



## **Handling and Installation Guide for Generic and Copper Cables Marine & Offshore Division**

*High Performance Cables Since 1913*



KNOWLEDGE  
RANGE  
EXPERIENCE

**Important notice:**

The information contained in this document has been carefully checked and is assumed to be entirely correct and reliable at the time of release. However, there no guarantees are made or implied herein and NEK Kabel AS will not accept responsibility for decisions made based on the use of this document.

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Further without cost to NEK Kabel AS, the user of our products is expected to take all necessary precautions to protect the public and minimize the disturbance and inconvenience to the public and the cable installer shall comply with all Governmental regulations as to the placing of traffic signals, flares, barricades, flags and other warning signs during the performance of the work, including transportation of cables in populated areas.

The cable installer is also recommended to take cognizance of all environmental issues and comply with laws, by-laws, rules and regulations related to the environment. This shall include but not be limited to avoiding unnecessary felling or damaging of trees, emission of noise & fumes, dust control, proper discharge of effluents, and proper handling of waste and toxic substances in the course of transporting, handling and installing fiber cables.

## Purpose & Scope

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The purpose of this document is to provide general guidelines for transportation, handling & storage as well as installation of copper cables, and applies to all types of copper cables manufacture by NEK Kabel AS.

Because it is impractical to cover all potential situations in the field and warehouse this document is not intended to be an exhaustive description of copper cable transportation, handling or storage techniques. Rather, this document is intended to highlight the main concepts that are important to prevent transportation, handling & storage related cable damage and/or degradation of copper cable performance. This document is not intended to supersede local practices, codes, laws or regulations.

As an additional preventive measure, NEK Kabel AS strongly recommends that the end user contact NEK Kabel AS with any cable transportation, handling & storage related questions, if any.

## Recommendations

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Always install cables with some foresight and care, in such a way as to secure cable performance for future applications.

- Never kink the cable
- Never exceed recommended bend radius, during or after installation
- Do not exceed recommended tensile loads.
- Do not crush the cable; avoid impacts to the cable.
- Copper cables should not rest against sharp edges, and must be “swept” around corners.
- Monitor tensile during pulls, avoid pulling long lengths in one direction.
- Plan on installing extra cable protection in high risk areas.
- Do not exceed maximum vertical rise.
- Secure cables in all installations
- Plan all cable routes before beginning, making sure the cable will not be exposed to hazard.
- Comply with all regulatory requirements and fire codes.
- Do contact NEK Kabel staff or its representative in case of doubts on both cable and installation issues.

## Planning

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Before you start, prepare to start.

- Have you got the cabling system design mapped onto the layout of the space?
- Do you have the correct materials ordered against the Bill Of Materials estimated to complete the project?
- Has the fire stop solution been approved?
- Are the deliveries scheduled to match the installation plan?
- Are there any site inductions required? If so, when are these held?
- Is the area to be handed over to you for your installation? If so, in what condition? Will you be required to run a 'Permit to Work' scheme for you and other trades?
- Is there a clean, dry, secure storage area allocated for your materials?
- Are there any special precautions to observe for site Health and Safety?
- Do you have a change control process and reporting scheme?
- Do you need to notify the site with the names or identification for your staff?
- Is the labelling method, scheme, style, colour agreed and approved by the client?
- Is the test equipment serviceable and to specification?
- Is there a headroom performance requirement from the tested cabling?
- Do you have access to power outlets for testers, laptops etc?

On site

- Is the containment installed in the correct place and to the right specification?
- Are you holding daily briefings for the site operatives?
- Is there any temporary fire stopping required during the installation phase?
- Is there any difference between the reality of the site and the plans?
- Are there any access restrictions or other trades working in the same areas at the same time?
- Is the earthing and electrical system installed?
- Is there restriction on the use of mobile phones or walkie-talkies?

## Site Environment Classification

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The environments where cabling is to be installed are classified to cover the different conditions under which the cabling is required to operate. Conditions which may affect the cabling performance are used to determine the applicable environmental classification. Use the environmental classification to select the components. The same classification is used to determine the appropriate containment and installation techniques.

The considerations for:

- Mechanical rating include shock/bump, vibration, crush, impact, bending, flexing and torsion
- Ingress rating include particulate ingress, immersion
- Climatic and Chemical rating include humidity, rate of change of temperature, solar radiation, damaging chemical concentration
- Electromagnetic rating include electrostatic discharge, conducted radio frequency, magnetic field

## Containment and Cable Routing

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### Power and Data Separation

Local and national safety regulations may require different separation or segregation distances. Separation and segregation for safety must take precedence over all other requirements.

