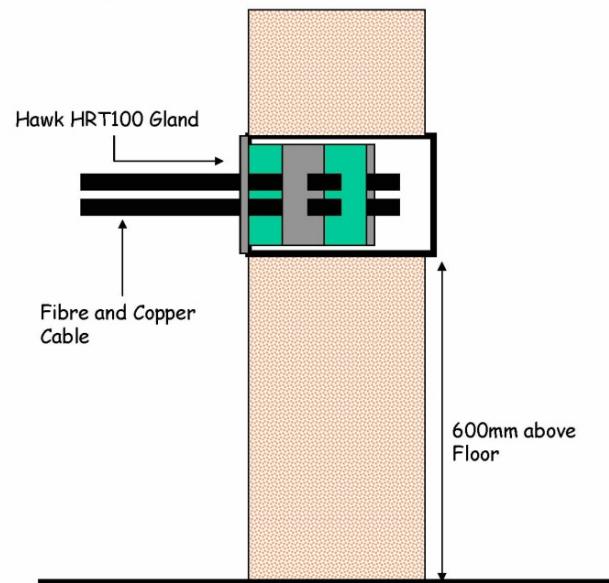


Figure 2.

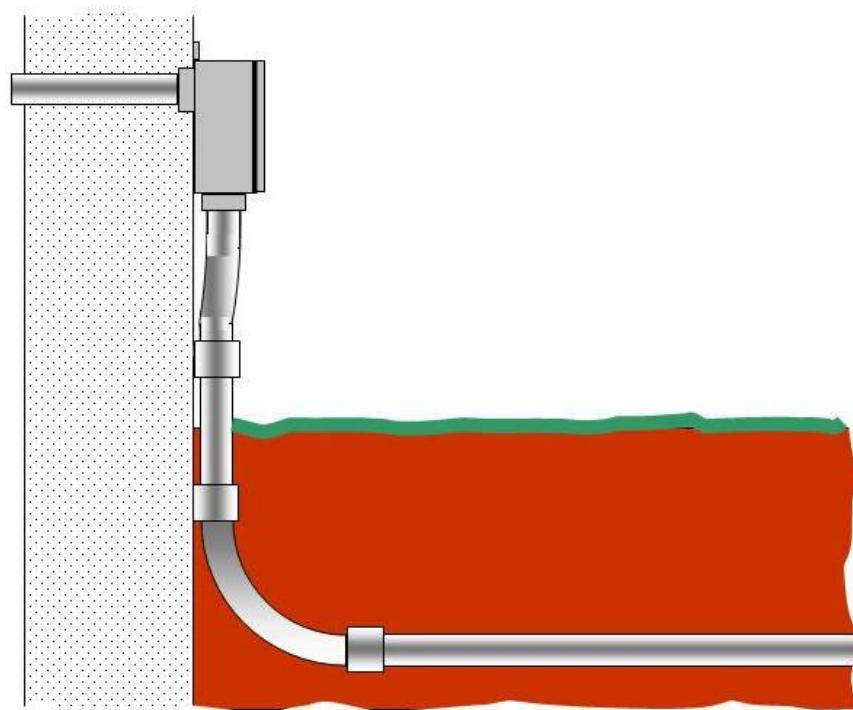


Figure 3 Building Entry above grounds.

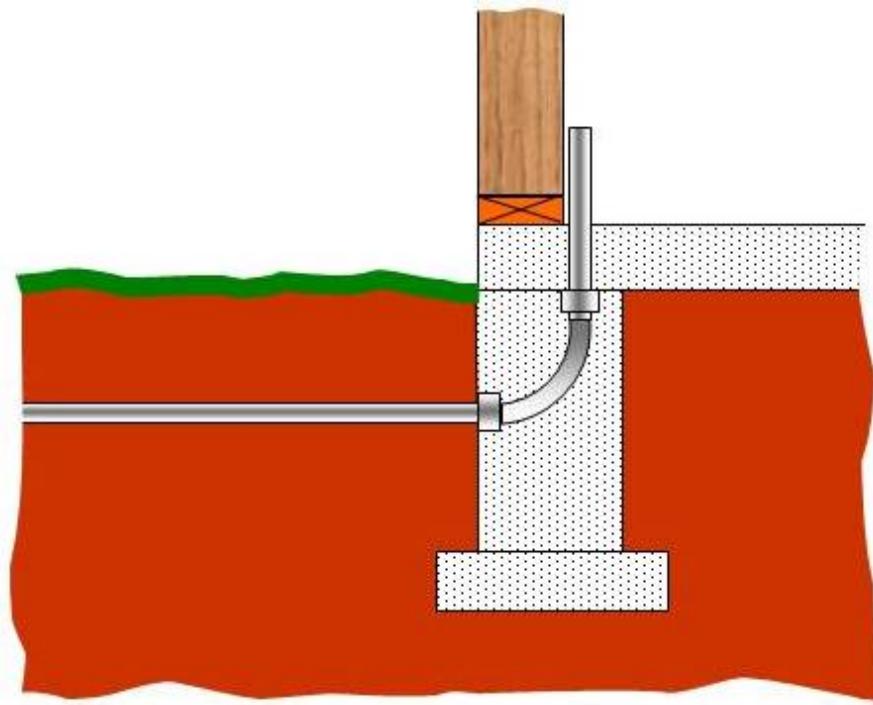


Figure 4 Entry below ground.

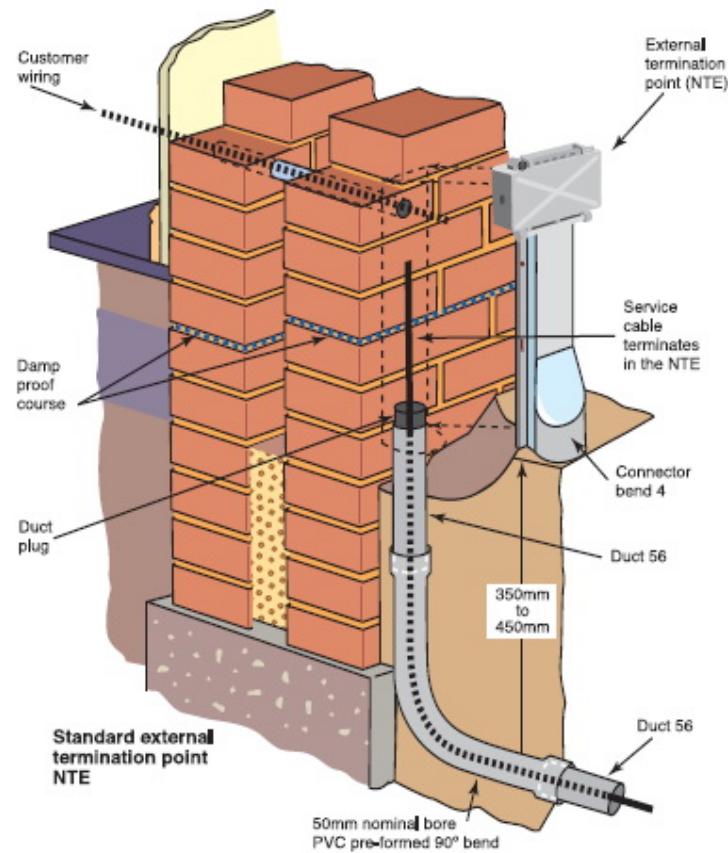


Figure 5 BT NTE Examples.

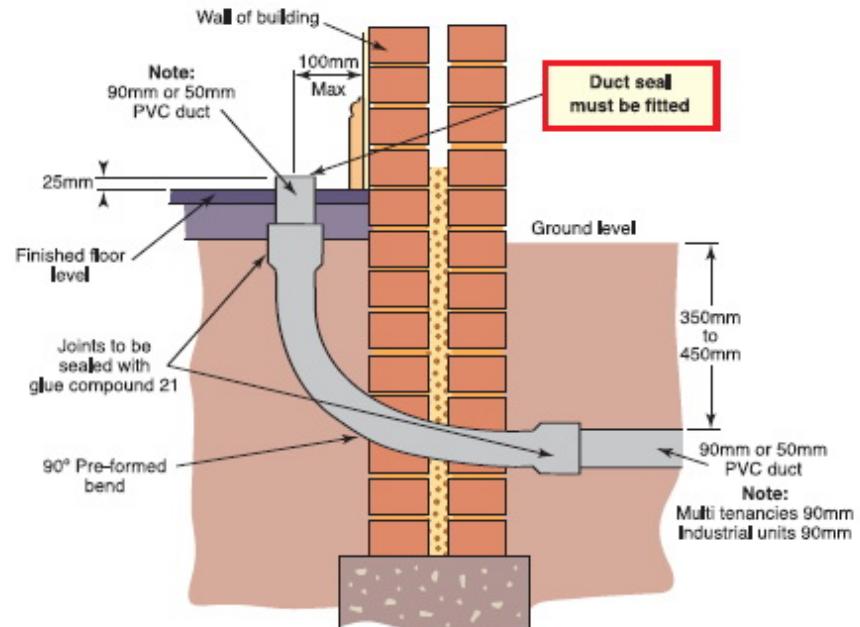


Figure 6 Entry below ground.

4.4.2 Manholes / Access Pits / Jointing Chambers & Refurbishment. (B)

General. (Numbering of Assets-Chambers)

The University requires that all draw pits and chambers shall bear a unique identifying number for record purposes. This is normally arranged by means of the University "free-issuing" suitably numbered covers for each contract, but should the Contractor intend or be required to supply covers, the University of Warwick's representative shall be contacted to supply details of the numbers to be used in order to avoid duplication.

4.4.2.1 ACCESS PITS.

4.4.2.1.1 Cable Pit Locations.

Cable access pits are to be provided at either end of a duct route, positioned to within 5mt to the external building walls adjacent to the equipment room in which the cables terminate.

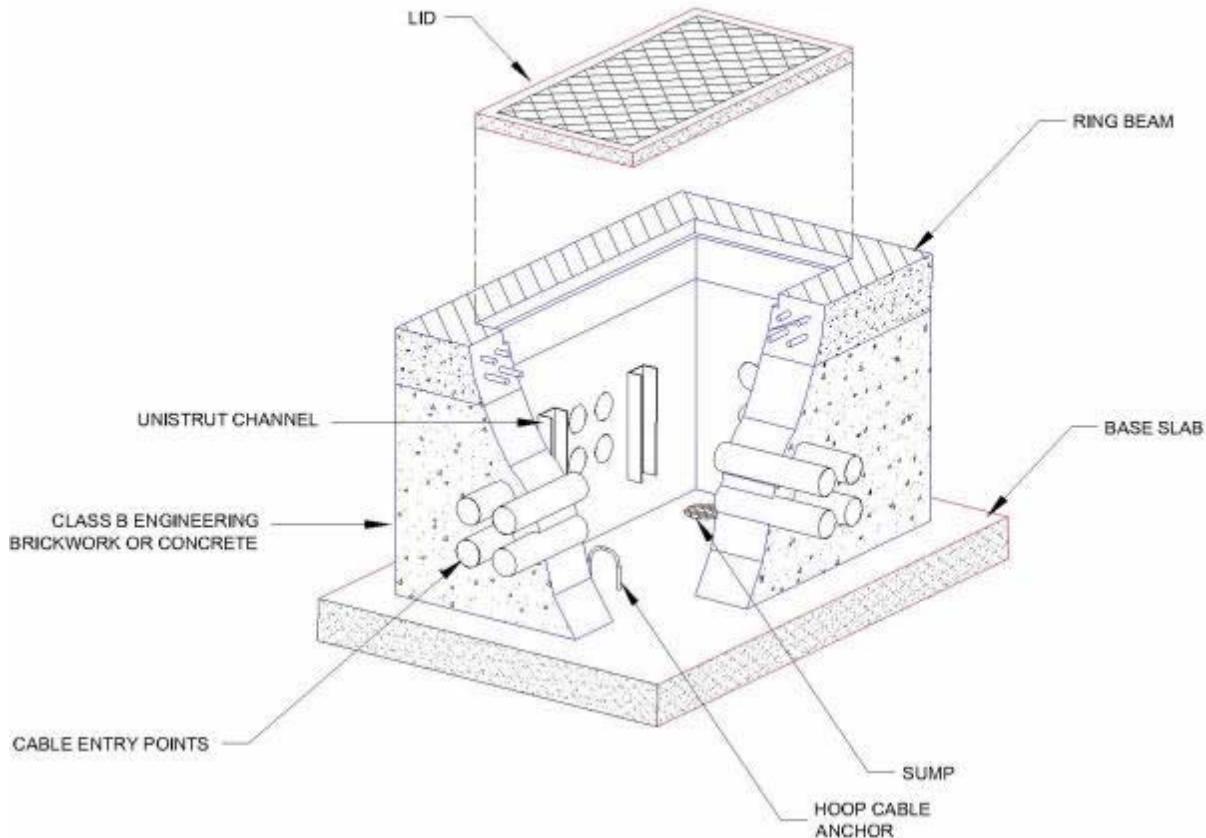
Pits are also to be provided along a duct route at 50 metre intervals, either side of a carriageway, and in accordance with the requirements of LN550 Issue 09.

And in all change of Directions.

4.4.2.1.2 Cable Pit Dimensions.

All cable access pits are to be sized sufficient to allow unobstructed access for cable pulling; typical pit layout is illustrated at 4.4.4.1 Figure 1. Actual size will depend on the number of duct entries the pit contains and the purpose it is principally designed for:

- Jointing pits are to be sized sufficient to house the joint closure of the largest planned cable and provide satisfactory space for personnel operating in it.
- Turning pits are to be sized sufficient to accommodate the minimum bend radii of all planned cables.
- Through, in-line pits are to be sized sufficient to allow rodding.



4.4.4.1 Figure 1 Cable Pit Layout

4.4.2.1.3 Construction

Base thickness (of concrete) must be a minimum of 150 mm for pits up to a depth of 1800 mm, and 225 mm thick for pits between 1800 mm and 4500 mm deep. Walls are to be a minimum of 225 mm thick.

Strengthened, carriageway standard, pits are to be provided either side of a road crossing, etc.

4.4.2.2 Pit Lids.

In addition to the requirements of BS EN 124:1994, the following requirements are to be met:

No more than 2 people should be required to effect access to the pit.



The pit lids will comprise of a galvanised steel tray filled with concrete

Split lids are to interlock when closed to enable a single lock security mechanism.

Split lids are to be supported by a removable bracing, securely fitted to the outer frame.

The University requires that all draw pits and chambers shall bear a unique identifying number for record purposes.

i.e. Lids are to bear the permanent mark of the University of Warwick (a pheon) to denote pit ownership.



This is normally arranged by means of the University "free-issuing" suitably numbered badges for each lid

It is recommended that all lids should be securable against intrusion, those associated with an Vital Circuit are to be secured in accordance with the requirements of the Employer with suitable Sub Cover Security Systems tested.



4.4.2.3 Pit Furniture.

For safety and cable management, the following items, manufactured from corrosion resistant materials or with corrosion resistant finishes, should be fitted in all cable pits:

- Cable bearers are to be installed 500 mm apart on the long sides of rectangular pits, and on all walls in square pits, to allow optimal positioning of cable joints.
- Two sets of cable bearers is the minimum number to be installed, large pits with many duct entries may require more.
- Cable bearer brackets, for supporting the cable and joints, need only be fitted as required.
- Ladders or Climbing Steps, with non-slip treads, are to be fitted to all cable pits.
- The ladder option is to include a stable, non-slip mounting bar around the upper part of the pit to allow the ladder to be moved and secured as necessary.
- Where steps are employed, they are to meet the specification of BS EN 13101.
- Cable Anchors of 12 mm diameter round section steel are to be secured in the pit base to facilitate anchorage of cable pulleys & draw ropes etc.



4.4.2.4 Drainage.

A 150 mm square or round soakaway, excavated to at least 300 mm deep and filled with coarse gravel, is to be provided in one corner of the pit to allow water drainage.

Alternatively, for areas with a high water table, a 225 * 300mm deep pumping sump may be substituted. Either option is to be finished with a flush fitting protective grating.

4.4.2.5 Cable Duct Entries.

Entries into pits are to be spaced at least 50 mm apart, both vertically and horizontally, and at least 100 mm from adjacent side walls and 150 mm from the base. Eight way ducts are to be arranged in two horizontal rows of four, four way ducts arranged in a square formation and two way ducts in a horizontal formation.

Ducts are to be cleanly cut, flush with the inside wall so there are no protrusions into the pit. To prevent water ingress, all "Stub Ends" duct entries are to be fitted with a short length of duct which has been sealed, with duct caps, at both ends.

4.4.2.6 JOINTING CHAMBERS

4.4.2.6.1 GENERAL.

Jointing Chambers shall conform to the standard drawing(s) and/or other drawing(s), as specified, unless (Page 79 Variation 4.4.2.13), Variations applies.

To enable access for future Pole Testing, a Brickwork, Concrete or JMF Series of Modular Jointing Chambers should be sited a minimum distance of 300mm from a Telephone Pole.

Prefabricated boxes other than Brickwork, Concrete or Modular construction shall be sited a minimum distance of 1000mm from the pole.

The frame and cover of a jointing chamber shall be installed flush and level with the surrounding ground, provided that the fall across the shortest side of the cover shall not exceed 100mm.

All covers shall be located so that they may be removed safely with UoW standard equipment.

4.4.2.6.2 TYPES of JOINTING CHAMBERS.

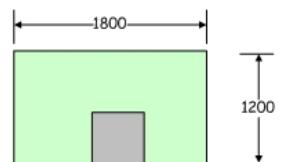
1) The more commonly used standard types of manholes, access shaft, cabling shaft and side shaft, with their code references, are as follows:-

CODE MANHOLE	CHAMBER INTERNAL DIMENSIONS in mm					CN DRAWING NUMBER
	Length	Width	Floor	Walls	Roof	
MRX401	1800	1200	200	200	200	CN14931
MRX402*	3500	1200	200	200	200	CN14932
MRX404	2400	1200	200	200	200	CN14933
MRX405*	4000	1650	200	200	200	CN14934
MRX410*	3100	1700	250	235	235	CN14935
MRX411*	4900	2300	250	250	250	CN14936
MRX412*	3700	2800	250	240	240	CN14937
MRX413*	3700	2000	250	240	240	CN14938
MRX509	2400	1700	200	200	200	CN14939
MRX510*	2900	2300	250	235	235	CN14940
MRX511*	3700	2700	250	235	235	CN14941
MRX512*	3400	3400	250	235	235	CN14942
MRX513*	3400	2400	250	235	235	CN14943
MRX607	2480	2150	200	200	200	CN14944
MRX608*	3800	2700	235	235	235	CN14945
MRX610*	4700	3700	250	235	250	CN14946
MRX611*	3700	3400	250	235	235	CN14947
MRX612*	5000	2500	250	250	250	CN14948
MRX613*	3800	2450	250	235	230	CN14949
MRX810*	4400	2100	250	235	235	CN14950
SIDESHAFT	10000	1000	200	200	200	CN14951
	max					
Access and Cabling Shaft	3000	610				CN 1153
	max					

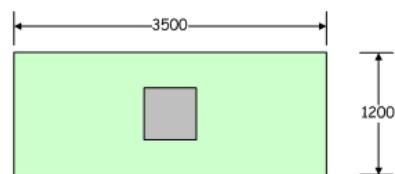
Manholes & Chambers.



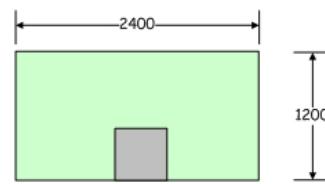
MANHOLES & CHAMBERS



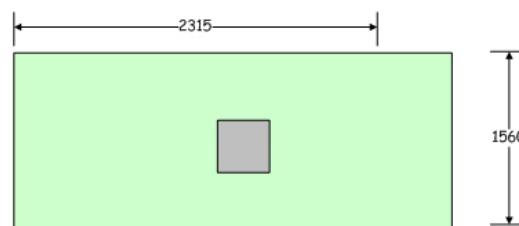
Depth(mm) 2000 MR X1



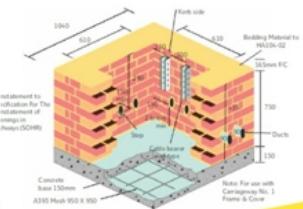
Depth(mm) 2000 MRX 2A
2225 MRX 2B
2450 MRX 2C



Depth(MM) 2000 MR X4



Depth(mm) 2000 MRX 11A
2225 MRX 11B
2450 MRX 11C



* These manholes have a range of internal heights.

It is the contractor's responsibility to ensure their operatives are in possession of the latest version of drawings.

2) (i) The Standard Side shaft on CN 14951 is detailed for 4 metres length and can be amended to a maximum of 10 metres.

(ii) When a manhole and side shaft are linked the floor of the manhole and the floor of the side shaft shall be nominally at the same level but there shall be a fall to the sump in the side shaft.

(iii) The internal height of the side shaft is 2000mm, and the internal height of a manhole may be greater. Where the height of the manhole exceeds the height of the side shaft a straight ventilation pipe shall be placed through the manhole wall, 50mm from the underside of the roof of the manhole, to the entrance shaft of the side shaft, above the level of the manhole roof. The ventilation pipe shall be a steel duct of 100mm minimum internal diameter. (Duct No.70 is suitable.) There shall be a minimum fall in the duct of 1:40 from the shaft to the manhole.

(iv) Access between the manhole and side shaft shall not be obstructed. A minimum clear space of 2000mm headroom and 1000mm wide unobstructed walkway is required between the manhole and the entrance shaft of the side shaft.

4.4.2.6.3 JOINTING CHAMBER REFURBISHMENT

GENERAL.

This specification details the requirements for the retrospective fitting or refurbishment of Jointing Chamber furniture and the fittings.

SAFETY.

- a) All work shall be carried out safely according to the current terms and conditions of this Specification and in accordance with UoW's minimum requirements for Confined Spaces Working and working in Radon affected manholes.
- b) Where work involves drilling into a structure, appropriate precautions shall be made to ensure no other plant or services will be encountered, additionally tests shall be made to ensure any structural reinforcing steel bars are avoided.
- c) Where a step has been omitted and is to be fitted retrospectively, the step shall be fitted in accordance with the relevant CN Drawing or UoW works instruction.
- 1. (d) Where a defective step is to be cut away and repositioned, it should be fitted immediately above the original step or according to the relevant CN Drawing or UoW works instruction.
- d) Where due to site conditions the new position is greater than 25mm from the position designated by UoW, the works shall be stopped until a Technical Departure Form Specification (TDFS) has been agreed with UoW.
- e) Any step fitted more than 25mm from the designated position or the position agreed with UoW may be considered to be defective and may be removed.
- f) Steps shall be fitted true and level and shall be fixed according to the relevant CN Drawing. Any step that is not fitted correctly shall be considered defective and shall be removed.

4.4.2.7 STEPS MANHOLE.

1) Step Removal. If an existing step is to be cut away or removed this should be carried out by the use of an angle grinder or other safe method. A flame shall not be used to cut a galvanised step. The step shall be cut flush with the wall. On completion no sharp edges, burrs or projections shall be left.



2) Step Replacement. A Step Manhole No 1 or 2 may be fitted as the replacement step in a manhole shaft or access chamber shaft, or within any jointing chamber.

3) Fitting a Step Manhole No 1.

Where a step has been omitted, a Step No.1 may be fitted or, at the contractor's discretion, a Step No. 2 may be fitted.

To accommodate the legs of the new Step No.1, two 30mm diameter holes shall be drilled with a good masonry drill bit. The step shall be offered to the holes so that the front lug is flush with the surface of the wall. It is acceptable to remove the far upstand of the Step if the Step proves difficult to place in the 30mm-drilled hole.

A mortar or resin mortar of 45 Nm strength shall be placed into the full depth of the holes, and the step shall then be driven into position without causing damage to the step.

The front lug shall be flush with the surface of the wall and the face of the wall made good around the legs of the step with the material used.

If mortar is used, the mortar shall be allowed to cure for a minimum of 12 hours before the step is used, for Resin Mortar a curing time of 2 hours must elapse.

4) Fitting a Step Manhole No 2.

The Step shall be fitted to the wall in the position shown on the relevant CN Drawing or alternative position agreed with UoW.

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A secure fitting must be achieved using Bolts Expansion 1A placed through all the fixing holes in each step. To achieve a secure fixing each bolt requires a clean and precise hole 13mm in diameter, drilled 65mm deep. The hole must be drilled into reinforced concrete or brickwork, and not into the mortar.

5) Tolerance.

On completion the Step No.1 or 2 shall be true and level to $\pm 5\text{mm}$ at the tip and in the position designated by the drawing for the chamber.

4.4.2.8 CABLE BEARERS WALL TYPE.

1) The Cable Bearer type specified in the works instruction shall be used.

2) Removal of an existing Bolt Foundation shall be carried out by the use of an angle grinder to cut out the Bolt.

On completion no sharp edges, burrs or projections shall be left.

3) Fixture of a new or replacement Cable Bearer shall be in the position designated in the relevant CN Drawing or works instruction. Each

Cable Bearer shall be fixed on the wall of the chamber using two Bolts Expansion 1a.

