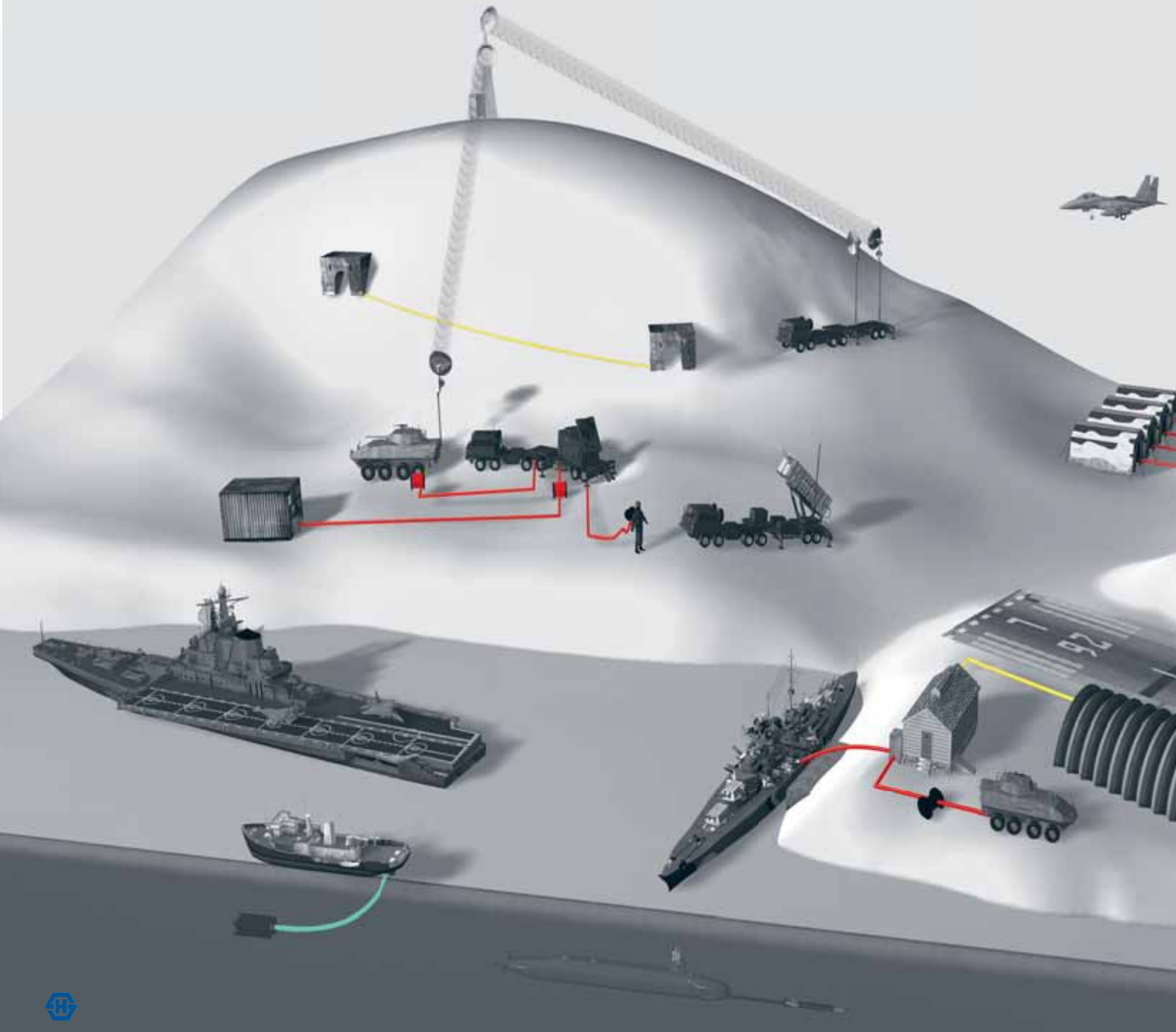


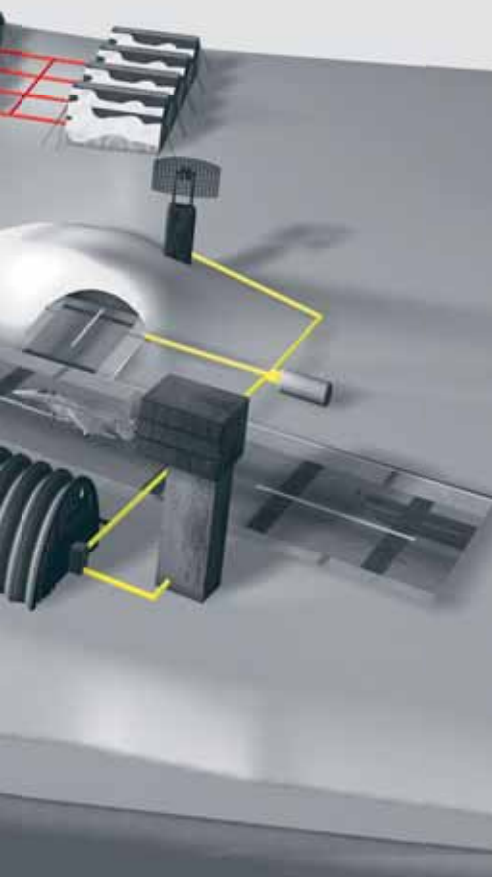
Fiber Optic Defence

Edition 2008/2009



Connect with Competence





Your Partner for System Solutions

HUBER+SUHNER is a partner for developing innovative solutions according to customer requirements, that includes individual product solutions as well as applications with existing components. For that purpose our specialists combine diverse components to build a complete solution in a professional manner, so that all the technical specifications are met and the reliability in harsh environment is guaranteed.

