Module 6 - Cable Pulling and Installation

This module looks at the techniques required to install the cable as well as safety precautions to take during preparation.

- **Preparation**
- **Cable "Pulling"**
- **Bend Radii**
- **Cable Ties**
- **Containment**
- **Separation and Segregation**

Preparation

1. Ensure the cable being installed meets the specification laid out in the contract, including Category, Screening and CPR Rating.
2. Pick out the location to start the ‘pull’ and protect with the use of barriers.
3. Secure the cable boxes or reels securely to ensure they don’t move during ‘pulling’.
4. Keep the amount of excess cable pulled from the box before cutting to less than 1m.



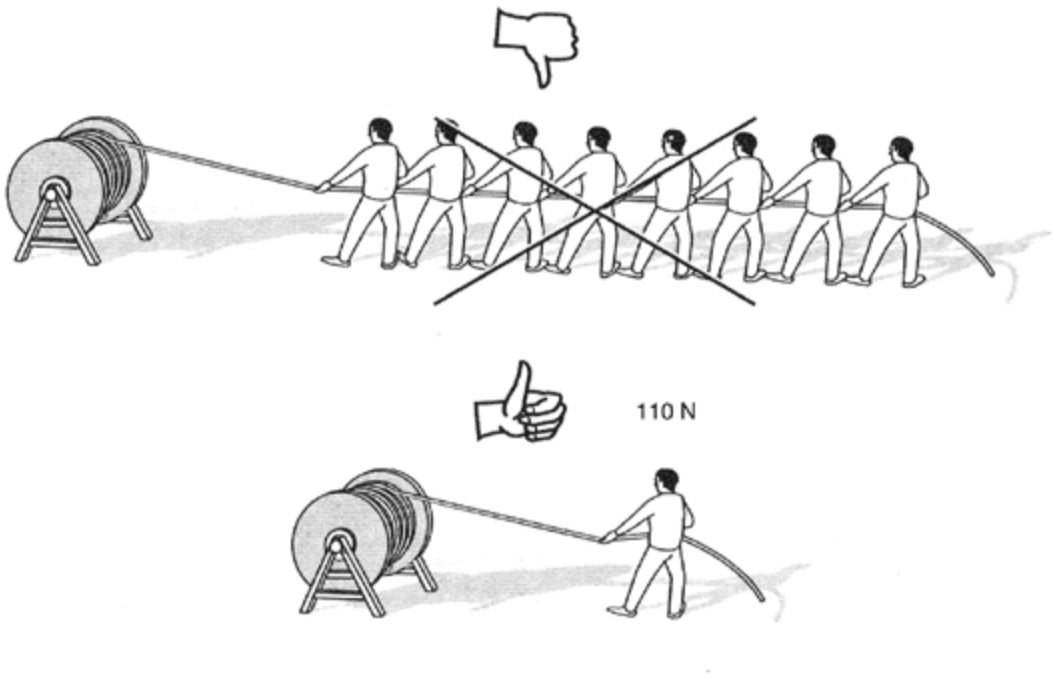
This is an example of how this can be achieved with boards and straps. One person could build this 12 box stack within 10 minutes.

Technical Note: Category 6A U/FTP in a Box - Set up Rig

A technical note is available on the Excel Networking website that outlines how the specific rig to hold all the 12 boxes in place is constructed.

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It should really be described as installing cable rather than pulling, but the term has been adopted, due to the action of pulling cable from a box. Excessive pulling on a cable can actually impact the performance of the cable. It is also important to understand that pulling out excessive amounts of cable from the box and then pushing it back can lead to snagging within the box causing problems going forward.



Avoid over-stressing the cable

If set up correctly it should only take one person to pull the cable off the drum and pass it to the next engineer and so on.

The bottom image shows the correct method however, it can be argued that pulling from the bottom of a drum is more efficient as it is less likely that the drum will 'overrun'.

For safety purposes, if the drum were to fall off the stand during pulling it would roll towards the engineer, whereas when pulling from the bottom it would roll away.

