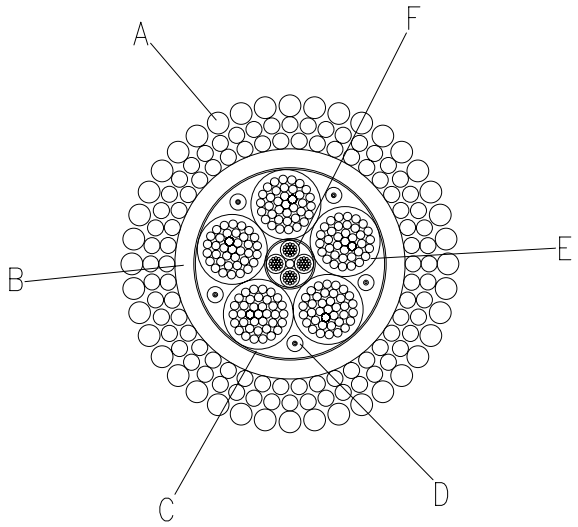
REVISIONS HISTORY		
00	FOR QUOTATION	13/10/03
01	Extra 3 Fibres & Include Insulation Thk	26/02/04
02	Revised armour to reduce dia.	27/04/04
03	12AWG Cores changed to 5 x 11AWG	13/05/04
04	Revised for steel tube FO's	12/10/06



A = Three Layer Torque Balanced Arour

B = Polyethylene Inner Jacket

C = Copper Polyester Tape Plus Drain Wires

D = 5 x Steel Tube Singlemode Fibre Optics

E = 5 x 11AWG Thin Wall Insulated (0.52mm nom. radial) Wires (4160v)

F = 24AWG Quad, Screened & Jacketed

Finished diameter:	17.3	mm.
Weight in air:	1110	kg/km.
Weight in sea-water:	870	kg/km, (note 1).
Minimum bend radius:	210	mm, (static).
Minimum bend radius:	230	mm, (dynamic).
Minimum breaking load:	180	kN.

Note 1) Assumed sea-water density = 1,026 kg/m³.

Unless otherwise specified, all dimensions are in mm.

All values nominal.

Drawing No: -- SQ7589 --

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Description: MBARI 5000m ROV Umbilical

Rev: 04

Scale: N.T.S. | Date: – 13 Oct. 03 – | Sheet: 1 of 1

Drawn: A.J. Clark | Approved:

SQ7589 Rev 4 Further Current Ratings & Voltage Drop Calculations

Cable SQ7589rev4 drawing is attached. It has 5 x 4mm² (11AWG) cores, a quad in the centre and 5 x steel tube singlemode fibre optics in the centre. It also has three layers of armour. The diameter over the armour is 17.3mm.

The winch drum size has been given as 60in (1524mm) for the barrel and 72" (1829mm) for the width. For a 5000m length there will be approximately 9.5 layers of the cable.

Based on 3 cores fully loaded and two cores lightly load (3.5amps)and a ambient temperature of 32 deg C:

Layers	Ambient Temperature		
	40 deg C	32 deg C	20 deg C
10	16.5amps	17.0amps	18.5amps
9	17.0amps	17.5amps	19.0amps
8	17.5amps	18.5amps	20.0amps
7	18.5amps	19.5amps	20.5amps
6	19.5amps	20.5amps	21.5amps
5	20.5amps	21.5amps	23.0amps

It is not possible to give values for current ratings when a water bath and spray system for cooling is installed. This is because it is impossible to predict how far into the windings the water will penetrate and also how much water. However, to increase the above current ratings by 25% would be a very conservative figure.

The voltage drop for the 4mm² (11AWG) cores can be calculated from:

Volts Drop = (√3 x I x L x R x T)/1000

Where I = current = 16amps
L = length = 5000m
R = Conductor Resistance at 20 deg C = 4.9ohms/km
T = Conductor resistance temperature correction = [(op temp – 20)0.00393)+1]
Op temp = 58degC (average). Therefore T = 1.15

Therefore;
Volts Drop = (√3 x 16 x 5000 x 4.9 x 1.15)/1000
Volts Drop = 780v (26% of a 3000v operating voltage and 18.7% of a 4160v operating voltage)

When I = 3.5amps then:

Volts Drop = 172v (5.7% of 3000v operating voltage and 4.1% of 4160v operating voltage)

From the figures it can be seen that the conductor resistance is increased because of the operating temperature. However, the increase is only 7% and reducing the operating temperature down to ambient would not enable the voltage drop requirement of 15% to be met on the 16amp circuit.

To minimise voltage drop it is best to operate at 4160v which will keep the voltage drop down to 17.5%.