Each bolt shall be fitted to the wall in a clean hole 13mm in diameter, drilled 65mm deep.



4) Note Fixings are to be made to any/all surfaces.

4.4.2.9 LADDER, HOOKS and BAR.

1) Ladders Steel.

Where required the ladder shall be replaced with the following, specified, standard sizes; 2150mm, 2300mm, 2400mm, 2600mm and 3750mm.

Intermediate sizes can be obtained by cutting a longer ladder to suit the local requirement.

On completion all sharp edges, burrs and projections shall be removed.

2) Ladder Hook Removal.

To fit a replacement hook, the existing shall first be cut away or removed this should be carried out by the use of an angle grinder.

The Hook shall be cut flush with the wall.

On completion all sharp edges, burrs and projections shall be removed.

3) Ladder Hook Replacement.

The position where the hooks are to be placed shall be marked ensuring that any reinforcing bars shall not be encountered.

A hole 35mm diameter and 100mm in depth shall be made with masonry drill bit, or similar.

A propriety grout or resin materials of at least 45Nm shall be placed into the hole and the hook driven into the hole.

On completion the face of the hole shall be made good with the same material and allowed to cure for 2 hours before the ladder bar and ladder are placed.

4) Ladder Bar.

When 2 hours have elapsed the ladder bar and ladder shall be replaced.

WARNING SIGNS.

- a) Any warning sign that requires to be fitted, e.g. "Exchange Manhole Ventilation" or "Multi-Level Manhole" will be specified by the works originator and issued locally.
- b) Signs must be placed in a position that will allow any person entering the chamber visible sight of the sign when removing the access cover. (I.e. at the top of the shaft above the ladder or steps, immediately below the frame and cover.)
- c) A 5mm masonry drill bit shall be used to make the appropriate fixing holes, and the sign shall be secured to the structure with masonry rawl plugs and galvanised screws.

UofW STORE ITEMS.

- Step Manhole No1 (item code 072136) CN 1168
- Step Manhole No2 (item code 073132) CN 14168
- Bolt Expansion 1A (item code 071906)
- Ladders Steel (item code 094911-19) CN 1161
- Bar for Ladder Steel (item code 100041) CN 1161
- Hook for Ladder Steel (item code 100425) CN 1161.



Note: A Ladders Steel is issued with two hooks and bar, but Ladder hooks and bar can be ordered separately.

The standard types of joint boxes with their code references are as follows: -

(i) Concrete joint boxes:

Item	Drawing Number	Reinforced Concrete Code	Drawing Number	Unreinforced Concrete Code
<i>Carriageway</i>				
No.4	CN 15644	JRC 4#	N/A	
No.11	CN 14159	JRC X11#	N/A	
No.12	CN 14160	JRC X12#	N/A	
No.14	CN 14161	JRC X14#	N/A	
<i>Footway</i>				
No.102	N/A		CN 14979	JUF 102#
No.104	N/A		CN 14980	JUF 104#
No.106	CN 14981	JRF 106#	N/A	
No.110	CN 14982	JRF 110#	N/A	
No.111	CN 14983	JRF 111#	N/A	

These joint boxes have a range of internal depths.

JBF 102 (CN 14979)

ORIGINAL FRAME SIZE 400mm X 574mm PRODUCED BY CAD DO NOT MODIFY

PLAN

TOLERANCES:- CN15456		
BEDDING MATERIAL ±5mm		
CEMENT MORTAR -20mm		
VOIDAGE 0.5%		
WALL FLATNESS ±1mm		
DUCT ENTRY POSITION 10mm TO 25 mm		
DUCT FLUSH WITH WALL -10mm		
F & C ROCKING NIL		
F & C SURROUND IN UNMADE ±5mm		
F & C UNSUPPORTED OVER BOX +10mm		
STRUCTURE INTERNAL LENGTH & WIDTH ±15mm		
STRUCTURE INTERNAL HEIGHT ±10mm		
VERTICALITY OF WALLS ±15mm		
SLAB THICKNESS -10mm TO +150mm		
BOLT FOUNDATION ±5mm		

SCHEDULE

ITEM	DESCRIPTION	No. OFF		
		DRG	2A	2B
1	BOLTS, FOUNDATION, INDENTED No.2	CN1166	4	4
2	CABLE BEARERS, WALL TYPE, No.2	CN1059	2	2
3	FRAME & COVER No.2C	CN1911	1	1
4	PIN LOCKING CABLE BEARER	CN1301	2	2
5	BRACKET CABLE BEARER No.5	CN1069	2	2

SECTION A-A

SECTION B-B

CONSTRUCT CONCRETE, MIN C32/40 SURROUND AS REQUIRED, TO OUTER EDGE OF WALLS FOR UNPAVED SURFACE, TO DEPTH OF FRAME

JOINT BOX FOOTWAY JBF 102 A & B

DIMENSIONS IN mm UNLESS OTHERWISE STATED

ANY MODIFICATION TO THE DRAWING OR THE USE OF ALTERNATIVE ITEMS TO THOSE SPECIFIED MUST BE AGREED WITH THE DESIGNER.

INCREASED NOTES AND TOLERANCE TABLE TEXT SIZE TO 3mm ADDED DESIGN DATE INFO TO NOTE 17

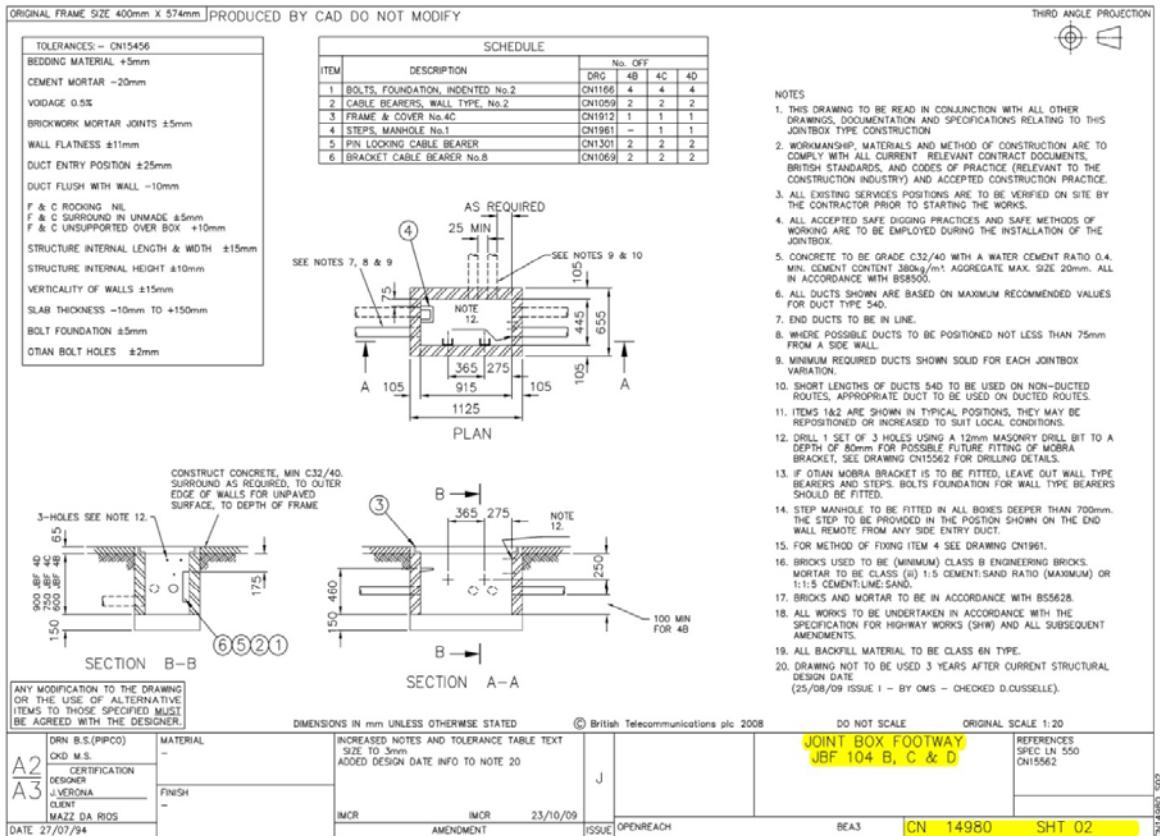
British Telecommunications plc 2008

NOTES

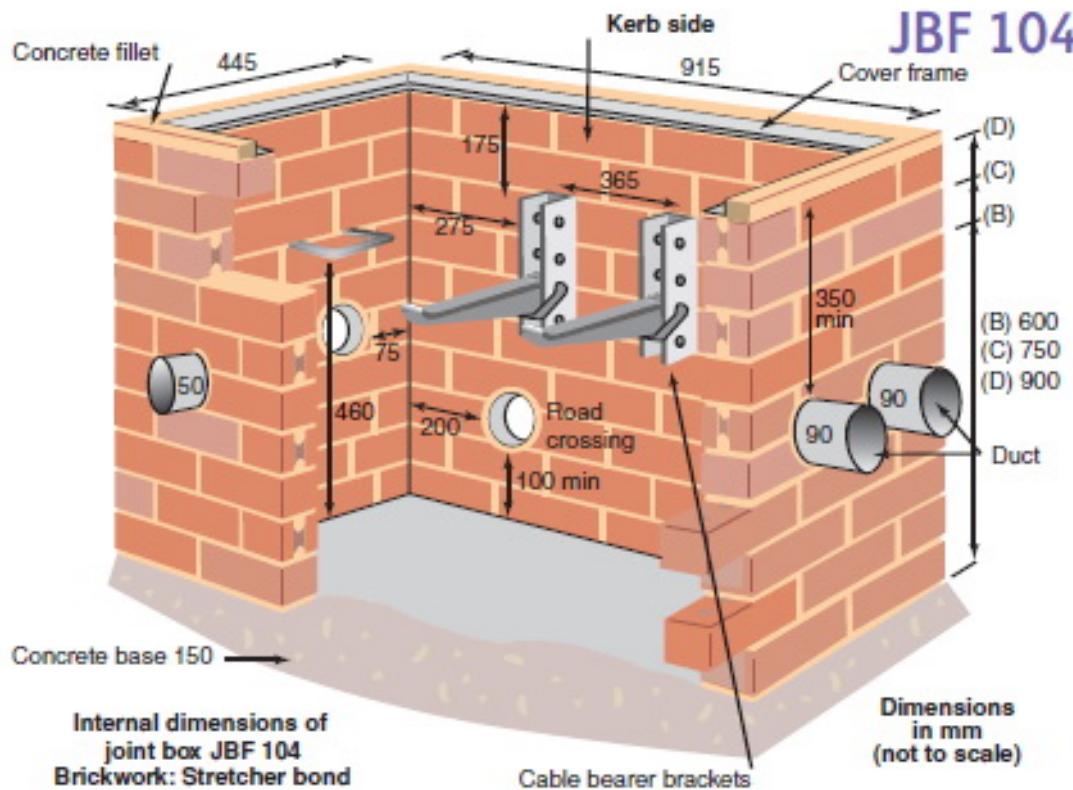
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, DOCUMENTATION AND SPECIFICATIONS RELATING TO THIS JOINTBOX TYPE CONSTRUCTION
2. WORKMANSHIP, MATERIALS AND METHOD OF CONSTRUCTION ARE TO COMPLY WITH ALL CURRENT RELEVANT CONTRACT DOCUMENTS, BRITISH STANDARDS, AND CODES OF PRACTICE (RELEVANT TO THE CONSTRUCTION INDUSTRY) AND ACCEPTED CONSTRUCTION PRACTICE.
3. ALL EXISTING SERVICES POSITIONS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO STARTING THE WORKS.
4. ALL ACCEPTED SAFE DIGGING PRACTICES AND SAFE METHODS OF WORKING ARE TO BE EMPLOYED DURING THE INSTALLATION OF THE JOINTBOX.
5. CONCRETE TO BE GRADE C32/40 WITH A WATER CEMENT RATIO 0.4. MIN. CEMENT CONTENT 380kg/m³. AGGREGATE MAX. SIZE 20mm. ALL IN ACCORDANCE WITH BS5850.
6. ALL DUCTS SHOWN ARE BASED ON MAXIMUM RECOMMENDED VALUES FOR DUCT TYPE 54D.
7. END DUCTS TO BE IN LINE.
8. WHERE POSSIBLE DUCTS TO BE POSITIONED EQUIDISTANT FROM SIDE WALLS.
9. MINIMUM REQUIRED DUCTS SHOWN SOLID FOR EACH JOINTBOX VARIATION.
10. SHORT LENGTHS OF DUCTS SAD TO BE USED ON NON-DUCTED ROUTES.
11. IN A JUF 102B ONLY AN ADDITIONAL DUCT CAN BE PLACED, DOTTED LINE INDICATES MIN 50mm FROM BASE.
12. ONE SINGLE WAY DUCT TO BE PROVIDED IF REQUIRED FOR POSSIBLE FUTURE SPUR THE DUCT TO BE POSITIONED IN EITHER OF THE SIDE WALLS.
13. ITEMS 1&2 ARE SHOWN IN TYPICAL POSITIONS, THEY MAY BE REPOSITIONED OR INCREASED TO SUIT LOCAL CONDITIONS.
14. ALL WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS (SHW) 1998 AND ALL SUBSEQUENT AMENDMENTS.
15. ALL BACKFILL MATERIAL IS TO BE CLASS 6N TYPE.
16. ALL CONSTRUCTION JOINTS TO BE AS PER CLAUSE 1710 SHW.
17. BRICKS USED TO BE (MINIMUM) CLASS B ENGINEERING BRICKS. MORTAR TO BE CLASS (ii) 1:5 CEMENT:SAND RATIO (MAXIMUM) OR 1:1.5 CEMENT:LIME:SAND.
18. BRICKS AND MORTAR TO BE IN ACCORDANCE WITH BS5628.
19. DRAWING NOT TO BE USED 3 YEARS AFTER CURRENT STRUCTURAL DESIGN DATE (27/08/09 ISSUE E - BY OMS - CHECKED D.CASSELLE).

AMENDMENT **ISSUE** **OPENREACH** **0CA3** **CN 14979** **SH7 02 OF 03**

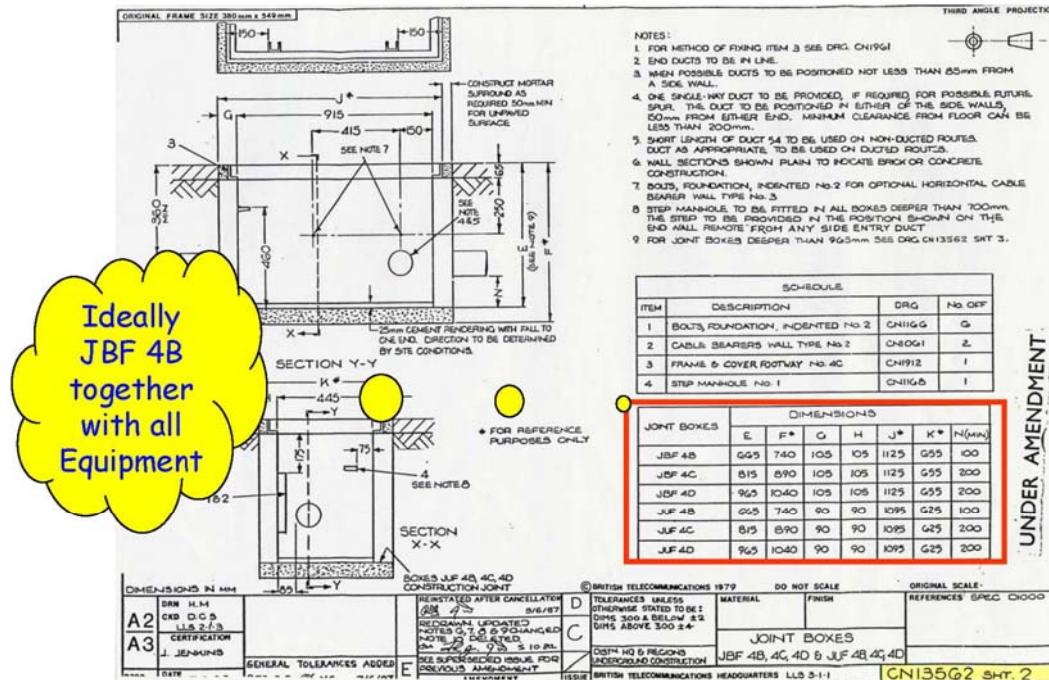
JBF 104 (CN 14980)



JBF 104.