Fiber optic technology

New systems and especially the electrical command assistance demand transmission of high data volume. Fiber optic technology is the only transmission medium for unlimited data volume and long distances. Furthermore fiber optic is space-saving, light and immune against electro-magnetic fields or pulses.

Solutions for defence applications

- Ground • Naval • Aviation • Space

HUBER+SUHNER designs solutions and manufactures products with the technologies

- Radio frequency connectors, cables and assemblies, lightning protectors, antennas
- Low frequency wires, cables, harnesses, cable systems
- Fiber optics connectors, cable, assemblies, cabling systems, fiber management systems

for the markets • Communication • Transportation • Industrial

Fiber optic product solutions

The fiber optic division offers a broad range of cabling solutions for communication that meet the requirements of the defence **ground and naval** applications.

Mobile systems have to be compact, light, robust and resistant to environment influences. On ships only halogen free and self-extinguishing cables are installed to give the highest protection to personnel and equipment in case of fire.

Testing

The components as well as the assemblies are tested extensively in HUBER+SUHNER's test laboratory and in external labs. The tests are performed according to international and military standards. Typical tests are

- Thermal tests temperature cycling, humidity, shock
- Mechanical tests tension, bending, crush, impact, vibration, durability
- Fire tests fire propagation, circuit integrity, smoke density, toxic gases
- Ingress resistance water and dust tightness
- Fluid resistance water, oils, fuels, solvents, acids
- Application tests coiling capability, run-over by vehicles, weathering

All the data for a product is summarised in the data sheet. On request, the detailed test reports can be supplied.

Military standards

Wherever MIL standards are applicable, they are used as a test specification. International standards and those from organisations are also used.

Some important standards

- MIL and DOD
- STANAG and AECTP (NATO)
- ISO, ISO/IEC and IEC
- EN
- ITU



Fiber Optic System Solutions for Defence

Certificates and Approvals

By mutual agreement a certificate, e.g. Certificate of Conformance, can be supplied for each product.

For specific applications approvals for a product are often mandatory, where high safety standards or high reliability are demanded. Several breakout and loose tube cables for shipbuilding application were approved to

- GL (Germanischer Lloyd) and
- RL (Lloyd's Register).

The certificates are available on request.

Quality standards

The performance of the system in the application is the top priority. Therefore the focus on superior design, constant manufacturing and effective test methods ensures the "Excellence in connectivity solutions".

Our quality management is certified by the Swiss Association for Quality Management Systems (SQS) according to

- ISO 9001 (quality management) and
- ISO 14001 (environment management).

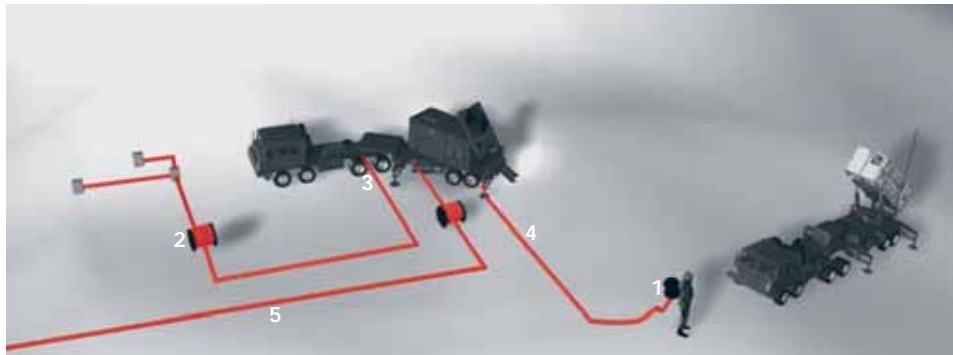
Contacts

For questions or inquiries please contact our local company in your country listed under «CONTACTS» in www.hubersuhner.com.



Platforms
 Communication vehicles and stations
 Mobile anti aircraft systems
 Surveillance and reconnaissance systems

Systems
 Radar and electronic systems
 Tactical and strategic communication
 Simulation and training systems



Backpack - portable system

- Robust and compact frame with metal drum
- For tactical cable assembly with harsh environment connectors
- Cable drum easily removable and with anti-rotation lock
- Adjustable carrying straps and hip belt
- Continuous bend radius guidance and connector holder on both sides
- Pocket for crank and documents



1

Mobile cable systems

- For easy storage of mobile cable assemblies
- Assemblies with multi-pole connectors
- MASTERLINE® mobile with standard connectors and removable protection tube
- Different sizes and materials of drums
- Two-part drums for protected inner cable end
- Both cable ends accessible



2

EBC - Expanded beam connector

- 2 and 4 channels; singlemode and multimode
- Hermaphroditic connector system
- Highest resistance; fully water tight and dust protected
- Easy cleaning and no maintenance required
- Plug assemblies with field cables; bulkhead assemblies with standard connectors
- Other types on request



3

Temporary Cabling of Mobile Units



3

ODC® - outdoor connector

- Butt joint connector with ferrules; female - male system
- 2 channels in singlemode and multimode; 4 channels in multimode
- Screwed locking mechanism (similar to RF type N)
- Water and dust proof; EMI safety
- Socket with square or hexagonal flange and standard connectors
- Patented product and registered trademark of HUBER+SUHNER



3

Variocconnect® - multi-pole butt joint connector

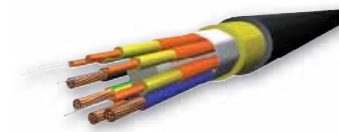
- Fiber contacts or hybrid with copper 1.5 mm², max. 8 contacts
- Hybrid variant for data transmission and power supply
- For all fiber types (SM, MM incl. HCS)
- Female - male system; screwed locking mechanism
- Robust mechanical design; water and dust proof
- Easy to repair by fiber overlength; repairable in the field



