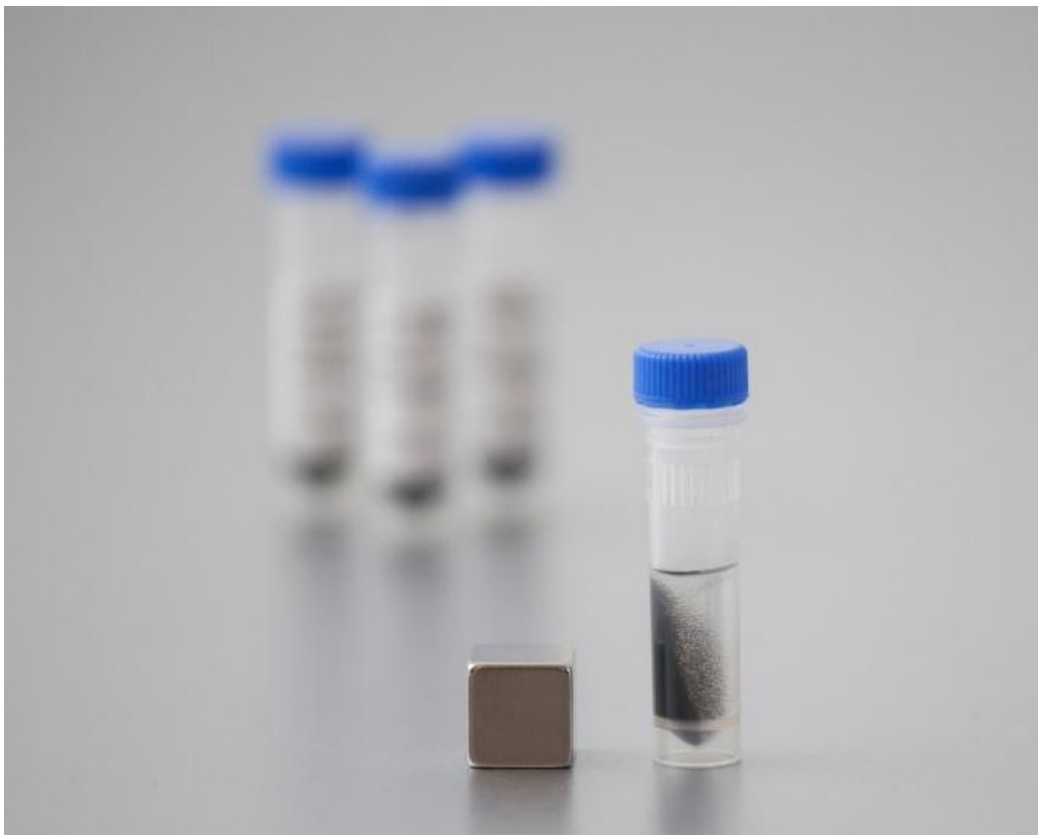
mAGic™ BioProcessing

DATA SHEET

# MAGicBeads Oligo(dT)



- Super-paramagnetic porous beads
- High binding capacity up to 2.5 mg mRNA/mL
- Minimal non-specific interaction
- High specificity

# MAGicBeads Oligo(dT)

MAGic™Beads Oligo(dT) are optimized for streamlined extraction of mRNA and other polyadenylated RNA using magnetic separation. MAGicBeads Oligo(dT) is optimized for high-capacity mRNA purification, primarily from IVT reaction batches, while also supporting crude RNA feeds and total RNA preparations.

The beads are spherical porous agarose beads (average size of 90 µm) that have been magnetized to become super-paramagnetic. Agarose-based beads are inert and hydrophilic, minimizing nonspecific interactions, and are compatible with a broad range of biomolecules. An 18-mer oligo(dT) has subsequently been coupled to these beads to produce MAGicBeads Oligo(dT). See Table 1 for the bead characteristics.

The black beads are easily observed by the naked eye, making them easy to follow and collect, and they do not aggregate, which facilitates the resuspension. The quantity of the high-capacity beads can easily be scaled up or down to match the mRNA concentration and sample volume.