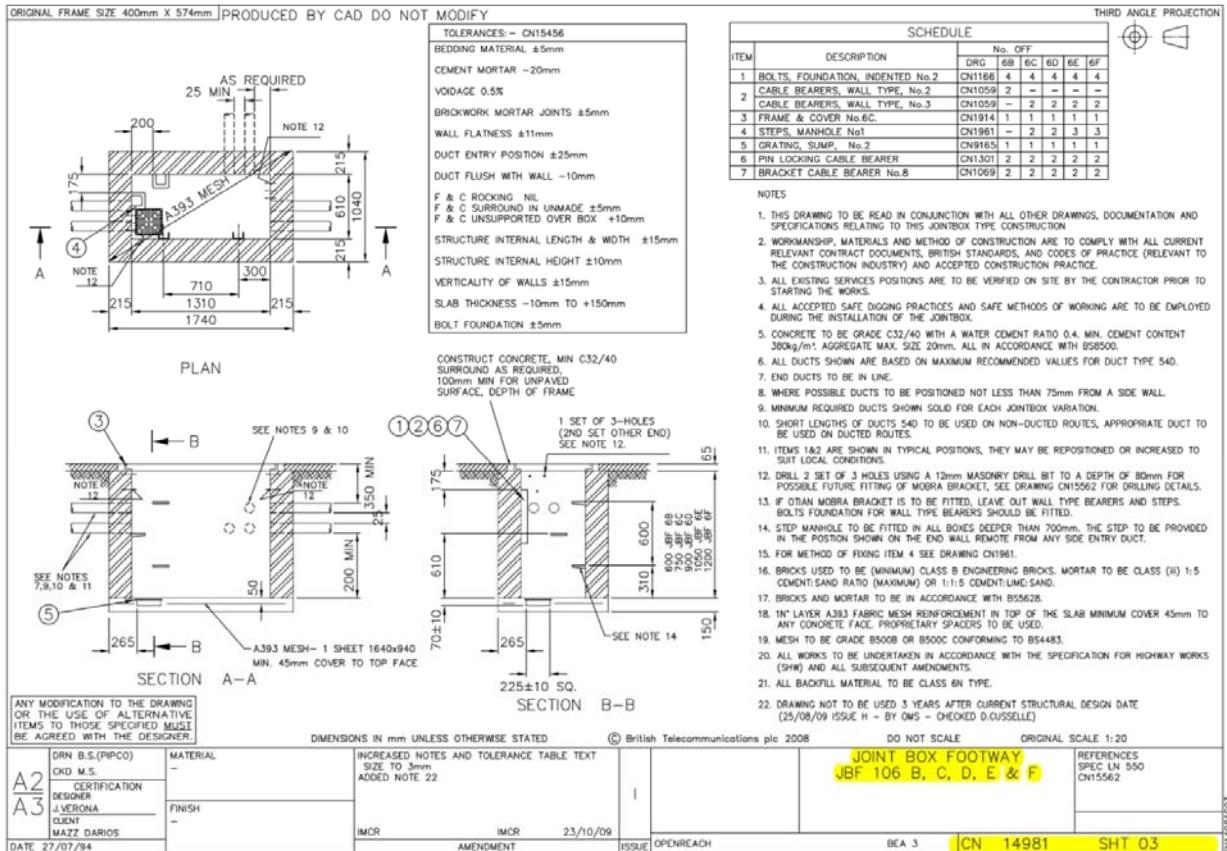


Joint Box 4 Series

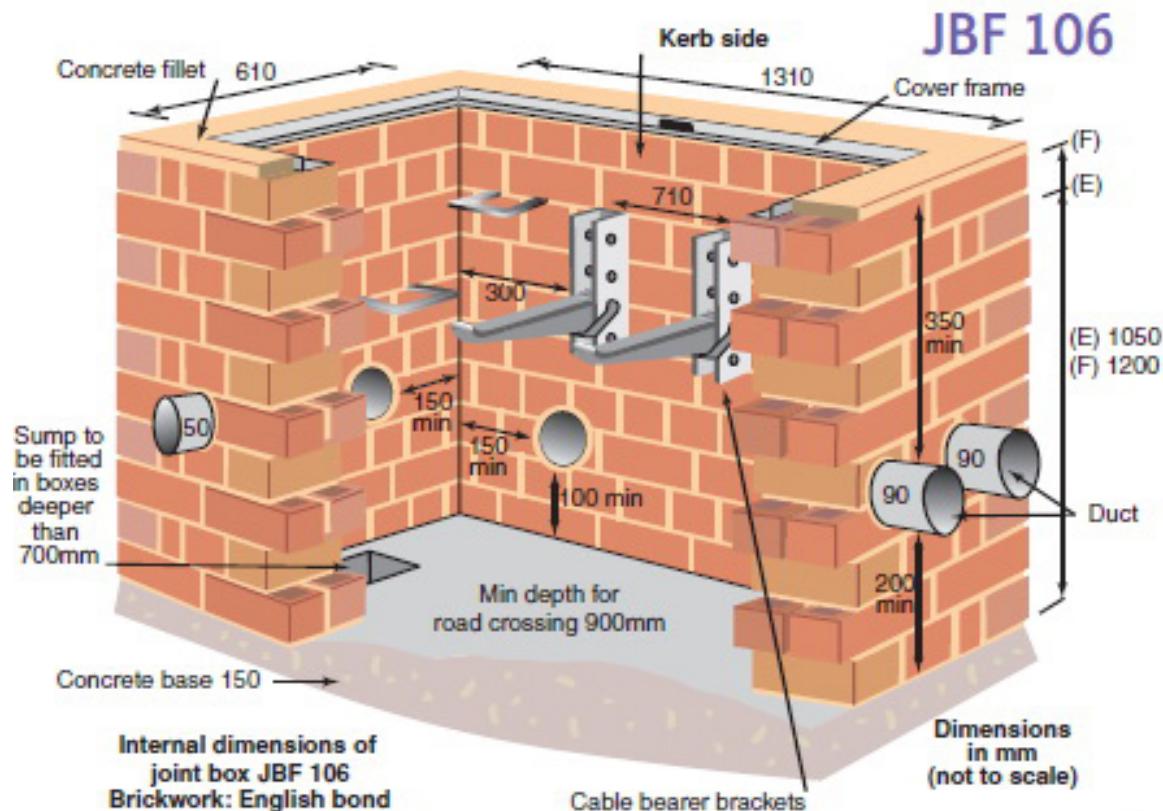


Ideally
JBF 4B
together
with all
Equipment

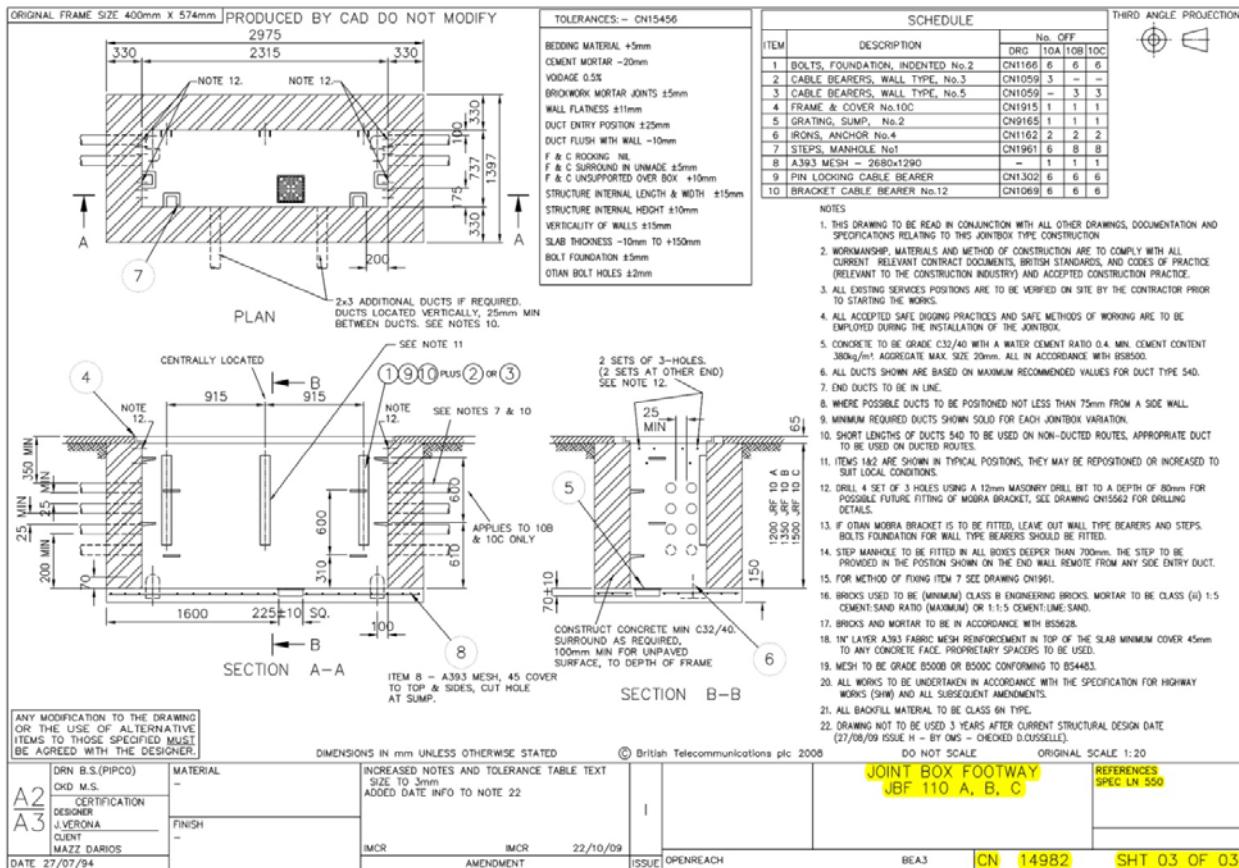
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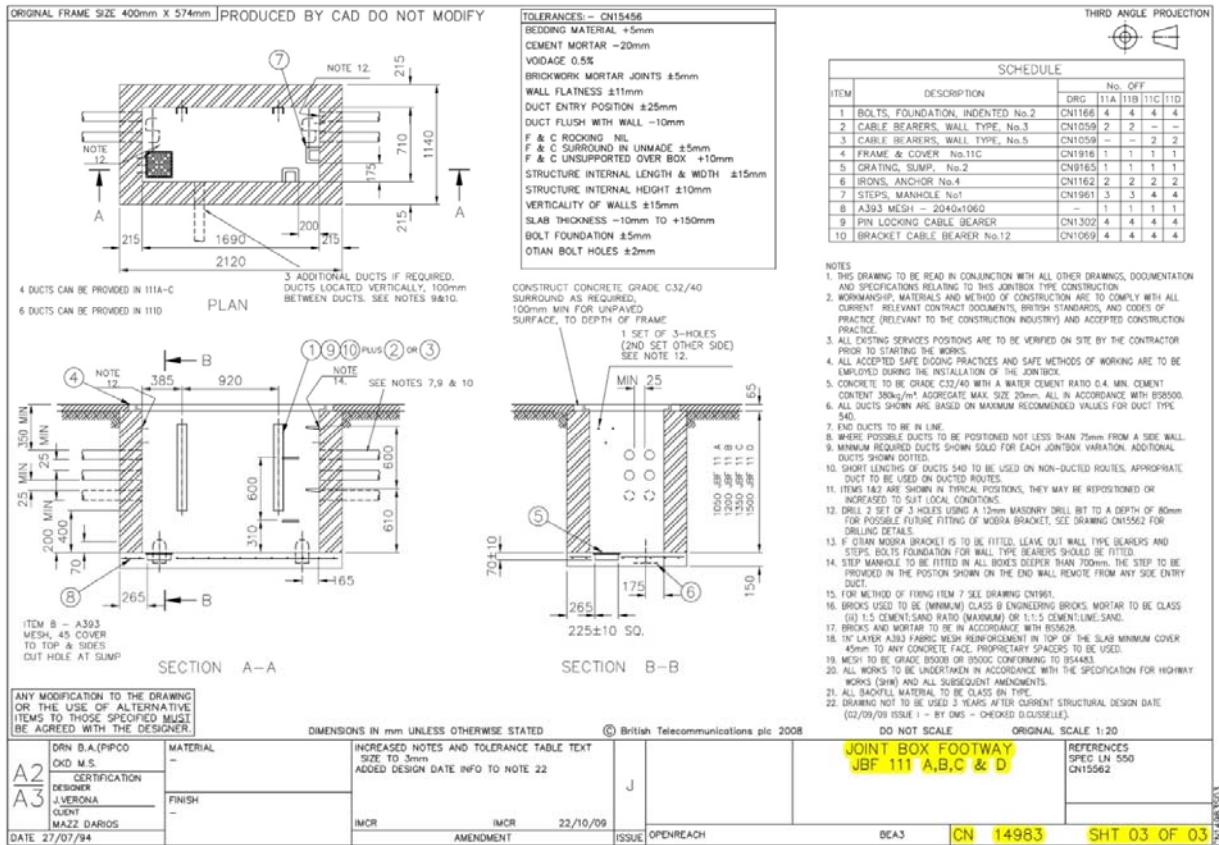
JBF 106.



JBF 110 CN 14982.

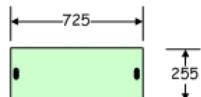


JBF 111 CN 14983.

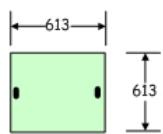


Concrete Chambers.

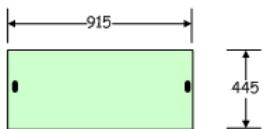
CONCRETE



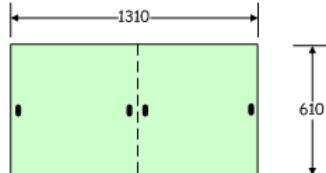
Depth(mm) 515 JUF2A
 665 JUF2B



Depth(mm) 515 JUF 5A
 665 JUF 5B



Depth(mm) 665 JUF 4B
 815 JUF 4C
 965 JUF 4D



Depth(mm) 665 JUF 6B
 815 JUF 6C
 965 JUF 6D
 1115 JUF 6E
 1265 JBF 6F



Depth(mm) 1265 JRF 10A
 1415 JRF 10B
 1565 JRF 10C



Depth(mm) 1115 JRF 11A
 1265 JRF 11B
 1415 JRF 11C
 1565 JRF 11D

(ii) Brickwork joint boxes:

Item	Drawing Number	Code
Footway		
No. 102	CN 14979	JBF 102#
No. 104	CN 14980	JBF 104#
No. 106	CN 14981	JBF 106#
No. 110	CN 14982	JBF 110#
No. 111	CN 14983	JBF 111#
Carriageway (for New sites only)		
No. 3N	CN 15648	JBC 3N
No.4	CN 15644	JBC 4

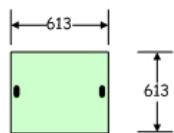
These joint boxes have a range of internal depths.

Brick Chambers.

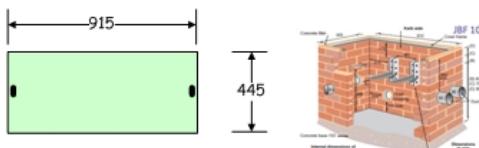
BRICK



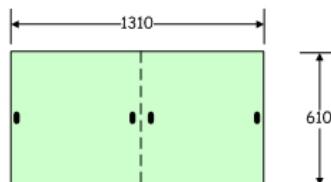
Depth(mm) 515 JUF 2A
 665 JUF 2B



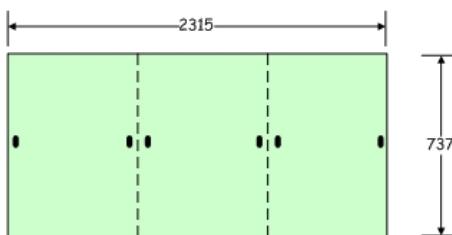
Depth(mm) 515 JUF 5A
 665 JUF 5B



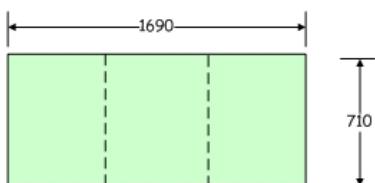
Depth(mm) 665 JUF 4B
 815 JUF 4C
 965 JUF 4D



Depth(mm) 665 JUF 6B
 815 JUF 6C
 965 JUF 6D
 1115 JUF 6E
 1265 JBF 6F



Depth(mm) 1265 JRF 10A
 1415 JRF 10B
 1565 JRF 10C



Depth(mm) 1115 JRF 11A
 1265 JRF 11B
 1415 JRF 11C
 1565 JRF 11D

Footway joint boxes (both brickwork & concrete) now require holes to be drilled in them for possible future installation of Optical Telecommunications equipment

The location of these holes are shown on the appropriate drawings.

Footway joint boxes (both brickwork & concrete) Where there is evidence or significant risk of vehicles using a soft verge e.g. as an undertaking area opposite a T-Junction, a passing point on a narrow road or a parking area, it will be necessary to install a Carriageway Chamber, Frame & Cover.

Carriageway joint box JBC3N is a brick based chamber designed for use in New site locations only, where kerb lines are not clearly defined or where vehicular traffic is likely to exceed 5mph. The chamber does not come in variable depths



(iii) Prefabricated joint boxes:

Item	Drawing Number and installation procedure	Code
Footway		
No. 23	CN 10941	JB 23
No. 26	CN 13917	JB 26

4.4.2.10 JOINT BOX 23.

Is a small prefabricated footway joint box.

It is supplied with its own exclusive frame and cover conforming to BS EN124 category A15.

Due to both the frame and cover classification and the box construction the chamber should only be installed in footways or grass verges where there is no vehicular access, accessible by pedestrians or pedal cyclist only.

I.e. at least 600mm from a 'constructed barrier' or natural barrier.



Definition of a constructed barrier is a defined kerb, crash barrier, bollards etc.

Definition of a natural barrier is a ditch or sharp angled embankment where the box is above carriageway level.

Exceptionally where there is no continuous barrier, they may be installed near a pole within 1.5 metre to the side or any distance behind, but not in between the pole and carriageway.

It is not permissible to cut the sides or the base of a Joint Box 23 to facilitate installation around shallow duct or other buried services. The permissible solutions are to use two Modular 102 Joint Box Rings set on a Type 1 Granular Sub Base Bed or equivalent, fitted with a Footway 102 cover or the standard brick / concrete JBF 102 / JUF 102.

4.4.2.11 JOINT BOX 26.

Is a small prefabricated footway joint box.

Although the chamber utilises a BS EN124 category B125 frame and cover suitable for light vehicular use up to 5mph, the box construction is such that the chamber should only be installed in footways or grass verges where there is no vehicular access, accessible by pedestrians or pedal cyclist only. I.e. at least 600mm from a 'constructed barrier' or natural barrier.

Definition of a constructed barrier is a defined kerb, crash barrier, bollards etc.

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Definition of a natural barrier is a ditch or sharp angled embankment where the box is above carriageway level.

Exceptionally where there is no continuous barrier, they may be installed near a pole within 1.5 metre to the side or any distance behind, but not in between the pole and carriageway

Duct entries to the box are made via "preformed duct entries". Where duct 56 is to be brought into the box, a suitable size duct entry should be drilled out within the defined preformed duct entries. A designated slot in the floor is provided and can be removed to facilitate the installation over in-situ cables or ducts. On no account shall the box be modified, or further holes be made into it.

For the installation of new duct into a JB 26, the duct may protrude a 10 - 25mm into the chamber.
(No Tolerance)

In paved surfaces or grass or unmade surfaces the voids behind the footway Joint box Nos. 23 and 26 shall be filled with Earth Free from Stones or graded granular material and well compacted or concrete ST 2.

In soft ground the chamber foundations to be well compacted and made level. Where soft soil is not prevalent, any large jagged boulders, brick or stone to be removed, replaced with compacted Type 1 GSB.

It is not permissible to cut the sides or the base of a Joint Box 26 to facilitate installation around shallow duct or other shallow buried services. The permissible solution are to use two Modular 102 Joint Box Rings set on a Type 1 Granular Sub Base Bed or equivalent, fitted with a Footway 102 cover or the standard brick / concrete JBF 102 / JUF 102.

(iv) Modular joint boxes:

Item	Drawing Number and installation procedure	Drawing No.	Code
Footway			
No. 102	see JMF 102 section below	CN 14979-03	JMF 102

No. 104	see JMF 104 section below	CN 14980-05	JMF 104
No. 106	see JMF 106 section below	CN 14981-04	JMF 106

These joint boxes have a range of internal depths dependent on the number of rings used.

The JMF series of footway joint boxes can be used similarly as their brick and concrete counterparts. This includes footways, grassed and pedestrian areas which may include occasional slow moving vehicular traffic. (Up to 5mph)

Where there is evidence or significant risk of vehicles using a soft verge e.g. as an undertaking area opposite a T-Junction, a passing point on a narrow road or a parking area, it will be necessary to install a Carriageway Chamber, Frame & Cover.

Details of the Joint box Modular Footway 102, 104, and 106 are available via the Estates Office.

4.4.2.12 DRAWINGS.

Drawings supplied by UoW for the construction of jointing chambers and associated works are included in the Drawing Folder within the suppliers Web Portal.

Where there is a conflict between the drawing and this specification, this specification shall take precedence.

4.4.2.13 VARIATION.

Bespoke Engineered Structures

Modified Chambers. Any chamber that is modified such that the materials, design or dimensions are not in accordance with this specification, the relevant standard CN Drawing for that chamber and the tolerances in CN 15456, shall be bespoke. All bespoke engineered structures shall require authorisation from UoW TAA, or their nominee and shall be agreed with the Work Originator for the structure.

Side Shafted Chambers. Standard chambers with side shafts shall be bespoke engineered and will require approval from the UoW TAA. Where the chamber roof has a greater internal height than the side shaft, a gas ventilation pipe shall be installed between the chamber and the entrance shaft.

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The ventilation pipe shall be positioned 50mm under the roof of the chamber and shall have an incline up to the entrance shaft. The ventilation pipe shall be Steel Duct 70 whilst stock last, or its replacement Duct 78

In the entrance shaft a notice shall be fixed stating "**VENTILATION PIPE DO NOT CABLE**"

c) Multi-tier chambers. All chambers with more than one floor level shall be bespoke engineered, subject to the requirements for modified chambers in (a) above. Each floor level shall be guarded against a fall with a suitable safety barrier and spring assisted gate closure. CN 10850 / CN 10851.

Between the surface level and each tier, provision shall be made for a personnel entrance shaft and a separate cabling shaft CN 1153.

Reference to CN 2727 Plates Caution No 19 to be placed in access shaft below frame and cover.

The floors of the tiers shall be constructed to prevent water flowing over the intermediate entrance shafts and to allow the water to flow to a drainpipe in one corner of the higher tier.

Cabling risers shall be provided to enable cables to pass between the floors.

The cable risers shall be constructed with a kicker, to prevent water flowing between the tiers

2) Obstructions.

The presence of unforeseen obstructions in the ground, or adverse ground conditions, may necessitate the construction of a type of jointing chamber, other than that specified, or a modification of one or more of the dimensions stipulated on the relevant drawings which would exceed the tolerances in CN 15456.

In these circumstances the Contractor shall apply for a Technical Departure Form Specification (TDFS). The Contractor shall not carry out modifications without the prior approval of UoW.

3) Unreinforced joint box floors.

The contractor may at his discretion use a C32/40 dry mix concrete to construct the unreinforced concrete floor of a joint box. The surface of the floor at handover to UoW shall have a flat smooth surface with no trips or depressions greater than 5mm. Where the surface is uneven a 10mm screed of 3:1 sharp sand and cement shall be laid to remove depressions or trip hazards.

4.4.2.14 PROTECTION of CABLES and ASSOCIATED EQUIPMENT.

During the cutting of duct entries into an existing structure, or during the demolition or building of jointing chambers, the Contractor shall take all reasonable measures to protect cables and associated equipment.

Such measures shall include any or all of the following requirements-

- All movement of cables shall be carried out in a controlled manner such that all cables are evenly supported throughout their length.
- For access into and out of manhole excavations a ladder shall be provided by the Contractor. Under no circumstances may cables, joints and equipment be used for climbing, standing or sitting on.
- Sufficient pumping capacity shall be made available and operated to ensure that when cables are removed from their bearers they shall not be immersed in water at any time.
- The responsibility of keeping cables and joints dry will pass to UofW, when UofW commences checking and/or testing the cables.
- All cables shall be protected at duct entries by shielding as necessary against mechanical damage.
- During demolition of the roof of a manhole, the Contractor shall erect a deck of timber between the cables and the roof of the manhole, to protect UofW plant.
- Contractor's plant or materials shall not be supported on cables or associated equipment at any time.
- On Completion all cables shall be left adequately supported on the new ironwork.

4.4.2.15 DUCT ENTRIES.

1) Clearance of Ducts.

Ducts shall enter Manholes as shown on the relevant drawings or as directed by UofW.

Unless otherwise required by the drawings or by UofWW, the ducts shall enter a manhole at such depths that will ensure a minimum clearance of 350 mm above the floor, 450 mm below the roof and 100mm from any adjacent wall.

Where a new chamber is being constructed a minimum clearance of 230mm must be allowed from an Anchor Iron. Where a duct enters an existing chamber a minimum of 300mm must be allowed. When these minimum clearances cannot be achieved the Anchor Iron must be removed.

Ducts shall enter joint boxes as shown on the relevant drawings or as directed by U OF W. Unless otherwise required by the drawings or by UofW, the ducts shall enter the Joint box a minimum 150mm above the floor, and 75mm from any adjacent wall.

Existing earthenware duct shall be extended into a new chamber with the appropriate Kits repair and split duct.

Existing PVC duct shall be extended into a new chamber with an appropriate PVC duct.

2) Duct Entries Into Existing Structures.

- General - existing structures, such as Jointing Chambers, Telephone Exchanges, Repeater Stations or any other building shall have all new duct entries cut by core drilling techniques only. Where the duct enters the chamber the finish shall be flush and smooth. The gap around the duct shall be filled for the full depth of the wall with cement grout, cement mortar or, suitable mastic or silicone, with no protrusions that may cause damage to cables.
- Position of Entry - shall be as specified in a schedule of work or relevant drawing. Any departure from this position must be agreed with UofW prior to the commencement of work. Where practicable the structural reinforcement shall not be cut or exposed. If steel bars are cut or exposed they shall be treated with a rust inhibitor.

- Protection - the Contractor shall protect UoW cables and/or equipment, prior to drilling operations.
- Highly Secure External Above Ground Lead In Where requested in the local Works
- Instruction or by the local UoW Representative, a 40mm bore steel tube with a 45° bend [Duct Secure Entry 1A (item code 075870)] shall be used to provide a highly secure, external above ground lead in as detailed in CN 15561. Method Statement to be provided by Contractor.

3) Duct Entries Into New Structures

The concrete or brickwork around all ducts where they enter jointing chambers shall be carefully flushed up and where necessary, rendered in cement mortar. Where the duct enters the chamber the duct shall enter flush with the wall, the finish shall be smooth, with no protrusions that may cause damage to cables.

4.4.2.16 JOINTING CHAMBER FITTINGS.

i) Cable Bearers, Ladders, Steps and other fittings shall be fixed according to the relevant drawings or in such other positions as UoW may direct.

ii) Anchor Irons, shall be buried to the underside of the depth plate, in the structural concrete of walls and floors. Floor screed shall be wiped away to expose the entire top side of the depth plate. Where an anchor iron is fitted the concrete shall be a minimum of C32/40 and the slab shall be reinforced according to the relevant structure drawing.

4.4.2.17 IRON and STEELWORK.

1) All iron and steelwork, except as in Paragraph. (2), supplied by the Contractor and which has not been galvanised by an approved method, shall be free from mill scale and treated with a suitable preservative after delivery and two coats of an approved bituminous paint after fixing.

2) Any ungalvanised iron or steel which is to be embedded in concrete shall be free from soil, oil, loose rust, loose mill scale, snow, ice, grease or any other substance which can be shown to adversely affect the steel or concrete chemically, or reduce the bond. Normal handling prior to embedding in the concrete is usually sufficient for the removal of loose rust and scale from reinforcement.

All reinforcement in the floor, walls, roof and shaft shall be secured together by means of approved ties, sufficient to prevent displacement of the reinforcement during the placing and compaction of the concrete.

Where the construction drawing indicates straight bars forming a mesh, a preformed mesh may be used. Extreme care must be taken to prevent damage, when a mesh is placed around existing cables. When a mesh has to be cut to accommodate existing duct or cable the aperture shall be trimmed.

4.4.2.18 RECOVERED MATERIAL.

After all works to UoW jointing chambers, any recovered serviceable fittings shall be delivered to a nominated UoW site, or disposed of as instructed by UoW.

4.4.2.19 SUMP.

Where a sump is provided, the floor shall have a slight fall thereto. The grating shall be located squarely over the sump, adequately fitted and easily removable, from a pre-formed recess in the floor or floor screed, in the position indicated on the relevant drawing. Where the drawing shows a square sump, a circular sump of 225mm internal diameter $\pm 5\text{mm}$, may be constructed at the contractors discretion.

The sump in a jointing chamber shall have a depth of 300mm $\pm 10\text{mm}$.

4.4.2.20 CONCRETING.

1) Low Temperatures - concrete for jointing chambers or cabinets shall not be mixed, or placed, when the concrete temperature is below 5°C. The recommendations of BS 8110 Part 1, clause 6.2.4 shall be followed and further guidance may be found in BS8500-1 Annex A.11.1

Where the air temperature is likely to fall below 5°C the Contractor shall provide a method statement signed off by a suitably qualified person, detailing the materials, placing and curing methods, to be agreed by the TAA.

When concrete has already been placed, and the air temperature unexpectedly falls below 5°C at any time during the period before removal of shuttering, the concrete shall be protected from freezing. The period of time that the temperatures remains below 5°C shall be added to the minimum periods quoted in Par.518 of this Specification.

- 2) Drying. Concrete, when placed and if subject to rapid drying out by sun and/or wind, shall be protected to prevent it becoming dry during the minimum curing period.
- 3) Handling, from the mixer to the workplace must, whatever method is adopted, ensure that the mix remains cohesive and that segregation does not occur.
- 4) Placing, of concrete must be carried out in a manner such that the concrete is deposited as close as practicable to its final position. The use of chutes or tremmie pipes must be adopted throughout the placing process to ensure that segregation does not occur.
 - i) Concrete must be placed in even layers and must not be moved into position with the poker or vibrator.
 - ii) Layer thickness must be compatible with the tools and methods to remove entrapped air, each layer must be thoroughly compacted before the placing of the next layer.
 - iii) Formwork must be filled with concrete in such manner as to avoid the formation of cold joints.

4.4.2.21 JOINTS IN CONCRETE.

- 1) Construction joints shall be provided where shown on the relative construction drawing or modified according to written agreement according to Paragraph 504. A minimum of 12 hours shall elapse between the construction stages thus indicated. The construction joint shall be effected by lightly wire brushing the existing concrete surface to remove the laitance and expose the aggregate, then cleaning and wetting before the new concrete is cast. The use of jack hammers or picks to scabble away the existing surface is not permitted. Such construction joints shall be sited at least.

150mm from any anchor iron position. Where a construction joint is shown on a drawing at floor level, a kicker may be constructed at the contractors' discretion.

- 2) Concrete walls shall be completed in one operation, whenever possible.

Where this is not practicable construction joints shall be made after the existing concrete has set but not hardened, the joint being cleaned with a stiff brush to remove the laitance to expose, but not disturb, the larger aggregate.

4.4.2.22 WET SITUATIONS.

In wet situations the Contractor must implement such methods as are necessary to prevent damage to freshly placed concrete or mortar and to ensure a correctly constructed jointing chamber.

4.4.2.23 COMPACTION and TAMPING of CONCRETE.

In the construction of concrete or reinforced concrete jointing chambers, the concrete shall be thoroughly worked and tamped into all parts of the moulds or forms and around the reinforcement. Care shall be taken not to disturb reinforcement steel during compaction.

Compaction of all concrete slabs shall be performed until a dense solid mass without voids is obtained, to meet the requirements for strength and durability.

Unreinforced concrete floor slabs may be compacted by hand tamping methods. All unreinforced concrete wall slabs shall be compacted by the use of a poker type vibrator.

Reinforced concrete slabs of jointing chambers shall be by the use of a poker type vibrator.

4.4.2.24 SHUTTERING.

1) Timber shuttering shall not be left in the road structure. Where it is impractical to remove timber shuttering after the completion of excavation works, the timber shall be cut off below the road structure and removed. Only suitably treated timber may be left in, below the road structure.

2) Subject to compliance with the drawings as regards dimensions, the Contractor shall be at liberty to adopt any arrangement he may think fit for the make-up of the shuttering, it being understood that on completion of the chamber, the whole of the internal shuttering material shall be removed.

3) In all cases the shuttering used shall be of such dimensions, and so constructed, as to remain rigid and unyielding to weight and vibration during the laying and tamping of the concrete. No shaking or jarring shall be permitted during setting.

4) Proprietary spacers shall be placed at 0.6 metre maximum centres, to ensure the minimum cover shown on the relevant construction drawing, is maintained from the shuttering, prior to and during, the placing of concrete.

