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Relativistic Heavy Ion Collider
Magnet Division Procedure

Proc. No.: RHIC-MAG-M-4135

Issue Date: Sept. 9, 1991

Rev. No.: _____

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Class: Ancillary
Title: RHIC Superconductor Wire Twist Measurement

- Cognizant Engineer: Signature on File
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REVISION RECORD

Rev. No.	Date	Page	Subject	Approved	QA
	12/29/92		Referenced in Specification RHIC-MAG-M-4141, ECN# MG00215.		

1. Scope:

This procedure details a method of determining the amount of twist that has been fabricated into an individual superconductor wire. This wire is utilized to make cable for RHIC superconducting coils.

2. Applicable Documents:

None

2.1 Process Materials

a) Superconductor wire sample material
b) 20 power microscope
c) Machinist microscope
d) Nitric Acid - nonfuming
e) Paraffin wax
f) Test fixture - the fixture has one end that can translate horizontally only and will not rotate. One wire sample end is clamped to this head. A spring will apply a tensile load of 7.0 to 8.0 pounds to the wire sample. The other wire end is held in a clamp that is part of a micrometer head. See Figure 1.

Note: Safety precautions must be adhered to during use of acid solutions. Safety glasses, gloves and shoes must be worn when in the proximity of these chemicals.

3. Procedure:

3.1 Cut a wire sample 1.5 in. long.

3.2 Dip both wire ends in molten paraffin wax to a depth of 0.25 0.06 in.

Note: The nitric acid etch bath to follow will undercut the paraffin wax coating by 1/64 in. Attempt to have the uncoated length of wire as near 1.0 in. as possible.

3.3 Using a solution of two (2) parts nitric acid to one (1) part water, submerge the wire sample for a period of 15 minutes.

Note: This step etches away the copper sleeve surrounding the superconductor filaments, while leaving the copper center core intact. The core keeps the filaments rigid while preventing the ends from untwisting. Observe the etched wire through a microscope to determine that no "blossoming" of the filaments has occurred. "Blossoming" is a condition whereby the filaments separate from the core and each other.

Normally, the acid etch step will only remove the outer copper covering and not affect the copper core in the wire center. If wire has not been twisted sufficiently, the acid etch step may cause the core to be etched away even before the total etch period has elapsed. If this occurs the sample is not suitable for twist measurement testing and should be discarded. "Blossoming" is also a simple indicator that the wire twist is incorrect.

3.4 Clean paraffin wax from the sample ends.
Make certain the micrometer setting is at 1.000 in.
Clamp one wire end to the fixture head having horizontal translation.

3.5 Shift the horizontal translating head toward the micrometer head until the free end of the wire sample enters the head and the proper tensile load is applied to the sample. Clamp the wire end.