4

Mobile field cables

- 2 up to 8 fibers
- For harsh environment in mobile or fixed applications
- High flexibility, high tensile strength and crush resistance
- Large temperature range
- Optional rugged minicord breakout cable with two fibers
- Optional cable with double jacket and 12 fibers



4

Mobile hybrid cables

- 4 fibers and 4 copper conductors
- Copper conductor 1.5 mm² for power
- High flexibility for mobile or fixed application
- High mechanical, thermal and chemical resistance



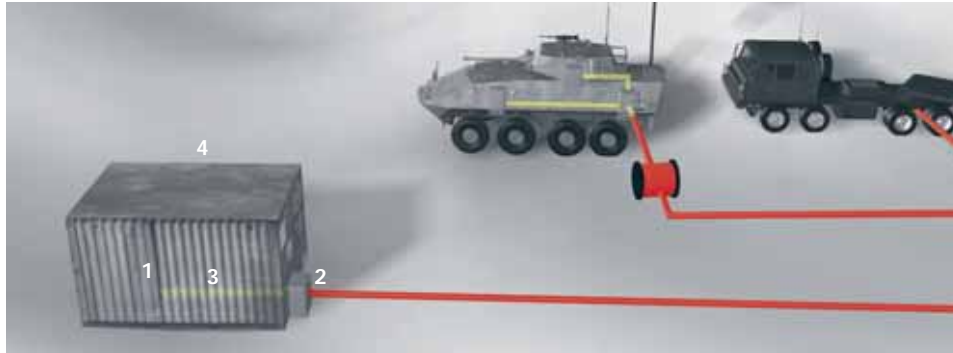
5

Cable repair kit

- Flexible tube; can be coiled on drum
- For repairing a defect field cable Ø 5.5 up to 6 mm
- With mechanical splices, max. 4 fibers
- Easy to assemble
- No epoxy, heating and polishing required
- Protection class IP65

Platforms
Communication vehicles, units and stations

Systems
Radar and electronic systems
Tactical and strategic communication
Simulation and training systems



Standard connectors

- All standard types as FC/PC, ST, SC, E-2000™, LC, LX.5, etc.
- Simplex and duplex types
- Singlemode and multimode incl. HCS
- Low insertion loss
- Compliant to international standards ISO/IEC 61754-x and TIA 603-x
- For patchcords, MASTERLINE® cabling system and bulkhead assemblies



ODC® - outdoor connector

- Butt joint connector with ferrules; female - male system
- 2 channels in singlemode and multimode; 4 channels in multimode
- Screwed locking mechanism (similar to RF type N)
- Water and dust proof; EMI safety
- Socket with square or hexagonal flange and standard connectors
- Patented product and registered trademark of HUBER+SUHNER

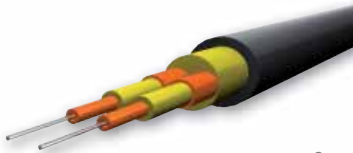


Protection boots

- For outdoor connections
- Protects unprotected standard connectors
- For connector types ST, FCPC, FSMA, SC, E-2000™, LC and LX.5 duplex
- Protection class IP65
- For cables of diameters min. 2.1 mm
- Easy to assemble



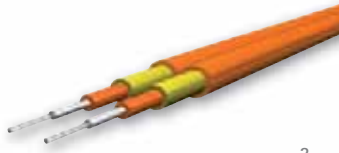
Internal Cabling in Vehicles and Units



3

Minicord breakout cables

- Includes 2 simplex cables 1.7 mm
- For harsh environment
- High flexibility for mobile or fixed application
- For direct connector termination with strain-relief
- High tensile and crush resistance; large temperature range
- Optional Industry Link cable types; one type with rodent protection



3

Simplex/duplex and breakout cables

- Each fiber strain-relieved for direct connector termination
- Tight bend radii
- Low smoke, halogen free and self-extinguishing
- For high safety requirements in case of fire
- 4 up to 12 fiber breakout cable types
- Suitable for indoor applications



4

Field termination - Quick Assembly

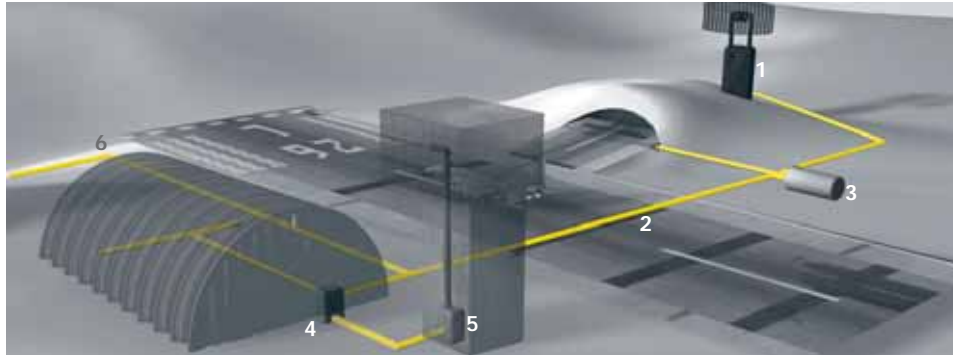
- Quick termination process in 90 seconds, no set-up time
- Reliability and constant quality as serial production
- All-in-one multifunction tool battery powered; easy-to-carry tool box
- Sophisticated connector design (ST, SC) for easy termination
- For multimode, singlemode PC and APC
- Separate kit for end face inspection in the field; tool kits for all standard connectors

