TS-SSC 91-080

COIL SLIP PLANE EXPERIMENT

Michael Gordon
Nick Hassan

Superconducting Super Collider Laboratory
2550 Beckleymeade
Dallas, Texas 75237

May, 1991

COIL SLIP PLANE EXPERIMENT

Introduction

This paper describes a series of experiments performed to investigate the use of lubricants as an assembly aide during the collaring operation. A 40 mm short model dipole was collared with two types of lubricants applied to the ground insulation, Teflon and molybdenum disulfide (MoS_2). The intention was to achieve a better load transfer from the coil midplane to the pole by reducing the loss due to friction. A discussion of the results and conclusions follow.

Procedures & Results

The experiment consisted of four collaring sessions, conducted with short model magnet DSO-312 at Fermilab. The first collaring was done without any lubrication, to serve as the control. Teflon was tested using two different configurations, plumbers tape applied directly to the coil surfaces and Teflon tape with adhesive applied to the Kapton ground insulation. Two types of MoS_2 sprays were tested, a wet oil based film and a dry film. Molybdenum disulfied is a lubricant typically used in applications which involve high loads. There are concerns that this product may become radioactive in a radiation environment. Also, electrical conductivity of MoS_2 should be examined to determine feasibility of its use in magnets. In this experiment, MoS_2 was used only to examine the effects of a lubrication. In each case strain gauge readings of transducer collar packs were recorded with every 1000 psi increase in hydraulic press pressure up to 9,300 psi at which point the

collars were keyed. The press capacity was 3,250 tons at 10,000 psi hydraulic pressure.

Figure 1 illustrates the overall coil stress as a function of press hydraulic pressure for the lubricants used. The graph shows that the use of lubricants results in a higher coil stress than the case without lubrication. An increased coil stress is an indication of the effectiveness of the lubricants. The lubricant reduces the loss in load transfer from the coil midplane to the pole due to friction. Teflon applied to the insulation had the highest coil stress, indicating that it was the most effective lubricant.

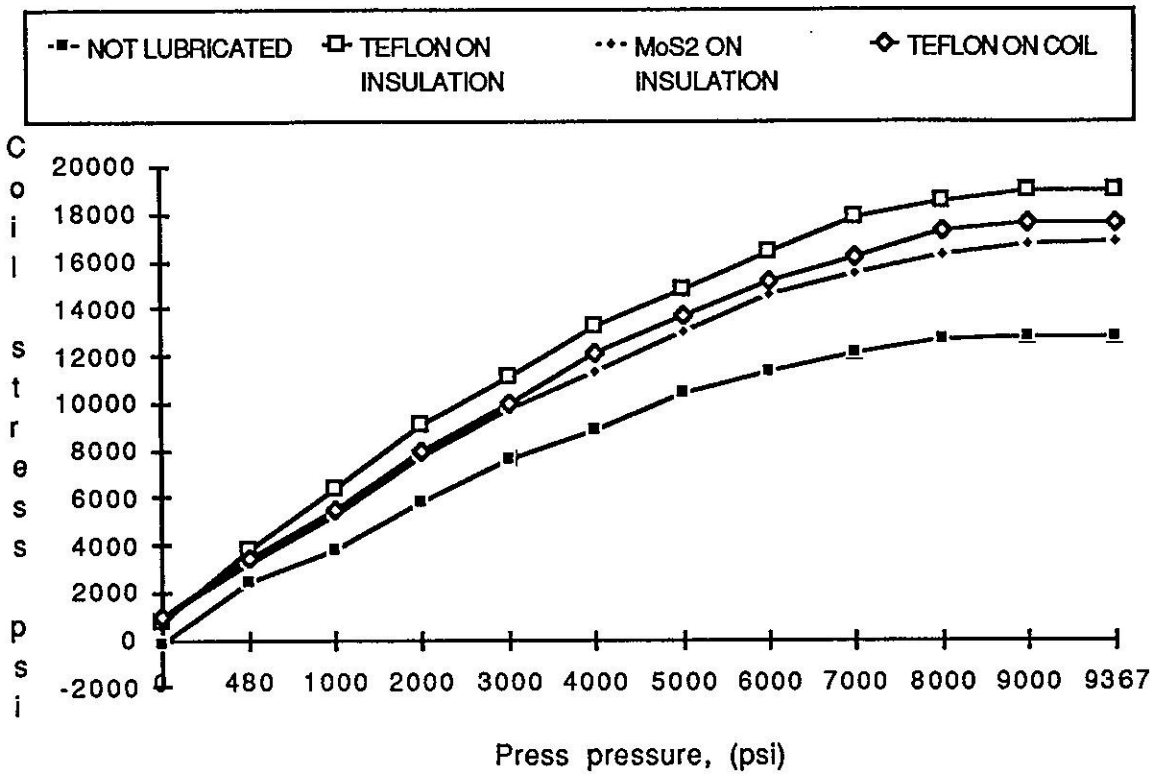

Figure 1

Figure 2 is a graph of change in coil stress with respect to change in press pressure as a function of press pressure. The graph in figure 2 presents the slope of the curve shown in Figure 1 as a function of press pressure. The graph displays the effectiveness of the lubricants. The steeper the slope, the greater the load transfer to the pole. The Teflon on insulation appears to be the most effective lubricant.