**Table 1.** Main characteristics of MAGicBeads Oligo(dT)

| | |
|---|---|
| Product | MAGicBeads Oligo(dT), 10% bead suspension |
| Target molecule | Polyadenylated mRNAs |
| Matrix | Super-paramagnetic porous agarose |
| Ligand | Poly(dT) 18mer with proprietary linker |
| Average particle size (DV50 )[1] | 90 µm |
| Particle size distribution | 50-150 µm |
| Surface group density | 0.25 µmol oligo(dT)/mL settled beads |
| Maximum binding capacity[2] | ≥ 2.5 mg mRNA/mL settled beads |
| Storage | +2 to +8°C in 20% ethanol. |

[1] The median particle size of the cumulative volume distribution

[2] The binding capacity (BC) will depend on the nature of the mRNA and the yield required. There is a trade-off between BC and yield. The reported BC number is based on a variety of mRNA constructs.

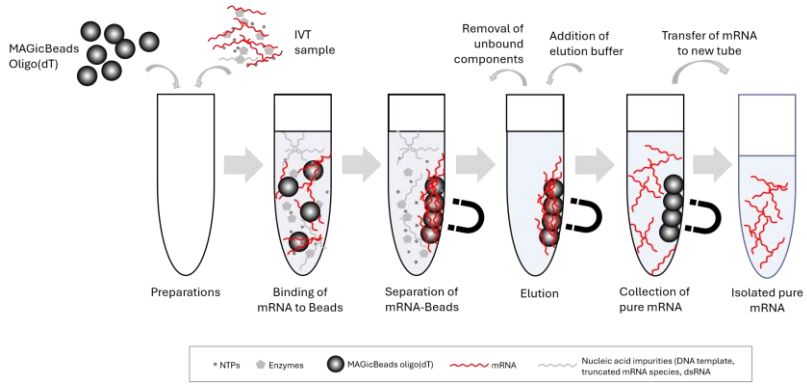
# Applications

## Principle

MAGicBeads Oligo(dT) is a magnetic affinity separation medium with high affinity for polyadenylated RNA transcripts, so-called mRNAs. This capture step generates high yields and purities of mRNAs in a single step and is therefore commonly used in mRNA purification processes or detection assays. The 90 µm super-paramagnetic MAGicBeads are based on porous agarose.

## MAGicBeads Oligo(dT) workflow

mRNA binds in the presence of high salt while all process-related impurities, such as non-polyadenylated RNA species, plasmid or linear DNA template, enzymes and unincorporated nucleotides, are removed in the wash steps, and purified mRNA is released under low- or no-salt conditions. Both binding and elution are performed at room temperature using standard buffers without harmful additives, enabling a simple and flexible purification workflow suitable for both therapeutic- and molecular biology–grade mRNA production.



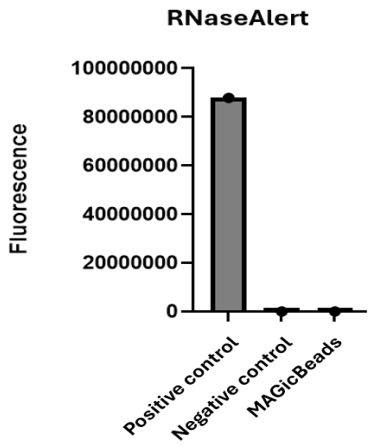

*As with any oligo(dT) method, selection is based on the poly(A) tail. Species that also carry a tail, such as 5'-truncated transcripts and some dsRNA by-products, can co-purify and may require a polishing step depending on the target specification.*

**Figure 1.** MAGicBeads Oligo(dT) workflow

## Super-paramagnetism

MAGicBeads are super-paramagnetic, and owing to our proprietary production method, magnetic separation is completed within seconds at small scale (1 mL). The beads resuspend easily and do not aggregate, which simplifies handling. This is because the agarose matrix is hydrophilic and the beads retain no residual magnetization (no magnetic memory) once removed from the magnet. These properties speed up the protocols at all scales.

## MAGicBeads Oligo(dT) solution is RNase free




RNA is highly susceptible to degradation by external RNases, which are highly abundant in the environment. Under natural conditions, mRNA has a very short half-life, making it essential to maintain an RNase-free environment when handling and processing RNA to prevent degradation. All equipment and reagents must therefore be RNase free. The quality of the beads was assessed using the RNaseAlert™ assay (Figure 2), which confirmed that the bead solution was free of detectable RNase activity.