Platforms

Premises cabling at airports, shelters, harbours, etc.
Communication stations

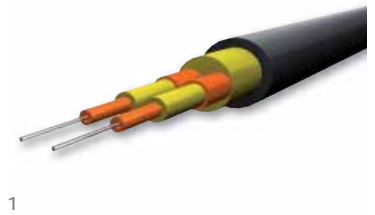
Systems

Radar and antennas; tactical and strategic communication
Surveillance, security and control
Simulation and training systems



Minicord breakout cables

- Includes 2 simplex cables 1.7 mm
- For harsh environment
- High flexibility for mobile or fixed application
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- High tensile and crush resistance; large temperature range
- Optional Industry Link cable types; one type with rodent protection



1

ODC® - outdoor connector

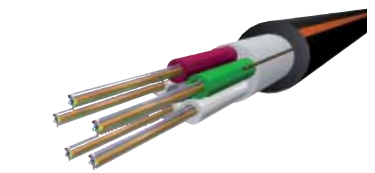
- Butt joint connector with ferrules; female - male system
- 2 channels in singlemode and multimode; 4 channels in multimode
- Screwed locking mechanism (similar to RF type N)
- Water and dust proof; EMI safety
- Socket with square or hexagonal flange and standard connectors
- Patented product and registered trademark of HUBER+SUHNER



1

Multi-fiber loose tube cables

- Glass and steel armoured types with rodent protection up to 144 fibers
- Watertight and high chemical resistance
- For use in ducts and unprotected environments
- Halogen free and nontoxic
- As LSFH™ variant ideal for high safety requirements in case of fire
- SECUFIRE type with LSFH™ jacket for highest fire resistance



2



3

Splice closures

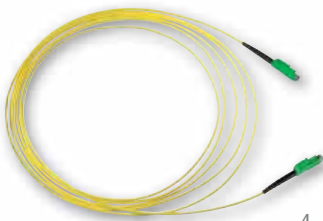
- Splice closures for permanent fiber connections and fiber branching
- SingleCircuit or MultiCircuit fiber management
- Different sizes; for max. 96 splice connections
- Protection class IP67
- Bend radius limitation of 35 mm for fibers
- Fixing at wall or mast, installed in duct or closure or buried in soil



4

Distribution modules and closures

- Weather-proofed outdoor cabinet for installation of optical modules
- Assembly of modular building blocks with 19" or ETSI dimensions
- Complete front mounting of all components; integration of active devices
- Different sizes of housing for up to 816 fibers
- Reinforced plastic or metal housing; protection class IP54
- Optional different distribution rack available (19" or ETS)



4

Patchcords

- For connection of channels within a closure
- Various cable and connector types
- Connector types with automatically activated dust cap
- Best optical performance within broad temperature range
- LSFH™ jacket material for high security in case of fire



5

Wall boxes

- Wall boxes for transfer and distribution points
- Different sizes and types for indoor and outdoor use
- Configuration variants: splice through, splice/patch, patch through
- SingleCircuit or MultiCircuit fiber management
- Continuous bend radius limitation
- Various cable entry possibilities

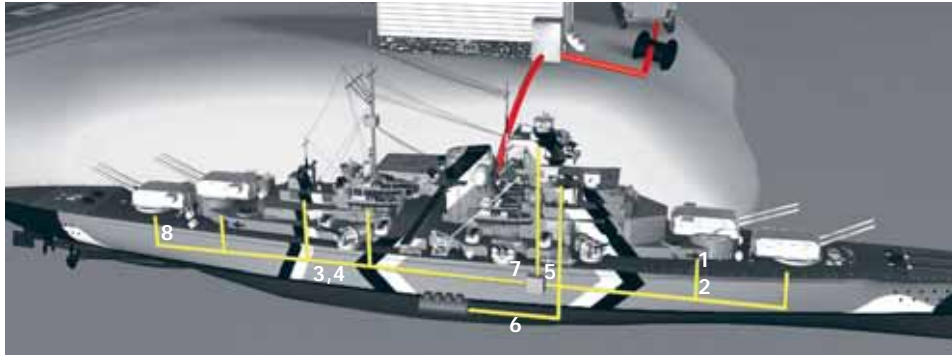


6

MASTERLINE® – pre-assembled cable systems

- Ready-to-use, plug and play system with 2 up to 144 fibers
- For indoor and outdoor use
- Fast and simple installation
- Dust, waterproof and reusable pulling tube (IP67)
- For all standard connector types
- Different MASTERLINE® types for mobile or fixed installation

	Platforms	Systems
	Surface ships such as frigate, aircraft carrier, etc.	Sonar, radar and electronic systems
	Submarines	Surveillance, information and security systems
		Communication network, propulsion systems wiring



ODC® - outdoor connector

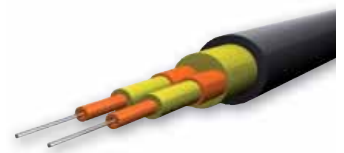
- Butt joint connector with ferrules; female - male system
- 2 channels in singlemode and multimode; 4 channels in multimode
- Screwed locking mechanism (similar to RF type N)
- Water and dust proof; EMI safety
- Socket with square or hexagonal flange and standard connectors
- Patented product and registered trademark of HUBER+SUHNER



1

Minicord breakout cables

- Includes 2 simplex cables 1.7 mm
- For harsh environment
- High flexibility for mobile or fixed application
- For direct connector termination with strain-relief
- High tensile and crush resistance; large temperature range
- Optional Industry Link cable types; one type with rodent protection