Cable "Pulling"

The engineer has a direct impact on two test values:

1. How the cables is installed is reflected in the Return Loss value
2. How the cable is terminated is reflected in the NEXT value



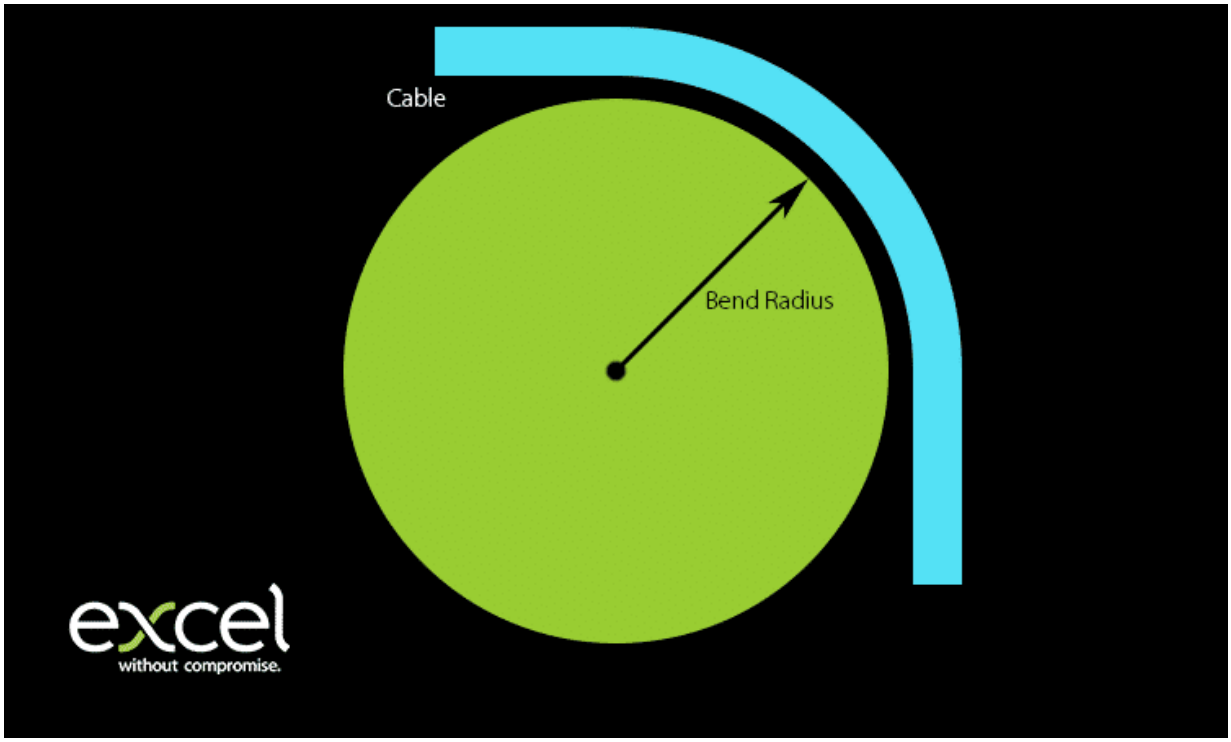
Cardboard packaging removed either from an old box or a reel sleeve provide the ideal ‘friction barrier’ allowing the cable to slip smoothly over the edge of a tray or basket.

The tell-tale sign that a cable has been installed incorrectly over rough edges is the white scratch marks that appear on the sheath of the cable.

Cable "Pulling": Key Factors

- Cable pulling is directly reflected in the test results
- Many hands make light work
- It is never a ‘one man’ job
- The cable should be ‘passed and laid’ rather than pulled
- Protect all sharp edges using off-cuts from the packaging as temporary waterfalls and as protection around bends

Bend Radii



Pulling a cable around too tight a bend can lead to the geometry of the 4 pairs being permanently altered, thus reducing the performance of a cable and directly impacting the Return Loss value.