5) Design, size and general arrangement of the chamber shall be in accordance with the appropriate drawing, suitably modified by the following variations:-

- Plastic sheeting, 1000 or 1200 gauge shall be positioned between the excavation or rear shuttering and the concrete of the jointing chamber. It shall also be placed over the roof before commencing the back-fill. Where the floor of the excavation has been well compacted and a blinding placed to prevent the contamination of the structural concrete, there is no requirement for the Plastic sheet to be laid on the floor.
- Duct entries into a jointing chamber shall, when required by UoW, be fitted with a Duct Seal.

6) The contractor must ensure that no soil or other deleterious material is allowed to collect between the inner faces of the internal and external shuttering or contaminate the structural concrete. Where this has been shown to occur the contractor will be responsible for the complete renewal of the structure. Repair of the affected area will not be accepted.

4.4.2.25 CHAMBERS RESISTANT TO SULPHATE ATTACK.

Where concrete is exposed to sulphate attack reference to Table A.15 of BS 8500: Part 1 indicates the allowable cement combinations to be adopted within the concrete mix. Irrespective of which option is adopted no relaxation on the required concrete strength will be accepted.

Note: Under no circumstances shall High Alumina cement be used.

4.4.2.26 CONCRETE QUALITY and FINISH.

- 1) All concrete used for the construction of Manhole Jointing Chambers shall be ready mixed Grade C32/40, in accordance with Table 7 BS8500: Part 2, except where the quality of concrete is detailed on the construction drawing. For Carriageway and Footway Joint boxes the use of site mix concrete in accordance with Part 2 of this specification is allowed.
- 2) Where ready mixed concrete is used UoW will require to see and retain a copy of the delivery certificate supplied with the concrete.
- 3) Where site mixed concrete is used the contractor shall supply a certificate of compliance according to Chapter 4.4.7 of this Specification.
- 4) When directed by UoW two Test Cubes will be taken from any concrete used for jointing chamber construction, otherwise 2 cubes shall be taken from every 20m³ or 20 batches.

For all manhole construction it is expected mandatory test cubes are taken on all builds.

The equipment necessary for the making of the test cubes shall be provided by the Contractor.

The cubes shall be tested by a Testing Laboratory approved by UoW and the Contractor shall supply a copy of test report to UoW within 14 days of the cubes being tested.

Work will not normally be delayed for the result of any test to be ascertained.

The making, curing and testing of all cubes of concrete for compressive strength tests shall be in accordance with BS EN 12390, Parts 1, 3 and 7 and the results shall satisfy the following tables:-

Type of cement used		
Age of concrete	Portland and Sulphate Resisting	Rapid Hardening
7 days	25 N/mm ² minimum	34 N/mm ² minimum
28 days	40 N/mm ² minimum	40 N/mm ² minimum

5) Test cores may be required, whether test cubes have been taken or not. UofW may, as a result of inspection or tests, require cores to be taken and tested in accordance with BS 6089 and BS EN 12504 Part 1.

The cores shall be examined and tested, by an independent NAMAS or UKAS approved testing authority / laboratory and the estimated in-situ strength ascertained.

The Contractor shall provide UofW with a copy of the test report as soon as it is available and, if this indicates that the quality of the concrete in the structure is unsatisfactory, the jointing chamber shall be demolished and replaced with a new structure.

The core drilled hole shall be made good with cement mortar.

6) On completion of a manhole the floor shall be rendered with a screed of 3 parts sharp sand and 1 part cement in accordance with the relevant drawing.

The walls of concrete jointing chambers shall have a smooth finish; any slight cavities exposed when the shuttering is removed shall be made good with cement mortar, and any projections removed.

Note: UNDER NO CIRCUMSTANCES SHALL THE WALLS BE COATED WITH CEMENT OR CEMENT SAND WASH TO ENABLE CONCEALMENT OF POOR WORKMANSHIP.

4.4.2.27 CONCRETE CURING TIMES.

The minimum concrete strength or curing periods after completion of any construction or modification work using cement mortar or concrete, which must elapse before:-

- (a) the shuttering of jointing chambers is removed.
- (b) the restoration of paving or surfaces may be commenced

Traffic is allowed to pass are as follows:-

FOR MANHOLES AND JOINT BOXES BUILT IN THE CARRIAGeway			
Type of cement	(a) to removal of shuttering	(b) before commencing the restoration of carriageway	(c) before allowing passage of traffic
Portland, Portland Blast Furnace Sulphate Resisting	5 days or 20N/mm ²	7 days or 25N/mm ²	7 days or 25N/mm ²
Rapid Hardening Portland	2 days or 20N/mm ²	3 days or 25N/mm ²	3 days or 25N/mm ²

FOR MANHOLES BUILT IN THE FOOTWAY

Type of cement	(a) to removal of shuttering	(b) before commencing the restoration of footway	(c) before allowing passage of traffic
Portland			
Portland Blast	5 days or 20N/mm ²	5 days or 20N/mm ²	7 days or 25N/mm ²
Furnace Sulphate Resisting			
Rapid Hardening	2 days or 20N/mm ²	2 days or 20N/mm ²	3 days or 25N/mm ²
Portland			

FOR JOINT BOXES BUILT IN THE FOOTWAY

Portland, Portland Blast Furnace, Sulphate Resisting, Rapid Hardening Portland	Shuttering shall not be struck in less than 24 hours or 10N/mm ²
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4.4.2.28 PAINTING of MANHOLES.

On completion of all construction works, in the case of all manholes, the shaft and underside of the roof and the top third of the manhole walls shall be cleaned and the surface prepared to be coated with a water resistant, non-toxic, white reflective coating, approved or specified by UofW at the time of tendering. Mixing and application of the material shall be strictly in accordance with the Manufacturers' instructions.

4.4.2.29 JOINTING CHAMBERS.

List of materials for use in UofW Underground Jointing Chambers:

- THOROSEAL® /ACRYL 60 supplied by:

BASF Construction Chemicals (UK) Ltd.

Earl Road

Cheadle Hulme

SK86QG

Cheadle,

Cheshire

P.O. Box 4

Phone +44 161 4856222

Telefax +44 161 4885220

E-Mail enquiriesuk@basf.com

Web Site <http://www.bASF.com/group/corporate/en/function:addressselector:/country-page/GB>

Product details:

<http://www.bASF-cc.com.eg/en/products/waterproofing/ThorosealAcryl60/Pages/default.aspx>

If a contractor wishes to use any other compliant white reflective material a certificate of compliance shall be submitted to the TAA, for approval.

4.4.2.30 BRICKWORK CHAMBERS.

1) Concrete in Brickwork Chambers,

Unless otherwise specified Grade C32/40 Concrete shall be used for the floors of all brickwork jointing chambers. When there is an Anchor Iron in the floor the floor must be allowed to set for at least 12 hours before commencing brickwork.

2) Brickwork.

All brickwork shall be constructed with a 10mm joint thickness of cement mortar and shall be of English Bond with the exception of 102.5 mm brickwork (BS EN 772) which shall be of Stretcher Bond.

The inside of all brickwork shall be flush jointed.

In a Brickwork JB 102 a dispensation allows the joint thickness of alternate levels in the end wall to be nominally 20mm each end.

Test cube made from cement mortar used for the construction of joint boxes shall have a minimum strength of 16N/mm² after 28 days.

The chamber shall not be opened to footway traffic until the cement mortar has achieved strength of 10N/mm².

Any requirement to corball brickwork, the bricks must be Class B Engineering bricks. The bricks shall be without holes or frogs. (HA-104).

4.4.2.31 FRAMES and COVERS.

Frames and Covers Footway Type 'C' to BS EN 124 class B 125.

Frames and Covers Footway Type 'C' to BS EN 124 class B 125				
Type of Frame and Cover	Used for Jointing Chambers	Dimensions of openings	No. of covers	Item Code
No.2	Type 102 & JB 26	725mm x 255mm	1	075874
No.4	Type 104	915mm x 455mm	1	075875
No.5	Manhole Shaft	610mm x 610mm	1	075876
No.6	Type 106	1310mm x 610mm	2	075877
No.10	Type 110	2315mm x 737mm	3	075878
No.11	Type 111	1690mm x 710mm	3	075879

Joint box No. 23 has its own unique cover, and the box itself is the frame.

Precinct Frames and Covers shall be installed when required by UoW and directed by the schedule of works. Block pavings shall be installed according to manufacturers' instructions.

See Paragraph 6 of this chapter for installation of footway frames and covers.

Frames and Covers Carriageway (Nos. 1, 2, 3 and 4; double triangular type.) to BS EN124 Class D400 including Lockable.

Frames and Covers Carriageway (Nos. 1, 2, 3 and 4; double triangular type.) to BS EN124 Class D400				
Type of Frame and Cover	Used for Jointing Chambers	Dimensions of openings	No. of covers	Item Code
No.1F	All carriageway manholes and Newsites JCB3N	610 mm x 610 mm	2	057243
No.2F	JRCX12	1220 mm x 685 mm	4	057244
No.3F	JRCX11 and JRCX14	1830 mm x 685mm	6	057245
No.4F	JRC4 and JBC4	915 mm x 445 mm	2	057246

Note: Cover Connecting Pins must be fitted during the installation of triangular covers.

See Paragraph 7 of this chapter for installation of carriageway frames and covers.

Frames and Covers Carriageway (Nos. 1, 2, 3 and 4; double triangular type.) to BS EN 124 Class D400 LOCKABLE				
Type of Frame and Cover	Used for Jointing Chambers	Dimensions of openings	No. of covers	Item Code
No.1F	All carriageway manholes and Newsites JCB 3N	610 mm x 610 mm	2	057247
No.2F	JRCX 12	1220 mm x 685 mm	4	057248
No.3F	JRCX 11 and JRCX 14	1830 mm x 685mm	6	057249
No.4F	JRC 4 and JBC 4	915 mm x 445 mm	2	057250

Note: Cover Connecting Pins must be fitted during the installation of triangular covers.

See Paragraph 7 of this chapter for installation of carriageway frames and covers.

3) Footway Lockable Frames and Covers.

When required by UoW, and specified within the schedule of work, Manholes and Jointing chambers shall be fitted with Lockable Frames and Covers.

Alternatively with Footway chambers you may fit Plates Plant Protection (PPP) High Security, Enhanced Security (JUF & JBF 102/104) or Adjustable Enhanced Security (JRF&JBF 106/110/111).

Frames and Covers Footway Type 'C' Lockable to BS EN 124 class B 125				
Type of Frame and Cover	Used for Jointing Chambers	Dimensions of openings	No. of covers	Item Code
No.2	Type 102 & JB 26	725mm x 255mm	1	049830
No.4	Type 104	915mm x 455mm	1	049831
No.5	Manhole Shaft	610mm x 610mm	1	049832
No.6	Type 106	1310mm x 610mm	2	049833
No.10	Type 110	2315mm x 737mm	3	049834
No.11	Type 111	1690mm x 710mm	3	049835
Key Security 1A (Lockable F&C)				054834

The following tables identify the relevant CN Drawings and the number of Padlocks Special Security, plus the items needed to provide the security cover.

Footway Frame and Cover	CN Drawing(s)
No.2 PPP High Security (2 x Padlocks)	13713 & 13714
No.4 PPP High Security (2 x Padlocks)	13808 & 13809
No.6 PPP High Security (2 x Padlocks)	13893 & 13894
No.10 PPP High Security (2 x Padlocks)	11817 & 11818
No.11 PPP High Security (2 x Padlocks)	11819 & 11820
No.2 PPP Enhanced Security (1 x Padlock)	N/A
No.4 PPP Enhanced Security (1 x Padlock)	N/A
No.6 PPP Enhanced Security Adjustable (1 x Padlock)	CN 15706
No.10A PPP Enhanced Security Adjustable (1 x Padlock)	CN 15707
No.10B PPP Enhanced Security Adjustable (1 x Padlock)	CN 15708
No.11 PPP Enhanced Security Adjustable (1 x Padlock)	CN 15709

Drawing CN 15013 gives installation details for Plate Plant Protection.

Carriageway Frame and Cover	U OF W Item Code of Frame and Cover
No.1 (2 x Padlocks)	095140
No.2 (4 x Padlocks)	095141
No.3 (6 x Padlocks)	095142
No.4 (1 x Padlock)	TBC
Padlock Special Security	129260

When a Frame and Cover Carriageway No.1 is used the frame shall, whenever practicable, be installed so that the lockable inserts are positioned either side of the ladder or steps.

Where due to site circumstances this is not practicable a Technical Departure Form Specification (TDFS) will be permitted.

4) Weights of Frames and Covers.

The tables below show approximate total weights of frames and covers. At all times safe lifting equipment and practices must be employed, and the use of mechanical lifting aids should be considered.

Carriageway Frame and Cover	Total Weight
Carriageway No. 1	206 kg
Carriageway No. 2	395 kg
Carriageway No. 3	567 kg
Carriageway No. 4	120 kg

Footway Frame and Cover, Type 'C' to BS EN 124	Total Weight
Footway No.2	38 kg
Footway No.4	72 kg
Footway No.5	66 kg
Footway No.6	133 kg
Footway No.10	276 kg
Footway No.11	198 kg

Footway Frame and Cover, Type 'C' Lockable to BS EN 124	Total Weight
Footway No.2	42 kg
Footway No.4	76 kg
Footway No.5	70 kg
Footway No.6	137 kg
Footway No.10	280 kg
Footway No.11	202 kg

The weights for the lockable footway F/Cs are for guidance only. To be confirmed at later date.

5) Concrete Surround.

- (i) In carriageways of flint, gravel, macadam, unsurfaced or other similar paving, the frame of a jointing chamber cover shall have a 150mm Grade C32/40 Concrete Apron surround, to the depth of the frame. Opening to traffic shall be subject to Page 89 in respect of the surrounding reinstatement.
- (ii) Where the carriageway has a concrete in-situ surface, a surround of concrete will be required around the frame of the jointing chamber cover.
- (iii) For carriageway covers in grass or soft or unmade surfaces, to enable the safe removal of covers by mechanical means, a concrete surround shall be constructed around the frame, according to CN 15353.
- (iv) For single course (102mm) brickwork and modular footway chambers (except JB 23 & JB 26) in grass or soft or unmade surfaces, the frame shall be surrounded with a strip of minimum Grade C25/30 concrete to the full depth of the frame. This concrete surround shall be 50mm wide or extend to the outer edge of the chamber walls whichever is less.
- (v) For all other footway covers in grass or soft or unmade surfaces, the frame shall be surrounded with a 100 mm wide strip of minimum Grade C25/30 concrete, to the full depth of the frame, finished level with the top edge of the frame and the outside edge finished straight and parallel to the frame.
- (vi) In all other situations, no fillet is allowed around the frame.

6) Installation of Standard Footway Frames and Covers

Any materials compliant with HA104. It is recommended that contractors use only quality and compliant materials as guarantee requirements will be enforced.

7) Installation of Standard Carriageway Frames and Covers.

Any materials compliant with HA104. It is recommended that contractors use only quality and compliant materials as guarantee requirements will be enforced.

Note: Cover Connecting Pins must be fitted prior to the installation of triangular covers.

8) Reinstatement of the carriageway and footway shall be commenced, in accordance with the relevant reinstatement specification, (see Para 4.4.6), after the minimum curing period for the frame bedding mortar material and the period from Page 89 (b) & (c) of this specification, have elapsed.

9) Opening to Traffic. Before opening to pedestrian or vehicular traffic the following conditions must be met:

- a) The seatings of the Frame and Cover(s) shall be clean and the covers shall fit firmly, flush and level within the Frame. The covers shall not rock or foul any existing removable grids or the sides of the shaft or joint box walls.
- b) If there is evidence of rocking or fouling, the cover shall be removed and remedial action taken to correctly fit the cover. The site shall not be left unguarded until the covers are correctly seated within the frame, in a manner acceptable to UofW.
- c) The minimum criteria of page 89 (c) and page 94 Para 4.4.2.31 (6) and (7) shall apply.

10) Preparation and Changing the level of Existing Jointing Chambers - shall be in accordance with Part 9 of this specification.

11) Lifting Tools for UofW covers.

For Footway covers, use Keys Joint Box No 5.

For Carriageway covers, use Lifter Manhole Cover No 4A.

In exceptional cases, after on site risk assessments have been carried out and the appropriate precautions taken, T keys may be used for Carriageway covers.

N.B. UoW does not supply keys or lifting tools, but AS AN EXAMPLE they can be purchased from:

T W Engineering.
Angular House.
Eagle Road.
Quarry Hill Industrial Park.
Ilkeston.
Derbyshire.
DE7 4RB.
Tel 0115 932 3223.

http://www.twtools.co.uk/online-tool-sales/MANHOLE_COVER_LIFTERS.html



4.4.2.32 CABINET CROSS-CONNECTIONS.

1) Excavation for Base.

(i) Excavations of the size shown on Drawing CN 1464 suitable for the requisite cabinet cross-connection base shall be made in the positions indicated by UofW.

(ii) The bottom of each excavation shall be well compacted.

2) Provision of Base.

(i) Template - a template shall be provided by the Contractor and used to register accurately the positions of the Bends Duct No. 54A and Bolts F.I. No. 1 and their position relative to the footway surface.

The bends shall be so placed to give the required depth of cover on the duct leaving the Cabinet (Chapter 4.4.3 refers) to project 30 mm above the proposed base. Any surplus duct shall be cut off and removed after the base has been placed and the periods given in Paragraph (2) (ii) have elapsed.

The foundation bolts shall be fixed in the template so that they are set vertically in the base and to project 40 mm above the proposed base.

Where Cabinets are installed on sloping ground, it may be necessary for part of the base to be above ground, in order to fully open the Cabinet doors.

(ii) Concreting - prior to concreting, the ends of the PVC duct bends shall be sealed with plugs (Part 4 refers). Grade C32/40 Ready Mix or site mixed concrete shall be used for the base and shall be placed round the PVC duct bends and carefully levelled at a depth of 75 mm below the surface of the ground or paving, as measured at the centre of the base.

The minimum period, after the completion of concreting, which must elapse before the Cabinet is erected, shall be as follows: -

Type of Cement Used	Period
Portland and Sulphate Resisting	12 hours
Rapid Hardening	8 hours

Where there is a risk of the bolts or fittings being disturbed or the stability of the cabinet is affected, the minimum period above shall be 24 hours unless the cabinet can be suitably braced and protected from disturbance.

(iii) Extending the Cabinet Base

Where the base of an existing cabinet is to be extended the adjoining surface of the in-situ concrete shall be scabbled by hand tools. The new template shall be positioned to align the duct entries and fixing bolts according to CN 1464. To facilitate standard left to right numbering for PCP Strips, any extensions if conditions allow are to be placed to the right of the existing cabinet base.

(iv) Additional Duct Entries to Cabinets (Cabinet expansions)

To facilitate standard left to right numbering for PCP Strips, new ducts must wherever possible, be brought in on the right hand side of the Cabinet, adjacent to the current last Duct entry unless otherwise indicated by the Works Originator. Where site circumstances prevent this, a non-auto TDFS must be obtained from the Works Originator for a Non Standard entry.

3) Erection of Cabinet.

(i) Erection.

(a) Prior to the erection of the Cabinet, the surface of the concrete base shall be thoroughly cleaned and a bed of cement mortar shall be laid to a depth of 13 mm over that part of the surface on which the base flange will rest.

The Cabinet internal walls shall be cleaned to a height of 40 mm from the base of the Cabinet to remove all rust, loose paint or materials.

The Cabinet shall then be set on the cement mortar in a truly vertical position and secured by the foundation bolts.

The cement mortar shall now be struck off in line with the internal surface of the Cabinet; on the outside the mortar shall be trowelled to form a fillet around the flange to assist in the shedding of water.

(b) When the mortar has set the Cabinet walls shall be cleaned and dried to a height of 40 mm from the concrete. When there is no surface water on the concrete surface inside the Cabinet, it shall be brushed to remove any dust and foreign matter.

The appropriate number of Resin Packs shall then be mixed and poured on to the floor of the Cabinet and a good seal formed around the ducts and the Cabinet walls to a depth of 20mm ± 5mm. (See Part 7 regarding Safety Issues).

If foaming occurs the Resin shall be removed and the process in (a) and (b) above shall be repeated.

(ii) Backfilling of the excavation shall proceed in accordance with Part 6 of this Specification.

(iii) Sealing ducts entering Cabinets. On completion of works to erect the cabinet the empty Ducts entering the cabinet shall be sealed according to Page 136 of this specification and cabled duct shall be sealed using Resin Pack No.14.

(iv) Hardstand in front of cabinet doors to be provided with a suitable HAUC CoP Footway Standard surface to provide a firm surface for safe access.

4) Key.

A "Key Pillar" or "Key Cabinet" or individual key, obtainable from UoW, is required to open all types of Cabinets Cross-Connection.

On completion of works the doors of the cabinet shall be shut and locked, and the key returned to UoW.

4.4.2.33 FTTC CABINET.

1) Excavation for Base

(i) Excavations of the size shown on Drawing series CN 15647 suitable for the requisite FTTC base shall be made in the positions indicated by UofW.

(ii) The bottom of each excavation shall be well compacted.

2) Provision of Base

Template - a template shall be provided by the Contractor and used to register accurately the positions of the Duct 36, Bends Duct No. 54A, Bends Duct 36B and Bolts F.I. No. 1 and their position relative to the footway surface.

The bends shall be so placed to give the required depth of cover on the duct leaving the Cabinet (Chapter 4.4.3 refers) to project 30 mm above the proposed base.

Any surplus duct shall be cut off and removed after the base has been placed and the periods given in Page 102 Provision of Base (2) (ii) have elapsed.

The foundation bolts shall be fixed in the template so that they are set vertically in the base and to project 40 mm above the proposed base.

Note The Duct 36 depth of cover of 450mm in footway. This to comply with NJUG documentation Volume 1, recommended DOC for electric ducts.

An earth rod must be installed through the hole provided for the purpose on the passive side of cabinet before the root and cabinet are installed.

All plinths must be provided measured and certificated with an earth value of 18 Ohms or less at point of construction.

Threaded earth rods need a minimum 25mm of rod above duct for the nut and washer connection.

If thread needs to be removed (when unable to drive any deeper) a minimum 40mm of rod above the duct is needed for an earth clamp connection.

Where Cabinets are installed on sloping ground, it may be necessary for part of the base to be above ground, in order to fully open the Cabinet doors.

(ii) Concreting - prior to concreting, the ends of the PVC duct bends shall be sealed with plugs (Chapter 4.4.4 refers). Grade C32/40 Ready Mix or site mixed concrete shall be used for the base and shall be placed round the PVC duct bends and carefully levelled at a depth of 100 mm below the surface of the ground or paving, as measured at the centre of the base.

The minimum period, after the completion of concreting, which must elapse before the Cabinet is erected, shall be as follows: -

Type of Cement Used	Period
Portland and Sulphate Resisting	3 Days

3) Erection of Cabinet.

(i) Erection

(a) Prior to the erection of the Cabinet, the surface of the concrete base shall be thoroughly cleaned and a bed of cement mortar shall be laid to a depth of 13 mm over that part of the surface on which the root flange will rest.

The Cabinet internal walls shall be cleaned to a height of 40 mm from the base of the Cabinet to remove all rust, loose paint or materials.

The Cabinet shall then be set on the cement mortar in a truly vertical position and secured by the foundation bolts.

The cement mortar shall now be struck off in line with the internal surface of the Cabinet; on the outside the mortar shall be trowelled to form a fillet around the flange to assist in the shedding of water.

(b) When the mortar has set the Cabinet walls shall be cleaned and dried to a height of 40 mm from the concrete. When there is no surface water on the concrete surface inside the Cabinet, it shall be brushed to remove any dust and foreign matter.

The appropriate number of Resin Packs to facilitate a depth of 20mm shall then be mixed and poured on to the floor of the Cabinet and a good seal formed around the ducts and the Cabinet walls to a depth of 20mm ± 5mm. (See Chapter 4.4.8 regarding Safety Issues).

(i) If foaming occurs the Resin shall be removed and the process in (a) and (b) above shall be repeated.

(ii) Backfilling of the excavation shall proceed in accordance with Part 6 of this Specification.

(iii) Sealing ducts entering Cabinets. On completion of works to erect the cabinet the empty Ducts entering the cabinet shall be sealed according to (Duct seal (Page 141) 4.4.4.2.7) of this specification and cabled duct shall be sealed using Resin Pack No.14.

(iv) Hardstand in front of cabinet doors to be provided with a suitable HAUC CofP Footway Standard surface to provide a firm surface for safe access.

To include likewise a firm surface to side entry power door areas, but not forming extension of cabinet front facing access doors. See CN 15725.

4.4.3 Excavation / Trench Specification. (C)

4.4.3.1 GENERAL.

The Contractor shall excavate in the Highway, in strict accordance with the requirements of the New Roads and Street Works Act 1991, and, in accordance where applicable to BS 6031; (Code of Practice for Earth Works), in positions so directed in the Schedule of Works or other UoW written instruction.

Where the contractor objects in writing to the line of route, location of site or the work instruction, UoW may at its absolute discretion: -

- a) Agree that the objection is valid and alter the line of route, or produce alternative proposals;
or
- b) Refute the contractor's claim in writing - giving the reasons why they are not considered valid.

