Two-metres, three-axis (3D), square Helmholtz coils

Ferronato® - BHC2000-3-A and BHC2000-3-B

- Two versions:
  BHC2000-3-A, with heavy windings, for relatively high magnetic fields to 1 mT.
  BHC2000-3-B, with lighter windings, well suited to cancel the local Earth's field.
- Free of eddy currents, what makes it suitable for operation in AC, else than in DC.
- Bifilar windings to get two identical circuits in each coil, with independent connecting terminals, allowing for different winding configurations (see Note 3).
- The aluminium forms are also connected and wired as one-turn coils, which can be used as extra one-turn coil-pairs to generate feeble fields (including small gradients), or these could be grounded, etc (each coil-form is electrically isolated from the others).
- Sturdy construction with a relatively low weight.
- Easy assembling. It is supplied dismounted, with assembly instructions.
- These can be supplied in 2D and 1D versions (see also Fig. 3):
  BHC2000-2A-A/B, 2D, with X and Y axes (both horizontal fields).
  BHC2000-2B-A/B, 2D, with Y and Z axes (horizontal and vertical field).
  BHC2000-1A-A/B, 1D with Y-axis (horizontal or vertical field, installation depending).

Fig. 1: The BHC2000-3-A/B (3D).

Fig. 2: The BHC2000-1A-A (1D).

Note 1: In Fig. 1 the coils are depicted without the windings.

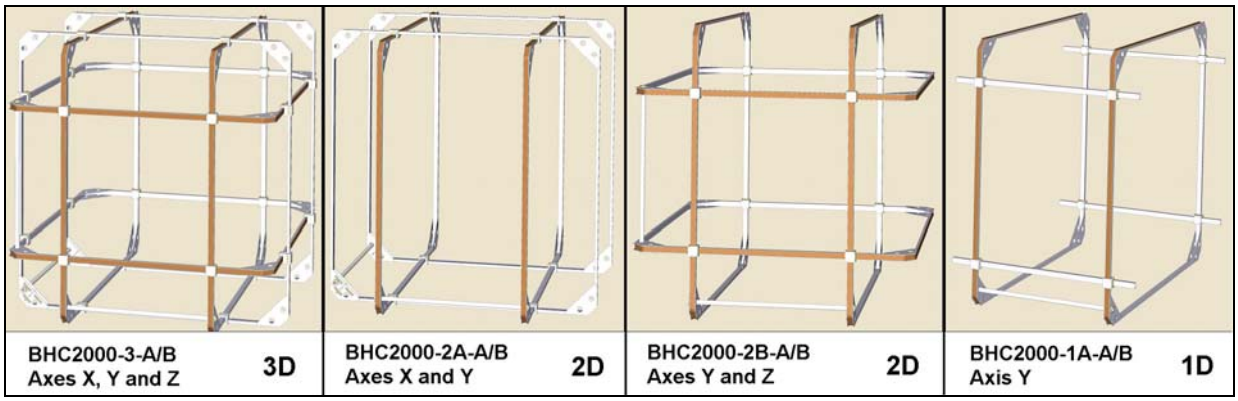

Fig.3: The different configurations available (BHC2000's family).

General specifications for BHC2000-3-**A**	
Field/Current ratio, ±3%. More precision for each axis in below	25.0 μT/A (0.5 G/A). For the bifilar winding circuits in parallel, as delivered from factory. See Note 3 in below. Or 25.0 + 25.0 μT/A for independent split windings (Note 3)
Maximum field	about 1 mT (10 G), each axis.
Maximum current	40 A, each axis, with bifilar windings in parallel. See Note 3. *For a max. heating to around 70 ºC, measured on coil surface.* 20 A, each axis, for each independent bifilar circuit (20 + 20 A).
Field homogeneity	±5% in a cube 925 mm by side. ±1% in a cube 480 mm by side.
Field from coil-forms (See Note 2)	0.82 μT/A, each axis. Maximum field: 16.4 μT. *Maximum current: 20 A, each axis (wiring capability limited).*
Weights	Single coil: about 35 kg. / Total: about 220 kg.
Maximum dimensions	2086 x 2040 x height 2086 mm. See Fig. 6.
Warranty	Two years, for manufacturing defects.

