

## Application No. 324: Building a Halbach array

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### Step-by-step instructions for those keen on experimenting

I'd like to present to you step-by-step instructions on how to build a Halbach array ([en.wikipedia.org/wiki/Halbach\\_array](http://en.wikipedia.org/wiki/Halbach_array)). I did a lot of experiments lately on this subject. The Halbach array is a special arrangement of magnets, which "bend" the magnetic flux: On the one side the magnetic field becomes up to twice as strong, on the other one it decreases. The longer the arrangement the stronger the effect.

### Material needed:

- 1 medium-size piece of iron or steel (approx. 20 x 15 cm)
- 1 small piece of iron or steel (approx. 10 x 3 cm)
- Straight piece of non-magnetic material, e.g. copper or wood
- Strong adhesive, e.g. UHU plus endfest 300 ([www.supermagnete.nl/eng/M-15](http://www.supermagnete.nl/eng/M-15))
- Small spatula or something similar to apply adhesive
- Transparent adhesive tape
- Waterproof felt pen
- Sand paper
- Supermagnets (at least 6), e.g. W-07-N ([www.supermagnete.nl/eng/W-07-N](http://www.supermagnete.nl/eng/W-07-N)) or Q-15-04-04-MN ([www.supermagnete.nl/eng/Q-15-04-04-MN](http://www.supermagnete.nl/eng/Q-15-04-04-MN))

You could use stronger magnets but I consider that a little bit too dangerous.

### Assembly:

1. Take the ordered magnets from supermagnete out of the plastic bag.
2. Cut the plastic bag open with scissors or a cutter knife, fold it apart.
3. Wrap the two iron or steel pieces tightly with the plastic foil.
4. Fasten the plastic foil with an adhesive tape.





**5.** Arrange the selected magnets in a row. Meaning: a north and south pole is always connected to each other.

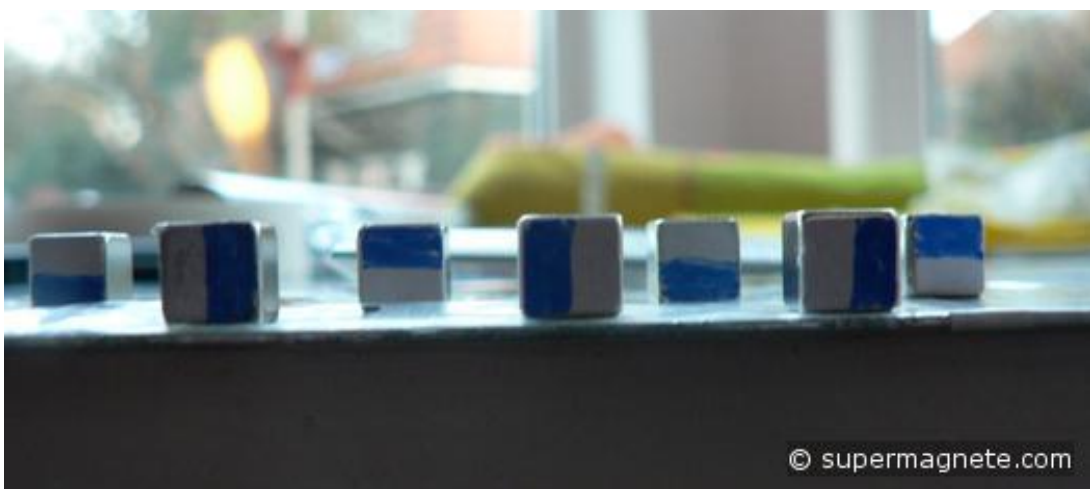
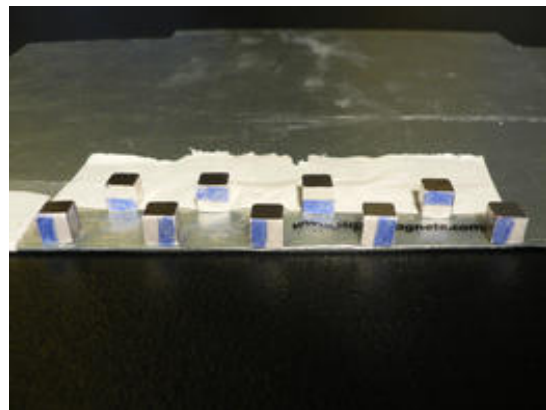
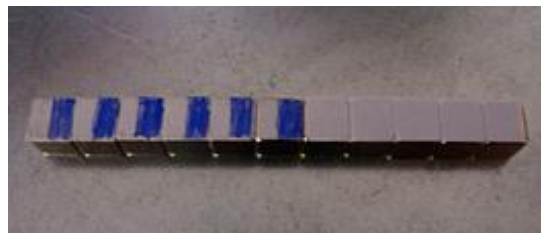
**6.** Put a small piece of adhesive tape over every magnet.

