Lubrication. In order to reduce wear, it would be very desirable to lubricate sliding electrical contact systems. This would be simple, were it not necessary to pass the electrical intelligence through the sliding members. The electrical aspects impose several restrictions on the nature of lubri-cants that are permissible.

Lubrication by fluids and greases can be classified generally into *hydrodynamic* lubrication and *boundary* lubrication. In hydrodynamic lubrication the two surfaces are completely separated by a layer of liquid. Frictional forces are those that occur from the shearing of the fluid. Hydrodynamic lubrication is useless in contact technology, except for liquid metal apparatus, because the liquid films are continuous, insulating and too thick to permit conduction by the tunnel effect.

Boundary lubrication is that in which part of the load is supported by the metals (i.e., there is *some* intimate contact of asperities) and the remaining portion of the load is supported by a thin lubricating film. The presence of some intimate metallic contact and micro-welds allows current to flow as does the thinness of the films which may conduct by tunnel effect.

It is important to recall that except for extreme vacuum conditions, all metallic surfaces contain some "natural" lubrication in the form of sulfides, chlorides, absorbed gases, water vapor and organic molecules. Any of these natural lubricants fall in the category of boundary lubrication in successful sliding contact systems. Thus *lubricated* contacts are referred to as those which have some *intentional* lubricant added, ordinarily in the form of a liquid or grease.

Among the lubricants presently used in sliding contact systems are hydrocarbons, chlorofluorocarbons, polyphenyl ethers, chlorinated biphenyls, diesters, and silicones. Unfortunately, complete information on conditions under which each was used is lacking and falls short of answering the many questions raised in the foregoing list of guidelines and precautions.

Contact lubricants cannot be classified into groups as excellent, good, poor, nor can any general rule be applied as to whether or not to use any lubricant. A few specific guidelines and precautions can be cited, however.
See list on following page...

1. A lubricant is totally unsatisfactory under any conditions where the combined effect of surface speed, contact force, geometry, viscosity or temperature would produce hydrodynamic lubrication. The physical separation of the surfaces is intolerable.

2. Silicone compounds can decompose in the presence of an arc, producing silicon deposits (sand) and resultant high abrasive wear. Hydrocarbon lubricants carbonize in an arc to cause erratic contact resistance.

3. In cases where the chosen contact materials oxidize too readily, surfaces can be protected from ambient atmosphere effect by use of a lubricant.

4. Some applications of lubricant have been known to increase wear rather than decrease it by preventing the formation of beneficial natural films.

5. Lubricants can act as dust collectors and carriers for the products of abrasion, producing a lapping compound. Viscous lubricants do not permit wear debris to readily fall from the wear path or be brushed aside.

6. A carefully selected lubricant has the potential for substantially reducing stick-slip, wear and improving electrical performance. The selection usually will entail verification of performance under *all* extremes of contact force, speeds and ambient conditions.