Essentially there are two ways of mitigating the effects of noise disturbing the transmission of data in a copper twisted pair cable; one way is to separate by distance the twisted pair cabling from the noise source, using air to attenuate any noise; the other way is to provide a barrier between the noise source and the twisted pair cabling using a grounded barrier to attenuate the noise.

The factors to consider are:

- Environment
- Type of containment
- Performance of cable type
- Application being supported
- Construction of power cable
- Scale of power source
- Proximity to the power cable

## Heating Effects

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Energy losses from within cabling will be translated into generation of heat. There are many factors which accumulate to create this effect. The installer needs to be aware that the temperature rise in the cabling at these points can be in the order of 10°C or higher when all of these factors come together. The temperature rise created is greatest where:

- the cabling is managed into large bundles
- and/or there are a large number of simultaneous users
- and/or cabling is run into constricted spaces such as at wall penetrations
- and/or the cabling is required to support higher energy applications / PoE applications.
- The energy loss due to heating effects is different for Screened and Unscreened cable.

All the performance criteria for the 100m Channel as outlined in EN 50173-2 is based upon it operating at an ambient temperature of 20°C and for every degree over this level this distance will be reduced. The following formula provided in the above standard gives the rate of reduction for unscreened cables, in short for temperature increases up to 20°C above the ambient the Channel should be reduced by 0.4% and for temperatures increased over 40°C above the ambient there is an additional 0.6% that has to be added.

### Unscreened

$$L_{t>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004)$$

$$L_{t>40^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004 + (T-40) \times 0.006)$$

This could potentially have a dramatic effect to the performance of installed cabling as recent research shows that the level of heating can be significant in some cases 30-40°C above the ambient.

Screened Cabling performs much better, as the research has proved it does not heat up as much as an unscreened cable and when it does the de-rating formula is much simpler as it is based upon 0.2%.

### Screened

$$L_{t>20^{\circ}\text{C}} = L / (1 + (T-20) * 0,002)$$

L = Length T = Temperature

These heating effects can be mitigated by:

- reducing the bundle size
- loosening the bundle ties at points of constriction
- distributing the high energy use across different cable bundles

## Cable Installation

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From the cabling system design and area plans, make a cable pulling schedule. Map the pulling schedule onto the area plans.

- Identify the labels and cable ID so that temporary labelling can be applied.
- It may be faster, cheaper and more accurate to print two sets of the final cable labels, using one set for installation purposes and then replacing them after testing is completed. This will avoid unsightly 'Pen Marks' on the cable.
- Ensure that for each group of finished labels they are aligned and attached so they are readable from the same direction.
- If the installation is a mixture of copper and fibre optic cabling install the copper cabling first.
- Plan the occupation of cabling in the containment and along the route so that crossovers are eliminated and entry points into and exits from the containment are not congested.
- In any cable run where the cable is to be pulled the run should contain no more than two 90 degrees bends. If more than two 90 degrees bends are required or the sum of all angles is greater than 180 degrees then there must be more pull points along the cable run where the cable is able to be managed in and out of the containment.
- Respect the installation bend radius of the cable. Never exceed the recommended maximum pulling load of the cables.
- Determine the pulling in points which will cause damage to the cable, through sharp edges or bends tighter than the installation bend radius.
- Apply any protection to the containment where damage to the cable sheath may occur. Consider using cable installation aids.
- Bundle size should be kept to a minimum.
- Maximum bundle size is 24 for 4 pair twisted copper cables.
- Smaller bundles make better use of limited containment space.
- With mixed length cables in a cable run always pull in the longest length cables first.
- Secure the stack of cable boxes or reels using a pulling frame or cable stands to hold the packaging in place.
- Pulling force must be respected. Maximum pull force for a single, or bundle of cables, is 110 N (25 lbf).
- Avoid any cable kinks and maintain proper bend radius control during cabling pulling. If any kinks should occur, kinked cable should be removed and replaced.
- For safety, only use cable jacks and pulling frames which are designed for and fit for purpose.
- Always control the rate at which cables are pulled off the drum.
- Take great care over the management of cable drum.
- Hook and eye cable fixings are preferred.
- If nylon type zip ties are used, ensure excess is cut flush, to avoid the creation of sharp and dangerous edges.
- Do not over tighten.
- No deformation, marking or compression of cable jacket is allowed.
- Acclimatise the cables to the location where they are to be installed, minimum 2 hours.
- Refer to the specification sheet for the installation and operating temperature ranges for the cables being installed.

