Many industrial enterprises which are introducing iron-graphite bearings in place of the nonferrous antifriction alloys are using the same lubricants without taking into account the specific characteristics of cermet antifriction materials. Our experiments have shown that during wear of the friction pair under identical conditions, the temperature in the friction zone of the iron-graphite bushings is somewhat higher than that of bronze ones (Fig. 1). In addition the more developed porous surface of friction accelerates the oxidation of oils and lubricants and thus affects their efficiency. The increase of the temperature in the friction zone and the accelerated oxidation of the lubricants necessitate selecting better lubricants which can ensure the performance of the friction unit under these conditions.

Since lubricating oils have optimal performance only within certain loading and temperature limits, the main task of our work was to establish the limits of applicability of a particular oil in combination with the iron-graphite bearings. For the selection tests we used mineral oils: from refined distillate oils — industrial-12 (spindle-2), industrial-50 (machine-SU), from unrefined transmission oils — axle oil-L, automotive-L (GOST 542-50), and from residual oils — cylinder-52 (Vapor) and aviation oil MK-22.

The lubricating capacity of the oils was characterized by the coefficient of friction, the specific pressure, under whose effect the oil film, or even the mating surfaces, is destroyed, and by the wear of the mating parts [9]. In our experiments we also determined the temperature in the friction zone relative to the type of oil. Unfortunately, it was complicated to use the well-known method of selecting oils on the four-ball machine [5] owing to the high plasticity and porosity of the iron-graphite in comparison with the materials of the balls. This also hampered the determination of the actual areas of friction and, consequently, the true specific pressures, magnitude of wear, etc.
Fig. 3. Dependence of the friction coefficient and temperature on pressure. Coefficient of friction with spindle oil-2 (1) and machine oil-SU (2); temperature dependence with spindle oil-2 (1') and machine oil-SU (2').

Fig. 4. Dependence of the friction coefficient and temperature on pressure. Coefficient of friction for axle oil-L (1) and synthetic calcium solidol oil (2); temperature dependence for axle oil-L (1') and synthetic calcium solidol oil (2').

Fig. 5. Dependence of friction coefficient and temperature on pressure: friction coefficient for oil MK-22 (1), nigrol (2), and cylinder oil-52 (3); temperature dependence for MK-22 (1'), nigrol (2'), and cylinder oil-52 (3').

The tests were carried out on the MI-1-M friction machine by the standard method at a sliding speed of 0.9 m/sec. A roller of normalized steel 45 and an iron-graphite bushing of ZhGr-20PF having a ferrite-pearlite structure with free graphite inclusions served as the friction pair.

The temperature was measured by a chromel-copel thermocouple by means of a direct-current potentiometer. The thermocouple was inserted through a hole into the friction zone in such a way that the heated layer of oil escaping from under the bushing bathed the thermocouple junction. In the readings of the potentiometer we also took into account the error from the friction of the thermocouple junction against the roller surface. The error was determined beforehand by specially set-up experiments. Such measurements enabled us to make a comparative evaluation of the lubricating capacity of the various types of oils at different temperatures in the friction zone.

Before determining the indexes of the lubricating capacity, each friction pair was preliminarily run in under a load of 50 daN/cm² for 4 h. The completion of running in was judged by the stabilization of the moment of friction,