Per axis specifications for BHC2000-3-**A**	**X**	**Y**	**Z**
Effective (mean) side, ± 4 mm	2046 mm	2000 mm	1954 mm
Field/Current ratio, ±1% Circuits in parallel, as supplied.	24.8 μT/A	25.3 μT/A	25.1 μT/A
Field/Current ratio, ±1% Separated circuits in series. See Note 3.	49.5 μT/A	50.6 μT/A	50.1 μT/A
Resistance, ± 5% (20 ºC) Circuits in parallel, as supplied.	0.62 Ω	0.61 Ω	0.57 Ω
Resistance, ± 5% (20 ºC) Each separated circuit. Note 3.	1.24 Ω	1.21 Ω	1.15 Ω
Inductance at 120 Hz, ± 5%	14.7 mH	14.3 mH	13.1 mH

General specifications for BHC2000-3-**B**	
Field/Current ratio, ±3%. More precision for each axis in below	14.7 μT/A (0.15 G/A). For the bifilar winding circuits in parallel, as delivered from factory. See Note 3 in below. Or 14.7 + 14.7 μT/A for independent split windings.
Maximum field	About 150 μT (1.5 G), each axis.
Maximum current	10 A, each axis, with bifilar windings in parallel. See Note 3. 5 A, each axis, for each independent bifilar circuit (5 + 5 A).
Field homogeneity	±5% in a cube 925 mm by side./±1% in a cube 480 mm by side.
Field from coil-forms (See Note 2)	0.82 μT/A, each axis. Maximum field: 16.4 μT. *Maximum current: 20 A, each axis (wiring capability limited).*
Weights	Single coil: about 7.5 kg. / Total: about 60 kg.
Maximum dimensions	2086 x 2040 x height 2086 mm. See Fig. 6.
Warranty	Two years, for manufacturing defects.

Per axis specifications for BHC2000-3-**B**	**X**	**Y**	**Z**
Effective (mean) side, ± 4 mm	2046 mm	2000 mm	1954 mm
Field/Current ratio, ±2% Circuits in parallel, as supplied.	14.4 μT/A	14.7 μT/A	15.1 μT/A
Field/Current ratio, ±2% Separated circuits in series. See Note 3.	28.7 μT/A	29.4 μT/A	30.1 μT/A
Resistance, ± 5% (20 ºC) Circuits in parallel, as supplied.	1.8 Ω	1.6 Ω	1.6 Ω
Resistance, ± 5% (20 ºC) Each separated circuit. Note 3.	3.3 Ω	3.2 Ω	3.1 Ω
Inductance at 120 Hz, ± 5%	4.9 mH	4.8 mH	4.7 mH

Note 2: The coil-forms in aluminium alloy are not closed square frames, but these have a purposely gap near the connecting terminal block of the coil. Electrical wires are soldered to both sides of the gap and are connected to the terminal block also, in order to use the coil-form as a one-turn coil when wanted. We call this exclusive technical concept "In-circuit coil-forms". So, the two forms on each axis make an extra Helmholtz pair of one turn per coil, what is usually named with the prefix "s". For instance: for the *X*-axis, the aluminium forms make the pair *Xs*. See Fig. 4 for an electrical schematic including the coil-forms.
The wiring to the coil-forms can be used also to ground the coils when needed.

Note 3: The bifilar winding provides two identical windings on each coil, which can be used as two independent coils to get two identical Helmholtz pairs on each axis. For instance, for the X-axis we have the circuits X1 and X2 on each coil-form, which can be used to make the pairs X1 and X2. The Fig. 4 depicts the electrical diagram for the X-axis.
Every coil-set is delivered with these two pairs on each axis converted in only one by means of a couple of jumpers. In other words, the two identical circuits are in parallel wired (see Fig. 4). In this way the system can be operated at the larger currents and the lower possible voltages. Just cutting the jumpers can easily separate the two circuits on each axis, to use these in different configurations as needed.
Possible configurations are: "anti-Helmholtz", to generate linear gradients, alone or superposed to a homogeneous field; "Sham mode" as used in Biophysics, in where current is running but no field is generated, etc.

