

Sound barriers and shock waves

What is the “sound barrier”

As a plane approaches the speed of sound, it encounters extreme buffeting, preventing the plane from going faster.

Is it really a barrier?

Yes, it is. The plane has trouble pushing through it.

What is sound?

Rapid compression of air molecules (several times/second)
Reaches the ear, etc.
Produced by something vibrating or expanding rapidly

What makes it a barrier?

Starts out as any other sound – compressed air
It moves in every direction about 750 mph
As plane goes faster, it catches up to the compressions
More sound is produced, but can't outrun the plane
Air is compacted more and more in front of the plane.
The air becomes much denser.
Much as steel is denser than Styrofoam.
Plane has a harder time pushing through this much denser air

Characteristics

Sound travels out in every direction
Sound behind plane is not a problem – less dense air
Faster plane flies, more acute angle becomes

Shock waves

Similarly, at supersonic speeds, air builds up in front -- drag
Needs to be pushed away, requires force, powerful engine
Larger the area, more force needed
Anything sticking outside the wave creates another wave, more drag
Supersonic craft have long, pointy noses
Puts the wave envelope outside the plane “footprint”

The Prandtl-Glauert condensation clouds can occur at lower speeds, and are not a visible indication of the sound barrier's being broken.