Pulling a cable over a tight edge from a box can also cause the gentle twist in the cable to be imparted during packaging, creating a concentrated tight twist between the containment and the box.

For Copper Cables, 8 times the outer diameter during installation, 4 times the outer diameter when installed

(under tension and relaxed)

Ie. A cable with an outer diameter of 6mm will have 48mm bend radii when installing and 24mm when installed

Cable Ties

Hook and Loop Cable Ties

Hook and Loop cable ties are a cost effective solution with far more advantages than traditional nylon cable ties:

- environmentally friendly
- re-usable for unlimited uses
- provide cables and wires with a secure hold
- made from flexible material
- no risk of over tightening and damaging cables
- no tools required to remove them



Nylon Cable Ties

Below are just a few of the disadvantages of using **nylon cable ties**:

- single use plastic
- non re-usable
- high risk of over tightening and damaging cables
- tools are required to remove them
- most common cause of Localised Impedance

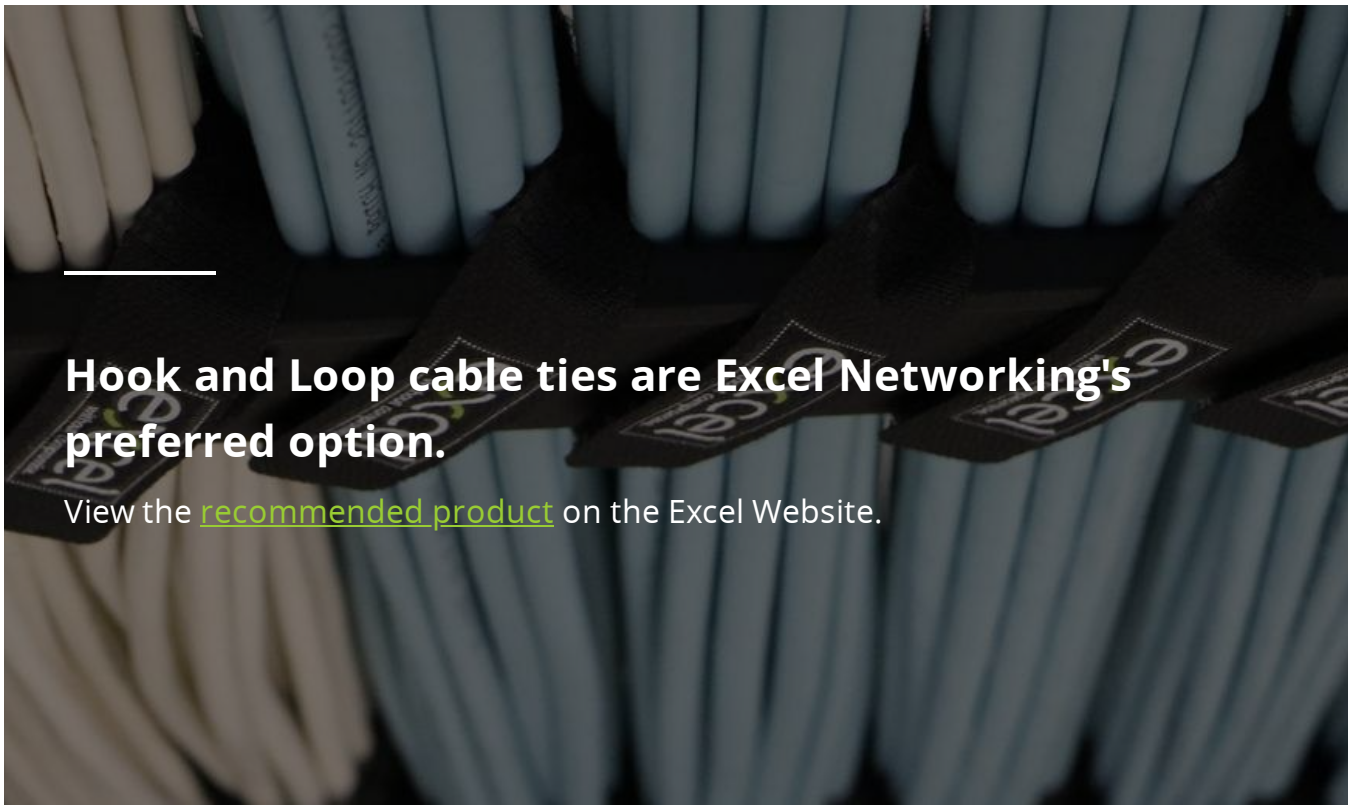
NOTE: *Nylon cable ties can be used as a temporary measure during the installation - just remember to change them before final handover.*