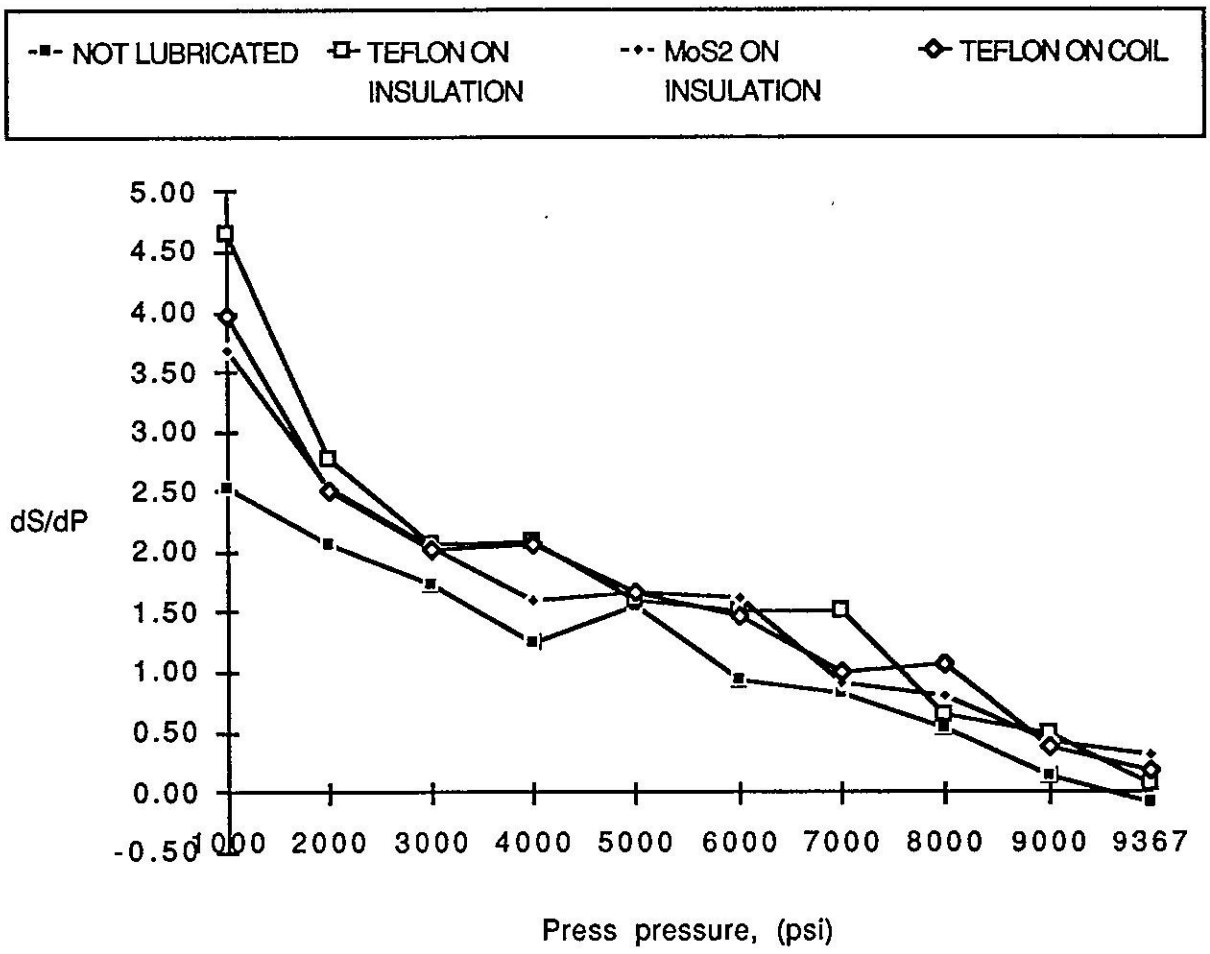

Figure 2

The Teflon on insulation portion of the experiment was repeated. Results of this experiment are displayed in Figure 3. The second Teflon on insulation trial showed a slightly different behavior than the first one. This can be explained by the fact that a different set of coils and a different strain gauge collar pack were used for this trial. However, the final coil stress, at peak pressure, is still greater than the stress levels usually observed in cases that lubrication is not used.

