## Types of Friction

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| types of friction |

There are different types of friction.

[**Sliding friction**](http://en.wikipedia.org/wiki/Sliding_friction) (also called dry friction) is when two objects are rubbing against each other. Putting a book flat on a desk and moving it around is an example of sliding friction.  
A book moving across the desk is an example of **sliding friction**. As the book slides cross the desk, the bottom of the book is touching the desk. The source of the friction is the contact between the surface of the book and the desk

The weight of the object and the type of surface it moves over determine the amount of sliding friction present between the two objects. A heavy object exerts more pressure on the surface it slides over, so the sliding friction will be greater.

[**Fluid friction**](http://en.wikipedia.org/wiki/Fluid_friction) is the interaction between a solid object and a [**fluid**](http://en.wikipedia.org/wiki/Fluid) (liquid or gas), as the object moves through the fluid. Fluid friction occurs between [fluid](https://en.wikipedia.org/wiki/Fluid) layers that are moving relative to each other. . This internal resistance to flow is named [*viscosity*](https://en.wikipedia.org/wiki/Viscosity). Air, water and oil are all fluids. Air resistance is a type of **fluid friction**. As an object falls, air resistance pushes up on the object. The [**drag**](http://en.wikipedia.org/wiki/Drag_(force)) of air on an airplane or of water on a swimmer are two examples of fluid friction

When you ride a bicycle, the contact between the wheel and the road is an example of **rolling friction**. When an object rolls over a surface, the force needed to overcome rolling friction is much less than that needed to overcome sliding friction.

## Kinetic Friction

When you moved your book across the desk, the book experienced a type of friction that acts on moving objects. This force is known as **kinetic friction force**. It is exerted on one surface by another when the two surfaces rub against each other because one or both surfaces are moving.

## Skin friction

*Main article:*[*Parasitic drag*](https://en.wikipedia.org/wiki/Parasitic_drag)

Skin friction arises from the interaction between the fluid and the skin of the body, and is directly related to the area of the surface of the body that is in contact with the fluid. Skin friction follows the [drag equation](https://en.wikipedia.org/wiki/Drag_equation) and rises with the square of the velocity.

**Static friction**Static friction is a force between two objects that are not moving relative to each other. For example, static friction can prevent an object from sliding down a sloped surface. Another important example of static friction is the force that prevents a car wheel from slipping as it rolls on the ground.

If you stack additional books on top of the first book to increase the normal force, the kinetic friction force will increase. Let's look at the **formula for kinetic friction force**.

There is a linear relationship between the kinetic friction force and the normal force. The **coefficient of kinetic friction** relates the friction force to the normal force. The kinetic friction force (F(f, kinetic)) equals the product of the coefficient of kinetic friction (µ(k)) and the normal force (F(N)). F(f, kinetic) = µ(k) \* F(N)

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| friction forces |

## Static Friction

Imagine trying to push a couch across the floor. You push on it with a small force, but it does not move. This is because it is not accelerating. Newton's laws tell you that the net force on the couch must be zero. There must be a second horizontal force acting on the couch, one that opposes your force and is equal in size. This force is **static friction force**, which is the force exerted on the surface by another when there is no motion between the two surfaces.

Static friction force acts in response to a force trying to cause a stationary object to start moving. If there is no such force acting on an object, the static friction force is zero. If there is a force trying to cause motion, the static friction force will increase up to a maximum value before it is overcome and motion starts.

Now let's look at the **formula for static friction force**. The static friction force (F(f, static)) is less than or equal to the product of the coefficient of static friction (µ(s)) and the normal force (F(N)).

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| static friction formula |

The maximum static friction force relates to the normal force in a similar way as the kinetic friction force. In the **equation for maximum static friction force**, µ(s) is the **coefficient of static friction** between two surfaces. The maximum static friction force that must be overcome before motion can begin is µ(s) \* F(N). In the example of pushing the couch, the maximum static friction force balances the force of the person pushing on the couch the instant before the couch begins to move.

## Measuring Coefficients of Friction

On what does a friction force depend? The materials that the surfaces are made of play a role. For example, imagine trying to play basketball while wearing socks instead of athletic shoes. You would slip and slide all over the basketball court. Shoes help provide the forces necessary to quickly change directions while running up and down the court. There is more reaction between your shoes and concrete than there is between your socks and a polished wood floor.

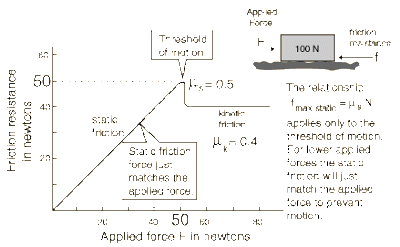
This table shows coefficients of static friction (µ(s)) and coefficients of kinetic friction (µ(k)) between various surfaces. The coefficients of friction show how easily one object can slide against another. These coefficients are estimates for each combination of surfaces. Exact measurements of coefficients of friction are quite sensitive to the conditions of the surfaces and are determined experimentally.