**7.** Mark every north and south pole with a waterproof felt pen (see picture).

**8.** Put the magnets with the marked surface facing forward on a medium-size piece of iron.

**9.** Pull the magnets apart and arrange them as follows:

- Front row: south poles left and right alternately
- Back row: south poles up and down alternately



Front view

**10.** Remove magnets one by one, roughen up the area to the left and right of the marked surface with sandpaper. Remove sanding residue with a piece of paper. Put the magnets back on the iron.



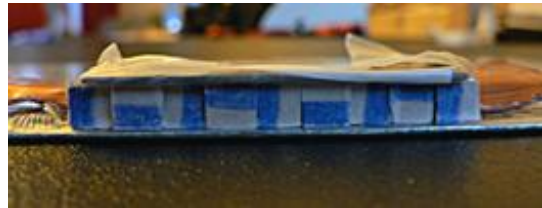
**11.** Place a small piece of iron on top of the back row of magnets (see picture).

**12.** Put glue on the roughened surfaces.

**13.** Push the back row between the front row: use a piece of wood or any other non-magnetic material to slowly push the back row in front until all magnets are on one line.

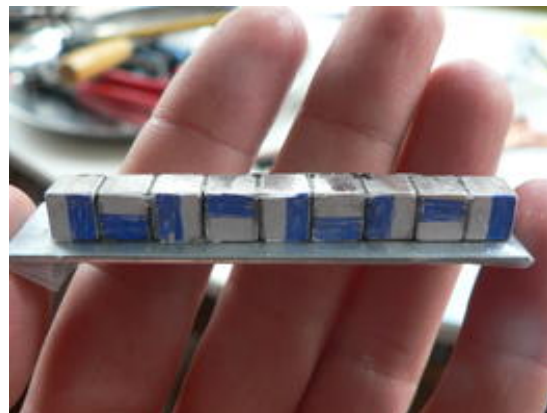


**14.** Push the magnets together sideways until the adherends touch each other.



**15.** Let the magnet arrangement dry for at least 24 hours.

**16.** Remove the iron pieces after drying. The top piece can be removed easily. Thanks to the Halbach arrangement, the magnets strongly adhere to the bottom piece though. How to remove the bottom piece: Place the magnets on the edge of a table (see picture below), hold on to the magnets and slowly push the iron piece downwards.





Now, the Halbach array is complete!

Caution: This magnet arrangement is very strong and breaks easily at heavy collisions!

#### Articles used

Q-15-04-04-MN ([www.supermagnete.nl/eng/Q-15-04-04-MN](http://www.supermagnete.nl/eng/Q-15-04-04-MN))

W-07-N ([www.supermagnete.nl/eng/W-07-N](http://www.supermagnete.nl/eng/W-07-N))

M-15 ([www.supermagnete.nl/eng/M-15](http://www.supermagnete.nl/eng/M-15))

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