

# [Helmholtz coils to create zero magnetic field in the laboratory](https://assignbuster.com/helmholtz-coils-to-create-zero-magnetic-field-in-the-laboratory/)

Helmholtz Coils to create Zero Magnetic Field in Laboratory The traditional purpose of Helmholtz coils has been to create a uniform magnetic field inthe laboratory[1]. A solenoid could easily have been used here but the Helmholtz coil has the added advantage that the process under experimentation is visible to the observer. The basic construction consists of two coaxial coils of equal radii placed so that the distance between their centers is equivalent to their internal radius. The current through the coils can circulate in either the same direction or in opposite directions. If the direction of current flow is the same, then, at the centre of the apparatus, a highly homogenous magnetic field is obtained. Under normal circumstances, the earth exerts its own magnetic field at every point in its surface. By adjusting the strength of the current through the coils, it can arranged to have the magnetic field of the earth completely cancelled out within the Helmholtz coils, thus creating a condition of absolutely zero magnetic field at the centre of the coils. The schematic diagram is shown below:

The axis of the coils are arranged horizontally [2]
The expression for magnetic field at the centre

The Biot Savart law [3] gives the magnetic field at a distance r from a line element dl as
Where,
Note that
By symmetry considerations and the geometry of the coil, we get that

Thus,

Or finally,
Adding the magnetic field contributions due to both the coils, the total magnetic field at the centre becomes:
As for Helmholtz coils the distance between the centers x = a/2,
This is the maximum field strength obtained in the Helmholtz coils and the for a given Helmholtz coil, it is directly proportional to the value of the current i.
If the magnetic field in the laboratory due to the Earth is H, then a zero magnetic field is obtained when:
Thus by passing a current given by the above equation, a condition of zero magnetic fields can be created at the centre of a Helmholtz coil.
Works Cited
[1]Feynman, R. P., Leighton, R. B., & Sands, M. L. (1963). The Feynman Lectures on Physics, Vol II. Addison-Wesley.
[2]Halliday, D., Resnick, R., & Walker, J. (2006). Fundamentals of Physics, Sixth Edition. Wiley.
[3]Sears, F. W., & Zemansky, M. W. (1955). University Physics. Addison-Wesley.