4.4.3.2 EXCAVATED MATERIAL.

Excavated material shall be protected in accordance with the New Roads and Street Works Act 1991- Highways Authorities and Utilities Committee (HAUC) Specification for the Reinstatement of Opening in Highways. Unsuitable excavated material shall be removed from site and suitable backfill material shall be imported and reinstated as per the above specification.

4.4.3.3 EXCAVATIONS.

- 1) Mechanical Excavation. Any mechanical excavator must be capable of allowing for, and, should be used in such a manner as to fulfil the requirements of segregation /separation of materials and width of trench obtainable by using manual excavation or, any other requirements of this Specification.
- 2) Excavation. Excavation shall be carried out in a controlled manner using equipment and methods appropriate for the task.

3) Excavation in the vicinity of trees. Special care must be taken when excavating in the proximity of trees to ensure that damage to primary roots or body of the tree does not occur.

Hand excavation, wherever possible, is to be carried out in such locations. When the following guidelines cannot be followed, advice must be sought from the Local Authority Agricultural Officer and reference made to NJUG publication Volume 4 titled "Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees".

i) Cutting of Tree Roots, roots of 25mm diameter or more should not be cut. (NJUG 4)

Where damage has been proved to be as a direct result of excavation or reinstatement works, the contractor shall bear all costs incurred for any remedial action required.

4.4.3.4 SILENCERS.

The contractor shall comply with any national or local regulation or by-law, to ensure that equipment used during works is fitted with suitable silencing devices, which minimise and eliminate undue noise.

4.4.3.5 PROTECTION OF PAVINGS.

The Contractor shall take all necessary steps to prevent damage or contamination to paving by his plant and equipment.

4.4.3.6 PILOT HOLES and TRIAL EXCAVATIONS.

The Contractor shall excavate in positions as are necessary to meet the requirements defined in this Specification.

4.4.3.7 EXCAVATION SUPPORT.

1) The excavation shall include all necessary timbering, sheet piling and shoring to maintain stability of the excavation.

2) The supports of an excavation shall be so designed and placed to prevent loss of any ground and to permit, wherever practicable, withdrawal of such supports and consolidation of the space occupied.

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Prior written agreement must be obtained from UofW and formally recorded where the withdrawal of supports is considered impractical.

3) Existing mains and other services shall be adequately supported by temporary slinging or strutting or, by brick or concrete piers.

4.4.3.8 WIDTH of TRENCH.

In no case shall the width of trench excavated be greater than is reasonably necessary for satisfactory execution of the work.

4.4.3.9 UoW STANDARD DEPTHS.

(i) Where the following depths are not achievable it is the contractors responsibility to ensure that compaction and reinstatement comply with the HAUC Specification for the Reinstatement of Openings in Highways and that bore clearances of the duct route are maintained allowing future cabling works to be carried out.

	Standard Depth of Cover to top of Uppermost Barrel or, for Ducts laid in concrete, to top of Concrete Surround.	
Type of Duct/Cable.	Footway. (including Grass Verges & minor* Vehicular crossings over footway) mm ± 10%	Carriageway. mm ± 10%
PVC Single way and 2 ways Duct No. 54D	350	600
PVC Multiway. Duct No. 54D (3 to 20 ways)	450	600
PVC Multiway. Duct No. 54D (Leads-in to buildings and over 20 ways for street tracks)	600	900
PVC Duct No. 56.	350	600
Steel Duct No. 70.	350 or as required by UoW	600 or as required by UoW
Polyethylene Duct No. 102.	350	600
Duct on customer's gardens or cultivated ground, including duct laid within 1000mm of the carriageway of a grass verge without a defined kerb line.	450mm	
All other types.	As specified.	
Polyethylene cable laid direct in ground	450 or as required by UoW	600 or as required by UoW
PVC Duct 36 & 36B (NGA Cabinets) To follow NJUG recommendation for electrical duct.	450	600

*i.e. crossings to private houses; other crossings to be as carriageway.

(ii) Standard Chamber Shaft Depth.

A vertical access man entry shaft to an underground chamber commences from a minimum point, 150mm for footway shafts and 290mm carriageway shafts, below the appropriate surface level down to the top of the manhole roof.

The maximum depth of a standard shaft is 3000mm, measured from the top side of the manhole roof to the surface level including the Frame and Cover.

4.4.3.10 CHANGE of LEVEL.

In passing from footway to carriageway and vice versa, or where ducts enter jointing chambers below standard depth, or in any other circumstances where it is necessary to change the level, the bottom of the trench shall rise or fall gradually. There should be no abrupt changes in level.

4.4.3.11 TRENCHES FOR POLYETHYLENE CABLE.

1) Excavation for the laying of polyethylene cables direct in the ground shall be carried out by the Contractor at such positions as may be directed in a schedule of works.

2) The general condition detailed in Chapter 4.4.3 of this Specification shall apply.

3) The trench may be "V" shaped provided that:

- The base of the trench is of sufficient width to accommodate the cable or cables, laid adjacent with no separation.
- It is of the required depth.

4) At points, detailed on the Schedule of Works, where a cable has to cross a boundary wall from a footway to a customer's garden or curtilage and is not possible to lay under the boundary wall, the Contractor shall core through the wall and insert a short length of suitable duct.

Any void around the duct shall be packed with concrete and the ends of the duct well rounded to prevent the possibility of damage to the cable.

4.4.3.12 TUNNELLING and TRENCHLESS EXCAVATION.

- 1) All tunnelling and Trenchless Excavation operations, shall be carried out in accordance with this specification, the UoW Statement of Requirements, BS 6164, the contractor's Works Method Statements (and relevant Specifications) agreed by the TAA./Estates Network Engineer.
- 2) Where it is cost effective, practical, safe and appropriate, trenchless methods shall be used with the prior approval of the TAA. For example vibratory mole ploughing in rural settings (Page 142 Para .2) and directional drilling under embankments or busy road intersections (Close scrutiny of other utilities line plant drawings must be considered). All tunnelling to be notified to the T.A.A./Estates Network Engineer.

4.4.3.13 GROUND WATER LOWERING.

The Contractor shall take all reasonable measures to keep all excavations in dry condition and:

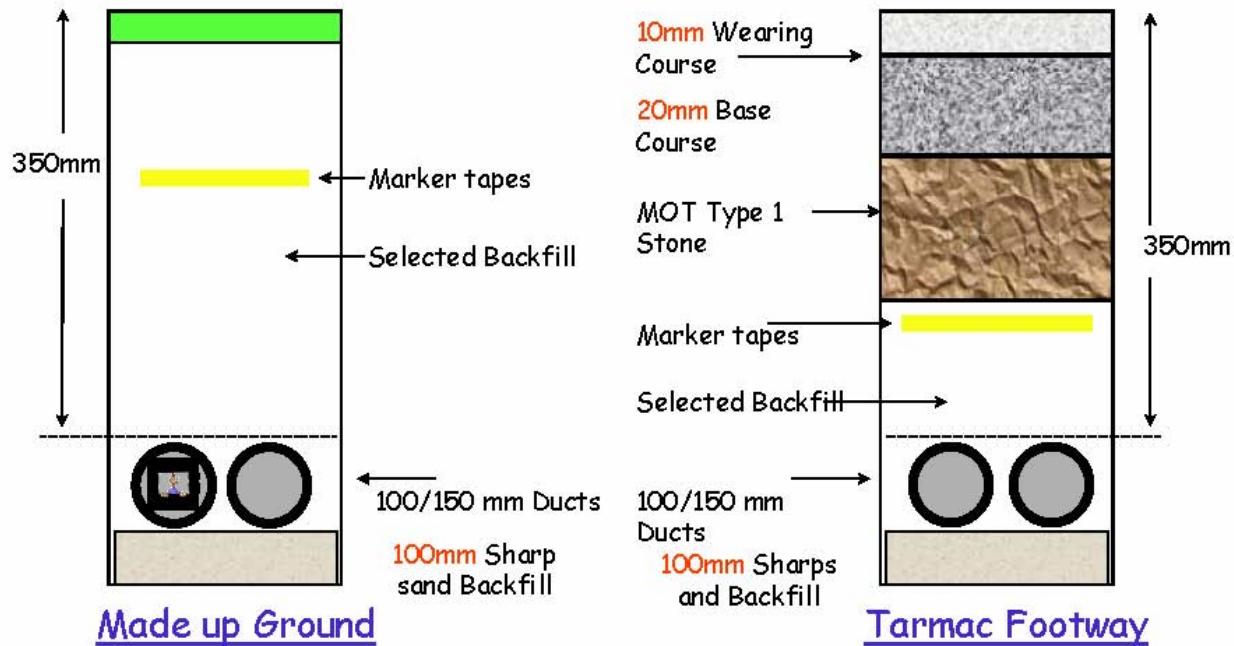
- (a) Supply all necessary equipment and temporary drainage as required.
- (b) Ensure that no fines, silt or other soils are drawn from the existing soil through the riser pipes in order to eliminate subsidence due to soil migration or shrinkage.
- (c) Provide settlement tanks where necessary before the water is pumped into the public sewer or drainage system. The Contractor must attain any prior approval necessary from the promoting authority for the discharge of water into their system.

All extracted water shall be properly disposed of.

Trench Details.

Made up Ground - Tarmac Footway.

Trench Details

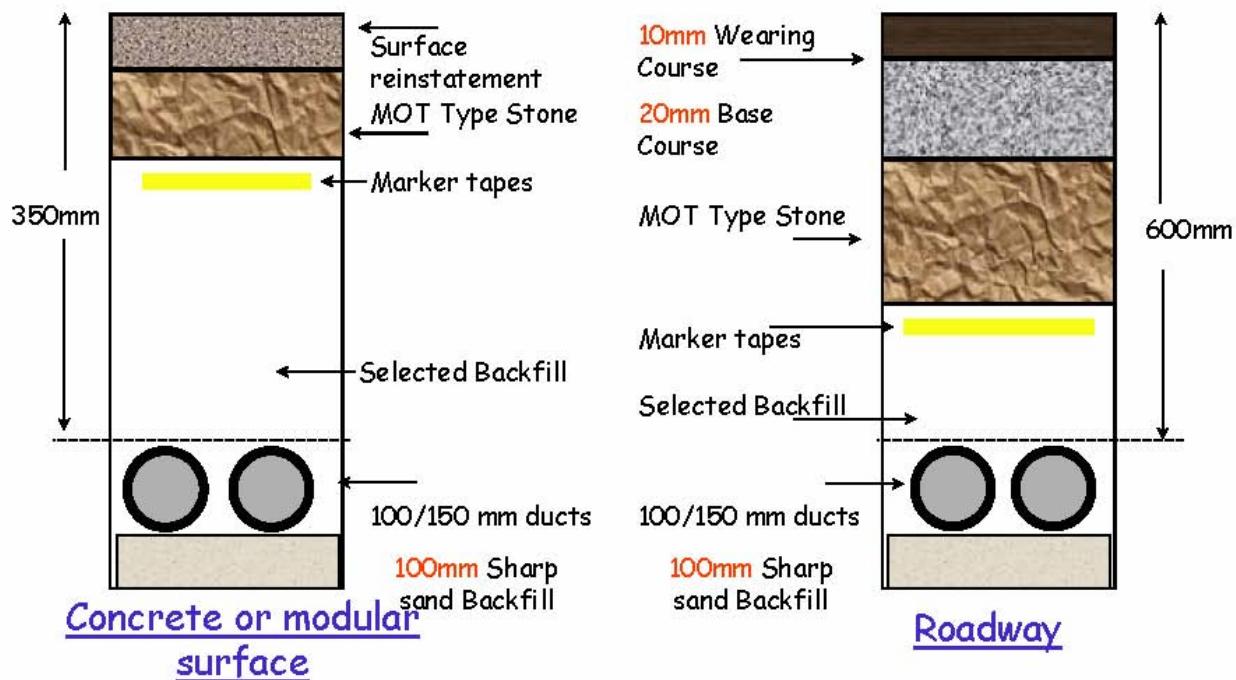


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Trench Details.

Concrete or Modular Surface - Roadway.

Trench Details



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4.4.3.14 Further Trench Specification.

The trench for ducting in grass, pathways and carriageways shall be a minimum of 450mm wide.

The base of the trench shall be level and free from stones, bricks and debris.

If there is a requirement to alter any of the above dimensions to service specific local regulations which contradict the above or the relevant British Standards, then the most stringent standard shall apply. If the standard cannot be achieved, then the university project manager shall be consulted for guidance.

A detectable guard tape shall be installed in all duct trenches. The tape shall be printed with "CAUTION COMMUNICATIONS CABLES BELOW" or equivalent cautionary statements throughout its length. The tape shall be laid directly above the minimum 100mm sand cover above the highest duct.

All ducts installed in trenches shall be in accordance with LN 550 Issue 9.

The line of duct lay shall be as direct as possible taking the position of other utility plant. A minimum separation of 150mm shall be maintained between telecommunications ducts and other services.

All conduits shall be sloped properly so they will drain into the manhole and away from the building entry. (When possible)

Ducts shall be laid with minimum bending and undulations but in any case shall not exceed 1 in 30 horizontally and 1 in 60 vertically.

No more than 50mt of duct shall be laid without an appropriately sized joint box being installed at this and every change of direction.

For grass areas a minimum of 200mm excavated graded material shall be laid on top of the sand and detectable guard tape.

The surface area shall be filled with existing soil infill and turf or seeded to make good.

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For hard dig areas the trench shall be backfilled and reinstated as per the code of practise,
Specification for the Reinstatement of Openings in Highways (second edition (England) June 2002

The newly installed duct route prior to handover shall be pulled through using a correct size mandrel & brush to remove any debris that may be present.

Each duct is to be left threaded with a 550 Newton minimum breaking strain nylon draw line, at least 5000 mm longer than the duct run.

4.4.3.15 Duct Laying.

All works will be carried out in accordance with the NRSWA 1991 and the codes of practice approved under the act.

The University of Warwick requires the Civil Engineering of Cable Chamber & Duct installations works to be carried out in accordance with the last Issue of British Telecommunications' Plc Specification LN 550 Issue 9 - Under ground Duct Laying & associated Works.

4.4.3.16 Marker /Tracer Tape.

A non-degradable plastic coated aluminium foil marker tape shall be laid in the trench 100 mm above the invert of the top duct / ducts. The tape shall be 150 mm wide and be marked at approximately 1200 mm centres with bold contrasting lettering '**FIBRE OPTIC CABLE BELOW**'.

The tape will be of a colour that will make it readily visible if exposed during subsequent excavations.



4.4.3.17 Roping.



Where appropriate all new duct sections shall be left suitably roped.

All loose ends shall be neatly secured to chamber furniture, in a safe position. Draw rope previously used for drawing in sub-duct or cable shall not be re-installed into a duct. Each length of rope shall be 5m longer, at both ends, than the duct.

Draw rope lengths shall only be joined together using rope splicing techniques; knots are not permitted.

All draw rope and draw cords shall be of polypropylene or other non-biodegradable plastic and have a minimum breaking strain of 550 kg.

Pre roped sub duct may be used if specified in the detailed design statement.

4.4.4 Ducting & Cable Laying. (D)

4.4.4.1 DUCT REQUIREMENTS.

4.4.4.1.1 Size of Duct.

The industry standard internal diameter dimension of underground duct is 90 mm.



However, 50 mm, 100 mm & 150mm duct may be utilised to suit a particular task or Project / conform with local site practice.

Sub-ducts have been frequently used in situations where both copper and fibre cables have been required to share the same duct.

Sub-ducts are not to be utilised on new duct routes as separate bores are to be provided for fibre and copper. Similarly, separate ducting systems are to be provided for Data and Power cables in order to comply with both safety and EMC requirements.

4.4.4.1.2 Linear Deviation.

Duct runs are, as far as is possible, to follow point-to-point straight lines with access pits provided at all points where deviation will exceed 1 in 30 horizontally or 1 in 60 vertically. However, long, slow curves are permitted providing the maximum pulling weight of the cables to be installed will not be exceeded. Building entrance deviation is to follow a 600 mm or greater radius.

4.4.4.1.3 Depth of Bore.

Bore depth must be sufficient to protect the duct from physical harm and is therefore dependent upon the ground material and surface fabric above the duct. Bore depth is to follow the requirements of Table 1 which provides a minimum value for clearance between the ground surface and the upper part of the underground plant, dimension 'D' of Figure 1.

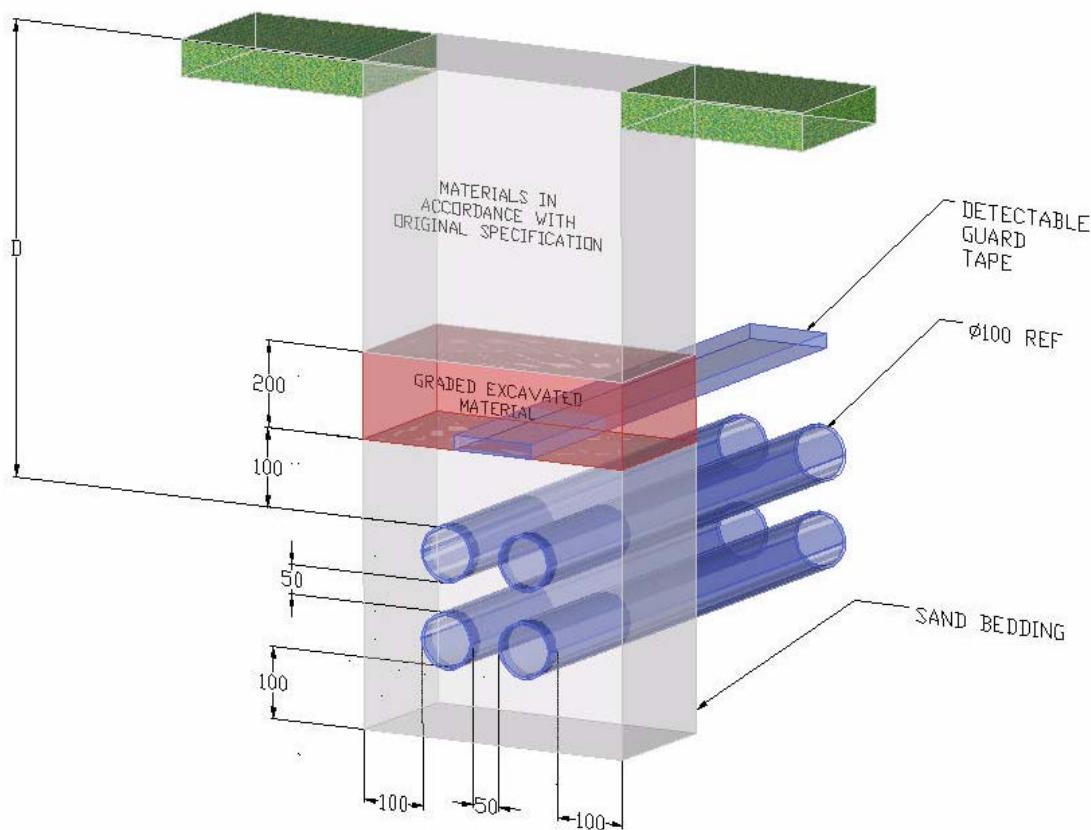


Figure 1 Section through Typical Duct Run.

Ground Material / Surface Fabric	Minimum Depth of Bore (dimension 'D')
Pavement or Grassed Area	350 mm
Urban and Rural Roads	600 mm
Motorway or Perimeter Track	800 mm
Runway or Railway	1000 mm

Table 1 Depth of Bore Minimum Requirement

4.4.4.1.4 Testing and Proving.

New ducts are to be tested and proved with a mandrel, a brush and a test length of cable connected together and pulled through the duct on a draw line.

- The mandrel is to be at least 250 mm long with a diameter at least 90% of the duct bore.
- The brush should be at least 200 mm long with a diameter at least 110% of the duct bore.
- The test cable is to be at least 3000 mm long.

Note see Para 4.4.3.14 for detailed information.

Each duct is to be left threaded with a 550 Newton minimum breaking strain nylon draw line, at least 5000 mm longer than the duct run.

4.4.4.2 DUCT AND CABLE LAYING.

4.4.4.2.1 GENERAL.

1) Drawings and Specifications. All relevant Drawing and Specifications shall be included with the contract documents.

2) Line of Duct. The line of duct shall be kept as straight as possible.

3) Duct Formation. The duct formation shall be maintained between chambers and shall be either as specified for the type of duct concerned or as detailed on the Schedule of Work.

4) Laying of Ducts. Duct laying shall be done only in accordance with this Specification, or where this specification is in-applicable, upon written instructions issued by UoW.

Where more than One (1) duct is installed the correct duct spacers are/shall be used in all circumstances.

5) Duct Lead In's into Buildings. ALL DUCT LEADING INTO UoW BUILDINGS & CUSTOMERS PREMISES SHALL BE SEALED AGAINST THE ENTRY OF GAS, WATER AND VERMIN INTO THE BUILDING/PREMISES.

6) Clearances from other services. All types of ducts and cables laid direct in the ground shall be kept well clear of gas or water mains, service pipes, sewers, subways, manholes, joint boxes or other plant belonging to other undertakers.

At least 150mm clearance shall be given wherever possible. Where two sets of plant cross each other, the minimum vertical clearance shall be 150mm with gas mains and 50 mm in the case of other plant.

Where the minimum separation cannot be achieved a UoW approved separator may be used. In no case shall the clearance be less than 25mm.

7) Clearances from Electricity Supplies. Clearances of UoW plant from electricity supplies shall be as follows: -

- As much clearance as is practicable shall be given to the bases of trolley wire standards, electric lamp standards, traffic signal posts and other similar plant. Where it is not practicable to provide a clearance of 150mm, a pre-cast slab, or a layer of grade 10 concrete not less than 50mm thick, shall be placed between the two sets of plant to provide a minimum tracking path of 75mm. For large masses of concrete, anti-crack mesh reinforcement may be necessary.
- High voltage single-core cables for electricity supply, electric tramway or electric railway systems, EXCEEDING 1000 VOLTS, shall have a standard minimum clearance of 450mm.
- High voltage multi-core cables for the same systems referred to in (b) above and EXCEEDING 1000 VOLTS, shall have a standard minimum clearance of 300mm. In difficult cases a reduced separation will be permitted, provided that where a separation of more than 150mm is impracticable, a pre-cast concrete slab or a layer of grade 10 concrete, not less than 50mm thick, shall be inserted between the two sets of plant. The concrete shall not be less than 50mm thick, have an overlap on each side and for the whole length where the clearance is 150mm or less, such that at every point the shortest path between the two sets of plant round the concrete shall exceed 200mm. For large masses of concrete, anti-crack mesh reinforcement may be necessary.
- Low voltage cables for supply systems NOT EXCEEDING 1000 VOLTS, shall have a standard minimum clearance of 50mm. Where difficulties arise, a reduced clearance down to 25mm will be permitted in which case the space between the two sets of plant shall be filled with a pre-cast slab, or a layer of concrete C10 not less than 25mm thick and of such width and length that at every point the shortest path between the two sets of plant, round the concrete, shall exceed 75mm.

8) Variation of Duct. If directed by UoW the type of duct may be varied for the good and sufficient execution of the work.

9) Duct in Tunnel Where duct is laid in tunnel or carrier pipe, and placed by trenchless methods or cut and cover, all voids within the tunnel or carrier pipe and all spaces around the duct shall be completely filled with a well compacted damp mix Grade 16/20 concrete, unless otherwise specified.

When a Timber Heading is constructed, a CCTV inspection shall be made through the Proving Bore to establish the condition of the packing of the backfill concrete.

If required by UofW, a 1:5 time lapse photography system shall be installed to monitor the working face or backfilling operation.

A video recording on VHS format shall be retained by UofW. All voids and spaces around the duct shall be packed with concrete minimum grade 16/20.

10) Covering of Duct. Unless otherwise specified, all duct not laid in concrete shall be covered by a layer of "Earth, Free from Stones" and compacted in layers - providing a finished thickness of not less than 75mm. Any spaces between the duct and the sides of the trench shall be filled with well compacted "Earth, Free from Stones". Compaction shall be by hand or mechanical methods, to suit site conditions.

11) Rocky Soils. In rocky or stony soils, "Earth Free from Stones", shall be spread over the trench bottom and compacted to afford a bedding up to 75mm thick on which to lay the duct. In such cases extra excavation of the trench will be necessary to achieve the required depth of cover. Stones protruding more than 75mm from the bottom of the trench shall be removed. Compaction shall be by hand or mechanical methods, to suit site conditions.

12) Cleaning and Testing.

(a) Unless otherwise specified, the following test shall be carried out on all duct 54 runs which are not in the local distribution ("D") side, to verify that Duct Bend 54A and Duct Bend 54C have not been used (see page 131 para 6). On completion of the duct line (including compaction of the backfill) between any two jointing chambers, or sites thereof, a UofW approved cylindrical brush followed by a uPVC mandrel (drawing CN 15563) shall both be passed once through each "way" - to test the duct 54 and to remove any foreign matter that may have entered. The size of the brush shall be as specified.