- Do not install copper cabling or optical fibre cabling with a metallic strength member outdoors when there is a thunder or lightening storm about.
- Only use approved lubricants and pulling gels for the cable type being installed.
- For external installations seal the ends of all cables with a water tight product before installation. When installing cable at high level the additional requirements are as follows:
  - Protect the edges of the basket or tray before starting to install the cable to ensure no damage is caused.
  - Ensure that the edges of the tray or basket have a bend radius that exceeds the installation Bend Radius of the cable concerned, this may be achieved by artificially increasing the dimension by the use of temporary packing material
  - If bundles of cable are being routed from tray at high level to enter a cabinet from the top, some form of 'waterfall' must be used to ensure the bend radius of the cable is not compromised. This can be simply and cost effectively achieved by the use of a section of split flexible plastic conduit installed along the edge involved. The following image gives an example.



When installing cable at high level ensure that sufficient engineers are available to carry out the work, it is recommended that cables are 'passed' from one engineer to the next rather than trying to drag them over the tray.



## Earthing, Grounding and Bonding

Unless you are a qualified and competent electrical person leave the connection of the earthing wire onto the electrical system to the electrical trade.

The following information is for guidance purposes, Grounding and bonding of all systems should be carried out in accordance with EN50174-2, EN50310 standards.

The best type of earthing conductor used to provide a signal earth connection is a flat braided strap. Flat is best because it offers a greater surface area and braided straps because impedance is affected by length and braid offers many different routes and therefore lengths of conductor for the unwanted signals to flow along. If you use a solid core conductor to provide an earth strap you can improve this by adding a second, different length, earth conductor to reduce the possibility of an impedance issue resisting the passage of the unwanted signals.

Do not coil an earthing conductor around a screwdriver to make it look neat and tidy, you are forming a coil which can restrict the transmission of signals.

It is best practice to connect the earth stud in a cabinet onto a separate earthing bar located in the cabinet. It is recommended that the bar is provided with four or more attachment points for equipment earths to be connected onto. This is because if all of the equipment earths are run back to the earth stud then for safety reasons the electrical supply must be disconnected every time a new piece of equipment is added or removed from the cabinet.

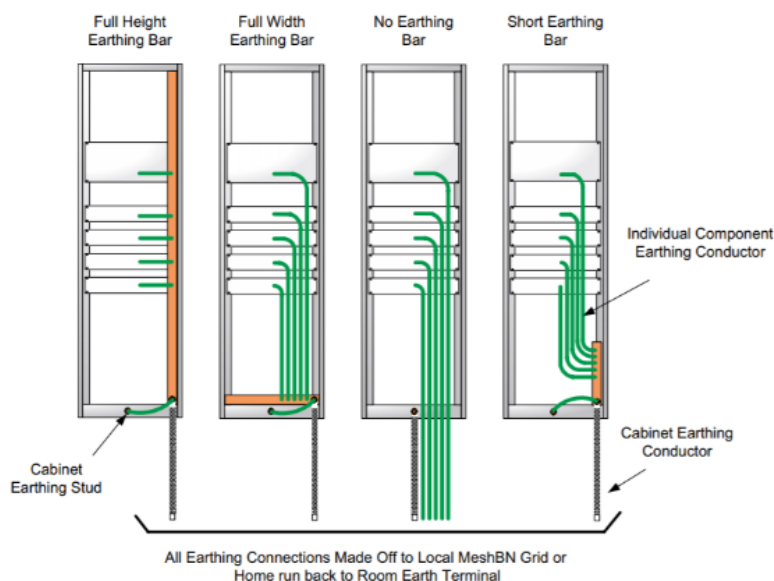
When installing a piece of equipment which requires a signal earth, always install the equipment, then attach the earth connection, then connect up the power.

ESD (Electrostatic Discharge) can kill equipment. When installing equipment into a cabinet or frame always use an ESD strap connected between you and the cabinet.

Each earthing conductor must be grounded onto a clean, purposeful earthing point. Use an approved cleaning method and bonding gel to protect the joint from oxidation.

Do not daisy chain earthing conductors; the only exception to this is where there is a run of metallic cable containment when each length must be grounded onto the next.

