

## E-Magnets UK Ltd

A dedicated and specialist supplier of Magnets

### Mission Statement –

**“Through operational excellence, we will provide our customers with a superior service experience and the highest quality magnet components and assemblies.”**

### Replicating True Radial Arcs and Rings with Pseudo-Radial Arcs and Rings

The manufacture of radially magnetised arcs and rings is extremely difficult and, in many circumstances, impossible.

Radially magnetised arcs are only really feasible when the arc angle is small. The actual shape and the magnetic material required also impact on feasibility.

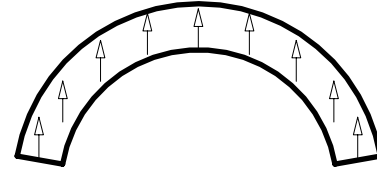
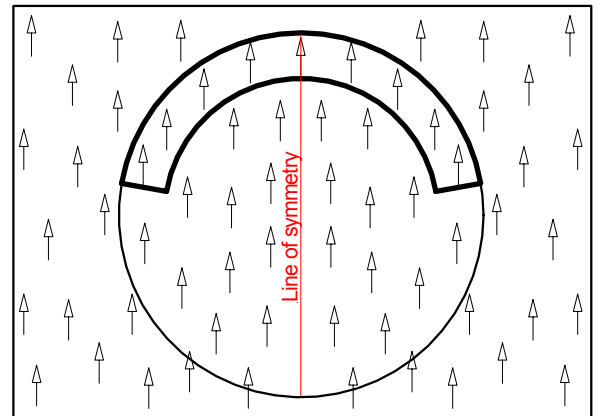
As a general rule, the design engineer should consider replacing a true radially magnetised pattern with a pseudo-radially magnetised pattern to allow ease of manufacture.

The majority of permanent magnets are produced with a single direction of magnetisation where the lines of flux within the magnetic material are parallel (e.g. axially magnetised disc and rod magnets, block magnets).

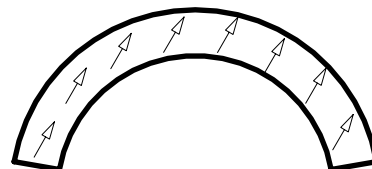
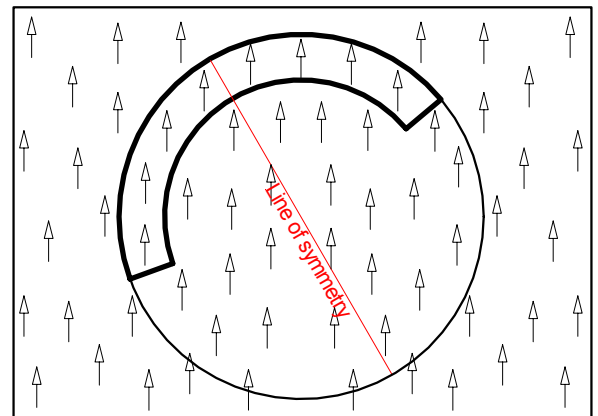
Arcs are cut from blocks of manufactured magnetic material. Note the standard direction of magnetization, as shown by the arrows in the first example. This direction is fixed into the structure during manufacture of the block (the block is pressed to shape in the presence of an external magnetic field that is produced by a solenoid surrounding the block). This method is a standard practice. The cut arc therefore shares the same direction of magnetization as the block.

In the first example, the arc has been cut so that the direction of magnetisation of the magnet is parallel to the line of symmetry of the magnet. We call this diametrically magnetised. The standard direction of magnetisation within such cut arcs is diametrically magnetised.

If the arc was rotated around by a defined angle the direction of magnetisation is also rotated around by the same defined angle, as shown in the second example. This is particularly useful for designs such as Halbach Arrays (see next page).