Unless otherwise specified, on completion of all other duct lines (including compaction of the backfill) between any two jointing chambers or sites thereof, a UofW approved cylindrical brush shall be passed once through each "way" to test the duct and to remove any foreign matter that may have entered. The size of the brush shall be specified for the particular duct. Notwithstanding, UofW reserves the right to demand a brush and metal mandrel test to verify any duct route.

(b) For details of the additional test required for ducts when the construction of a jointing chamber is deferred until after the completion of a section of duct, see page 126 (13) of this Specification.

(c) The Contractor shall supply the labour and equipment needed for the cleaning and testing operations.

(d) If the duct formation is not maintained between chambers or as directed in the schedule of works, or any defect is discovered during cleaning and testing operations U OF W shall be notified. Under normal circumstances, the contractor will be expected to make good the defect.

(e) If requested by UofW, prior notice shall be given by the contractor to UofW, to enable a UofW representative to be present during the cleaning and testing operations.

(f) When any defect is discovered during the cleaning and testing operations UofW shall be notified and if required by UofW, the defect shall be rectified.

13) Deferred Jointing Chamber. When the building of a jointing chamber is deferred until after the completion of a section of duct, the last 2 metres of each "way" shall be tested by the contractor, on completion of the jointing chamber, by means of the brush specified for the particular duct. A visual check shall first be made that no foreign matter or materials are likely to be pushed up the duct.

14) Plugs. A suitable plug may be inserted in the end of each "way" of a duct route to prevent the ingress of water and/or other foreign matter, until all work has been completed on that section and the length tested and accepted by UofW.

For the socket end of Duct 54 Plug 4B (**Red**) shall be used.

For the spigot end of Duct 54 Plug 4C (Yellow) shall be used.

For both socket and spigot ends of Duct 56 Plug Duct 1A (Foam) shall be used.

15) Draw Rope. Unless otherwise specified a draw rope shall be threaded through and left in every "way" following duct laying operations and satisfactory tests. Jointing together lengths of draw rope to make up the necessary length between jointing chambers may be carried out as directed in accordance with Drawing CN 13207. Draw rope shall not be joined for the purpose of conserving lengths shorter than 50 metres.

16) Alignment Test of Disturbed Duct. When jointing chambers are provided on an existing duct route or when any disturbance takes place which may affect the alignment of the duct, a brush of the appropriate dimensions shall be drawn through each of the spare "ways" in a similar manner to that detailed in Page 126 (13), and on completion of the test a draw rope shall be left in each spare "way".

17) Clearance from Electric-Tramways. When crossing under electric-tramways PVC Duct shall be used. In all cases there shall be a minimum cover from the surface to the uppermost duct of 900mm.

18) Expansion Joints. Where ducts pass through bridge decks, it may be required due to bridge construction methods, for the duct route to have expansion joint arrangements in place. With PVC ducts D54 & D56 this may be achieved using duct collars D54A / D56A, where compound 21 fixes one duct to the collar, with the second duct free to move within the collar.

Where duct 70 is used, there is no standard steel collar available, the expansion joint will become a non standard item and fabrication of a suitable collar will be submitted to UoFw (TAA) for approval.

19) Water Run Off. Where steel duct 70 is used, provision shall be made for adequate run off of aggressive fluids - e.g. from de-icing salts on bridge decks.

20) Marker Posts when required by UoFw, a marker Post or other suitable form of identification shall be placed to locate underground plant.

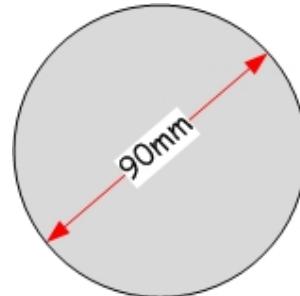
21) Additional Protection of Plant Where additional protection is required for ducts (e.g. during construction work in the vicinity), guidance is given in CN 15565.

4.4.4.2.2 PVC-U DUCT 54D.

1) General. Duct 54D is manufactured from Unplasticised Polyvinyl Chloride (PVC-U).

It is supplied in lengths of 6.0m and 1.5m, has an internal diameter of 90mm and a nominal wall thickness of 3.25 mm.

Each duct length has a tapered socket at one end that will accept the barrel of the duct.



Collar Duct 54A* 200mm in length, are also available for use with short lengths of duct which have no socket.

Spigot and Socket markers are shown for maximum and minimum insertion of duct.

*Collars Duct 54A shall not be used for duct lead-in track referred to in Page 142 (para3) or for the section of lead-in within the curtilage of a building.

2) Trench. The trench shall be excavated to the required width and depth, to allow a minimum of 25mm between the sides of the duct and the sides of the trench and allow the trench bottom to be free from stones, level and well compacted.

The duct shall be laid at standard depths (Chapter 4.4.3 refers) unless otherwise specified.

3) Formations. Duct 54D may be laid as a single duct or in multiway formation as follows: -

- (a) Up to and including 9 ways in rectangular formation.
- (b) Over 9 ways in rectangular formation with concrete surround.

4) Laying and Jointing.

- (a) Single way:

- (i) The open starting end of the trench shall be blanked off with a board or boards, to act as an anvil against which the duct can be driven home.
- (ii) The duct shall be laid on the trench bottom, the spigot end and the inside of the socket of the ducts to be jointed shall be thoroughly cleaned.
- (iii) The spigots and sockets of Duct 54D are so designed that, taking into account all manufacturing tolerances, the spigot will start to engage with the socket between 1/3 and 2/3 the socket depth. Two spigot markings are provided on the duct to show the maximum and minimum insertion depths. The minimum marking must be level with, or inside the socket. In most cases of satisfactory engagement, due to manufacturing tolerances, the maximum spigot marking shall still be visible at the socket end.
- (iv) When jointing short lengths of duct together with a Collar Duct 54A both spigot ends and the inside of the Collar shall be thoroughly cleaned. The spigot ends should be given a liberal coating of Compound No.21 and then fitted into the Collar so that they butt together at the midpoint.

(b) Multiway up to and including 9 ways:

- (i) The preparatory work and jointing shall be as outlined in PVC Duct 54D Page 126 (2) & (4) (a) (i) & (ii) of this Specification.
- (ii) The first layer of ducts shall be laid on the prepared trench bottom so that their outer surfaces touch each other and a minimum gap of 75mm remains between the outside of the ducts and the sides of the trench, or trench timbering where used. Wooden stakes or an approved alternative shall be driven into the ground at 3 metre intervals along the trench to keep the ducts in the correct position. "Earth, Free from Stones", shall be placed to fill the spaces between the ducts and the next layer of duct when the latter is bedded down. The second and subsequent layers of duct shall be laid between the wooden stakes so that they are vertically above and then bedded down to touch the ducts in the layer below, the spaces between the ducts being filled in the same way with "Earth, Free from Stones".
- (iii) At approximately 5 metres from the jointing chamber at each end of the track, the duct formation shall open out to provide a gap between each duct, both vertically and horizontally, of 25mm using Spacers, Duct 2. Over this 5 metre section all spaces between the ducts and the trench wall shall be filled with well compacted "Earth, Free from Stones" as well as all spaces between the ducts.

(c) Multiway over 9 ways, Drawing CN 10686 refers.

- (i) The preparatory work and jointing shall be as outlined in PVC Duct54D Page 126 402 (2) & (4) (a) (i) & (ii), of this Specification.
- (ii) The first layer of duct shall be laid on the prepared trench bottom so that their outer surfaces touch each other and a minimum gap of 75mm remains between the outside ducts and the sides of the trench, or trench timbering where used. To maintain the duct formation, when required or directed by UoFWW, wooden stakes or mild steel bars, of the required length, shall be driven into the ground at 3.0 metre intervals along the trench. The second and subsequent layers of duct shall be laid between the mild steel bars so that they are vertically above and touching the ducts below. The joints shall be staggered so that no joint touches any other joint. On completion of the assembly of the duct nest, the apparatus surround shall be filled with concrete of minimum Grade 16/20.
- (iii) Where the total number of layers of duct in any one formation exceeds 8 and the number of ducts in each layer exceeds 2 the following shall apply. Between the two layers of duct, midway, or approximately midway, from the top and bottom of the duct nest, an intermediate layer of reinforced concrete, 75 mm in depth and with 12mm mild steel reinforcing bars conforming to the layout of reinforcing in the top cover detailed in Drawing CN 10686, shall be placed across the duct nest. The additional reinforcing required by this sub-paragraph shall not be required in the 5 metre sections detailed in sub-paragraphs (iv) and (v) below.
- (iv) At approximately 5 metres from the jointing chambers at each end of the track, the duct formation shall open out to provide a gap between each duct, both vertically and horizontally, of 25mm. Banks of Spacers, Duct 2 shall be placed at 325mm and 1325mm from the jointing chamber wall to provide this spacing. Each spacer bank shall enclose all the ducts except those in the bottom layer on which the spacer bank shall rest. Where sub-paragraph (iii) applies, the 75 mm intermediate layer shall be reduced over the 5 metre sections to provide the required 25 mm spacing at the jointing chambers.
- (v) Where the total number of layers of duct exceeds three, concreting of spaced formations shall be in stages such that the number of layers of duct laid and concreted at each stage shall not exceed three. The concrete shall be brought to a level that shall not interfere with the laying of subsequent layers of duct and spacers.

(vi) Concrete made with Rapid Hardening Portland cement may be used. The concrete shall be evenly placed around the duct to give a finished minimum thickness of 75mm on both sides and to a depth of 130 mm above the top layer of ducts. Care must be taken to ensure that each batch, as it is placed, is properly compacted without creating unbalanced side thrust against the ducts. Each batch shall be vibrated; the poker shall be lowered into the concrete between the wall of the trench and the outside of the duct nest and shall not touch the duct. In spaced formation sections care must be taken to ensure that the gaps between the ducts are properly filled with concrete of minimum Grade 16/20.

(vii) With formations of four or more ducts wide, mild steel reinforcing bars conforming to Drawing CN 10686 shall be placed and wired in position before placing concrete over the uppermost ducts of the completed nest.

(viii) In the case of column entry manholes, the duct formation shall open out to enter the manhole as shown on the appropriate manhole drawing and at right angles of the entry wall.

The distance over which the transformation is made shall be no greater than is necessary to satisfy the 5 metres minimum bending radius for Duct 54D.

The ducts shall be secured in position during concreting either with Spacers, Duct 2 and Spacers, Duct 3 built up to the required centres or by reinforcing rods which may be encased in the concrete.

5) Alternative Method of Jointing & Laying.

(i) Provided space permits, Duct 54D may be jointed above ground and fed into the trench from one end.

(ii) The Contractor may, with UoW's agreement, use UoW approved Mole ploughing equipment and techniques, in grass or unmade ground, dependent upon the nature of the sub-soil, position of other services, access to line of route and the depth at which the duct is laid.

6) Bends and Duct Tees. Duct 54D is sufficiently flexible to provide a minimum bending radius of 5 metres. Tighter bends should not be attempted with straight lengths of duct otherwise kinking of the duct may result.

When required by UofW.

A pre-formed Bends Duct 54 (5180mm radius, 10° with socket and spigot ends); Bends Duct 54A (457mm radius, 90° with socket and spigot ends); Bends Duct 54B (2685mm radius, 18° with socket and spigot ends), Bends Duct 54C (700mm radius, 22° with socket and spigot ends) or a Duct Tee 54/56 shall be connected into the track.

- Bends Duct 54A shall only be used for a vertical transition from a route to the surface.
- Bends Duct 54C shall only be used on D-side routes.

Bends Duct, 54A and 54C, are for use on local distribution to the customer only, they shall not be used on Main or Trunk routes on the E-side of the network.

The following limitations are placed on the use of Duct Bend 54C in the D side of the network:

- For Duct 54 runs over 60m, no Duct Bends 54C may be used
- For Duct 54 runs between 40m and 60m, a maximum of 2 Duct Bends 54C may be used
- For Duct 54 runs under 40m long, a maximum of 4 Duct Bends 54C may be used

Four Duct Bends 54C may only be connected simultaneously to form a large 90 degree bend in section lengths less than 20m.

Where these limits cannot be met, consideration should be given to the introduction of a chamber or termination point, and the approval of the local UofW Representative must be obtained.

7) Backfill.

(a) Backfilling of trenches where Duct 54D has been laid shall be carried out in accordance with Part 6 of this Specification.

(b) Where Duct 54D has been laid any end shuttering and trench supporting timber, if used, shall be removed not less than 12 hours after the concrete has been placed. Backfilling of the trench, in accordance with Part 6 of this Specification, shall not be carried out until a further 48 hours have elapsed.

8) Cleaning and Testing.

(a) The cylindrical cleaning brush shall be 95mm in diameter and when compressed not less than 83mm in diameter

(b) When a section of Duct 54D track contains a pre-formed bend with a radius of less than 3000mm, the cleaning shall be carried out with a suitable rag mop.

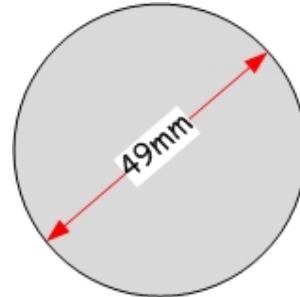
(c) When required by UoW, prior notice shall be given by the contractor, to enable the UoW representative to be present while cleaning and testing operations are in progress.

4.4.4.2.3 PVC-U DUCT 56.

1) General. Duct 56 is manufactured from Unplasticised Polyvinyl Chloride (PVC-U).

It is supplied in 3.0 metre lengths, has an internal diameter of 49mm and a nominal wall thickness of 2.5mm.

Each duct length has a tapered socket formed at one end, which will accept the normal barrel of the duct. Collar Duct 56A, in 150mm lengths, may be used to join lengths of duct 56 that have no socket. Spigot and Socket markers are shown for max and min insertion of duct.



2) Trench. As per para 4.4.4.2.2 Page 128 (2); (4) (a) and (b).

3) Laying and Jointing.

The spigots and sockets of Duct 56 are so designed that, taking into account all manufacturing tolerances, the spigot will start to engage with the socket between 1/3 and 2/3 the socket depth.

Two spigot markings are provided on the duct to show the maximum and minimum insertion depths.

The minimum marking must be level with, or inside the socket. In most cases of satisfactory engagement, due to manufacturing tolerances, the maximum spigot marking shall still be visible at the socket end.

4) Bends and Duct Tees. Duct 56 is sufficiently flexible to provide a minimum bending radius of 9.5 metres.

Tighter bends should not be attempted with straight lengths of duct otherwise kinking of the duct may result.

Bend, Duct 56 (350 mm radius, 90° with socket each end) and Bend, Duct 56A (Duct Tee 56/56, 622 mm radius, 90° with socket and spigot ends) are supplied for use when required by UoW. Bend, Duct, 56B (350mm radius, 90° socket and spigot ends) are only for connecting to Duct Tees 54/56 and 56/56. Duct Connecting 54D/56 used to connect Duct 54D to Duct 56.

5) Backfill. Backfilling of the trench shall be carried out in accordance with chapter 4.4 6 of this Specification.

6) Cleaning and Testing.

(a) The cylindrical cleaning brush shall be 57 mm in diameter and when compressed not less than 43mm in diameter.

(b) When a section of Duct 56 contains a pre-formed bend, the cleaning shall be carried out with a suitable rag mop.

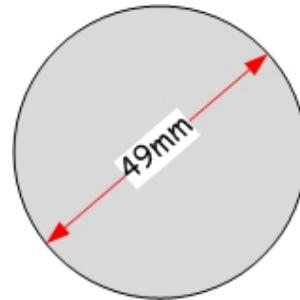
(c) Branch sections of Duct 56 connected to the main track with a Duct Tee 54/56 and 56/56 shall be cleaned prior to connection.

4.4.4.2.4 PVC-U DUCT 36.

1) General. Duct 36 is manufactured from Unplasticised Polyvinyl Chloride (PVC-U).

It is supplied in 3.0 metre lengths, has an internal diameter of 49mm and a nominal wall thickness of 2.5mm.

Each duct length has a tapered socket formed at one end, which will accept the normal barrel of the duct. Spigot and Socket markers are shown for max and min insertion of duct.



The principle use of this duct is to facilitate the feeding of power cables to NGA cabinets.

The colouring of this duct is Black to follow current NJUG guidelines for electricity use duct.

Note: some tasks specify RED duct. Where this occurs supplies should be sourced from UoFw duct supplier.(TBC)

2) Trench. As per Page 127 (2); (4)(a).

3) Laying and Jointing.

The spigots and sockets of Duct 36 are so designed that, taking into account all manufacturing tolerances, the spigot will start to engage with the socket between 1/3 and 2/3 the socket depth.

Two spigot markings are provided on the duct to show the maximum and minimum insertion depths.

The minimum marking must be level with, or inside the socket. In most cases of satisfactory engagement, due to manufacturing tolerances, the maximum spigot marking shall still be visible at the socket end.

4) Bends.

Duct 36A is sufficiently flexible to provide a minimum bending radius of 9.5 metres.

Tighter bends should not be attempted with straight lengths of duct otherwise kinking of the duct may result.

Bend, Duct 36A (350 mm radius, 90° with socket each end) are supplied for use when power and earthing cables to NGA FTTC cabinets

5) Backfill.

Backfilling of the trench shall be carried out in accordance with Chapter 4.4 6 of this Specification.

6) Cleaning and Testing.

When a section of Duct 36 contains a pre-formed bend, the cleaning shall be carried out with a suitable rag mop.

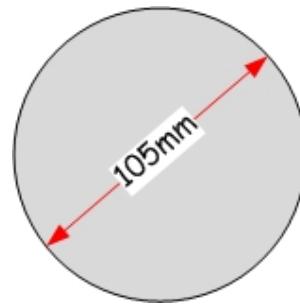
4.4.4.2.5 STEEL DUCT 70.

1) General. Duct 70 (CN1016) is supplied in lengths of 6.37m and has a nominal internal diameter of 105mm. Each duct length has a socket at one end that will accept the barrel of the duct.

2) Trench. As per para 4.4.4.2.2 Page 128 (2).

3) Laying and Jointing.

- Prior to jointing, the spigot and socket of each duct shall be thoroughly cleaned. The spigot shall be pushed fully home into the socket
- All spaces alongside and between ducts shall be filled with "Earth Free from Stones", and well compacted. When two or more layers of steel ducts are laid in the same trench, "Earth, Free from Stones" shall be well rammed to a thickness of 25mm between layers.
- The end of every steel duct entering a jointing chamber shall be recessed to within 10mm of the inside wall of the jointing chamber. The ends of the duct shall then be made flush with the internal face of the wall with cement mortar, to be rounded off so as to provide a smooth entry to the duct.



4). Cutting and Bending of Duct. Bends are not supplied to effect deviation in the line of route, but slight curvatures in the steel duct may be obtained by the use of a method agreed by UoW, care shall be taken not to damage the duct.

The Contractor shall do any necessary cutting of duct and bending of steel duct according to the requirements of the work.

Only purpose designed equipment capable of providing a gradual curve shall be used for the bending of steel duct.

Exceptionally, apparatus of the 'Jim Crow' type may be employed subject to the apparatus being repositioned frequently to produce a smooth curve.

During the bending operation the duct shall be continuously tested with a cylindrical cleaning brush 95mm in diameter and when compressed, not less than 83mm in diameter.

The inside edges of all cut ducts shall be thoroughly rounded off or so dressed to prevent damage to cables.

5) Backfill. Backfilling shall be carried out in accordance with Part 6 of this Specification, unless otherwise directed.

6) Cleaning and Testing. The cylindrical cleaning brush shall be 108 mm in diameter and when compressed not less than 95 mm in diameter.

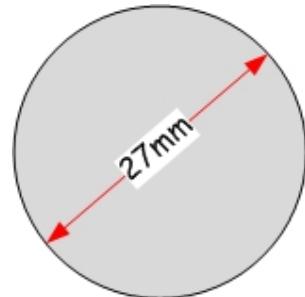
7) Connecting Duct 70 to Duct 54. When connecting Duct 70 directly to Duct 54, a Duct Connector 54/70 shall be used.

4.4.4.2.6 POLYETHYLENE DUCT 102.

1) General. Duct 102 is polyethylene duct. It is supplied in 150 metre coils and has a nominal internal diameter of 27mm. Duct 102 is used for leads-in to customers' premises, under pavements, gardens and parks, and, in certain circumstances as directed by UoW, for leading up to Distribution Points.

2) Trench. as per Para 4.4.4.2.2 Page 128(2).

3) Laying and Jointing. As the duct is laid in the trench it shall be kept straight by placing a quantity of "Earth, Free From Stones", on the duct at regular intervals. The duct shall be laid without joints.



4) Bends. The duct is flexible, but, to avoid cabling difficulties, bends in the line of route shall not be less than 500mm radius. Where it is necessary to lead the duct up a pole or wall, a Bend, Duct 102 (350mm radius, 90° with a socket at each end) shall be used.

5) Backfill.

(a) All spaces around and above the duct shall be filled and well compacted with "earth, free from stones", to a thickness of not less than 75 mm above the duct, unless otherwise specified.

(b) Backfilling shall be carried out in accordance with Section 6 of this Specification, in so far as it applies.

6) Cleaning and Testing. Duct 102 is laid without any joints and therefore cleaning and testing to obtain a clear bore is not normally required.

4.4.4.2.7 DUCT SEAL.

(Note Chapter 4.4.5)

1) General.

- (a) Where a Duct Seal is provided to a new structure in accordance with CN 10836, the first 1.5 metres of Duct 54D leading into a structure, will be included in the construction of the structure. The remaining lead-in duct shall then be connected to the 'starter' duct and laid to the next jointing chamber.
- (b) Alternatively, when directed by UofW, specified individual holes may be 'Core Drilled' in the wall at minimum 150mm centres. Each length of duct shall be assembled and sealed into the holes.
- (c) Breakthrough into customer's premises shall be performed according to CN 15507, good engineering practices and in compliance with any wayleave condition or specification or works instruction issued by UofW.
- (d) When a duct seal is provided all ducts shall be sealed within the structure, to prevent the ingress of water between the outside of the duct and the structure and the ingress of gas, water and vermin through the duct.
- (e) When an in-situ duct seal is disturbed and cannot be resealed using the existing materials, then the end shall be cleaned out and the appropriate Duct Seal and associated accessories shall be used to complete the seal.

2) Installation.

- (a) The template for the duct end shall be positioned on the inner wall of the cable chamber/trench, reinforced and braced as necessary to ensure that it will remain flat and in position during the subsequent operations.
- (b) As the ducts are fixed to the template they shall be temporarily supported to prevent damage to the duct or duct joint. The Contractor shall ensure that all ducts are parallel and, except for an angled lead-in, at right angles to the templates and so maintained during the subsequent concreting operations.

(c) For multiway duct installed to an existing structure, the lead-in duct outside of the structure shall be spaced and Concrete ST 2, with maximum 10mm aggregate, shall then be carefully placed to completely fill the interstices of the duct nest and to provide a minimum cover of 150mm on the top and sides of the duct. Steel reinforcement shall be supplied at the top.

(d) For new structures page 136 (1) applies.

(e) When at least 2 days have elapsed after placing the concrete, the front template shall be removed and the concrete examined.

Small voids shall be filled and rendered flush with the existing face providing they do not extend beyond two adjacent ducts or do not exceed 50mm in depth.

If larger voids than this exist, the concrete will be regarded as substandard and must be completely removed and replaced.

3) Lead-in Track.

(a) All lead-in sections between a building and the first chamber in the UofW network shall be gas tight and watertight, and irrespective of the number of ways, shall be laid in accordance with this specification, terminating with duct flush with the inside face of the jointing chamber.

(b) The spigot end of the duct shall be thoroughly cleaned. Compound No.21 shall be liberally applied to the full circumference of the outside 100mm length of the spigot. The spigot shall then be correctly fitted into the socket. Surplus adhesive shall be wiped around the spigot end to form a sealing fillet.

Note: When using Compound 21 care should be taken to ensure that working areas are adequately ventilated. Naked Flames should not be used under any circumstances, and No Smoking is allowed.

4) Pressure Testing of adhesive joined ducts. Pressure testing of the duct ways into UofW Buildings, and elsewhere if called for, shall be carried out in the following manner prior to concreting.

After the last joint has been completed in each way of the duct track (or section of the track where backfilling is carried out in stages), a pressure plug shall be inserted at each end and tightened, care being taken to avoid over tightening the pressure plug which could over stress the end of the duct.

Not less than 10 minutes after making any adhesive joint on a duct way to be placed under test, an air pressure of 275 millibars (4 p.s.i) shall then be applied to each duct under test. When a mechanical compressor is used for the pressure test, a suitable relief valve shall be fitted to ensure that 4 p.s.i is not exceeded. If, after 30 minutes a loss in pressure is recorded, the fault shall be located and any remaining pressure released from the duct. The leak shall be sealed. After a further 10 minutes the pressure shall be re-applied to check that a satisfactory repair has been effected.