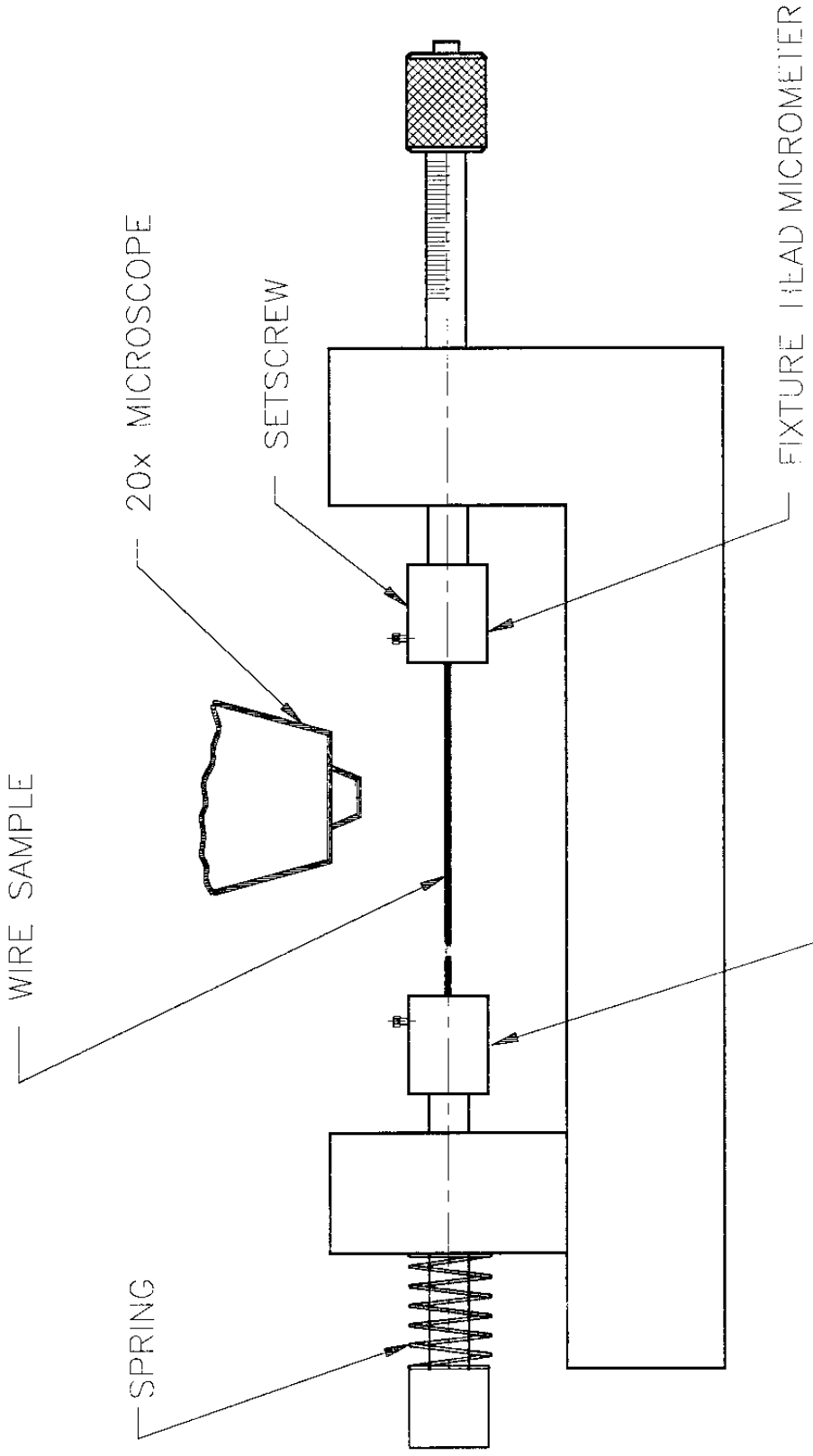
3.6 Rotate the micrometer head in a clockwise direction while observing the wire filaments through the 20 power microscope. Record micrometer reading when the filaments are parallel to each other.

Note: A viewing aid is provided by reflecting light from a white surface along the side of the sample. This will allow clearer viewing of the filaments to determine parallelism.

3.7 Using a machinist microscope measure and record the etched length of wire while under tension in the fixture.

3.8 Calculate the wire twist in turns per inch as shown in the Data Sheet.

3.9 Contact Cognizant Engineer if the wire does not meet the specification.



SUPERCONDUCTOR WIRE TWIST TEST
FIGURE 1

Data Sheet

A. Micrometer: 1.0 revolution of barrel (360 degrees) = 0.025 in.

Each 0.001 in. translation = 14.4 degrees

B. Turns (twist) per inch of length = $\frac{\text{Measured rotation (degrees)}}{\text{360 degrees x etched length}}$

C. Measured translation (inches) = 1.000 - micrometer reading

D. Twist requirement: see appropriate wire or cable specification.

No.	Micrometer Reading (in.)	Rotation (degrees)	Etched Wire Length (in.)	Turns (twist) per in. length	Meets Spec.	
					Yes	No
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						