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Magnet calculation report

MP 14/4x3 / N38
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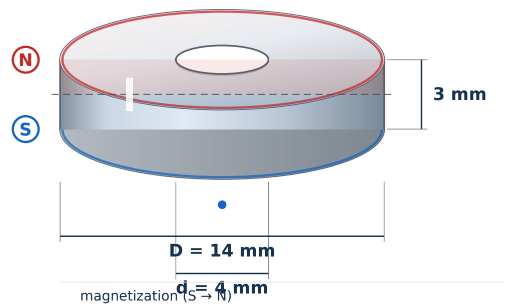

Shape:	ring
Dimensions:	⌀14,0 / ⌀4,0 × 3,0 mm
Grade:	**N38**
Br:	12.2-12.6 kGs
Hcb:	860-915 kA/m
BHmax:	287-303 kJ/m³
Temperature:	**≤ 80 °C**

Catalog data

MP 14x8/4x3 / N38 - ring magnet

Catalog number	**030181**	Induction	**244,11 mT / 2 441 Gs**
GTIN / EAN	**5906301811985**	Coating	**[NiCuNi] Nickel**
Dimensions	**⌀14,0 / ⌀4,0 × 3,0 mm**	Grade	**N38**
Magnetization direction	**axial**		

https://dhit.pl/en/product/magnes-neodymowy-pierscieniowy-14x8-4x3-n38-osiowy

Calculation result

2,54 kg PULL FORCE model value: 2,5366 kg	**2 440** Gs SURFACE INDUCTION	**3,18** g MAGNET MASS	**0,316** Pc PERMEANCE COEFF.

Range resulting from material tolerance: 2,46 – 2,62 kg

Key takeaways for the designer

1. The 2,54 kg figure applies only to ideal conditions: thick, clean steel, full contact, 20 °C.
2. Under shear loading (a vertical wall) the real holding force drops to about 30%.
3. A flat magnet held in air loses its thermal safety margin far sooner than one attached to steel.
4. Always apply the safety factor from the table — at least ×2.0 for workshop assembly.

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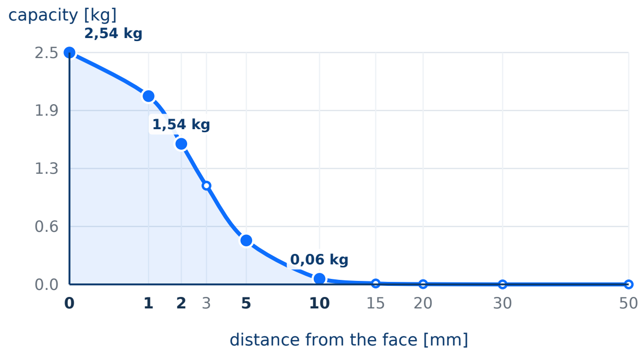
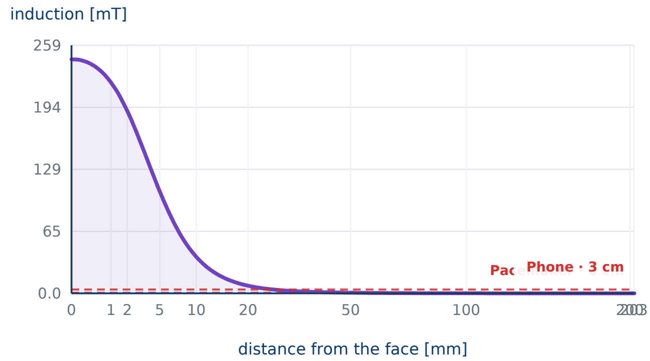


Force vs. distance



Magnetic field map B(z)

Induction computed on the magnet axis, in air, with no steel plate. The horizontal axis is compressed near the face, so one figure shows both the steep fall close to the magnet and the reach of the residual field. The horizontal lines mark safety-relevant thresholds.