Once it has been confirmed that the duct way is free from leaks, the pressure must be released and the pressure plugs removed. It should be noted that under no circumstances should any attempt be made to remove pressure plugs from a duct way that is under pressure. Where a lead-in is to be constructed and is to connect to existing starter ducts, the starter ducts shall be pressure tested prior to constructing the lead-in. The subsequent pressure testing of the lead-in will include re-pressurising the starter ducts.

5) Sealing. On completion of the cleaning and testing of the lead-in duct route and acceptance by UoFW, a rope shall be inserted and secured in each bore with sufficient surplus to enable future cabling operations.

The rope shall be attached to the Duct Seal Rope Anchor or the Plug Pressure Anchor Eye.

Under no circumstances shall a rope be fitted through a duct seal.

Each duct way shall then be sealed as specified in the Job Pack, in the following manner:-

ITEM	USE
Plug Pressure 1	Sealing uncabled Duct 54 for up to 30 days Sealing uncabled duct entries in Cabinets, permanently
Plug Pressure 3	Sealing uncabled Duct 56 for up to 30 days
Plug Duct 4B and 4C	Uncabled Duct 54 temporarily stopped with PVC cap to prevent ingress of debris.
Duct Seal 1A	Duct 54 uncabled Bores, or Duct 54 with one cable less than 40mm diameter, or two or more cables with a bundle diameter less than 40mm (this option also requires an Insert 1A)
Duct Seal 1B	Duct 54 with one cable greater than 40mm diameter, or two or more cables with a bundle diameter greater than 40mm. (this option also requires an Insert 1A)
Duct Seal 1C	Duct 56 uncabled Bore Or Duct 56 with one cable Or Duct 56 with two cables (this option also requires an Insert 1B)
RISE Duct Seal Kit	All Duct Lead-ins, usually where multiple cable entries make sealing difficult. To be used only when standard duct sealing as above is not possible.

6) Sealing of Conduits and Pipes. Unless otherwise required by a further specification or drawing, ducts, conduits and pipes into customers' premises, call offices, kiosks, cabinets, posts etc., shall be sealed at the end within the structure or customers' premises as follows: -

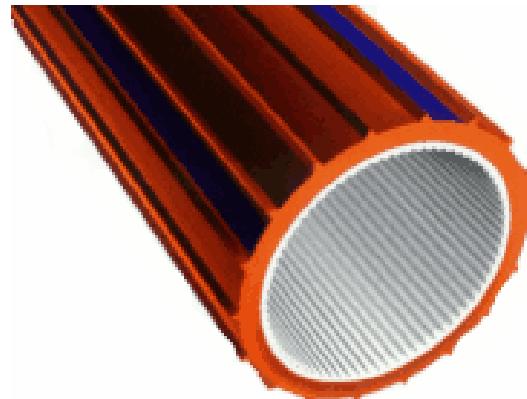
- The duct shall be sealed in a similar manner to that detailed in Page 144 (5).
- Where a cabled duct enters a cabinet Resin Pack 14 shall be used.
- Where an uncabled duct enters a cabinet, Plug Pressure 1, Plug Duct 4B or 4C or, Resin Pack 14 shall be used.
- Smaller conduits and pipes shall be sealed by pressing a clean rag into the aperture and facing off with a layer of Compound 16A. A 25 mm depth of rag and a 10mm depth of compound shall be used.

4.4.4.2.8 Sub Duct Specification.

Sub-ducts are used to divide existing main ducts and provide a continuous low friction path for cable placement.

Where sub ducts are specified they shall be of a type suitable for fibre optic cables and pre lubricated, from Emtelle, of ribbed type (both internal and external) to reduce pulling friction.

The exact sizes shall be defined in the individual project design document but in the absence of detailed information the standard shall be 32mm/27mm.



The manufacturer's instructions regarding installation shall be strictly adhered to.

Generally, all fibre cables shall be installed into sub ducts. Fibre optic cables can be installed into standard ducts only by written exception in the detailed design statement.

Fittings for sub ducts shall be from the same manufacturer.

4.4.4.2.9 Line of Duct Lay & Installation.

The line of duct lay shall be as direct as possible taking account of surface types and costs, and the position of other utility plant. It is essential that the contractor take cognisance of this when preparing proposals and documents.

All conduits shall be sloped properly so they will drain into the manhole and away from the building entrance. (When possible)

No more than 75m of duct shall be laid without an appropriately sized joint box

Ducts shall be laid with minimum bending and undulations but in any case shall not exceed 1 I in 30 horizontally and 1 in 60 vertically.



The newly installed duct route prior to handover shall be pulled through using a correct size mandrel & brush to remove any debris that may be present.

The size of the mandrel shall be 150mm and 12mm less in diameter than the inside diameter of the duct.

The diameter of the brush shall be 12mm greater than the inside diameter of the duct

A minimum of two ducts shall be laid during any construction.

When multiple ducts are installed in the same trench plastic duct separators shall be used.

A minimum separation of 150mm shall be maintained between telecommunications ducts and other services, for example water.



4.4.4.3 POLYETHYLENE CABLE LAYING.

4.4.4.3.1 Cable

1) Polyethylene Cable.



- (a) The cable will be supplied by UofW.
- (b) The drum shall be set up at static positions and the cable drawn off and laid into the trench. Alternatively, the drum may be set up on a mobile vehicle or trailer and the cable paid off along the trench. The method employed is dependent upon the circumstances, obstructions and access to the trench.
- (c) In rocky or stony soils, "Earth, Free From Stones", rammed to form a 50 mm layer both below and above the cable shall be provided as directed by UofW.

2) Mole ploughing. The Contractor may, with UofW's agreement, use UofW approved Mole ploughing equipment and techniques, in grass or unmade ground, dependent upon the nature of the sub-soil, position of other services, access to line of route and the depth at which the cable is laid.

3) Terminating Points. A sufficient length of cable for terminating purposes will be coiled, and the coil shall either be buried in the ground or fastened to a pole or wall, as directed by U OF W. In the latter case, the cable coil shall be fastened at a point above a length of steel or PVC Capping or Polyethylene Duct. Where Capping, Polyethylene Duct or cable is fixed to a wall, the wall shall be plugged to take the fixings.

4) Capping. Capping, in various lengths, together with Connector Bend 4 and associated fixings will be fitted by the Contractor in positions determined by UofW.

5) Joint Marker. A Marker Cable will be installed by the Contractor at each buried joint or terminating point, as directed by UofW.

4.4.4.3.2 SLEWING AND/OR LOWERING OR RAISING OF DUCT.

1) Excavation.

(a) The size of the excavation for slewing and/or lowering or raising a duct line shall be of a size only of that is practicable to carry out the work.

(b) Where lowering only is necessary the duct line shall be suspended and the required excavation taken out down the side and under the duct line. When this method is impracticable the duct line shall be slewed and raised or lowered temporarily for a distance that is just sufficient to allow access for carrying out the excavation.

(c) With the exception of making slight adjustments to the duct line after slewing and lowering, the duct line shall not be moved in any way without adequate reinforcement in the form of a strongback being firmly lashed on it.

2) Strongback.

(a) The strongback shall be lashed to the duct line, with both ends of each duct firmly held, using separate lashings or a continuous rope. The lashings shall be tightened, by driving wedges between the ducts and the strongback.

(b) Any forces that it is necessary to apply to the duct line to move it in any way shall be applied not directly to the duct line but to the strongback lashed to it. Such forces shall be applied at points whose spacing is sufficiently close to keep the bending of the duct line and strongback between the points to a negligible amount.

3) Suspension. When the duct line is to be lowered, the complete length shall be suspended from suitable beams or tripods and/or approved winching devices spanning the excavation. When the duct line is to be slewed whilst suspended in this way, the suspending ropes shall be fastened to sling poles resting on the supporting beams and running parallel to the duct line and strongback, and free to move across the beams.

All suspending ropes shall be so arranged that the duct line can be raised or lowered as required, smoothly and continuously, and can be tied off firmly at any stage.

4) Slewing Only. When the duct line is to be slewed only, it may be moved without suspending it, provided that:-

- (a) The surface across which the duct line is to be slid shall be reasonably level and regular, made so if necessary by setting boards in the surface.
- (b) For self-aligning duct, grooves shall be cut across the surface in positions to allow the socket of each duct to remain in a groove throughout its movement.
- (c) The strongback shall be firmly lashed to the side of the duct line.
- (d) The moving force shall be applied to the strongback by rope, jack or other method to allow the duct line to be moved smoothly and without jerking.
- (e) In the final position of the duct line the holes for the sockets of self-aligning duct shall be made large enough to allow access to the underside of each joint for the purpose of making the seal. Such holes shall be subsequently filled with cement mortar.

5) Movement. The slewing and/or lowering of the duct line shall be carried out by making a succession of very small movements of the duct line, each made progressively along the effected length.

The curvature of the duct line at any intermediate stage between the initial and final positions shall not exceed the deviation limits laid down for laying new duct of the same type.

Where no information is available a maximum deviation of 1:50 is permissible.

6) Trench Bottom. Prior to finally placing the duct, the trench bottom shall be prepared in the same way as is specified for duct laying.

The holes for self-aligning duct collars shall not be taken out until the duct line is sufficiently near its required position in order to ensure accurate location.

7) Irregularities. After the duct line has been finally lowered into its required position and the strongback has been removed, any slight irregularities in the general line of the ducts shall be corrected.

8) Pulled Joints. Where, following slewing and/or lowering or raising operations, a duct joint or joints have pulled apart, short lengths of ordinary or split duct may be inserted in the duct line and satisfactory joints effected.

9) Inspection. After all operations are completed, including the repair of the duct where necessary, the joints of all ducts shall be inspected to ensure that they are forming an effective seal. Any defects shall be made good.

10) Testing. All spare bores of the duct line shall be rodded and roped and/or cleaned and tested as specified for the particular duct concerned.

4.4.4.4 REPAIRING DUCTS.

All ducts shall be repaired using the appropriate UofW items listed below. Debris shall be removed from the effected area, ensuring that there are no sharp edges or burrs that may cause damage to in-situ cables or during future cabling operations.

TYPE OF DUCT	ITEMS TO BE USED	UofW ITEM CODE
Duct 56 Nominal bore 49mm	Duct 56 split, 3 metre lengths, and straps cabling fixing 10A.	095086
Self Aligning Duct (SAD) 11 Nominal bore 76mm (3 inch) NB. The repaired bore will be reduced to 67mm.	Duct Repair Kit No.2A Duct 59A split supplied in 3 metre lengths.	095089 095088
Duct 54, 54D & 55 Nominal Bore 90mm SAD 5, 6, 7, 8, 9 & 10. Duct 15, 16 Nominal Bore 92mm (35/8inch) NB. The repaired bore will be reduced to 82mm.	Duct Repair Kit 3A Duct 54D split, supplied in 3 metre lengths.	095051 095039
SAD 12 Duct 57 Both of nominal bore 102mm NB. The repaired bore will be reduced to 92mm.	Duct Repair Kit 4A Duct 57 split, supplied in 3 metre lengths.	095090 095087
Duct Bends	Duct Bend cut longitudinally on site Straps Cable Fixing 10A Strip Duct fitted longitudinally	As required 094979

When a duct repair is to be performed on SAD or Earthenware duct, the damaged duct must be cut back to a clean square edge or the spigot and socket ends, to enable the repair kit to be installed.

4.4.5 Duct sealing. (E)

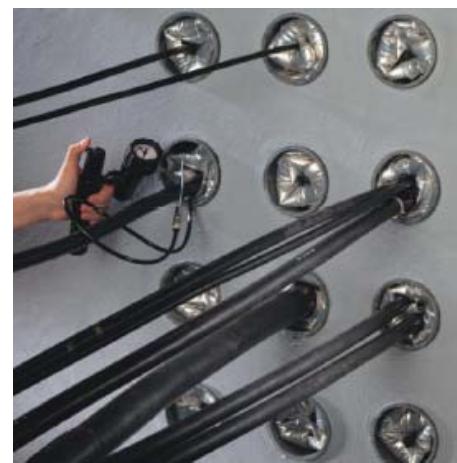
Note Reference 4.4.4.2.7.

Duct entries into structures of whatever construction shall be sealed to the building fabric immediately after construction to prevent the ingress of gas, fluids or vermin between building and duct.

Ducts into structures shall be sealed against the ingress of gas, fluids or vermin through the duct with a Hawk round transit duct gland of type HRT along with the correct fillers for all future cables to afford a gas tight seal



Where existing ducts with already installed cables are used it may not be possible to fit Hawke duct seals. In these instances Raychem TDUX sealing fittings shall be used



Where ducts are installed without any cable present they shall be sealed when entering structures as per the relevant section of this document.

Where ducts do not enter structures they shall be sealed as per instructions in this section.

Empty ducts shall be sealed using a correctly sized expanding plug seal.

A Schrader valve connected to a length of plastic tubing will be set into the foam seal. The tube will extend beyond the backstop of the seal.



Joints between duct lengths and/or bends on sections of duct between chamber and building entry shall be joined using solvent weld cement, or duct collars are to be fitted with a push type seal to achieve an airtight seal between each length of installed duct.

Tests shall be made on seals by pressurising the duct length to 275 millibar (4 psi) and leaving the duct under pressure for not less than 60 minutes. Seals that fail to maintain this pressure will be remade.

All tests are to be recorded & handed over on completion.

All unused ducts shall be sealed within chambers by using a temporary duct seal of the screw expansion type to prevent the ingress of water and gas.



All blank ducts exiting draw pits for future use shall have an expanding duct seal within the pit and an end cap external to the pit to prevent debris from damaging the duct

4.4.6 Reinstatement of the Highway.

New Roads & street Works Act 1991: Part III Refers.

4.4.6.1 GENERAL.

The Contractor shall execute the interim and permanent reinstatement in accordance with the provisions of The New Roads and Street Works Act 1991 and associated HAUC Specification for the Reinstatement of Openings in Highways.

In problematic locations where it is difficult to achieve a good reinstatement around carriageway covers (e.g. where the quality of the road is poor), liquid mastic asphalt may be used, with the prior approval of UoW and the Highway Authority.

To confirm quality of reinstatement, UoW may instruct the taking of core samples.

4.4.6.2 COMPACTION.

1) The periods of time between the placing of concrete and the commencement of backfilling shall be in accordance with Sections 4 and 5 of this Specification, and must be strictly followed.

2) All spaces outside the walls of jointing chambers shall be carefully filled in with granular material or concrete and compacted, care being taken to ensure that compaction does not disturb recently completed work.

3) All duct installed by open cut and cover methods and not laid in concrete shall be covered by a layer of "Earth Free From Stones", in accordance with Part 4, and compacted to a thickness of not less than 75mm.

4.4.6.3 FRAME and COVER SEALING.

Prior to reinstatement in a bituminous surface, the outside of any UofW Frames shall be cleaned of all loose material and primed with an approved edge sealant. Edge Sealant should not be used for Overbanding.

4.4.6.4 OBLIGATIONS.

Whatever method is used, the filling-in and restoration of Streets shall comply with the obligations imposed on UofW by the New Roads and Streets Works Act 1991 or in Northern Ireland by the Street Works Northern Ireland Order 1995.

4.4.7 Materials Stock Control.

The University of Warwick will make available a secure area for storage of appropriate levels of stock as seen below for use on this contract. This will be at client cost although responsibility for stock control, quality and continuity will remain with the contractor.

- JB 23 * 1
- JB 26 * 1
- J4 Frame & Cover * 3
- J6 Frame & Cover
- Duct D54 * 10 Lengths.

4.4.7.1 SPECIFICATIONS.

Where British Standards, or other specifications, are quoted these will be the current issues adopted by the British Standard Institution or other Authority. Where equivalent European standards, to those quoted, exist, then the European Standards must be adhered to insofar as they are deemed to apply.

All materials not otherwise specified shall be in accordance with the conditions above.

4.4.7.2 CEMENT.

1) All cement used shall comply with the requirements of the following;

- BS EN 197 Specification for Portland Cement
- BS4027 Specification for sulphate-resisting Portland cement.
- BS EN 450-1:2005+A1 Specification for Fly ash for concrete. Definition, specifications and conformity criteria.
- BS5838-1 Specification for dry packaged cementitious mixes. Prepacked concrete mixes.
- BS EN 998-2 Specification for mortar for masonry. Masonry mortar.
- BS EN 15167-1 & 2 Ground granulated blast furnace slag for use in concrete, mortar and grout. Definitions, specifications and conformity criteria

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- 2) The use of High Alumina (HA) cement shall not be permitted.
- 3) The contractor may employ rapid hardening Portland cement in lieu of ordinary Portland cement for his own convenience and acceleration of progress.
- 4) Cements of different types shall not be mixed one with another.
- 5) Where cement is kept on site it shall be stored according to BS EN 197.

4.4.7.3 REINFORCEMENT.

- 1) All reinforcement shall comply with the requirements of BS 4449 - Steel for Reinforcement of Concrete with the exception of plain round bar. For sizes up to and including 12mm in coil, plain round wire of Grade 25 MPa shall be to BS4482. BS EN10025-1 shall be used for larger sizes and dowel bar applications. BS EN 13877-3 is to be used for dowel bars for use in concrete pavements.
- 2) Unless otherwise specified all main reinforcement to be Type 2 with a specified characteristic strength of 500 N/mm². Secondary reinforcement to be plain round steel bars with a specified characteristic strength of 250 N/mm².
- 3) All reinforcement material supplied must be supported by test certificates, which certify compliance to BS 4449.
- 4) All reinforcement steel scheduling, bending and cutting shall comply with the requirements of BS 8666.

4.4.7.4 AGGREGATES.

All aggregates used shall comply with the requirements of BS EN 12620 - Aggregates for concrete.

Course aggregate shall be in accordance with the requirements of BS EN 12620 Table 2. Unless otherwise stated grading should be up to and including 20mm.

Fine aggregate shall be in accordance with the requirements of BS EN 12620 Table 4.

All aggregate supplied must be supported by supplier information as defined within sections 7, 8 & 9 of BS EN 12620.

4.4.7.5 ADDITIVES.

1) The use of additives in cement or concrete for works carried out exclusively under this Specification may only be employed in ready mixed concrete and guaranteed by the ready mix concrete supplier. Placing times must be adjusted to suit suppliers' recommendations.

Prior approval for the use of any additives in site mixed concrete must be obtained from the UoW Technical Approval Authority.

4.4.7.6 CONCRETE.

1) All concrete used shall comply with this specification and the requirements of:

- BS EN 206 - Part 1: Concrete. Specification, performance, production and conformity.
- BS 8500 - Concrete.

Where test results indicate that the concrete is non-compliant, the contractor may, at UoW's discretion, be instructed to remove all non-compliant material and to replace it with material of suitable quality according to this specification.

2) (a) Unless otherwise specified all concrete used for the construction of Concrete Jointing Chambers shall be ready mixed to mix grade C32/40 as defined in BS 8500 and BS EN 206.

(b) For footway and carriageway joint boxes, site mixed concrete will be permitted.

3) Where the use of site mixed concrete is specified for Joint box construction, as an allowed alternative to the preferred use of ready mix, it shall be of minimum grade C32/40. The minimum cement content shall be 380 kg/m³; the maximum aggregate size shall be 20mm; the maximum free water/cement ratio shall be 0.6 and slump limits shall be 50mm ± 25mm.

All site mixed concrete shall be mixed by machine.

Care must be taken prior to, during and after mixing to ensure that the concrete or mortar ingredients, collectively or separately, are not allowed to enter gullies or drains.

All highway surfaces footway or carriageway should be protected from concrete staining.

Sand and aggregate, shall be stored separately on site.

All other materials must be kept dry and free from any deleterious materials.

The standard of cleanliness of water for mixing is that it shall be fit for drinking.

Where a contractor intends to use site mixed concrete for the construction of carriageway and footway Joint boxes, an initial design Certificate of Compliance must be submitted to the UoW Technical Approval Authority.

This must be supported by strength Test Cube results, where the initial sample rate shall be 10 cubes tested at 28 days.

Thereafter the rate of sampling shall be distributed through the production in accordance with Table 13 of BS EN 206-1.

Each sample shall consist of 2 cubes tested at 28 days. Compliance requirements shall be in accordance with BS 8500: Part 2.

In addition to the sampling above, when required by UoW, 2 Test Cubes or Test Cores shall be taken by the contractor and, at UoW's discretion, shall be tested by a NAMAS approved testing authority.

All testing shall be carried out in accordance with BS 1881 and BS EN 12350 - Testing Concrete.

The contractor shall hold the Test Certificates for 12 months and make them available for audit or inspection by UoW.

Where the integrity of a structure is impaired due to non-compliant materials the structure shall, at UoW's discretion, be completely demolished and replaced.

4) Unless otherwise specified all concrete used for ancillary work shall be Grade 8/10 ready mixed to mix designation ST 2 as defined within Annex A of BS 8500: Part 1. Tables A.9 and A.17.

5) Concrete used as surround to duct apparatus shall be a minimum Grade 16/20, with a nominal maximum 10mm aggregate size, in accordance with BS EN 12620

4.4.7.7 BRICKS.

1) Bricks shall be in accordance with BS EN 771 & BS EN 772 - Clay Bricks.

2) Bricks shall be Class A or B Engineering Bricks in accordance with Table NA.6 of BS EN 771-1. They shall be type FL in accordance with Table NA.5 of BS EN 771-1.

3) Bricks shall be marked in accordance with ZA.3 of BS EN 771-1. The contractor must supply certification of compliance to UoW.

Bricks for the use of corbelling shall be Class A or B Engineering Bricks but without holes or frogs.
(HA-104)

4.4.7.8 MASONRY & MORTAR.

1) Unless otherwise specified materials and workmanship shall be in accordance with BS 5628 - Use of Masonry - Parts 1 and 3.

2) Mortar shall be as designated within BS 5628; Part 1,- Requirements for Mortar Table 1; Type (i)

3) Mortar for the use of placing or raising of frame and covers must be compliant with HA-104.

4.4.7.9 EARTH FREE FROM STONES.

Material surround to duct apparatus:

- 1) A material which must be graded, pass a 14.0mm sieve and otherwise comply with the requirements of Appendix A1 of the Specification for Reinstatements of Openings in Highways, a Code of Practice under sections 71 and 130 of The New Roads and Street Works Act 1991.
- 2) Coarse aggregates that meet the criteria for (1) above and mainly retained on a 5mm BS410 test sieve, and in accordance with BS EN 12620.
- 3) Materials in Page 155. (1) & (2), shall be capable of being thoroughly compacted around and between, ducts of any type. In either case the material shall not cause damage to the ducts during compaction and backfilling, and shall not leave voids or form a watercourse.

4.4.8 Safety Precautions.

UNDERGROUND DUCT LAYING AND ASSOCIATED WORKS

4.4.8.1 GENERAL.

(a) Ducts, pipes and cables existing in the ground shall not be diverted either by levering or otherwise. They shall not be allowed to rest upon, other than as a temporary means of support, or be incorporated into any UofW Structure or duct unless instructed to do so by a UofW representative. U OF W duct or cabling shall not be allowed to rest upon other existing duct, pipes and cables.

(b) Paraffin lamps shall not be used within the vicinity of any excavation or structure. Only Battery operated lamps are permissible in such circumstances.

(c) Smoking is not permitted as per the par above.

(d) Where it is proposed that LASER (Light Amplification by Simulated Emission of Radiation) equipment is to be used in connection with any work to this specification, UofW must be informed in advance of work commencing.

4.4.8.2 COMPOUND No 21 and METHYLATED SPIRITS.

When using or working with either of these materials, care should be taken to ensure that working areas are adequately ventilated. Naked flames should not be used under any circumstances, this to include smoking.

4.4.8.3 RESIN PACKS.

When mixing or using Resin Packs, the manufacturers instructions must be followed and

- Barrier cream should be applied to the hands and forearms if exposed.
- Disposable gloves shall be worn.
- After use, all soiled containers, waste and gloves are to be correctly disposed of.
- The Resin shall always be mixed in a well ventilated place.
- Safety Goggles and dust masks should be used during mixing of materials.

4.4.9 Re-Levelling of Frames & Covers in the Footway & Carriageway.

4.4.9.1 GENERAL.

- 1) This specification describes the methods to be used for re-levelling frames and covers in the footway and carriageway. The work shall include the re-bedding or extending of the chamber/shaft of up to two courses of engineering brickwork or the placement of slip bricks or tiles to achieve the correct surface level.
- 2) For types and weights of UofW Frames and Covers, footway and carriageway refer to Chapter 4.4.6 of this specification.

4.4.9.2 TESTING FOR GAS.

The contractor shall take all necessary steps to ensure that the jointing chamber is free from unsafe and flammable gases before commencing work. If gas is discovered then the cover is to be carefully replaced and no further work is to take place. The matter must be reported immediately to UofW Gas Reporting on 024 76 522083 (Security). If unobtainable, the matter shall be reported to Transco on 0800 111999. All other necessary and /or appropriate action shall be taken.