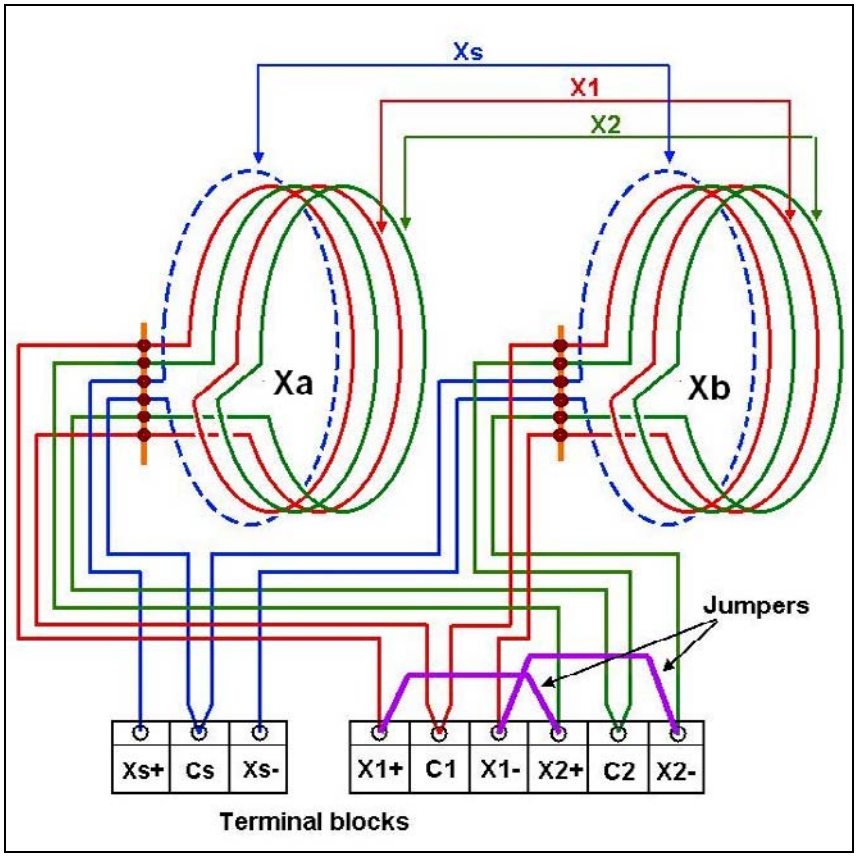

Fig. 4: Electrical diagram of X-axis.

The connecting terminal blocks

All the terminal blocks, with M4 brass screws, can be grouped in one corner of the coil-set, as can be seen in Fig. 4.
That corner would be usually located at the lower position, however the set can be also assembled to have that connecting corner on top of the coil-set, when preferred.

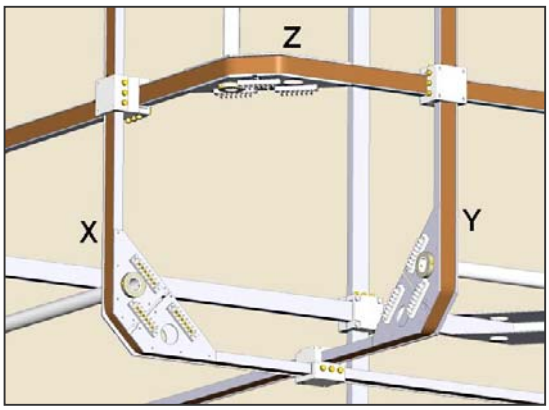

Fig. 5: Location of terminal blocks.