### Example of Cabinet Earthing



## Example of Rack Earthing



The best practices for communications rooms recommend provision of an equipotential earthing grid or MESHBN (a bonding network in which all associated equipment frames, racks and cabinets and usually the DC power return conductor, are bonded together as well as at multiple points to the Common Bonding Network).

This grid is used to earth all of the metallic components (frames, racks, floor tiles and pedestals, cable containment, etc) providing:

- a reliable signal reference
- adequate immunity from electromagnetic interference carried by the earthing network

Each rack and frame must be provided with an earthing conductor made back to either the MESH-BN or home run back to the main communications grounding bar within the room. For some installations this may be the electrical earthing bar in the main power distribution board.

## Testing

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NEK Kabel AS recommends Fluke Networks testing equipment.

### Twisted Pair Copper

This section describes and sets out the requirements for Class D (Cat 5e) , Class E (Cat 6), Class EA (Cat6A), Class F (Cat7) and Class FA (Cat7A) balanced twisted pair copper Permanent Link testing and Channel testing.

The preferred test equipment is a Fluke DSX 5000 and for a list of acceptable alternatives, please contact NEK Kabel AS for its recommendations.

### Permanent Link Testing

The test set must be fitted with a set of:

- Fluke Permanent Link Adapter PLA004

### Channel Testing

The test set must be fitted with a set of Fluke Channel test heads.

### Recommendations:

- Permanent Link Adapters must be 'serviced' every 5,000 tests.
- Channel Test heads last for a maximum of 2,000 tests, and cannot be serviced, they should be discarded and new ones purchased. N.B. This number is based on the amount of matings, i.e. how often a Patch Lead is plugged into them. When testing a channel you MUST leave that Patch Lead behind or that channel test is no longer valid.
- The test set must be within 12 months of calibration.
- Tests must be run with Graphs Stored enabled and HDTDR / HDTDX recorded for all \*PASS/FAIL.
- All Channel Test Heads, Personality Modules or Personality Module tips must be frequently inspected for damage or undue wear.
- Power frequency must be set to 50Hz.
- Installers should budget and schedule for replacement of Channel Test Heads, PLA4 tips and Personality Modules. The replacement rate may be lower than recommended or required depending on wear and condition of the test equipment on site.

## Handling: Safety Risks And Precautions

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There are a number of key safety issues that are important to keep in mind while handling cables supplied by NEK Kabel AS.

- The Purchaser is expected to take responsibility for Health, Safety and Environment (HSE) once the cable drums are received at specified delivery location. The Purchaser will also ensure that the HSE policy is widely disseminated and understood among employees and subcontractors employees.
- The storage areas and work facilities shall be designed, provided and constructed such that they are safe and fit for use.
- Fire and safety regulations & laws are to be adhered to in cable storage areas. Local fire codes must be consulted before warehousing of cables.
- All local government and end user regulations must be followed at all times.
- Cables being provided in circular drums are susceptible to roll over. Hence cables when being transported or stored in inclined surface could cause physical injury.
- Cables are generally provided in wooden drums, there is hence a fire hazard.
- When stored in harsh desert / high heat environments, long term storage (4 weeks+) has to be in covered areas.
- Extended water logging will cause damage to cable reels, and to cables in reeling off the drums thereafter.

## Working Practice: Safety Risks And Precautions

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The installer must be aware of the precautions to be taken:

- Avoid contact with eyes or skin or clothing.
- Eating and smoking should not be permitted in the vicinity of processing chemicals.
- Have readily available a basic First Aid kit.
- The provision of the correct safety labeling is a mandatory requirement on all products where transmission features any hazard. All potential hazard areas must be similarly marked.
- The user should ensure that all authorised personnel are aware of the relevant safety issues and should obtain training where appropriate.

## Transportation & Handling of Cable Drums

The cable must be treated with care and precautions taken to prevent moisture entry and physical damage to the outer sheath and inner components.

NEK Kabel cables are normally supplied on wooden drums. These drums must be handled properly to assure optimum payoff control of the cable. At the time of taking delivery or receiving cable in warehouse / work site inspect the condition of the drum. If there is any evidence of drum damage, the damage must be repaired prior to storage / installation to avoid damage or over-tensioning of the cable. Special attention must be paid to ensure there are no protruding nails or other sharp objects that can damage the cable sheath during usage.

### **Do not lay drums on their side during transportation, storage or installation.**

Cable drums weighing over 200 kg gross should only be handled through single point lift by forklift, trucks and cranes using wire ropeslings. It is necessary to ensure that proper slings, shackles and other lifting devices are available whenever cables are being handled.