Metal Cable Ties

Vertical riser and high-level cables below basket require **metal cable ties** at regular intervals. Some regulations - especially in the UK - will dictate this approach.





Hook and Loop cable ties are Excel Networking's preferred option.

View the recommended product on the Excel Website.

Many consultants and end users are insisting on the use of **Hook and Loop style cable ties**, so be sure to check the specification and contract to avoid a costly replacement exercise towards the end of the project.

While neatly combed bundles of cables might look really nice in exposed overhead cable trays and in racks and cabinets, this aesthetically pleasing deployment isn't always a thing of beauty when it comes to performance.

Problems with **Localised Impedance** can appear even worse with an unscreened Category 6A solution, impacting the Alien Crosstalk values.

Overtightened nylon cable ties can lead to poor Return Loss Values and reflections that can amplify poor terminations and NEXT values.



A few examples of Excel's Hook and Loop cable ties from our Demonstration Facilities in Birmingham HQ.



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Please note that the use of nylon cable ties in the above image were by other trades and subsequently replaced before handover.

The current UK wiring Regulations stipulate that cables should be supported in a manner to prevent premature collapse in the case of a fire, therefore it precludes the use of non-metallic cable fixings for cable not supported by or in containment, therefore the suggestion for vertical sections and cables installed on inverted cable tray is to install with cable ties every 300mm with an additional metal tie over every third one.

Containment

Containment: Key Factors

- Must be fit for purpose
- Must be an adequate size for the amount of cable that will be installed
- Must be able to support the predicted weight
- Must be free from burrs, sharp edges or projections
- Must be suitable for the environment it is being installed into
- Must allow for the maximum stack height of cables - 150mm



Any pathway system chosen must also take into consideration the impact of the environment into which it is being installed.

In the standards, EN50173 -1 & ISO 11801 – 1, this is covered in the M.I.C.E. classification:

Mechanical

Ingress

Climatic & **C**hemical

Environmental

Expand each element of the accordion below to find out more detail about the various types of cable containment:

Solid Tray Containment

- Sometimes called a ‘Cable Trough’
- Optional lids available - provides the maximum Electromagnetic Interference (EMI) protection when fitted with lid
- Most costly option and requires careful cutting
- Only offers limited ventilation for PoE enabled cables
- Whilst it is referred to as "Solid Tray", it will still allow the ingress of liquids. It is **not** a solid conduit in relation to running external cables within a building.

BS EN 50174-2 states that "***any external cable must be terminated within 2m of entering the building, either to a patch panel or a transition point to an internal cable.***" The only exception to this rule is if that cable is run in solid sealed conduit - however solid tray containment does not qualify.



Perforated Tray Containment

- Provides maximum support
- Provides a medium-level of EMI protection
- Medium cost and requires careful cutting and preparation
- Provides a level of ventilation for PoE enabled cables
- The second most common form of containment seen in modern installations
- Performs exceedingly well and provides maximum support, however if there are any leaks from pipes above the perforations allow any liquids to drain away.



Ladder Rack Containment

- Mainly seen in Data Centre applications
- Extremely strong for large density of cables
- Provide no protection against EMI
- Optimal ventilation for PoE
- Tends to be a costly option
- Typically a system may comprise of many complex parts, such as special bends, side supports and waterfalls. This will normally take a special design and can be either suspended from the ceiling or by way of special brackets that mount on the top of the racks.