Model methodology and validation

This report was not produced by an FEM solver and was not copied from a catalogue table. Everything is computed by a closed-form analytical model — the on-axis field from the potential of a uniformly magnetised body, the pull force from Maxwell stress at the magnet-steel interface. The whole calculation path is set out below, so any result can be checked on paper.

Model equations

Disc and ring — on-axis induction at distance z from the pole face

$$B(z) = (Br / 2) \cdot [(H + z) / \sqrt{R^2 + (H + z)^2} - z / \sqrt{R^2 + z^2}]$$

Pull force — Maxwell stress integrated over the pole face

$$F\,[N] = B_{load}^2 \cdot A / (2 \cdot \mu_0) \quad F\,[kg] = F\,[N] / g$$

Flux concentration factor — a thick steel plate behaves like a magnetic mirror, closing the circuit and lifting the gap induction above the free-space value

$$B_{load} = B(0) \cdot sf \quad sf = 1 + 1.6 \cdot \exp(-1.2 \cdot \lambda) \quad \lambda = H / D$$

Permeance coefficient — a measure of the self-demagnetisation that follows from the geometry alone; De denotes the equivalent diameter of the pole face

$$Pc = k \cdot 1.7 / (1 + 0.9 \cdot k) \quad k = H / De$$

Calibration constant — without correction the model underestimates the force systematically, since it omits side-wall leakage flux that also closes the circuit through the plate. The coefficient was fitted by least squares to 127 dhit catalogue items

$$F\,[kg] = k_{cal} \cdot B_{load}^2 \cdot A / (2 \cdot \mu_0 \cdot g) \quad k_{cal} = 1.4837$$

Model constants and input parameters

Symbol	Meaning	Value
Br	Grade remanence, mid-range	**12,40 kGs (1,240 T)**
Hcb	Induction coercivity, catalogue	**860-915 kA/m**
Hcj	Intrinsic coercivity, guaranteed minimum	**≥ 955 kA/m**
μrec	Recoil permeability	**1,05**
k_cal	Model calibration constant	**1,4837**
Pc	Permeance coefficient of this geometry	**0,316**
sf	Flux concentration factor	**2,237**
A	Pole face area	**1,41 cm²**
ρ	Sintered NdFeB density	**7,50 g/cm³**

The permeance coefficient is given to three decimal places throughout this report. The calculations themselves run on the unrounded value, so reproducing a result from the rounded figure may differ in the last digit.

Calibration and goodness of fit

The model has precisely one fitted parameter — k_cal. Everything else is physics without adjustments. The value came from a least-squares regression over 127 dhit catalogue items. The calibration set is a subset of the bare-magnet catalogue described below; its detailed composition is recorded in the internal fitting documentation and is not reproduced here.

The catalogue behind the calibration set contains bare magnets in three geometries — discs, rectangular blocks and rings. The dimensional range reaches from a few millimetres to about 200 mm, with grades from N35 to N52, including the higher-coercivity variants (H, SH, AH). Across that catalogue the permeance coefficient runs from about 0.10 to about 1.6 with a median near 0.42; roughly one item in ten sits below 0.2, that is among the distinctly flat bodies. All three geometries were fitted jointly under one constant — there are no separate coefficients for discs, blocks or rings.

The distribution of deviations after calibration is markedly skewed: median 0.09%, ninth decile 0.45%, largest value 1.9%. Read practically: for most items the difference does not exceed half a percent, and the isolated two-percent cases concern extreme dimensions. It must be remembered what these numbers refer to — they describe the model's agreement with the dataset it was fitted to, not the uncertainty of measuring a physical item. The real product spread is broader — it is driven by material tolerance and contact quality, covered in the separate sensitivity tables.

The constant exists above all to capture side-wall leakage flux — and its share grows the flatter the magnet is. It is precisely at low permeance that the correction does the most work, and there that an uncalibrated model would stray furthest. This class of magnet is present in the calibration base, so the size discussed sits inside the fitted range, not outside it.

