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|---|---|
| **Protocol** | #A.2 |
| **Title** | **BOMB ring magnetic racks** |
| **Keywords** | magnetic racks; magnetic separation; microplate; deep-well plate; HT |
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| **Citation** | Oberacker et al.(2019), Bio-On-Magnetic-Beads (BOMB): Open platform for high-throughput nucleic acid manipulation. PLOS Biology,17(1), https://doi.org/10.1371/journal.pbio.3000107 |
| **Online** | https://bomb.bio/protocols/ |
| **Revision** | V1.0 (13th August 2018) |

## Summary

Racks for magnetic separations can be purchased commercially or prepared in house much more cheaply with a 3D printer [1], a laser cutter or by retrofitting recycled laboratory materials. Strong magnets can be purchased cheaply in bulk.

This protocol describes how to make a ring magnetic rack using 3 mm acrylic sheeting, magnets and a laser cutter. Two patterns are cut out of the acrylic sheet, to form the "TOP PLATE" (where the magnets are held) and the "BOTTOM PLATE" (sits under the TOP PLATE and provides a seat for the tubes or microplate). The two plates are held together using M3 button head screws, and magnets seated in place with a press fit.

## Equipment and materials

**$CO_2$ glass tube Laser Cutter (e.g. 130 W Global)**

**Strong Neodymium permanent magnets. Please get informed how to work safely with strong neodymium magnets to avoid injuries!**

**96x Nickel-Copper-Nickel N35 8 mm x 4.5 mm x 3.5 mm neodymium ring**

**(for the BOMB ring magnet rack)**

e.g. Guys Magnets (SKU): RI8/4.5/3.5AN35NI

https://www.guysmagnets.com/neodymium-magnets-c11/8-mm-x-4-5-mm-x-3-5-mm-neodymium-ring-p288

**M3 5 mm Button Head Socket Screw 10.9 Black or silver**

(e.g. RS components, RS Stock No.822-9094)

**3 mm tap set**

## Laser Cutting

| Step | Task |
|---|---|
| ⚠ | *The procedure requires at least basic experience with laser cutting* |
| **1** | Download the .dxf file from the supplement |
| **2** | Source 3 mm acrylic sheets |
| **3** | Laser cut TOP and BOTTOM plate pattern out of 3 mm acrylic sheet. Speed and power settings will need to be adjusted according to machine (we used 20 mm/s and 40% power respectively). |
| **4** | Create 3 mm tap in the 6x small holes of TOP plate. TOP and BOTTOM plates are to be fixed using 6x M3 button head screws (details above). Head of screw is to be on the bottom plate. |
| **5** | Press-fit ring magnets inside top plate holes. Hole size may vary depending on laser calibration, so fine adjustment in 0.05 mm increments may be required. |
| **End** | Test the functionality of the rack with suspended magnetic beads |

## Modifications

A rack that is reduced in size can also be cut if small-scale 8-strips PCR tubes are preferred. Alternatively, if access to a laser cutter is not possible, recycled lab equipment can also be used to create magnetic racks. For example, ring magnets can be glued on top of pipette tip boxes.

## Troubleshooting

| Problem | Solution |
|---|---|
| **The TOP PLATE holes are too small, so the magnets do not fit** | Increase the hole size in 0.05 mm increments until desired fit is attained |
| **The TOP PLATE holes are too large, so magnets keep falling out** | Decrease the hole size in 0.05 mm increments until desired fit is attained |
| **Holes are not perfectly round** | Slow the cutting speed |

## Exemplary results

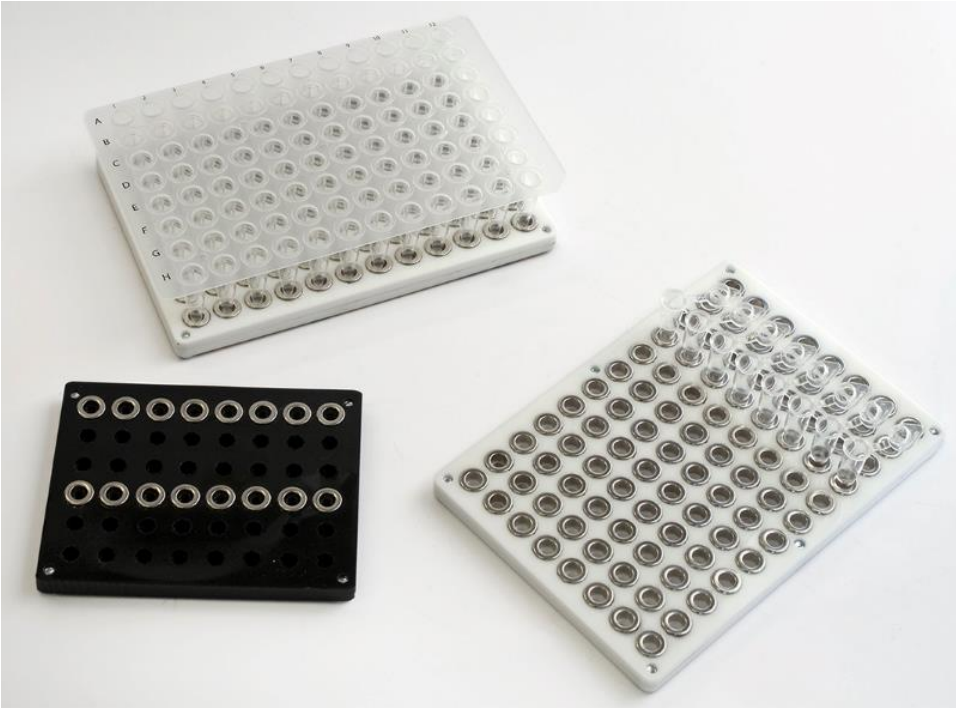

*Fig 1: Laser-cut ring magnetic racks*

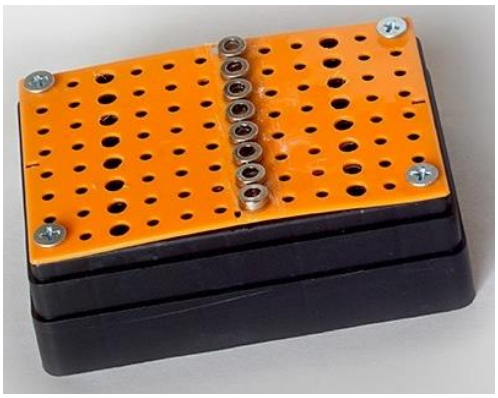

*Fig 2: Magnetic racks from recycled tip boxes*

## References


1. Baden T, Chagas AM, Gage G, Marzullo T, Prieto-Godino LL, Euler T. Open labware: 3-D printing your own lab equipment. PLOS Biol. Public Library of Science; 2015;13: e1002086. doi:10.1371/journal.pbio.1002086