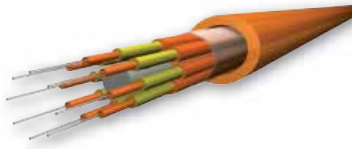
2

Multi-fiber loose tube cables

- Glass and steel armoured types with rodent protection up to 144 fibers
- Watertight and high chemical resistance
- For use in ducts and unprotected environments
- Halogen free and nontoxic
- As LSFH™ variant ideal for high safety requirements in case of fire
- SECUFIRE type with LSFH™ jacket for highest fire resistance



3



4

Breakout cables

- 4 up to 12 fiber cable types
- Low smoke, halogen free, flame-retardant and self-extinguishing
- Special type with flame-barrier for circuit integrity
- For direct connector termination with strain-relief
- Suitable for indoor applications
- Approved by Germanischer Lloyd (GL) and Lloyd's Register (RL)



5

Standard connectors

- All standard types as FC/PC, ST, SC, E-2000™, LC, LX.5, etc.
- Simplex or duplex types
- Singlemode and multimode incl. HCS
- Low insertion loss
- Compliant to international standards ISO/IEC 61754-x and TIA 603-x
- For patchcords, MASTERLINE® cabling system and bulkhead assemblies



6

MASTERLINE® – pre-assembled cable systems

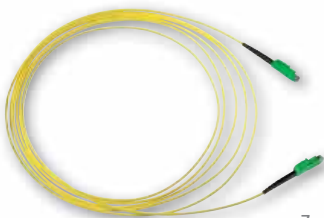
- Ready-to-use, plug and play system with 2 up to 144 fibers
- Fast and simple installation
- Dust, waterproof and reusable pulling tube (IP67)
- For all standard connector types
- Different MASTERLINE® types for mobile or fixed installation
- Approved type by Germanischer Lloyd (GL)



7

Distribution housings

- Compact and robust construction
- For splicing and/or with patch panel
- Optimized cable and fiber management
- Design according to customer requirements



7

Patchcords

- For connection of channels within a closure
- Various cable and connector types
- Connector types with automatically activated dust cap
- Best optical performance within broad temperature range
- LSFH™ jacket material for high security in case of fire

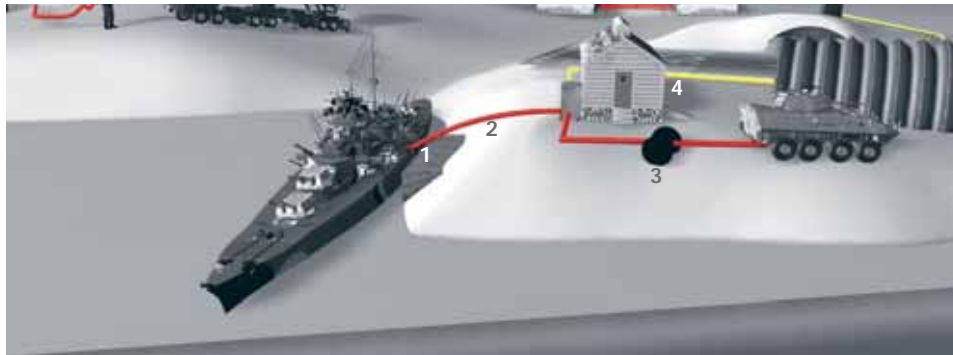


8

Field termination - Quick Assembly

- Quick termination process in 90 seconds, no set-up time
- Reliability and constant quality as serial production
- All-in-one multifunction tool battery powered; easy-to-carry tool box
- Sophisticated connector design (ST, SC) for easy termination
- For multimode, singlemode PC and APC
- Separate kit for end face inspection in the field; tool kits for all standard connectors

	Platforms	Systems
	Surface ships and submarines	Ship-to-shore; vehicle to station
	Vehicles	Communication networks
	Premises	Surveillance, security and control



EBC - Expanded beam connector

- 2 and 4 channels; singlemode and multimode
- Hermaphroditic connector system
- Highest resistance; fully water tight and dust protected
- Easy cleaning and no maintenance required
- Plug assemblies with field cables; bulkhead assemblies with standard connectors
- Other types on request



1

Variocconnect® - multi-pole butt joint connector

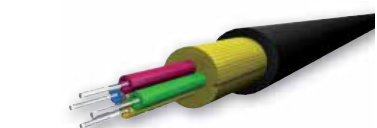
- Fiber contacts or hybrid with copper 1.5 mm², max. 8 contacts
- Hybrid variant for data transmission and power supply
- For all fiber types (SM, MM incl. HCS)
- Female - male system; screwed locking mechanism
- Robust mechanical design; water and dust proof
- Easy to repair by fiber overlength; repairable in the field



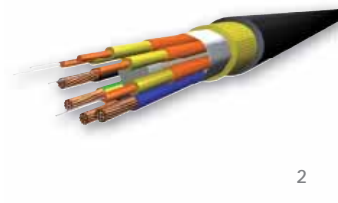
1

Mobile field cables

- 2 up to 8 fibers
- For harsh environment in mobile or fixed applications
- High flexibility, high tensile strength and crush resistance
- Large temperature range
- Optional rugged minicord breakout cable with two fibers
- Optional cable with double jacket and 12 fibers



2



2

Mobile hybrid cables

- 4 fibers and 4 copper conductors
- Copper conductor 1.5 mm² for power
- High flexibility for mobile or fixed application
- High mechanical, thermal and chemical resistance



3

Mobile cable systems

- For easy storage of mobile cable assemblies
- Assemblies with multi-pole connectors
- MASTERLINE® mobile with standard connectors and removable protection tube
- Different sizes and materials of drums
- Two-part drums for protected inner cable end
- Both cable ends accessible