**Figure 2.** RNaseAlert assay validating absence of RNase

## Running conditions without harmful additives

MAGicBeads Oligo(dT) enables efficient mRNA purification for a wide range of applications, from small-scale detection assays and Northern blotting to large-scale mRNA isolation. The standard protocol is optimized for the purification of therapeutic-grade mRNA without the need for Triton X-100 or lithium chloride (LiCl), as sodium chloride (NaCl) promotes mRNA binding as efficiently (Figure 3). All purification steps can be performed at room temperature, ensuring a simple and versatile workflow in accordance with the recommended conditions outlined in the product instructions.

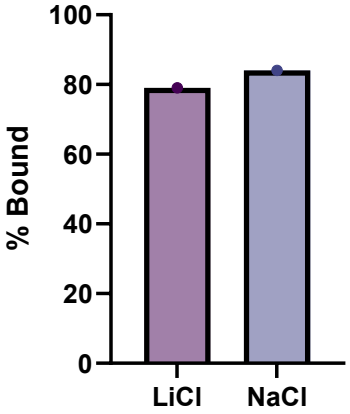



**Figure 3.** Salt effects on binding

## High binding capacities without compromising on integrity

MAGicBeads Oligo(dT) offers high capacities comparable to high-performing packed-bed resins. Due to the scaling flexibilities and high capacities of these beads, it is advantageous to use magnetic separations to isolate mRNAs in a simple batch mode.

For binding capacities up to **2.5 mg** mRNA/mL beads:

- Yield: ~60%

For binding capacities up to **1 mg** mRNA/mL beads:

- Yield: >80%

Binding capacity (BC) varies depending on the diversity of mRNA constructs, the specific mRNA characteristics, and the desired yield, with a trade-off between BC and yield. The stated values are based on a diverse range of mRNA constructs using the same buffer system, with uncompromised mRNA integrity serving as a strict acceptance criterion.

An IVT-synthesized ~900-nt RNA transcript was purified using MAGicBeads Oligo(dT). Approximately 1 mg of mRNA was loaded per mL of settled beads, followed by two wash steps prior to elution. The wash buffer contained a lower salt concentration than the binding buffer, allowing nonspecific interactions to be disrupted and removed, including interactions from RNA species containing naturally occurring A-rich regions and other impurities. Following the wash steps, the purified mRNA was eluted under low-salt conditions.

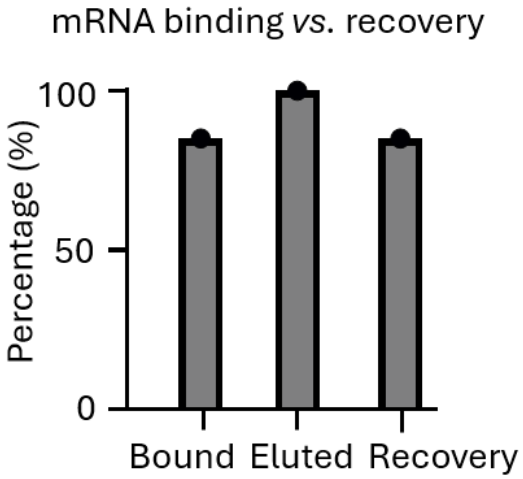



**Figure 4.** The plot shows the binding and elution profile for the purification, demonstrating efficient capture and recovery of the mRNA.

The binding capacity and recovery data are important for defining the process parameters, however, it is essential that mRNA integrity remains uncompromised by the purification conditions. To evaluate mRNA integrity, all RNA species were analyzed using an Agilent TapeStation both before and after purification. mRNA integrity after purification is shown in Figure 5.

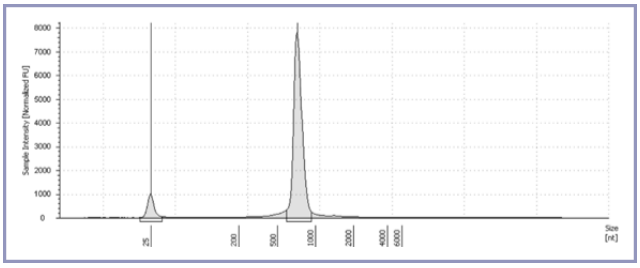


**Figure 5.** mRNA analysed on a TapeStation following the purification run shown in Figure 4 to assess RNA integrity. Intact mRNA is expected to produce a sharp, concentrated peak, whereas RNA degradation results in a broader peak with increased signal preceding the main mRNA peak.

