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TYPES OF FLOW

1) LAMINAR FLOW

2) TURBULENT FLOW

**1. Laminar flow: O**ccurs when the fluid flows in parallel layers, with no mixing between the layers. Where the center part of the pipe flow the fastest and the cylinder touching the pipe isn’t moving at all. The flow is laminar when [Reynolds number](https://me-mechanicalengineering.com/reynolds-number/) is less than 2300.

In [fluid dynamics](https://en.wikipedia.org/wiki/Fluid_dynamics), **laminar flow** (or [**streamline**](https://en.wikipedia.org/wiki/Streamlines%2C_streaklines_and_pathlines) **flow**) occurs when a fluid flows in parallel layers, with no disruption between the layers.[[1]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-Batchelor-1) At low velocities, the fluid tends to flow without lateral mixing, and adjacent layers slide past one another like playing cards. There are no cross-currents perpendicular to the direction of flow, nor [eddies](https://en.wikipedia.org/wiki/Eddies) or swirls of fluids.[[2]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-Geankoplis.2C_Christie_John_2003-2) In laminar flow, the motion of the particles of the fluid is very orderly with particles close to a solid surface moving in straight lines parallel to that surface.[[3]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-3) Laminar flow is a flow regime characterized by high [momentum diffusion](https://en.wikipedia.org/wiki/Momentum_diffusion) and low momentum [convection](https://en.wikipedia.org/wiki/Convection).

When a fluid is flowing through a closed channel such as a pipe or between two flat plates, either of two types of flow may occur depending on the velocity and viscosity of the fluid: laminar flow or [turbulent flow](https://en.wikipedia.org/wiki/Turbulence). Laminar flow tends to occur at lower velocities, below a threshold at which it becomes turbulent. Turbulent flow is a less orderly flow regime that is characterized by [eddies](https://en.wikipedia.org/wiki/Eddies) or small packets of fluid particles, which result in lateral mixing.[[2]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-Geankoplis.2C_Christie_John_2003-2) In non-scientific terms, laminar flow is *smooth*, while turbulent flow is *rough*. A common application of laminar flow is in the smooth flow of a viscous liquid through a tube or pipe. In that case, the velocity of flow varies from zero at the walls to a maximum along the cross-sectional centre of the vessel. The flow profile of laminar flow in a tube can be calculated by dividing the flow into thin cylindrical elements and applying the viscous force to them.[[5]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-5)

Another example is the flow of air over an aircraft [wing](https://en.wikipedia.org/wiki/Wing). The [boundary layer](https://en.wikipedia.org/wiki/Boundary_layer) is a very thin sheet of air lying over the surface of the wing (and all other surfaces of the aircraft). Because air has [viscosity](https://en.wikipedia.org/wiki/Viscosity), this layer of air tends to adhere to the wing. As the wing moves forward through the air, the boundary layer at first flows smoothly over the streamlined shape of the [airfoil](https://en.wikipedia.org/wiki/Airfoil). Here, the flow is laminar and the boundary layer is a [laminar layer](https://en.wikipedia.org/wiki/Boundary_layer). [Prandtl](https://en.wikipedia.org/wiki/Ludwig_Prandtl) applied the concept of the laminar boundary layer to airfoils in 1904.[[6]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-6)[[7]](https://en.wikipedia.org/wiki/Laminar_flow#cite_note-7)

**2. Turbulent flow:**

In turbulent flow occurs when the liquid is moving fast with mixing between layers. The speed of the fluid at a point is continuously undergoing changes in both magnitude and direction.

The flow is turbulent when [Reynolds number](https://me-mechanicalengineering.com/reynolds-number/) greater than 4000

**Turbulence** or **turbulent flow** is a flow regime in [fluid dynamics](https://en.wikipedia.org/wiki/Fluid_dynamics) characterized by [chaotic](https://en.wikipedia.org/wiki/Chaos_theory) changes in [pressure](https://en.wikipedia.org/wiki/Pressure) and [flow velocity](https://en.wikipedia.org/wiki/Flow_velocity). It is in contrast to a [laminar flow](https://en.wikipedia.org/wiki/Laminar_flow) regime, which occurs when a fluid flows in parallel layers, with no disruption between those layers.[[1]](https://en.wikipedia.org/wiki/Turbulence#cite_note-Batchelor-1)

Turbulence is commonly observed in everyday phenomena such as [surf](https://en.wikipedia.org/wiki/Breaking_wave), fast flowing rivers, billowing storm clouds, or smoke from a chimney, and most fluid flows occurring in nature and created in engineering applications are turbulent.[[2]](https://en.wikipedia.org/wiki/Turbulence#cite_note-ting-surf-2)[[3]](https://en.wikipedia.org/wiki/Turbulence#cite_note-tennekes-3):2 Turbulence is caused by excessive kinetic energy in parts of a fluid flow, which overcomes the damping effect of the fluid's viscosity. For this reason turbulence is easier to create in low viscosity fluids, but more difficult in highly viscous fluids. In general terms, in turbulent flow, unsteady [vortices](https://en.wikipedia.org/wiki/Vortices) appear of many sizes which interact with each other, consequently [drag](https://en.wikipedia.org/wiki/Drag_%28physics%29) due to friction effects increases. This would increase the energy needed to pump fluid through a pipe, for instance. However this effect can also be exploited by such as aerodynamic [spoilers](https://en.wikipedia.org/wiki/Spoiler_%28aeronautics%29) on aircraft, which deliberately "spoil" the laminar flow to increase drag and reduce lift.

The onset of turbulence can be predicted by a dimensionless constant called the [Reynolds number](https://en.wikipedia.org/wiki/Reynolds_number), which calculates the balance between kinetic energy and viscous damping in a fluid flow. However, turbulence has long resisted detailed physical analysis, and the interactions within turbulence creates a very complex situation. [Richard Feynman](https://en.wikipedia.org/wiki/Richard_Feynman) has described turbulence as the most important unsolved problem of classical physics.[[4]](https://en.wikipedia.org/wiki/Turbulence#cite_note-eames-quoting-feynman-4)

EXAMPLES OF TURBULENT FLOW

 Smoke rising from a [cigarette](https://en.wikipedia.org/wiki/Cigarette) is mostly turbulent flow. However, for the first few centimeters the flow is [laminar](https://en.wikipedia.org/wiki/Laminar_flow). The smoke [plume](https://en.wikipedia.org/wiki/Plume_%28fluid_dynamics%29) becomes turbulent as its [Reynolds number](https://en.wikipedia.org/wiki/Reynolds_number) increases, due to its flow velocity and characteristic length increasing.

 Flow over a [golf ball](https://en.wikipedia.org/wiki/Golf_ball). (This can be best understood by considering the golf ball to be stationary, with air flowing over it.) If the golf ball were smooth, the [boundary layer](https://en.wikipedia.org/wiki/Boundary_layer) flow over the front of the sphere would be laminar at typical conditions. However, the boundary layer would separate early, as the pressure gradient switched from favorable (pressure decreasing in the flow direction) to unfavorable (pressure increasing in the flow direction), creating a large region of low pressure behind the ball that creates high [form drag](https://en.wikipedia.org/wiki/Form_drag). To prevent this from happening, the surface is dimpled to perturb the boundary layer and promote transition to turbulence. This result in higher skin friction, but moves the point of boundary layer separation further along, resulting in lower form drag and lower overall drag.