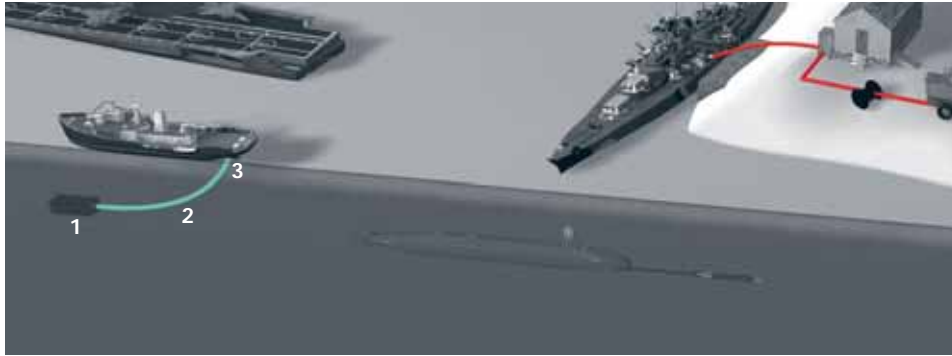


4

MASTERLINE® – pre-assembled cable systems

- Ready-to-use, plug and play system with 2 up to 144 fibers
- For outdoor and indoor cabling
- Fast and simple installation
- Dust, waterproof and reusable pulling tube (IP67)
- For all standard connector types
- Different MASTERLINE® types for mobile or fixed installation

	Platforms	Systems
	Surface ships such as frigate, aircraft carrier, etc. Submarines	Mine sniper vehicles Underwater warfare systems, missiles Sonar systems



Fiber optic system solutions

- Custom-made solutions
- Stress free fiber guidance
- Compact and lightweight design
- For mobile and remote controlled vehicles and sonar systems
- For underwater mine sniper systems and missiles

Standard connectors

- All standard types such as FSMA, FC/PC, ST, SC, E-2000™, LC, LX.5, etc.
- Simplex or duplex types
- Singlemode and multimode incl. HCS
- Low insertion loss
- Compliant to international standards ISO/IEC 61754-x and TIA 603-x
- For patchcords, MASTERLINE® cabling system and bulkhead assemblies



Swim cable

- Compact construction
- Fiber strain-relieved
- For direct connector termination with strain-relief
- Floats in water
- For mobile underwater and sonar systems



Cabling of Remote-Operated Vehicles



3

Protection boots

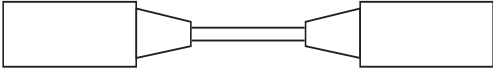
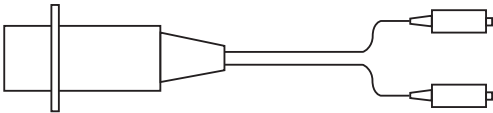

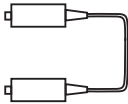
- For outdoor connections
- Protects unprotected standard connectors
- For connector types ST, FCPC, FSMA, SC, E-2000™, LC and LX.5 duplex
- Protection class IP65
- For cables of diameters min. 2.1 mm
- Easy to assemble



Fiber optic versus copper cabling

Characteristic	Fiber optic	Copper
Weight	low	heavy
Dimensions	small	moderate
Attenuation (loss)	low	moderate
Range	big	small to medium
Data rate	high over long distances	limited for long distances
Electro-magnetical sensitivity	none	yes
Cross talk	none	critical
Potential equalization	not necessary	necessary
Lightning protection	not necessary	necessary
EMP damage	none	big
Electro-optical conversion	necessary	not necessary
Security in explosion endangered environment	yes	no
Installation/handling	min. bend radii	no crushing

Types of assembly

Description	Systematic drawing	Connector type	Application
Plug assembly		multi-fiber butt joint or expanded beam	to connect equipment (outdoor)
Bulkhead ¹⁾ assembly (one side with fanout)		multi-fiber butt joint or expanded beam and standard	for equipment side (indoor)
Cabling system ²⁾ (one or two sides with fanout)		standard	to connect equipment (indoor and outdoor)
Standard patchcord		standard	to connect fibers at patch panel (indoor)

¹⁾ also called socket or panel plug

²⁾ MASTERLINE® and SMARTLINE are pre-terminated and ready-to-install cabling systems from HUBER+SUHNER.

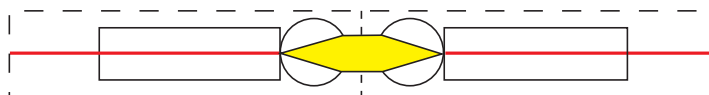
Connector design types

Butt joint connectors



Butt joint connectors are where the fibers normally are mounted in cylindrical ferrules. The ferrule ends are then spherically polished, so that the fibers will meet with a physical contact and are precisely aligned by a slotted sleeve.

Expanded beam connectors (EBC)



Expanded beam connectors include lenses, that are placed in front of the fibers to expand the emitting beams of light. The expanded beam is refocused back into the fiber at the other side. The distance between the lenses may vary. The connector design is hermaphroditic so that two similar connectors can be mated without adapter. The attenuation of one connection is higher than by a butt joint connector, but the sensitivity of contamination is much lower. For example a small dust particle results in a minor attenuation increase only, whereas with a butt joint connector it can result in high attenuation increase.

Standard connectors

They are widely used in Datacom and Telecom applications and are mostly simplex or duplex butt joint types. They are usually not suitable for using in harsh environment without additionally protection (protection class IP20). Examples: ST (BFOC), FCPC, SC, E-2000™, LC, etc.

Multi-fiber connectors

They consist of several fibers and some can even include copper conductors. Examples: ODC®, Variocconnect®, Expanded beam connector, etc. The advantage is that several fibers can be connected with one multi-fiber connector.

