

# Atmospheric Pressure and Its American Unit

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December 2020

**Practical Problem:** How do you specify 1 atmospheric pressure in the USA?

**Solution:** We won't go into why the USA keeps the FPS system of measurement, but instead, focus on the problem as it is faced by a young and hapless student of science.

In the USA, pressure, which is force per unit area, is expressed in **pound-force/in<sup>2</sup>**, **lbf/in<sup>2</sup>**, or **psi** in short. Note that the 'p' in psi stands for *pound-force* and not pound, although informally it is taken that way (i.e. pound/in<sup>2</sup>). If you ask a random person in America they might say that the unit of pressure there is "*pound* per square inch". Historical aspects of the resulting mess are described in [1].

As if this were not confusing enough, the definition of **1 pound-force** or **1 lbf** was defined as the *weight* of 1 pound *mass*<sup>1</sup> on the surface of earth! This was really short-sighted. Anyway, the weight  $W$  in **lbf** of **1 pound mass** (or 454 g or

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<sup>1</sup>We feel sorry for those who were taught in a manner to treat mass and weight interchangeably.

0.454 kg) on the surface of earth, is

$$\begin{aligned}W &= mg \dots^2 \\&= 1 \times 9.8 \text{ lb m/s}^2 \\&= 0.454 \times 9.8 \text{ kg m/s}^2 \\&= 4.4492 \text{ N} \dots^3\end{aligned}$$

Thus, **1 lbf** force is equivalent to **4.448 N**.

Then,

$$\begin{aligned}1 \text{ psi} &= 1 \text{ lbf/in}^2 \\&= 4.4492 \text{ N/in}^2 \\&= 4.4492 \times 39.37 \times 39.37 \text{ N/m}^2 \\&= 6896.246 \text{ Pa}\end{aligned}$$

Pascal: Pa is the SI unit of pressure. Since 1 atmospheric pressure is 101325 Pa, from the above we get:

$$\begin{aligned}1 \text{ atm} &= \frac{101325}{6896.246} \text{ psi} \\&= 14.693 \text{ psi}\end{aligned}$$

That's it. 1 atmospheric pressure is 14.693 psi.

## References

- [1] François Cardarelli. Encyclopaedia of Scientific Units, Weights, and Measures: Their SI Equivalences and Origins. Springer. 2003.

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<sup>2</sup> $g$  on earth is  $9.8 \text{ m/s}^2 = 32.2 \text{ ft/s}^2$

<sup>3</sup>SI unit of force is N (Newton) which is cleanly defined as the force required to accelerate 1 kg *mass* at  $1 \text{ m/s}^2$