4.4.9.3 TESTING FOR WATER.

In the event of a waterlogged chamber needing to be pumped out, the Contractor shall carry out a water test prior to pumping - to ensure that the water has not become contaminated. Where pollutants or contaminants are found, appropriate action shall be taken to remove the water and/ or material in a careful, responsible and environmentally friendly manner. The material shall not, under any circumstances, be pumped into the public drainage system or waterways.

In testing and removing water in UofW chambers the Contractor shall adhere strictly to the Environment Agency's Pollution Prevention Guidance 20, ([PPG20](#)). The Authority is not authorised to carry out testing and pumping of water in chambers other than in accordance with this guidance.

4.4.9.4 INSPECTION OF FRAMES AND COVERS.

- a) If the existing frame and cover/s is not fit for re-levelling then they shall be replaced by the appropriate UoW standard item.
- b) Where a frame and cover/s is unsuitable and the replacement item is larger than the existing chamber (walls or shaft) refer to drawing CN 1750.
- c) If the original frame and cover is to be reused all covers must be marked so that when replaced they occupy the same position in the frame that they occupied before the removal.

4.4.9.5 RE-LEVELLING OF FRAMES AND COVERS - FOOTWAY.

- 1) An area around the existing frame shall be excavated to dimensions that will allow adequate space for materials and compaction tools used for the final reinstatement see Chapter 4.4 6 of this Specification. During excavation care shall be taken not to damage the chamber walls or shaft. The cover shall be removed and prepared for reuse if applicable.

Once the cover/s and cross piece/s are removed, the frame shall be removed from the chamber.

If the frame and covers are suitable for re-use it shall be prepared for reuse by removing all the old bedding material, debris and rust.

All existing bedding material shall be removed from the uppermost surfaces of the chamber (walls or shaft) to leave a clean dry surface.

All brickwork or concrete on which the frame is to be bedded must be sound and if necessary removed, re-bedded or re-pointed.

- 2) If the change in level is less than 50mm then either;

- a) A suitable bed of mortar shall be trowelled around the uppermost surface of the chamber (walls or shaft) and the frame tamped and bedded on the mortar so the frame is level with the surface.

All voids under the frame shall be filled with mortar and any excess mortar shall be neatly trowelled and struck off in line with the inside of the frame.

b) Bed the frame in position level with the final footway surface. All voids under the frame shall be filled with mortar and any excess mortar shall be neatly trowelled and struck off in line with the inside of the frame. Remove packing pieces and fully fill voids with mortar.

3) If the change in level is greater than 50mm, then suitable proprietary and purpose made packing material or dry bricks to increase the chamber (walls or shaft) height must be considered.

4) If the new level is less than the existing surface then a course/s of brick may have to be removed using non percussive methods.

If the chamber is of concrete construction non percussive methods must be adopted.

If any steel reinforcement is encountered then the exposed steel must be cut and treated with a suitable rust inhibitor.

Where there is a difference between the width of chamber wall i.e. 150mm concrete and 215mm brick, the entire width of the wall will require building up to the required level. When using bricks on thinner concrete walls the brick will require cutting with saw or chisel.

This may make it better placing a concrete ring beam instead of bricks.

The frame must not be bedded on a just a single course 102.5mm of brick unless the constructed chamber itself is single course i.e. JBF 102 or JBF 104 chambers.

The local UoW representative must be contacted with regards to what reduced levels are acceptable for both brick and concrete chambers.

In all eventualities the placing of the cover/s shall not take place until 12 hours have elapsed if cement mortar is used. If a rapid cure bedding material has been used, covers can be placed in accordance with the manufacturers recommendations.

On completion the cross piece/s shall be replaced and the cover/s shall fit firmly in the frame and not rock. If the covers rock corrective action is required to ensure the cover is free from debris and bedding material. A rocking cover is a safety hazard to pedestrians and will not be accepted by UoW

4.4.9.6 RE-LEVELLING OF FRAMES AND COVERS - CARRIAGEWAY.

1) Carriageway Bedding Material;

Bedding materials compliant with HA104 shall be used in conjunction with the manufacturers' recommendations.

2) Materials; Only approved materials shall be used.

a) Bricks and mortar as per Chapter 4.4.7 of this specification

b) Bedding materials compliant with HA 104.

3) Requirements.

If the original Frame and cover are to be re-used all covers shall be marked so that when replaced they occupy the same position within the frame as before their removal. The cover shall be removed and prepared for reuse if applicable by removing all the old bedding material, debris and surface corrosion.

An area around the existing frame shall be excavated to dimensions that will allow adequate space for materials and compaction tools used for the final reinstatement see Part 6 of this Specification.

During excavation care shall be taken not to damage the chamber walls or shaft.

All existing bedding material shall be removed from the uppermost surfaces of the chamber (walls or shaft) to leave a clean dry surface, a minimum 165mm below the carriageway level by cutting back or building up as described Chapter 4.4.9 of this specification.

The gap between the frame and chamber shall be typically 12 mm - 50 mm.

The finished surface must be free from debris and any deposits that are detrimental to the bedding material.

Where there is a difference between the width of chamber wall i.e. 150mm concrete and 215mm brick, the entire width of the wall will still require building up to the required level.

When using bricks on thinner concrete walls the brick will require cutting with saw or chisel.

This may make it better placing a concrete ring beam instead of bricks.

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If the new level is less than the existing surface then a course/s of brick or the required level of concrete may have to be removed using non percussive methods.

If any steel reinforcement is encountered then the exposed steel must be cut and treated with a suitable rust inhibitor.

If the covers rock corrective action is required to ensure the cover is free from debris and bedding material. A rocking cover will not be accepted by UofW.

Note: Cover Connecting Pins must be fitted prior to the installation of triangular covers.

4.4.9.10 SECURITY.

- 1) For CN Drawings refer to page 94 of this Specification.
- 2) To enhance security against the unauthorised entry of UofW chambers, when Lockable Frames and Covers are renewed, relevelled or replaced, the Frame shall be bedded on the shaft or chamber, with Bedding compliant with HA104.

4.4.9.11 REINSTATEMENT.

- 1) Where products compliant with HA 104 have been used, for levelling or re-levelling Frames and Covers, the reinstatement can commence in conjunction with the manufacturers recommendations.
- 2) Prior to reinstatement in a bituminous surface, the outside of the frame shall be primed with an approved edge sealant.
- 3) Reinstatement shall be in accordance with Chapter 4.4.6 of this Specification.

4.4.10 Tools, Plant & Equipment.

Unique UoW Articles Required by the Contractor.

The articles named in the following list may be required: -

Anchor Irons for Jointing Chambers.	Ducts, PVC, Steel and Polyethylene or other types as specified and associated fittings.
Bends, Duct.	Duct Seal 1A & 1B, 1C & Rise Seal.
Bolts, No. 37 and 38.	Frames and Covers for Jointing Chambers - all types.
Bolts, Foundation Indented (FI)	Gratings, Sump.
Boxes, Joint, No. 23 and 26.	Keys, Joint Box.
Brackets, CN 14051, CN 14071 or CN 14089.	Key, Lifting, for Manhole Covers.
Brackets, Joint Box.	Keys, Pillar/Cabinet.
Brushes Cylindrical for cleaning ducts.	Ladders, MS with Hooks and Bar.
Cabinets, Cross-Connection.	Markers, Cable No. 2.
Cabinets NGA.	Nails, Bonding.
Cable Brackets / Bearers / Pins Locking.	Posts, Marking.
Cable, Protected and Unprotected.	Plugs Duct 1A & 4B & 4C.
Capping, Steel or PVC.	Plugs Pressure 1 & 3.
Clips Binding.	Spacers, Duct, Nos. 2 and 3.
Collars, Duct.	Steps, Manhole.
Compound No. 14B.	Strips, Binding.
Compound No. 16A.	Tape, Plastic, Adhesive.
Compound No. 21.	Washers, No. 19.
Connectors, Bend.	
Couplings, all types.	
Draw Rope No. 1.	

4.5 Q&A and Handover Specification - Presentation of Information.

4.5.1 Overview.

The Supplier shall supply all Topographical Underground Services and as digital data in the following formats:

- Two-dimensional AutoCAD .dwg format files (suitable for R2000)
- MS Word files.
- Adobe PDF files.
- MS Excel files.
- Jpeg format photography.

4.5.2 Topographical and Underground Services Surveys.

All topographical and underground services surveys shall be processed using DWG Format Software. Survey Reports shall be prepared in Microsoft Word format and shall be supplied in Adobe PDF format.

In the case of Underground Services Surveys, all manholes and chambers surveyed shall be uniquely referenced and record cards shall be prepared.

Records shall be included in the Underground Services Report and manhole numbers shall be referenced within all relevant AutoCAD drawings.

4.5.3 Quality Audits.

Inspections of works being conducted and those completed will take place with agreed frequency to ensure the contract is being fulfilled correctly and to ensure full conformity.

There will be two elements to this process. The first will be self certification audits, conducted by a consistent, nominated contact from the contractor.

You are to issue a criteria based system for fulfilling this requirement, detailing methodology and corrective actions.

Please enclose an example of your own Quality Assurance records from a recent, relevant project.

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All contractors are to have a QMS audit trail and are to demonstrate this process.

Secondly, a nominated representative from the University will conduct audits and appraisal reports of selected tasks during and post completion.

The results of this will be shared and used to manage and monitor quality and are designed to assist the contractor with the effective management of their requirements to comply with this contract.

4.5.4 Extending/Updating Existing Survey Data.

Where existing survey information from previous software formats is required to be extended and/or updated, the Estates Office shall supply all available files for the Supplier to use.

The Supplier shall review his work and shall advise the Estates Office of any anomalies without delay and prior to issue of any deliverables.

4.5.5 AutoCAD Topographical and Underground Services Surveys

All AutoCAD Topographical Survey and Underground Services drawings shall be generated by exporting in 2D with colour by layer.

The exported drawing shall be inserted wholly in AutoCAD model space.

Drawings for each survey shall be issued in a single AutoCAD file in Model Space, with individual views defined for each separate sheet.

The final plan drawings shall be produced on standard sized sheets in paper space with text sized at a minimum height of 1.5mm when plotted at the appropriate scale.

Sections shall be fully annotated with the following minimum information:

- Ground Levels.
- Names of Features Crossed by Section.
- Ground Type.
- Descriptive Name.

Section alignments shall be referenced and annotated on plan drawings as appropriate.

4.5.6 Duct System Validation Forms.

Duct System Validation Forms.

Duct bank installation validations encompass the end to end of each duct installed.

Use the sample (found in Appendix 5) Duct System Validation Forms to assist in the validation of the completed duct.

The ducts must be verified to match the Start end to the Field end to prevent crossed ducts.

A validation of the installation of a duct bank run includes all items in the validation plan as well as any additional information the Site Manager wishes to include

4.5.7 Drawing Titles and Numbering.

Final plans shall contain a title box indicating the site name, date of survey, grid origin, level datum, any section scales and the identity of the Surveyor, Draughtsman, and Validator.

A sheet layout diagram shall be provided in the margin of each drawing where necessary.

4.5.8 Photography - Geo Tagging.

Digital photographs shall be supplied in jpeg format. All photograph locations shall be shown on SCC Models / AutoCAD dwg files.

Quality of digital photography should be min 10 million pixels.

You shall integrate all of the supplementary data, namely photographs and text files, to be displayed within the mapping deliverables.

Data that is collected on and around the campus is to be geographically shown by means of an active node, which will then be presented in its native program.

The supplementary data is required to be geo referenced to the mapping using co-ordinates; this data usually consists of latitude & longitude coordinates, & will also include altitude, bearing accuracy data & place names.

All mapping is to be related to the University of Warwick Grid Network.

The Supplier shall also provide @ no extra cost a licensed copy of suitable software programme to interpret the Geo-tagged Images.

4.5.9 Topographical Survey Reports.

The Survey Report shall be completed as follows:

- Site Reconnaissance - The Supplier shall detail in this section the findings of his site reconnaissance and shall include Dates, Environmental Safety and Issues.
- Dates of Survey - The Supplier shall detail the dates between which Fieldwork and Data-processing was undertaken together with the final completion date.
- Personnel - The Supplier shall complete the table indicating the initials of each person involved in the survey, his or her position and the activities undertaken.
- Grid System(s) & Orientation - The Supplier shall identify the Grid System used and shall state whether or not this is based upon existing survey control.
- E.g., Local Arbitrary Grid with North related to OSGB36 based upon previous survey control.
- National Grid OSGB36 on Airy Spheroid transformed from GPS observations using OSTM02 Local Scale Factor shall be specified to 9 decimal places.
- Local Grid Origin shall be identified by reference to a specific Survey Control Marker or National Grid Reference as appropriate. Formulae shall be inserted in this section defining the method of converting Local Grid Co-ordinates to National Grid and vice versa.
- Height Datum shall be identified as "Ordnance Datum Newlyn" and derived from either GPS Observations or spirit levelled from Ordnance Benchmarks, unless another local datum was used.
- Field Equipment used - The Supplier shall identify all optical and electronic surveying equipment used on the survey using the table provided.
- Accuracy Compliance - The Supplier shall prepare a summary of accuracy achieved and validation undertaken with reference to his Quality System.
- Traverse Observations and Processing - The Supplier shall provide an explanation of the Primary Traverses undertaken, the means of computation and adjustment and shall include a network diagram and network adjustment reports.
- Levelling Observations and Reductions - The Supplier shall provide an explanation of the levelling loops undertaken, the means of reduction and adjustment and shall include a network diagram and network adjustment reports.
- Survey Results - Schedules of Primary and Secondary Control Markers shall be prepared in National and Local Grid.

4.5.10 Underground Services Survey Reports.

Existing Service Records - Details of the service records made available for the survey shall be recorded:

- Dates of Survey - The Supplier shall detail the dates between which Fieldwork and Data-processing was undertaken together with the final completion date.
- Personnel - The Supplier shall complete the table indicating the initials of each person involved in the survey, his or her position and the activities undertaken.
- Field Equipment - The Supplier shall identify all equipment used for this survey including serial numbers.
- Accuracy Compliance - The Supplier shall prepare a summary of accuracies achieved and validation undertaken with reference to his Quality System.
- Survey Results - The Supplier shall report upon each of the services surveyed and shall comment on successes, problems, failures and any differences between record drawings and surveyed information. Any manhole records made during the survey shall be appended in this section of the report.
- Conclusion / Recommendations - The Supplier shall summarise any Conclusions and make any Recommendations in respect of his findings in the course of the survey, with reference to the Survey Results table.
- The Supplier shall ensure that footer details and the table of contents are updated prior to delivery of the report.

4.5.11 Duct Space Formula & Planning.

Appendix 5 shows an example of the formula & duct space planner layout required in any reports when tasked to investigate any duct capacity issues.

4.5.12 Delivery Method.

All deliverable data (Drawing & Reports) shall be transmitted by e-mail and issued on CD together with hard paper copies within 48 hours of Site Visits.

4.6 Codes of Practice & British Standards NR&SWA.

You shall be fully compliant as a very minimum with the following:

HSG 47 (Avoiding Danger from Underground Services)

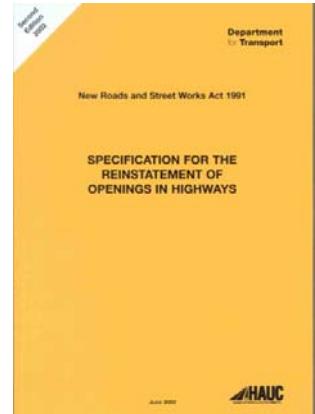


LN 550 Issue 9 Openreach ©

BS EN 124 - 1994

New Roads & Street Act 1991 Section 50 & 54 & 58) - Chapter 8 (2009)

HAUC



As there is no recognised UK wide industry best practice for Utility / Civils, you shall provide details & evidence of equipment used, training & development regime to include to what level Employees' are competent.

All access chambers and associated hardware shall conform to the BT Openreach LN550© Issue 9.

Standards and Publications where the majority of the content is required.

All are considered an essential source of reference for those involved in the installation of OSP into UoW facilities.

4.6.1 STANDARDS.

Detailed requirements and guidance relating to the installation planning and practices of outside cabling and plant by defining a planning strategy and guidance, design and installation rules for metallic and optical fibre cabling, requirements for satisfactory operation and the practices and procedures to be adopted to ensure that outside cabling and plant is installed in accordance with the specification, are contained in: BS EN 50174-3:2003

Specification for pit lids, correctly termed manhole tops, for installation within areas subjected to pedestrian and/or vehicular traffic, in terms of definitions, classes, materials, design and testing requirements, marking and quality control, are contained in BS EN 124:1994

Data security aspects applicable to external cable management systems are fully detailed in the Employers' requirements'.

Employers' approved routes are to follow the appropriate mandates detailed in ITS Facility Design Criteria and Installation of Equipment for the Processing of Classified Information.

All external cabling and plant used for the management of cables carrying University of Warwick data is to be implemented in accordance with the specifications contained within the above standards and publications.

Requirements associated with the installation of University of Warwick outside plant for which there are no extant International, European or British Standards are detailed below.

Listed below are Standards that are required as background information, all of which should be available within any engineering organisation

4.6.1.1 British Standard.

BS 410	Test Sieves.
BS 1881	Concrete Testing
BS 4027	Specification for Sulphate Resisting cement
BS 4449	Specification of Carbon Steel Bars for reinforcement of concrete
BS 5400	Steel, concrete and composite bridges
BS 5499-5:2002	Graphical symbols and signs ~ Safety signs; including fire safety signs ~ Signs with specific safety meanings.
BS 5628	Use of masonry
BS 5834-1:2009	Surface Boxes, guards & underground Chambers for the purposes of Utilities.
BS 5838	Dry Packaged Cementitious Mixes
BS 5954-2:1985	Dimensions of mechanical structures of the 482.6 mm (19 in) series. Specification for cabinets and pitches of rack structures
BS 5911-3:2002	Concrete pipes & ancillary products.
BS 6031	Code of Practice for Earth Works
BS 6089	Concrete Testing

BS 6164	Safety in Tunnelling in the construction industry
BS 7903:1997	Use of Gully tops & Manholes covers within the Highway.
BS 7083:1996	Guide to the accommodation and operating environment for Information Technology (IT) equipment.
BS 7671:2001	Requirements for Electrical Installations ~ IEE Wiring Regulations.
BS 8110	Structural use of concrete
BS 8500	Concrete. Complementary British Standard to BS EN 206-1.
BS 8666	Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete.
BS 8888:2002	Technical product documentation ~ Specification for defining, specifying and graphically representing products.

4.6.1.2 British Standard EN.

BS EN 124:1994	Gully tops and manhole tops for vehicular and pedestrian areas ~ Design requirements, type testing, marking, quality control
BS EN 197-4	Cement. Composition, specifications and conformity criteria for common cements.
BS EN 206	Concrete. Specification, performance, production and conformity.
BS EN 450	Part 1 - Fly ash for concrete. Definition, specifications and conformity criteria
BS EN 771	Specification for masonry units. Clay masonry units
BS EN 772	Methods of testing for masonry units.
BS EN 1052	Methods of test for masonry.
BS EN 12350	Testing Fresh Concrete.
BS EN 12390	Testing Hardened Concrete.
BS EN 12620	Aggregates for concrete
BS EN 13101:2002	Steps for underground man entry chambers ~ Requirements, marking, testing and evaluation of conformity.
BS EN 15167	Ground Granulated Blast Furnace Slag for use in Concrete, Mortar and Grout. Definitions, Specifications and Conformity criteria
BS EN 50173:2002	Information technology ~ Generic cabling systems ~ General requirements and office areas.
BS EN 50174:2001/2003	Information technology ~ Cabling installation ~ Outside Buildings.
BS EN 60529:1992	Degree of protection provided by enclosures (IP code)

4.6.1.3 SI.

SI 1989 No 635	Health And Safety ~ The Electricity at Work Regulations 1989
SI 1996 No 341	Health And Safety (Safety Signs and Signals) Regulations 1996.
SI 1998 No 2306	Health And Safety ~ The Provision and Use of Work Equipment Regulations 1998

4.6.1.4 LN.

LN 358C	British Telecommunication Specification for Frames & Covers. Footway 2,4,5,6,10 & 11
LN 550	Specification for Underground Duct laying & Associated Works.
LN 593	British Telecommunication Specification for Frames & Covers. Precinct

4.6.1.5 BS EN ISO.

BS EN ISO 128-20:2001	Technical drawings ~ General principals of presentation ~ Basic conventions for lines.
BS EN ISO 128-21:2001	Technical drawings ~ General principals of presentation ~ Preparation of lines by CAD systems.
BS EN ISO 128-23:1999	Technical drawings ~ General principals of presentation ~ Lines on construction drawings.
BS EN ISO 128-30:2001	Technical drawings ~ General principals of presentation ~ Basic conventions for views.
BS EN ISO 3098-0:1998	Technical product documentation ~ Lettering ~ General requirements.
BS EN ISO 3098-5:1998	Technical product documentation ~ Lettering ~ CAD lettering of the Latin alphabet, numerals and marks.
BS EN ISO 4157-2:1999	Construction drawings ~ Designation systems ~ Room names and numbers.
BS EN ISO 5455:1995	Technical drawings ~ Scales (BS 308-1.4:1995)
BS EN ISO 5457:1999	Technical product documentation ~ Sizes and layout of drawing sheets.
BS EN ISO 5468	Rotary and rotary impact masonry drill bits with hard metal tips. Dimensions
BS EN ISO 6433:1995	Technical drawings ~ Item references (BS 308-1.8:1995)
BS ISO 7200:1984	Technical drawings ~ Title blocks on drawing sheets.
BS EN ISO 7519:1997	Technical drawings ~ Construction drawings ~ General principals of presentation for general arrangement and assembly drawings.
BS ISO 7573:1983	Technical drawings ~ Item lists.
BS ISO 10007:2003	Quality Management Systems ~ Guidelines For Configuration Management.

4.6.1.6 EN 124 Standard Surface Covers.

Surface manhole covers installed in Europe should meet the requirements of the European Standard EN124: 1994.

Products designed to EN124 are grouped depending on their place of installation.

Load Classes



1. 15kN



2. 125kN



3. 250kN



4. 400kN



5. 600kN

1. Pedestrians only areas
2. Footways, pedestrianised areas, car parks
3. Kerbside channels
4. Roads, carrying fast moving, heavy vehicles
5. Very heavy wheel loads as found on construction sites, mining and industrial areas

This table demonstrates that B125 covers of BS EN 124 are suitable for use in any area subject to slow moving vehicle traffic including HGV's.

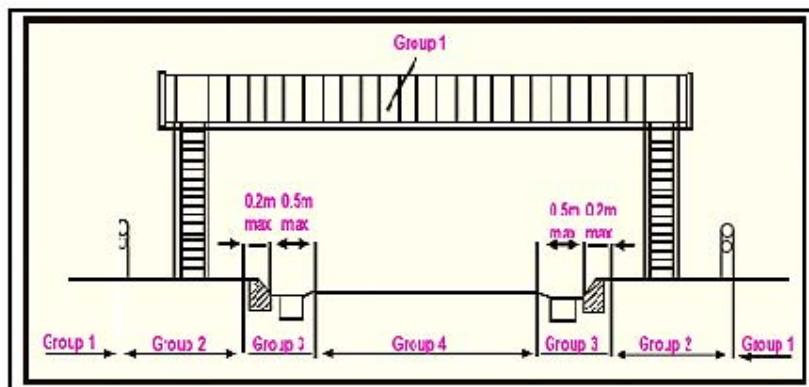
Maximum European gross vehicle weight	44.000 tonnes
Maximum gross axle weight	11.500 tonnes

Maximum wheel load - assuming single wheel per axle	5.750 tonnes
+ 10% for overloaded vehicle	+ 0.575
+ 15% for slow moving wheel load	+ 0.949
+ 60% for margin of safety	+ 4.364
Total slow moving wheel load	11.638 tonnes

Test load of B125 covers	12.500 tonne
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BS EN 124:1994.

BS EN124:1994 CLASSIFICATION



GROUP 1

Class A15

Access covers and gratings capable of withstanding a 1.5 tonne test load. For use in areas where only pedestrians have access.

GROUP 2

Class B125

Access covers and gratings capable of withstanding a 12.5 tonne test load. For use in car parks and pedestrian areas where occasional vehicular access is likely.

GROUP 3

Class C250

Gully gratings capable of withstanding a 25 tonne test load. For use in areas which do not extend more than 500mm from the kerb face onto the carriageway.

GROUP 4

Class D400

Access covers and gratings capable of withstanding a 40 tonne test load. For use in areas where cars and lorries have access, including carriageways, hard shoulders and pedestrian areas. All units either non-rock or silent operation.

Class E600

Access covers and gratings capable of withstanding a 60 tonne test load. For use in areas where heavy wheel loads are imposed such as loading areas, docks or aircraft pavements.

Class F900

Access covers and gratings capable of withstanding a 90 tonne test load. For use in areas where very heavy wheel loads are imposed such as aircraft pavements.

APPENDIX 1. MANHOLE - CHAMBER SPECIFICATION OVERVIEW.

University of Warwick

Manhole Specification

2 / The site and

Results from the E



Screenshot of Microsoft Excel Document (in PDF format)