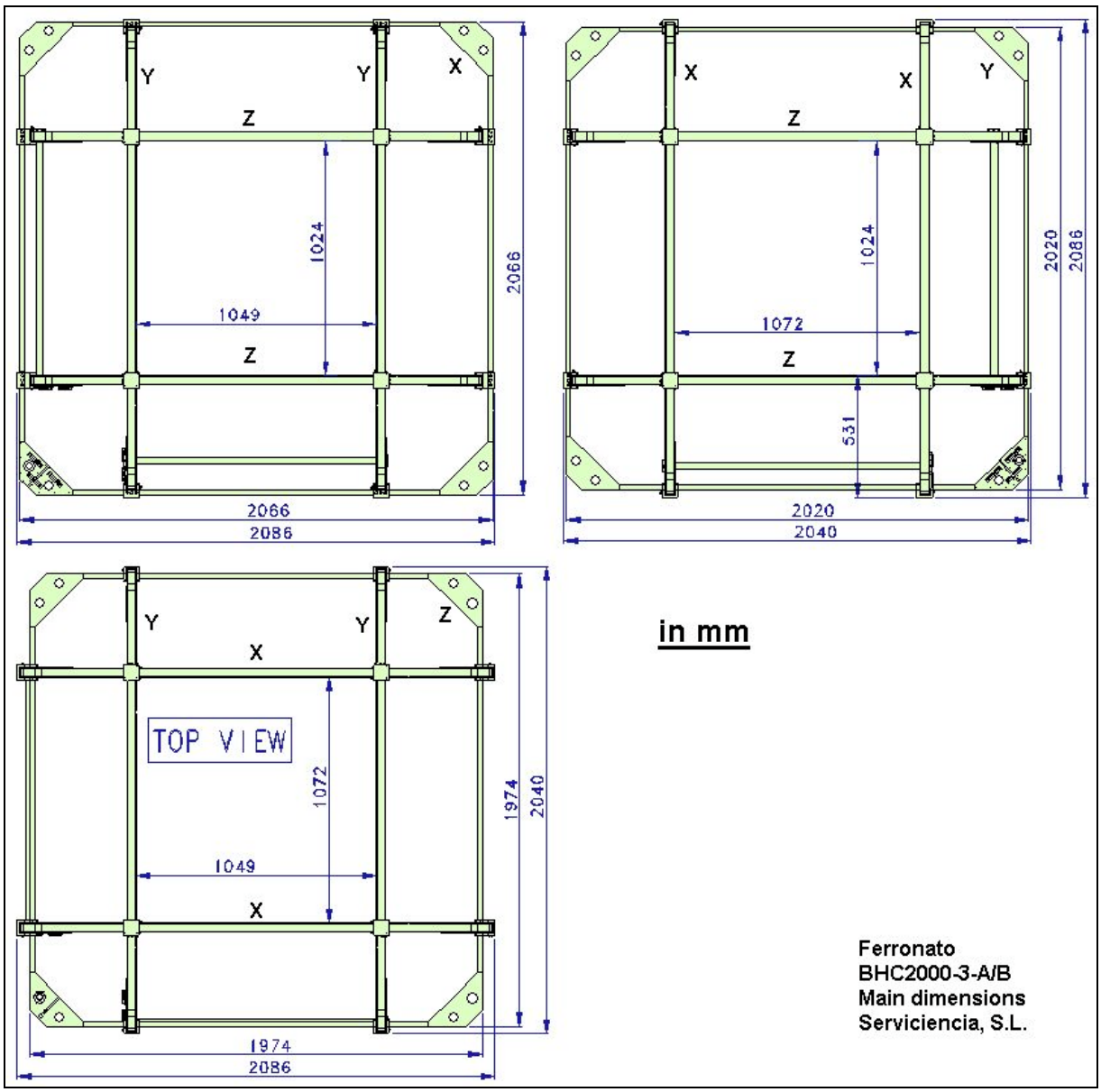

Fig. 6: Main dimensions.

- These specifications are preliminary and are subject to minor modifications in future -

Optional accessories

Elevated floor

When the BHC2000-3-A/B is installed on a surface (normally the floor of a room) it is usually convenient to install an elevated floor into the coil-set.
We have devised a simple modular system for that, manufactured with non-magnetic materials.
Each module is of 520 x 1540 x height 101 mm.
Three of these modules are necessary to cover all the bottom, with a total surface of 1560 x 1540 mm. The resulting floor, or platform, is 101 mm elevated in respective to the parent floor.

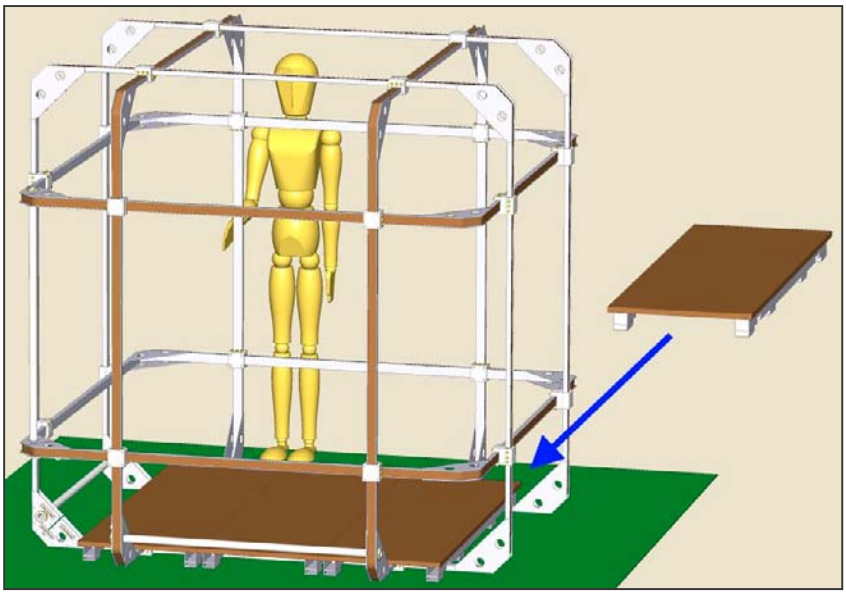

Fig. 7: Elevated floor.

It can be ordered in quantities of 1, 2 or 3 modules.
More details under request. There is also a document with details of that flooring available on our web site (under "Helmholtz coils" - "Accessories").

Others

Some other accessories will be made available in future.
We can supply many other accessories under request.

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