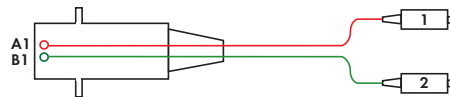
Standard fiber allocation for expanded beam connectors

Plug assembly



Functionally each channel pair is crossed, visually it is not crossed.

Bulkhead assembly



Link



The fiber allocation is made in the way shown above, so that in case one or more assemblies are connected, the channel no. 1 from the left side is always connected to the channel no. 2 of the right side (transmitter to receiver), channel no. 2 to channel no.1 (receiver to transmitter). Thus a bidirectional link is established over two fibers. A four-way connector type uses channel identification A1, B1, A2 and B2 and it works similar to the two channel version.

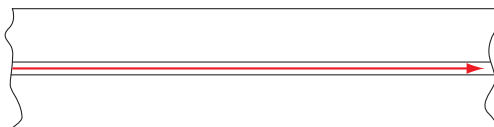
Notes:

In communication networks this procedure is working adequately.

A few expanded beam connector types have a channel identification with A, B, C and D, nonetheless it is working similar as with A1, B1, A2 and B2.

Fiber optic terms

Singlemode

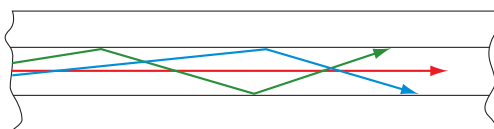


The core is reduced to only a few times of the wavelength of the light, so that one single mode is propagating through the fiber (monomode). The most commonly used wavelengths are 1310 and 1550 nm.

As the attenuation and dispersion are low, the fiber can be used for long distances and high data rates.

Example of fiber type: 9 μm

Multimode



The core has a diameter of 50 μm or bigger. Lots of modes are propagating through the fiber (multimode). Often used with 50 μm and 62.5 μm are graded index, whereas types with larger cores (e.g. 200 μm) are step index fiber types. The most commonly used wavelengths are 850 and 1300 nm. The fibers can be used for short and medium distances since the attenuation and dispersion are significantly greater.

Attenuation

It is the measure of the amount of light loss that occurs in a fiber or fiber optic system; normally measured in dB (e.g. 3 dB is 50% loss).

Dispersion

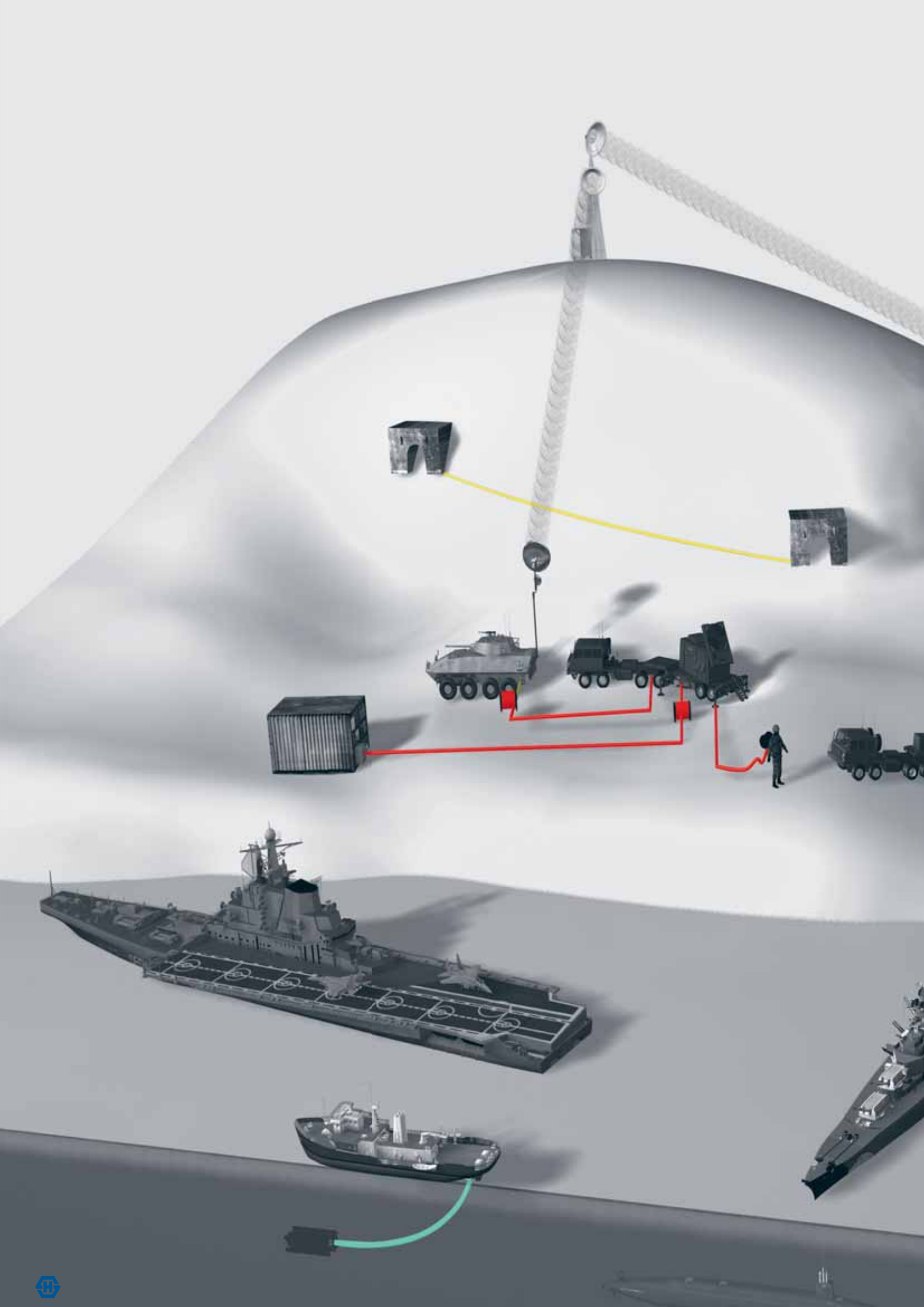
The dispersion is a signal widening caused by run time differences of the modes, wavelength-dependent velocity of the light and/or wavelength-dependent light distribution in the core and cladding. Dispersion can cause bit error.

