

Helium Explained

The concept of floating in air is the same as floating in water. If we take a disposable 1 litre water bottle and replace the water with air, it will float in water. When we take it to the bottom of a swimming pool it will want to rise to the water surface when we let it go. This is because air (1.25 gram/litre) is lighter than the water (1000 grams/litre) it displaces.

The helium filled balloon on a string will rise towards the top of the atmosphere (a pool of air many kilometres deep) because helium (.01785 grams/litre) and the balloon, are much lighter than the air they displace. This is the Archimedes principle and the law of buoyancy. .

In order for a helium balloon to float it must be large enough for the differential between the weight of air and helium to overcome the weight of the balloon itself. The helium balloon will rise until it bursts, then the helium will keep going until it exits the edge of the atmosphere.

Hydrogen balloons were once quite popular. Hydrogen weighs just 0.08988 grams per liter. As demonstrated by the Hindenburg, it is highly flammable, so the slightest spark can cause a huge explosion.

Why are hydrogen and helium lighter than our air?

The approximate atomic weight of hydrogen is 1, helium is 4 and nitrogen is 14 because they have fewer electrons, neutrons and protons. Approximately the same number of atoms of each of these elements fills approximately the same amount of space.

How much can helium balloon lift?

A cubic foot of helium will lift 28.2 grams. To calculate the volume of spherical balloon the formula is as follows. $\text{Pi} * r^3(\text{cubed}) * 4/3$. The volume of 10' balloon is $(3.14 * 125 * 4/3)$ 523 cubic feet. This would generate a lifting force of 14.757 kilograms or about 32 pounds.

Combining the lift capability of helium and the power of wind, a Helikite can lift twice the payload of a similar sized blimp. Or a blimp would be twice the size, use twice the amount of helium and be more awkward to deploy and handle.

How does temperature affect lift?

Heating the balloon makes the helium atoms move faster. The force of their collisions with the wall of the balloon increases. The increased force is an increase in pressure which, in turn, stretches the Mylar and makes the balloon expand. Cooling does the opposite. When the balloon cools, the pressure inside drops, then the elasticity of the rubber shrinks the internal volume, and the overall volume of the balloon gets smaller. As a result, it displaces less air and therefore loses some of its lifting capacity. In a desert climate, the balloon will expand in the heat of the day, and contract in the cool of the night. This will cause the balloon fall at night. It will also stretch the seams resulting in helium loss, and poor performance.

How to purchase Helium.

Helium is readily available from the major gas suppliers. In North American the majors are Linde, Praxair and Boc gases. They will typically sell cylinder of helium and rent the cylinder on a monthly or yearly term. They will offer both pick-up and deliver service.

Do not use Hospitality or Balloon gas from a party store. This type of gas is less pure as it is typically recovered from medical institutions. Even though it may be labelled UN1046 it is not pure enough to give enough buoyancy to a HeliKite.

These suppliers do not include the regulator. Regulators may be purchased from the gas supplier, from some party supply stores and from GasKites. The regulator with a "push-in" valve is less tedious to operate than a "hold sideways" valve.

Sample prices of Helium in Canadian dollars.

Tank size	Volume of Helium		Cost in CDN\$	
"T"	7.85m ³	277.22 ft ³	\$182	\$23.18/m ³
"K"	5.90m ³	208.36 ft ³	\$135	\$22.88/m ³
"M"	2.98m ³	105.24 ft ³	\$89	\$29.86/m ³

Cost to fill a bird scarring Vigilante Helikite(.15m ³)	\$3.47
Cost to fill an advertising Skyhook HeliKite (1m ³)	\$23