Wire Mesh Basket Tray Containment

- The most common solution found in commercial/enterprise applications
- Does not require a complex list of special bends and T-pieces
- Simply cut wires and shape lengths to form bends and waterfalls etc.
- Minimal/No protection against EMI
- Optimal ventilation for PoE
- There are a number of options regarding the wire spacing lengthwise, with the most common being 100mm

BS EN 50174 has changed the requirements regarding 'stack height'. On flat and perforated tray it is still 150mm, however in 2018 for wire mesh with 100mm spacing it has been reduced from 140mm to 125mm due to the thermal impact of PoE potentially 'softening' the cable insulation and making the impact of the wires more of a factor.



Loose Lay on Floor Slab

It is acceptable for cables to be laid directly on to the floor slab. If this approach is used:

- Concrete floor must be fully dry and sealed
- Cable matting shall be used on the routes
- Bundles at the edge to ensure they remain on the cable matting*
- All corners and transition points are bundled** to maintain correct bend radii

* The function of cable matting is to provide a moisture barrier. It is **not** to cushion the cable against the floor.

** Bundling at corners and transition points is essential. The latter includes small bundles of cables leading to floor boxes and GOP (Grid Outlet Point) boxes

Some consultants may insist on random bundles on the cable matting and this is totally within their rights.



Solid Conduit Containment

- Can be metal or plastic*
- Metal can be used to transition external cables within building
- Metal provides the ultimate protection against EMI
- Provides no ventilation however usually only contains 1-2 cables
- Key issues regarding bend radii if not designed correctly
- Sometimes special lubricants will be required to pull the cable through

* Regardless of whether plastic or metal they must be de-burred after cutting to remove sharp edges.

NOTE: do not rely on T-Pieces as they do not meet the bend radii requirements for the cable, you must use specific manufactured bends.



Flexible Conduit Containment

- Available in steel, plastic coated steel and plastic

- The most common for data applications is plastic
- Typically used as flexible leads to GOP Boxes (Grid Outlet Points)
- **Be careful!!!** They are quoted on their OD, the Internal Diameter (ID) is much less!*

* The key factor is they are sold on the basis of their OD to calculate how many cables will fit you need to use their ID. For example, 25mm flexible conduit has an internal diameter of 18mm. Grommets and Glands can reduce this even further.



Plastic and Dado Trunking

- Common in schools and hospitals without raised floors
- With 3 compartment dado trunking the centre section is used for power
- Advisable to use top section for data
- Care is required to ensure the bend radii is maintained

Part 1 of EN 50174 states, "*the design of the termination points SHALL:*

- Allow safe access
- Ensure link performance, keep MBR (minimum bend radius)

- Have adequate clearance to install components in accordance with cable manufacturer's instructions.
- A back box chart is provided within the Excel Installation Guidelines



Excel Containment Sizing Calculator

Containment sizes may be calculated based on the: dimensions of the containment, diameter of the cable and fill ratios. Our simple spreadsheet configurator will help to guide you with regards to calculating your containment sizing requirements.

VIEW NOW

Some of the key things to bear in mind when considering your cable containment include:

- Ensure the capacity is correct - a minimum of 50% spare capacity for future expansion

- Ensure the containment satisfies the EMI requirements
- Ensure all solid conduit is fully deburred and gland used as required
- If the drop from the pathway is more than 500mm from the top of the cabinet, a section of vertical tray should be installed to support the cables
- Waterfalls should be used for all drops from basket and tray



Separation and Segregation

There is nothing in any of the standards that calls for a separate pathway for each service.

It is good practice for each one to have their own containment.

If pathways are shared it is vitally important that each service is bundled and labelled and occupies its own route on the pathway.

Power and Data MUST be separated for performance reasons. This is best achieved by separate pathways.

The containment calculator provides a tab that allows you to calculate the distance required.

The distance of separation can be reduced by the use of metal dividers in the pathway.

Clear labelling of pathways and services is vital for ongoing maintenance of the systems.