Assumptions built into the calculation

1. We assume the whole body is uniformly magnetised, with the magnetisation vector parallel to the axis given as the magnetisation direction.
2. The steel plate is flat, clean, degreased, at least as thick as the point at which the model shows full flux utilisation (see the plate thickness table), and does not enter saturation.
3. Contact covers the entire pole face and the only gap is the thickness of the protective coating.
4. The load acts perpendicular to the contact face and builds up slowly, with no impact and no turning moment.
5. The magnet and the steel are at 20 °C and the recoil permeability is taken as $\mu_{rec} = 1.05$.
6. The calculation takes the mid-range remanence of the grade band — the extreme values are shown in the method comparison table.
7. We assume there are no other magnetic sources or ferromagnetic parts in the field beyond the plate described.

Limits of the model

1. The model determines the field only on the axis of symmetry. Near the pole edge the induction distribution looks different: a magnet at the plate edge loses about 45% of its force, which a separate parameter accounts for, not the field equation itself.
2. Bodies with very low Pc (below about 0.2, that is distinctly flat shapes) have their operating point close to the knee of the demagnetisation curve. The model treats their characteristic as linear, which holds at 20 °C but breaks down once the magnet is heated — the real loss can then exceed the calculated one. For such proportions, read this report together with the thermal analysis section.
3. The model's scope is axial magnetisation — for diametric and radial the poles fall differently and we do not generate a report.
4. Closed circuits — pot magnets, separators, bars and grippers — have a different flux topology. The pot magnet figures in this report are an approximation based on a gain factor, not a magnetic circuit solution.
5. Hysteresis, eddy currents and dynamic effects during rapid separation are not modelled. Under impact loading the pull force can go above the static value.
6. The calculation excludes flatness and parallelism deviations, and it is precisely these that most often explain a workshop result below the calculated value.

Force and induction vs. distance

Distance	Gauss	mT	kg	lbs	N	Force share
0 mm	2 440	244,0	**2,54**	5,59	24,9	100%
1 mm	2 199	219,9	**2,06**	4,54	20,2	81%
2 mm	1 900	190,0	**1,54**	3,39	15,1	61%
3 mm	1 593	159,3	**1,08**	2,38	10,6	43%
5 mm	1 062	106,2	**0,48**	1,06	4,7	19%
10 mm	380	38,0	**0,06**	0,14	0,6	2%
15 mm	160	16,0	**0,01**	0,02	0,1	0%
20 mm	79	7,9	**0,00**	0,01	0,0	0%
30 mm	27	2,7	**0,00**	0,00	0,0	0%
50 mm	7	0,7	**0,00**	0,00	0,0	0%

Shear force (sliding)

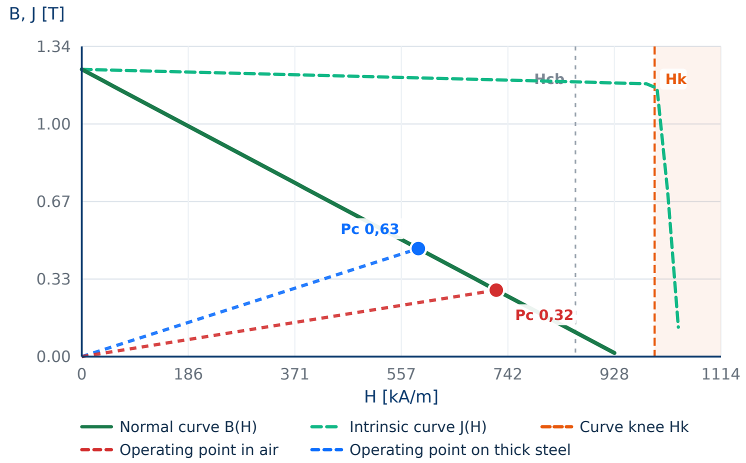
Surface	Friction	kg	N
Bare steel	0,30	**0,76**	7,5
Painted steel	0,20	**0,51**	5,0
Oily surface	0,10	**0,25**	2,5
Rubber coating	0,50	**1,27**	12,4

