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Diving operations require a clear, reliable communications link between surface support personnel and the diver. The electrical umbilicals presently used are heavy and cumbersome or require an external strength member. These cumbersome tethers hinder the diver's ability to accomplish search, inspection, repair or maintenance tasks.

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THE CONFERENCE RECORD

DOD FIBER OPTICS CONFERENCE '88

March 22-25, 1988
McLean Hilton Hotel
McLean, Virginia

Sponsored by

The Tri-Service Fiber Optics Coordinating Committee

and

The Armed Forces Communications and Electronics Association

in Cooperation With

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and

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FIBER-OPTIC PRIMARY DIVING TETHER

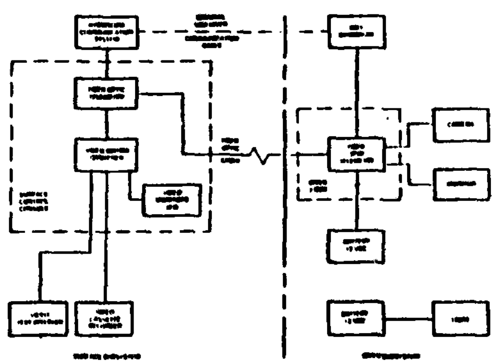
STEVEN R. TERWILLIGER, Project Engineer

NAVAL OCEAN SYSTEMS CENTER, Hawaii Laboratory

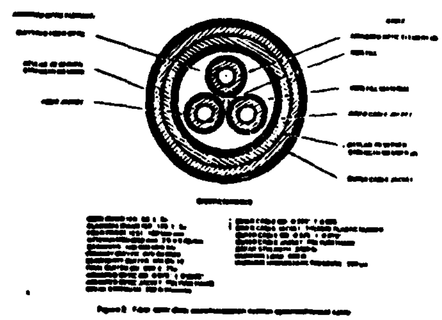
Diving operations require a clear, reliable communications link between surface support personnel and the diver. The electrical umbilicals presently used are heavy and cumbersome or require an external strength member. These cumbersome tethers hinder the diver's ability to accomplish search, inspection, repair or maintenance tasks.

Use of fiber optics in combination with synthetic strength members have been used to overcome many of the problems inherent to existing communication cables. These materials allow a reduction in cable weight, diameter, and electromagnetic signature while maintaining the tensile strength required in diving tethers. The combination of high-quality communications and increased diver mobility significantly improves safety and the ability of a diver to complete a task.

A system was developed to demonstrate the role fiber optics can play in diving communications. The system (figure 1) provided for round-robin voice and video data transmission between multiple divers and the surface and interfaced to fleet equipment with no modification to that equipment. The system can be reconfigured depending on mission requirements.



The optomechanical cable contains an outer armor and jacket over a jacketed core (figure 2). The jacketed core is composed of three armored optics: graded-index (multimode) fibers, each individually Kevlar armored and jacketed. This jacketed core is then armored with the primary Kevlar strength-member and jacketed.



The cable design permits the outer armor to be strength terminated at the diver's waist while passing the core through to the optical connector on the junction box. The optical connector on the junction box was a multi-pass, expanded-beam connector with internal strain relief manufactured by Litton Veam.

Tests were performed to evaluate the cable's performance when subjected to mechanical and environmental stresses. The tests indicate the cable performs well under severe loading and bending conditions.

Tensile-Load test results showed an average break strength of 1665 pounds (termination influenced) compared with a design break strength of 2000 lbs. Constructional stretch was 0.35 percent and the strain at 500 pounds was 0.8 percent. Tensile tests on three armored-optic samples resulted in an average ultimate strength of 250 pounds.

The Tensile-Attenuation test measured the change in optical attenuation in a long length of cable under cyclic tension. Attenuation measurements were taken at 100 pound intervals up to 500 pounds and a final reading at 750 pounds during tension cycles. Over three tension cycles, the excess attenuation caused by this tension loading was less than 0.8 dB (0.85 um wavelength) in any fiber.

Bend-Attenuation tests were used to evaluate the effects of bending over a sheave on optical transmission. Excess attenuaiton was never greater than 2.8 dB (0.85 um wavelength) over any size sheave. Transmission was only lost when the cable was kinked.

The optomechanical cable is approximately the same diameter as the electrical umbilical it replaced and it has a strength member. The calbe contains three fibers; two fibers were used for telemetry (simplex communication) leaving the third fiber for future system expansion. With a 750 pound safe lift rating (2x safety factor), the cable can be married into an existing surface-supply diving tether or act along as the primary diving tether.

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