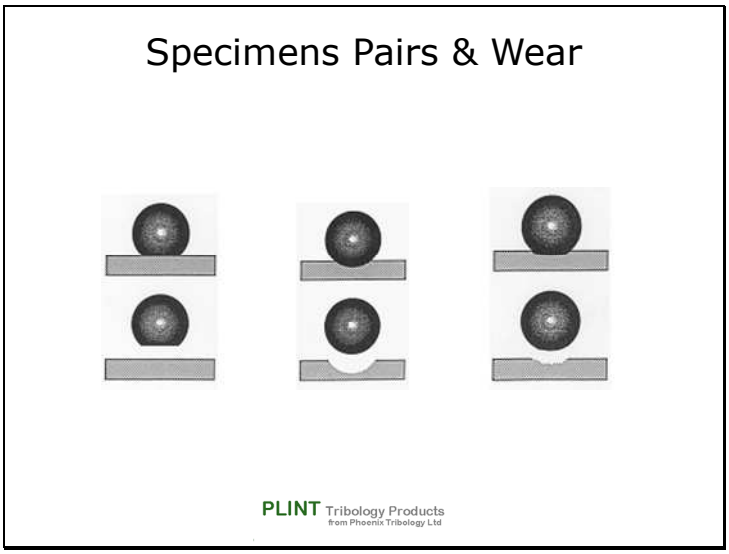
Guidance – Specimen Pairs & Wear

Extract from:

https://www.phoenix-tribology.com/wp-content/uploads/products/guidance/Tutorial-Tribology-Testing.pdf



The first issue to address in designing a test is which way round, in terms of relative hardness, to have the specimen pair. Traditionally, many wear tests have involved running a soft pin or ball on a hard disc or plate. Under these conditions, the wear occurs on the softer material, sometimes accompanied by the generation of a transfer film on the harder material.

Measurement of material lost from the softer pin or ball is relatively easy. It should however be remembered that if material has been transferred to the disc or plate, its mass may increase.

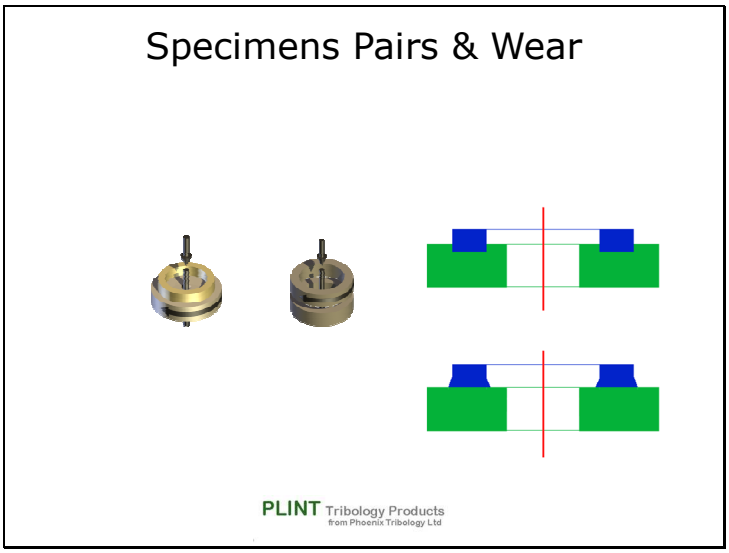
If the specimen pairs are reversed, with a harder pin or ball running on a softer disc or plate, we generate a different mechanism, depending on the relative hardness, the contact pressure and contact shape. What happens to the disc or plate specimen depends on the nature of the material.

With metallic specimens, plastic deformation of the surface and work hardening may take place, thus changing the nature of the material. With coated surfaces, repeated passes by a hardened pin or ball may give rise to adhesion-de-lamination and subsequent failure of the coating.

If we define wear exclusively as the removal of material, it will be apparent that if the scar generated on the disc or plate specimen involves plastic deformation (material is redistributed but not removed), then it cannot be considered in the true sense as a “wear” scar.

With this contact configuration, the processes involved may be more analogous to forming or machining processes. In the case of forming, we would anticipate plastic deformation, and in the case of machining, removal of material by cutting or ploughing action.

In real machines, we frequently find contacting materials of similar hardness, with the result that wear is shared between the two contacting surfaces. The only solution here is to measure the wear on both surfaces, not forgetting that, if the materials are different, the wear rate will still be dependent on which material is used for the pin or ball and which is used for the disc or plate. This is because the energy inputs are different for the two specimens.



With area contact specimens, there are similar considerations. For example, the thrust washer test configuration provides a continuous contact on both test surfaces and thus avoids any of the leading edge problems associated with pin on disc or pin on plate configurations.

However, even with a continuous contact, edge effects must be considered, especially if one specimen has a smaller outer diameter and larger inner diameter than the other.

If the smaller outer diameter specimen (the upper specimen in the sketch) is harder than the larger diameter specimen, it will cut into surface of the latter and the frictional behaviour of the contact will be dominated by circumferential edge effects.

If the smaller upper specimen is softer than the larger diameter lower specimen, the edge effect is removed, but elastic deformation of the softer material may result in a change in apparent area of contact.