When drums are moved by rolling, the direction of roll shall comply with the drum rotation markings.

Rolling of cables or transportation by physical roll over long distances could cause winding tension release of cable reels and subsequent entanglement during cable installation.

Therefore rolling of cable drums over long distances and uneven surfaces is to be avoided as far as possible. Cables are to be transported in vehicles with rated capacity to handle the cable gross weight.

Cables are to be properly secured while transporting either by sling ropes through arbour holes and / or by preventing roll back through blocks.

When lifting the drum from above with a crane or other lifting device, a spreader bar must be used above the drum to prevent inward pressure on the top of the drum flanges. The proper technique is shown in the photos below.



All movement of NEK Kabel drums shall be monitored to ensure that no mechanical damage occurs during, on or while loading. Suitable equipment shall be available on site for off loading, lifting and moving large and heavy cable drums.

When using a forklift to load and transport cables, the drum slats shall not be used as the load-bearing portion. Cable drums shall be picked up from the side.

If damage to the drum is observed during transportation or handling, a complete drum retest for that particular drum shall be completed. If physical damage occurs on the outer loops of the cable on the drum, this short portion may be undrummed, cutoff and discarded.

## **Storage Of The Cable Drums**

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The cable drum shall be stored in a suitable location until required for use. Due consideration shall be given to security and environmental conditions. Extended storage periods (4 weeks+) calls for storage of cables away from direct sunlight. Water logging will cause damage to cable reels, and to the cables thereafter as they are reeled off the cable drums. Hence, storage should be in such location that water logging is clearly avoided.

The cable shall not be unpacked until required for drum testing prior to installation. For routine testing and records, the 2-3 meter cable bottom end provided for the purpose is to be used for cable testing (routed through the cable flange). Drum slats are not to be removed until the cable is ready for installation.

The end of the cables is sealed to prevent ingress of moisture and contaminants. These are not to be removed until cables are being installed.

For long term storage of cable drums, it is not advisable to expose the drum to direct sunlight or excessive levels of moisture. Cables must also not be subjected to long term exposure to sand and fine particle dust storms, sand laden winds, thunderstorms, heavy rain and chemical contaminants. Accordingly, storage in closed & protected premises is advised.

### **Drums are not to be laid flat.**

Weatherproof liners provided over cable drums are not to be removed until installation.

Before transporting to field, a physical inspection is to be carried out to ascertain whether there is any evidence of damage. Damage if any is to be notified to us for possible remedial action prior to transportation.

The drum number provided by NEK Kabel AS on the cable reel is a unique identification tag which facilitates tracking and is a reference for any communication related to the said cable reel. Hence, care must be exercised to ensure that the reel number information provided on the cable drum is retained at all times until cable installation.

In warehouses where rodent and termite attacks are likely frequent inspection of cable drum condition is to be carried out for early detection of damage.

Truncation of cable reel lengths in warehouse should only be done when proper prop up is available with rated capacity to handle cable gross weight. Cable ends are to be sealed thereafter to prevent moisture ingress.

### **Stacking of cable reels is not an acceptable practice.**

## Periodic Monitoring of Cable Conditions

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NEK Kabel AS recommends detailed records are kept of warehoused cable drums in a different location.

NEK Kabel AS further recommends a cable-monitoring scheme to identify problems at warehouse owing to natural calamities, water seepage, attack by rodents and other contaminations.

## Inspection

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### Cable inspection

Inspect every cable reel for damage before accepting the shipment. Be particularly alert for cable damage if:

- A reel is laying flat on its side
- Several reels are stacked
- Other freight is stacked on a reel
- Nails have been driven into reel flanges
- A reel flange is damaged
- A cable covering is removed, stained or damaged
- A cable end seal is removed or damaged
- A reel has been dropped

### Handling

Remove all nails and staples from the reel flanges before moving a reel and avoid all objects that could crush, gouge or impact the cable when moving. Never use the cable as a mean to move a reel.

### Pulling

When pulling cables, respect the minimum bending radius and maximum pulling forces. Check the datasheet of the cable used. Be aware that in cold environment the cable jackets are stiffer and more sensitive to bending and pulling. The range of recommended installation temperatures of cables is much smaller than the operating temperature range. When unreeling do take all necessary precautions to prevent cable kinking, ravelling or twisting.



*Your Cable Supplier Beyond 100 Years*

*Established 1913*

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