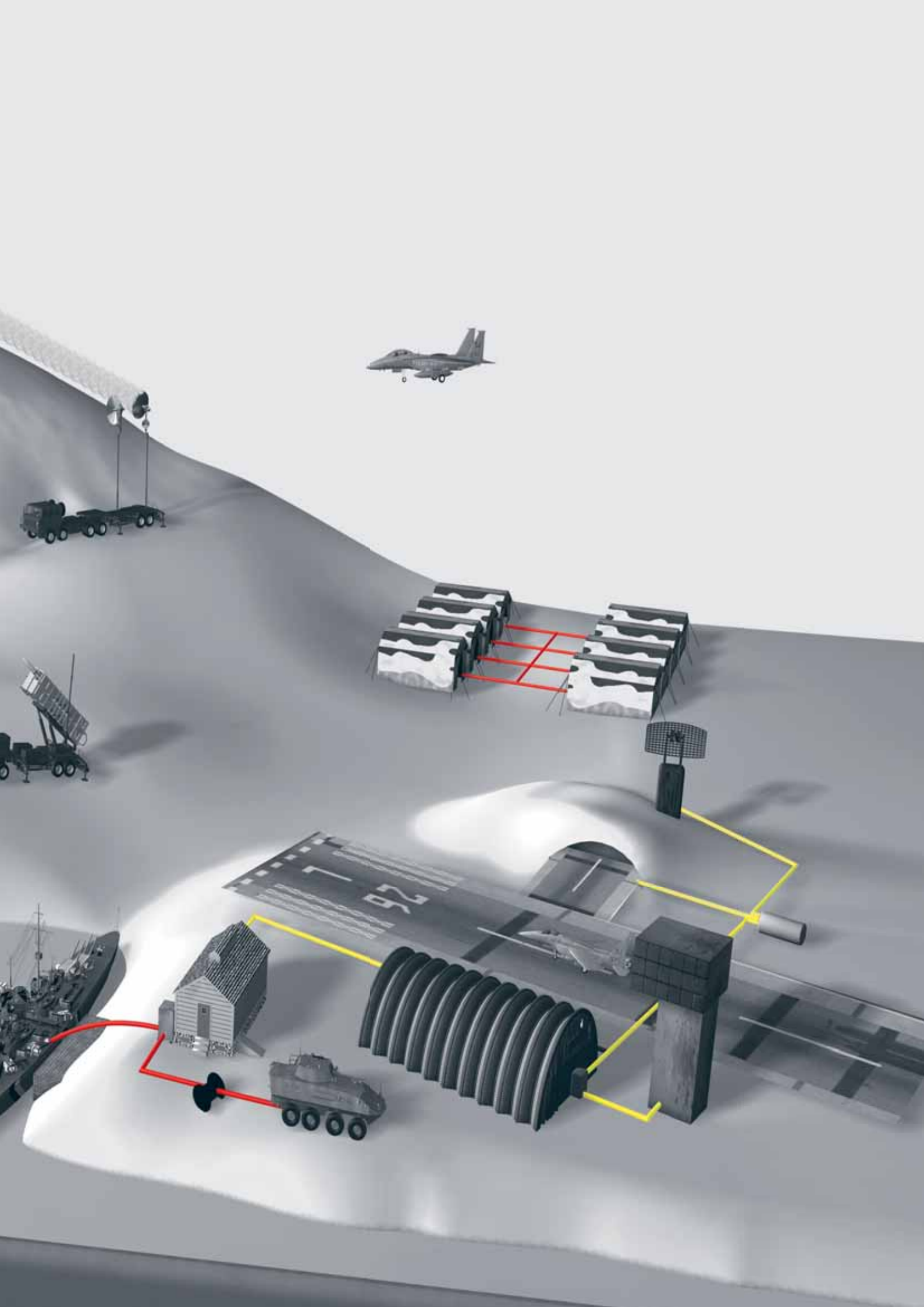
Insertion loss (IL)

It is the increase in attenuation caused by inserting a connector pair into a fiber optic link. A certain amount of light will be lost at each joint. Main causes of loss are core offset and angular misalignment of the fibers.

Return loss (RL)

It is the ratio of the forwarded optical power to the reflected optical power. This reflected light is mainly dependent on the form and quality of the fiber end. Usually a singlemode connector with ferrule technique has a RL of better than 45 dB. If an air gap occurs between the fibers, then the RL will drop to approx. 14 dB.

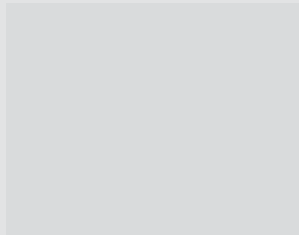




HUBER+SUHNER certified according to
ISO 9001 and ISO 14001.

WAIVER

It is exclusively in written agreements that we provide our customers with warrants and representations as to the technical specifications and/or the fitness for any particular purpose. The facts and figures contained herein are carefully compiled to the best of our knowledge, but they are intended for general informational purposes only.



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