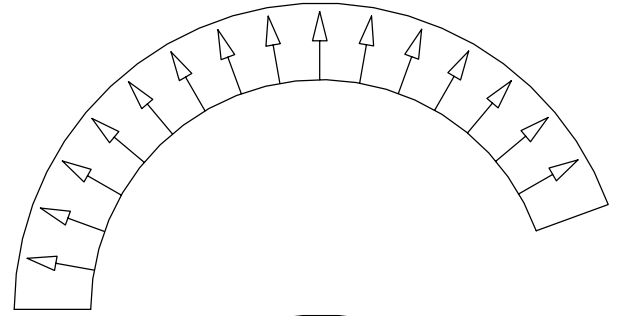
**Example 1**  
Diametric arc magnet  
Cut from large block.



**Example 2**  
Arc magnet  
Cut from large block.

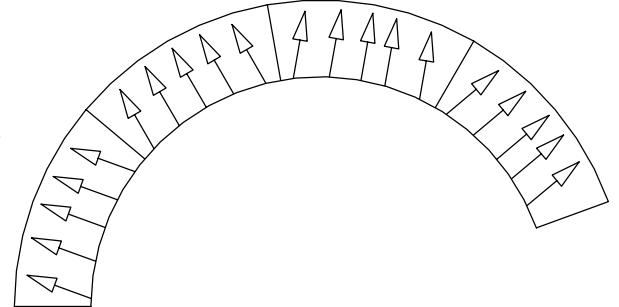
## True Radial Arcs and Rings

As already stated, these are extremely hard to manufacture and often impossible to make. The best chance is to have small angled arcs but do not be too surprised if they cannot be made. Instead, please consider using pseudo-radial arcs and rings to replicate a radially magnetised arc or ring.



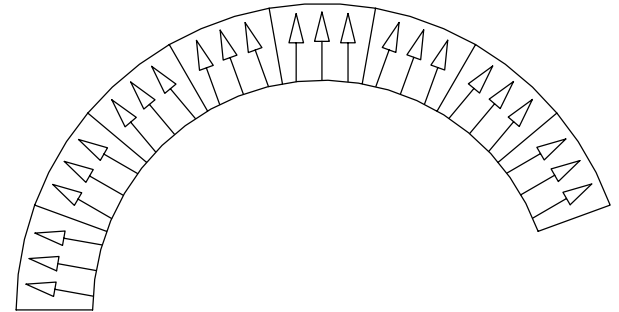
## Making Pseudo Radial Arcs and Rings from large angle diametrically magnetised arcs

Using diametrically magnetised arcs segments of large angle, a magnetic pattern in the completed arc and ring starts to mimic a desired radial pattern. The effect may be cruder if large angle arcs are used but assembly time is relatively fast. Forty degree arcs are shown in the example.



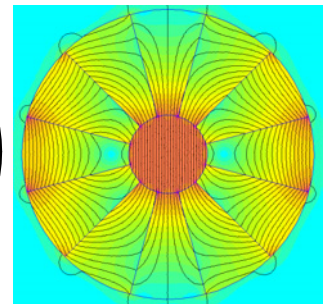
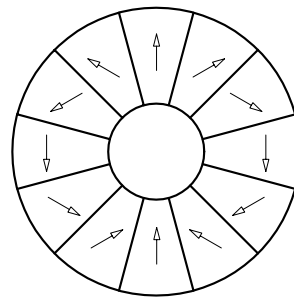
## Making Pseudo Radial Arcs and Rings from small angle diametrically magnetised arcs

Using diametrically magnetised arcs segments of small angle, a magnetic pattern in the completed arc and ring starts to mimic more closely the desired radial pattern. The effect may be improved if even smaller angle arcs are used but this increases the assembly time required. You will not get a perfect radial pattern but it may be satisfactory for the application. Twenty degree arcs are shown in the example. Some designs may use multiple rings stacked axially with each ring being rotated relative to the next to improve the pseudo-radial magnetic waveshape even further.



## Special use of arc magnets – the Halbach Array

Using arcs where the direction of magnetisation is set to different angles, a Halbach Array can be produced, giving a highly uniform (homogenous) magnetic field in the air gap. The field strength in the air gap can also be very large (e.g. over 1 Tesla / 10000 Gauss).



## How to contact us:

We believe in listening to, understanding and working with our customers. We have a dedicated, expert sales team who are available Monday to Friday from 8.30am to 5.30 pm (GMT). If you have any queries or would like us to visit you, please get in touch:



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