From: MDTF07::BCBROWN 23-APR-1991 13:37:55.17
To: FNAL::DELCHTS
CC: BCBROWN
Subj: Probe wire doc

TS-SSC 91-090

Some information on existing and proposed wires for probes
Bruce C. Brown

This will attempt to provide a set of information on the wires we use for probes. We have fabricated the probes from single wires and from Litz-wound wire (cable) made with various numbers and diameters of strands.

A standard source for us is

New England Electric Wire
365 Main Street
Lisbon, New Hampshire 03858

(603)838-6625
Contact include
-Terry O'Brien - Feb 91
-Robert Meserve (long time contact -- associated with Superconducting Cable manufacture for SAVER, etc...

In their catalog (which I got in about 1990) is a source for descriptions of Litz wire. However, I got the following approximate formula over the phone for calculating the diameter of a Litz wire:
Wire Dia = SQRT(number of strands) * 1.155 * Strand Dia

##########

13 February 1991

The 'traditional' materials for MTF Litz wire probes is a 20 turn tangential coil and a 7 turn wire for the 'belly band'. Usually we use 4 of the 7 wires in the belly band.

##########
20 Turn Litz:
Source: Brookhaven Nat'l Lab stocks
(probably New England Electric, originally)
Properties (measured): Wire Diameter 0.035" (with fabric on outside)
Strand Diameter 0.006" as insulated
0.005" bare

Guess on what this is:
20 strand Litz, 36 gauge heavy coated
Listed Properties: 36 Gauge (NE36 heavy film)
Bare Strand Diameter 0.0050 nominal
Strand with film 0.0060 nominal
Calculated Wire Properties:
Dia = 1.155 x (strand dia) x sqrt(# of Strands)
1.155 x .006. x 4.472 = 0.3099
Add 0.0015 for fabric (nylon) dressing
(I note that the agreement with measured diameter is not at all great)

##########
7 Turn Litz - Belly Band wire
Source: New England Electric Wire (BCB ordered in 1985 or 1986- it was something that they had in stock at the time.)
Properties: 7 turns of #32 wire with Heavy Nyleze insulation

Measured Properties: Wire Diameter 0.0275"
Strand Diameter 0.00925"

Listed Properties: Bare Strand Diameter 0.0080" nom
Coated Strand Diameter 0.0095" nom
Calculated Wire Properties:
Dia = 1.155 x (strand dia) x sqrt(# of Strands)
1.155 x .0095. x 2.646 = 0.0290
##########

19 Feb

I have a FAX from NEEW which provides me with the following quotes
NELB22/38SN about 7 lbs @ $9.302/lb (1 week delivery)
NELB50/38SN approx 10 lbs @ 7.895/lb (1 week delivery)
both items are also subject to a $0.0475/lb petrochemical surcharge
where the delivery signifies that they are stock items. We would need to spend about $100 minimum and suffer a 4-6 week delivery to order what we might choose. They also had NELB33/38SPSN (has nylon cover) in stock but I was less interested. Also had NELB13/30, NELB9/36, NELB10/36,NELB43/36HP,DNS and NELB32/36SPSN.

Contact on 13 Feb 1991 was Terry O'Brien. He clarified for me the types of insulation. The discuss 'solderable' insulations including Nylese (Polynylon) and Sodereze (Polyurathane) vs 'stripable' insulations such as Formvar. I thought that the soderable sounded great for us. We have had it in the 7 turn Litz above, but we have not realized it should be nor proved that it is.
##########
Per phone call info I interpret the information in the above offer as follows:

##########
22 Turn Litz - NELB22/38SN
They have about 6000' or 6.929 lbs

Source: New England Electric Wire (BCB orders now - Feb 1991)

Properties: 22 turns of #38 wire with Single Nyleze insulation
Listed Properties: Bare Strand Diameter 0.0040" nom
Coated Strand Diameter 0.0045" nom
Calculated Wire Properties:
Dia = 1.155 x (strand dia) x sqrt(# of Strands)
1.155 x .0045 x 4.69 = 0.0244

Its here --- 6 March 1991
Measured bare wire size: .0042" (with micrometer division only to .001")
Hard to measure full diameter but seems to be about .021"
Will add some low viscocity glue and try again.
##########
50 Turn Litz - NELB50/38SN

Source: New England Electric Wire (BCB orders now - Feb 1991)

Properties: 50 turns of #38 wire with Single Nyleze insulation
Listed Properties: Bare Strand Diameter 0.0040" nom
Coated Strand Diameter 0.0045" nom
Calculated Wire Properties:
Dia = 1.155 x (strand dia) x sqrt(# of Strands)
1.155 x .0045 x 7.071 = 0.03675

Its here --- 6 March 1991

Measured bare wire size: .0042" (with micrometer division only to .001")
Cannot measure full diameter.
Will add some low viscocity glue and try again.
##
We could consider the problem more broadly and look at some alternatives.

Litz Wire Design Table

Nominal Size = 1.155 * sqrt(Turns)*Strand Dia.

Strand Size AWG	Size Nominal Bare Wire Inches	Heavy Film Coated Nominal Coated Size Inches	22 Turn Litz Size Inches	44 Turn Litz Size Inches	Single Film Coated Nominal Coated Size Inches	22 Turn Litz Size Inches	44 Turn Litz Size Inches
32	0.008	0.0095	0.05147	0.07278	0.0088	0.04767	0.06742
33	0.0071	0.0085	0.04605	0.06512	0.0078	0.04226	0.05976
34	0.0063	0.0075	0.04063	0.05746	0.007	0.03792	0.05363
35	0.0056	0.0067	0.0363	0.05133	0.0062	0.03359	0.0475
36	0.005	0.006	0.0325	0.04597	0.0056	0.03034	0.0429
37	0.0045	0.0055	0.0298	0.04214	0.005	0.02709	0.03831
38	0.004	0.0049	0.02655	0.03754	0.0045	0.02438	0.03448
40	0.0031	0.0038	0.02059	0.02911	0.0035	0.01896	0.02681
42	0.0025	0.003	0.01625	0.02298	0.0028	0.01517	0.02145
44	0.002	0.0025	0.01354	0.01915	0.0022	0.01192	0.01686