## Impact of mRNA length on binding capacity

To ensure the versatility of the mRNA platform for producing different proteins and antigens, purification performance was evaluated using mRNA transcripts of varying lengths. Three transcripts were investigated: GFP (1000 nucleotides), firefly luciferase (ffLuc; 2000 nucleotides), and spike protein (4000 nucleotides). A target recovery of greater than 80% was established

as a process criterion, provided that mRNA integrity remained uncompromised. The binding capacities obtained for each transcript are presented in Table 2 and Figure 6.

**Table 2.** Description of RNA transcripts and their binding capacities under process conditions achieving >80% recovery without compromising transcript integrity

| Construct | Size (nts) | Mw (kDa) | Molar loading (nmol mRNA /mL beads) | BC (mg mRNA/mL beads) |
|---|---|---|---|---|
| GFP | 1000 | 329 | 1.86 | 0.76 |
| ffLuc | 2000 | 634 | 0.83 | 0.76 |
| Spike | 4000 | 1485 | 0.15 | 0.36 |

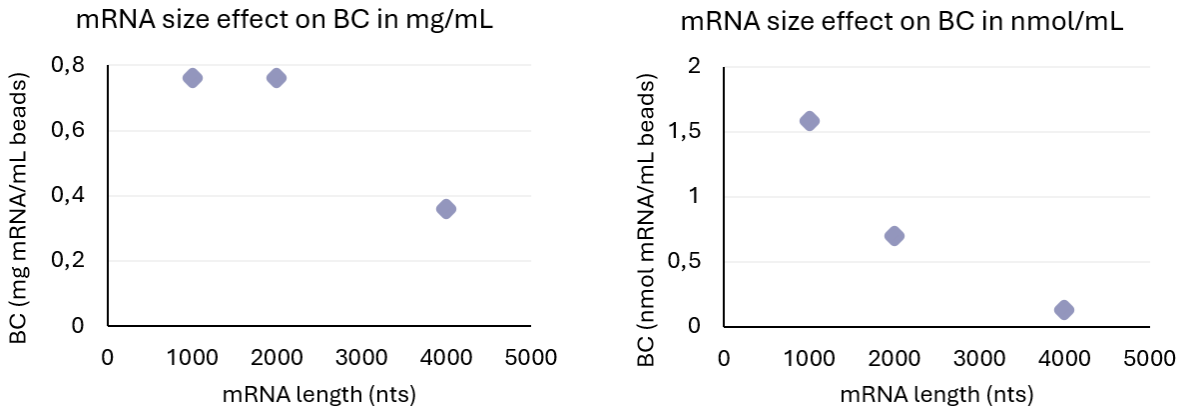



**Figure 6.** Obtained binding capacities under process conditions achieving >80% recovery without compromising transcript integrity for 3 RNA transcripts described in Table 2 in A) mg mRNA/mL beads or in B) nmol/mL beads.

Expressed as mg/mL beads, binding capacity is similar for the 1000- and 2000-nt transcripts but roughly half for the 4000-nt transcript, likely due to steric hindrance and limited access to binding sites. Molar-based measurements provide a different perspective, highlighting the importance of using both units when comparing transcripts. These size-dependent effects, together with the trade-off between bead loading and recovery, must be considered when optimizing the target-to-bead ratio to maximize capture efficiency and maintain mRNA integrity.

## Scalable from small- to large-scale applications

MAGicBeads Oligo(dT) combines high binding capacity with the flexibility and automation-friendly handling of magnetic beads. Its simple bind–wash–elute workflow eliminates the need for fast protein liquid chromatography (FPLC) systems and extensive clarification, making it advantageous for large, sensitive molecules such as mRNA.

Conventional Oligo(dT) capture technologies have limitations: membranes, monoliths, and fiber-based adsorbents offer high capacities but limited

flexibility and scalability; small-scale solid magnetic beads often have low slurry concentrations and limited scalability; and chromatography resins can be flow-restricted and require clarification.