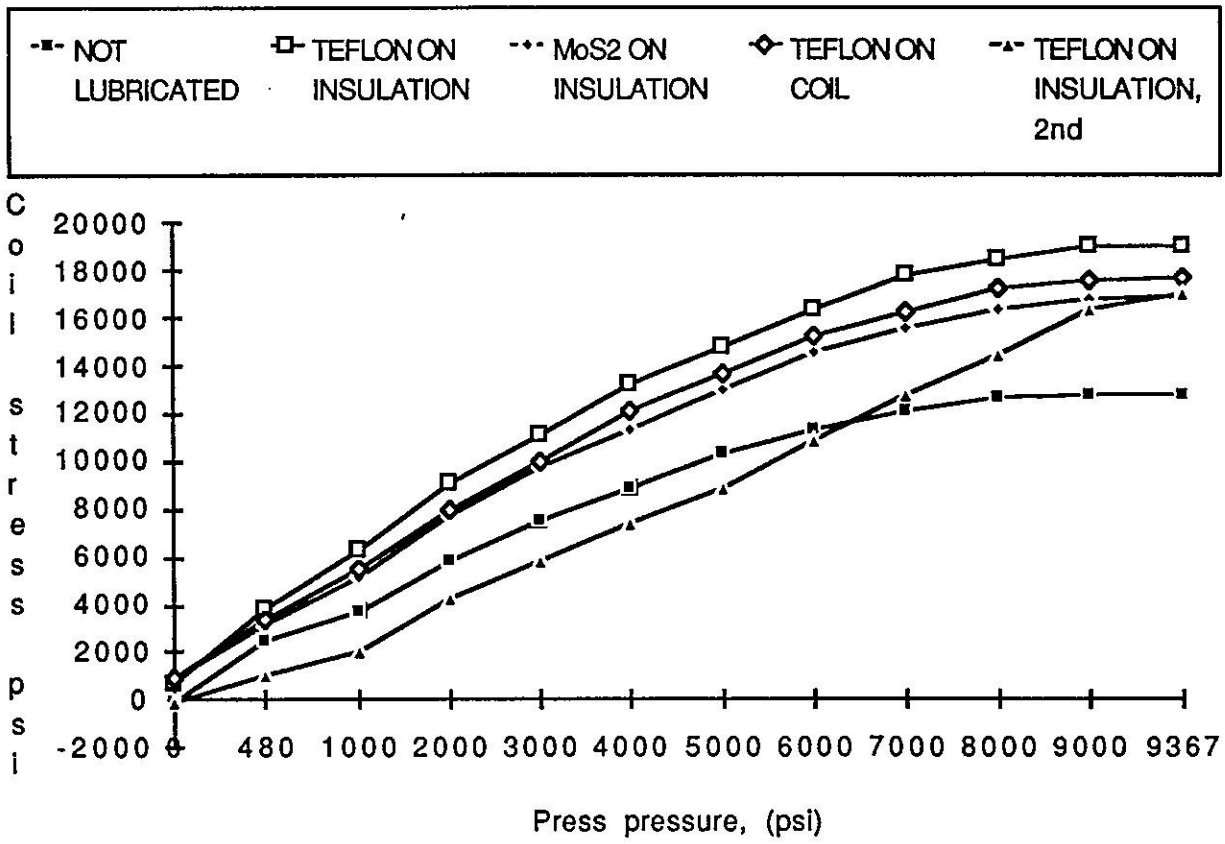

Figure 3

Conclusions

The experiment yielded two important conclusions. First, a lubricant improves the load transfer from the midplane to the pole position of the coil. Secondly, of the lubricants used, Teflon on insulation is the most effective slip plane.

Reduction of the load loss due to friction results in achieving the required coil stress at lower press loads. This will help to reduce the risk of damaging the coil insulation.

An important advantage of applying Teflon to the coil insulation is the ease of assembly. Teflon on insulation was considerably easier to apply than the other lubricants.

Distribution:

R. Bossert
J. Carson
S. Delchamps
S. Gourlay
W. Koska
R. Sims
J. Strait
M. Wake
M. Winters

Conclusions

The experiment yielded two important conclusions. First, a lubricant improves the load transfer from the midplane to the pole position of the coil. Secondly, of the lubricants used, Teflon on insulation is the most effective slip plane.

Reduction of the load loss due to friction results in achieving the required coil stress at lower press loads. This will help to reduce the risk of damaging the coil insulation.

An important advantage of applying Teflon to the coil insulation is the ease of assembly. Teflon on insulation was considerably easier to apply than the other lubricants.

Distribution:

R. Bossert
J. Carson
S. Delchamps
S. Gourlay
W. Koska
R. Sims
J. Strait
M. Wake
M. Winters