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| coefficients of friction caption= |

Another important fact regarding the table is that all the measurements were made on dry surfaces (with exception of the oiled steel). Wet surfaces behave quite differently than dry surfaces.

The coefficient of static friction, typically denoted as μs, is usually higher than the coefficient of kinetic friction. The initial force to get an object moving is often dominated by static friction.  
Another important example of static friction is the force that prevents a car wheel from slipping as it rolls on the ground. Even though the wheel is in motion, the patch of the tire in contact with the ground is stationary relative to the ground, so it is static rather than kinetic friction.  
The maximum value of static friction, when motion is impending, is sometimes referred to as limiting friction,**[[3]](http://en.wikipedia.org/wiki/Friction" \l "cite_note-Bhavikatti-2" \o ")** although this term is not used universally.[**[4]**](http://en.wikipedia.org/wiki/Friction#cite_note-Beer-3) The value is given by the product of the normal force and coefficient of static friction.

Static frictional forces from the interlocking of the irregularities of two surfaces will increase to prevent any relative motion up until some limit where motion occurs. It is that threshold of motion which is characterized by the [**coefficient**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict.html#coe) of static friction. The coefficient of static friction is typically larger than the coefficient of [**kinetic friction**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict2.html#kin).

In making a distinction between static and kinetic coefficients of friction, we are dealing with an aspect of "real world" common experience with a phenomenon which cannot be simply characterized. The difference between static and kinetic coefficients obtained in simple experiments like wooden blocks sliding on wooden inclines roughly follows the model depicted in the [**friction plot**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict2.html#plo) from which the illustration above is taken. This difference may arise from irregularities, surface contaminants, etc. which defy precise description. When such experiments are carried out with smooth metal blocks which are carefully cleaned, the difference between static and kinetic coefficients tends to disappear. When coefficients of friction are quoted for specific surface combinations are quoted, it is the kinetic coefficient which is generally quoted since it is the more reliable number.

**Kinetic friction**  
Kinetic (or dynamic) friction occurs when two objects are moving relative to each other and rub together (like a sled on the ground). The coefficient of kinetic friction is typically denoted as μk, and is usually less than the coefficient of static friction.

Examples of kinetic friction:  
[**Sliding friction**](http://en.wikipedia.org/wiki/Sliding_friction) (also called dry friction) is when two objects are rubbing against each other. Putting a book flat on a desk and moving it around is an example of sliding friction.  
[**Fluid friction**](http://en.wikipedia.org/wiki/Fluid_friction) is the interaction between a solid object and a [**fluid**](http://en.wikipedia.org/wiki/Fluid) (liquid or gas), as the object moves through the fluid. The [**drag**](http://en.wikipedia.org/wiki/Drag_(force)) of air on an airplane or of water on a swimmer are two examples of fluid friction. This kind of friction is not only due to rubbing, which generates a force tangent to the surface of the object (such as sliding friction). It is also due to forces that are [**orthogonal**](http://en.wikipedia.org/wiki/Orthogonal) to the surface of the object. These orthogonal forces significantly (and mainly, if relative velocity is high enough) contribute to fluid friction. Fluid friction is the classic name of this force. This name is no longer used in modern [**fluid dynamics**](http://en.wikipedia.org/wiki/Fluid_dynamics). Since rubbing is not its only cause, in modern fluid dynamics the same force is typically referred to as drag or fluid resistance, while the force component due to rubbing is called [**skin friction**](http://en.wikipedia.org/wiki/Skin_friction). Notice that a fluid can in some cases exert, together with drag, a force orthogonal to the direction of the relative motion of the object ([**lift**](http://en.wikipedia.org/wiki/Lift_(force))). The net force exerted by a fluid (drag + lift) is called **[fluidodynamic force](http://en.wikipedia.org/wiki/Aerodynamic_force" \o "Aerodynamic force)** (aerodynamic if the fluid is a gas, or idrodynamic is the fluid is a liquid).

When two surfaces are moving with respect to one another, the frictional resistance is almost constant over a wide range of low speeds, and in the [**standard model**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict.html#fri) of friction the frictional force is described by the relationship below. The [**coefficient**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict.html#coe) is typically less than the coefficient of [**static friction**](http://hyperphysics.phy-astr.gsu.edu/hbase/frict2.html#sta), reflecting the common experience that it is easier to keep something in motion across a horizontal surface than to start it in motion from rest.