MAGicBeads Oligo(dT) bridges these gaps, offering a versatile, scalable, and automation-friendly high-capacity solution for mRNA capture.

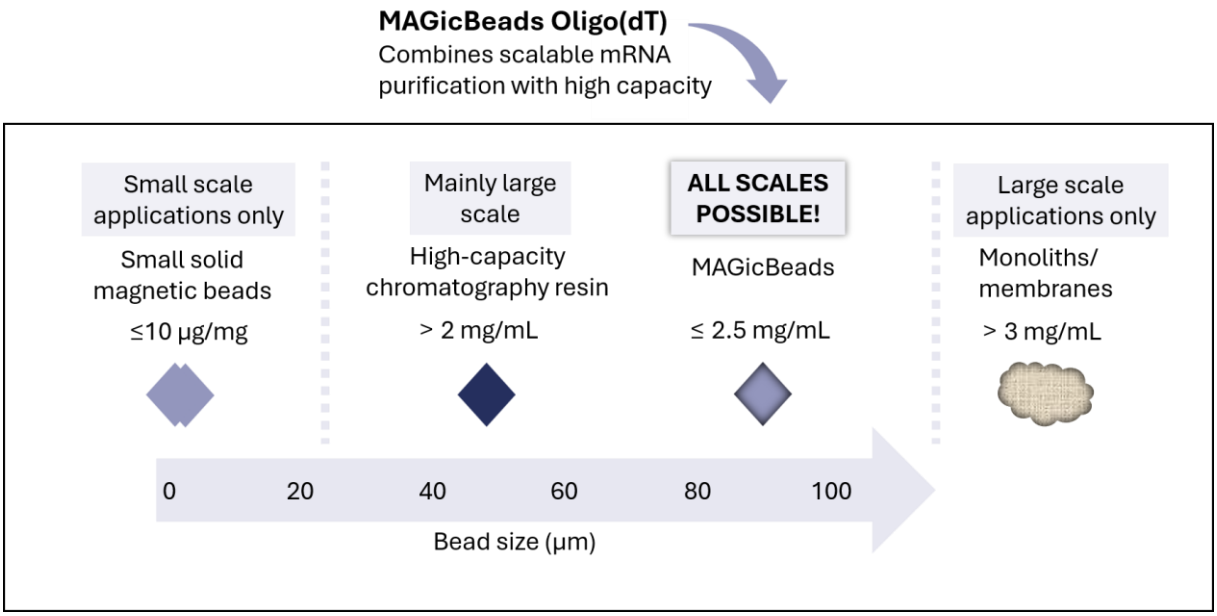



**Figure 7.** Illustration of Oligo(dT)-derivatized beads/resins/materials used for mRNA purifications at different scales.

## Scale-up

The beads are suitable for separations using appropriate magnetic separators, such as the MAGicAccio LAB, MAGicAccio PILOT 50, MAGicAccio PILOT 500, MAGicAccio PILOT 2000 and MAGicAccio PROCESS.

These separators range from lab scale to medium scale/process development up to large scale/bioprocessing scale.

MAGic BioProcessing's proprietary MAGicAccio PROCESS is an integrated large scale magnetic separation system that combines clarification and capture into one scalable process.

## Storage

MAGicBeads Oligo(dT) should be stored as a 10% bead suspension at +2 to +8°C in 20% ethanol.

# Ordering information

| Products | Quantity | Product No. |
|---|---|---|
| MAGicBeads Oligo(dT) | 1 mL | 1700 |
| MAGicBeads Oligo(dT) | 10 mL | 1701 |
| MAGicBeads Oligo(dT) | 50 mL | 1705 |
| MAGicBeads Oligo(dT) | 100 mL | 1710 |
| MAGicBeads Oligo(dT) | 250 mL | 1725 |
| MAGicBeads Oligo(dT) | 500 mL | 1750 |

| Related products | Product No. |
|---|---|
| MAGicBeads ACT | 13XX |
| MAGicAccio LAB rack | 2000 |
| MAGicAccio LAB cube | 2100 |
| MAGicAccio PILOT 50 | 2200 |
| MAGicAccio PILOT 500 | 2300 |
| MAGicAccio PILOT 2000 | 2400 |
| MAGicAccio PROCESS | 3100 |

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