Effect of steel thickness

Thickness	Utilisation	Force
0,5 mm	10%	**0,25 kg**
1,0 mm	25%	**0,63 kg**
2,0 mm	50%	**1,27 kg**
3,0 mm	75%	**1,90 kg**
5,0 mm	100%	**2,54 kg**
8,0 mm	100%	**2,54 kg**
10,0 mm	100%	**2,54 kg**
12,0 mm	100%	**2,54 kg**

Demagnetisation curve and operating point

The normal curve B(H) describes the net induction inside the magnet; the intrinsic curve J(H) describes the material polarisation alone. The intersection of the normal curve with the load line B = μ0 · Pc · H marks the operating point. The lower it falls, the closer to the J(H) knee the magnet works and the easier flux is lost for good.



Working condition	Pc	Bd [T]	Hd [kA/m]
Operating point in air	**0,316**	**0,287**	722
Operating point on thick steel	**0,633**	**0,466**	586

	Margin to knee Hk/Hd	Irreversible loss risk
Operating point in air	**1,38**	none
Operating point on thick steel	**1,70**	none

Hk = 998 kA/m · Hcj 955–1 051 kA/m · Hcb 940 kA/m

Placing the magnet against a thick steel plate closes the magnetic circuit and roughly doubles the permeance coefficient. The operating point moves up the curve, the induction inside the magnet rises and the margin to the knee widens appreciably. This is exactly why flat magnets are kept stuck to steel or in opposite-pole pairs, never loose.

The body's proportions place the operating point high on the curve, well clear of the knee. In normal service irreversible flux loss is practically no threat, and the grade's maximum operating temperature is what limits us.

Force loss vs. temperature

Temperature	Loss	Force	%
20 °C	0,0%	**2,54 kg**	100%
40 °C	-2,2%	**2,48 kg**	98%
60 °C	-4,4%	**2,43 kg**	96%
80 °C	**-6,6%**	**2,37 kg**	93%
100 °C	**-28,8%**	**1,81 kg**	71%

The table above is a summary: it captures only the force loss due to remanence change and serves for quick assessment. The extended thermal analysis in the following section breaks the same loss into reversible and irreversible components, shows the margin to the knee of the J(H) curve and gives the force after returning to room temperature. When selecting a magnet for elevated-temperature duty, the extended table is the one that decides; this one is for orientation only.

Extended thermal analysis

Temperature removes force through two mechanisms that must be distinguished. The reversible loss comes from the remanence falling by 0.11% per kelvin and disappears entirely on cooling. Only when the operating point drops below the knee of the J(H) curve does an irreversible loss appear, and it never returns. Because intrinsic coercivity falls with temperature more than five times faster than remanence, the boundary of safe operation is set not by the grade's stated maximum temperature but by the magnet's shape.

Temperature	Reversible loss	Margin to knee Hk/Hd	Irreversible loss	Force at temperature	Force after cooling	Irreversible loss risk
20 °C	0,0%	1,38	0,0%	**2,54 kg**	**2,54 kg**	none
40 °C	-2,2%	1,24	0,0%	**2,43 kg**	**2,54 kg**	low
60 °C	-4,4%	1,10	0,0%	**2,32 kg**	**2,54 kg**	moderate
80 °C	-6,6%	**0,95**	**-10,5%**	**1,77 kg**	**2,03 kg**	**high**
100 °C !	-8,8%	**0,79**	**-31,8%**	**0,98 kg**	**1,18 kg**	**high**

The 'force after cooling' column is the one that matters for product life: it shows what the magnet will hold permanently after a single overheating episode. The irreversible-loss numbers are estimated from the distance of the operating point to the curve knee — they are not thermal test results. The real loss depends on soak time and on the actual coercivity of the given material batch.

The practical consequence: a flat magnet held in air loses its margin far sooner than the same magnet attached to steel. At elevated operating temperature the cheapest answer is not a stronger grade but closing the magnetic circuit or a thicker magnet.

Sensitivity and tolerance analysis

The capacity quoted is a nominal value — for nominal dimensions and reference conditions. The tables below show how much the result shifts under the deviations that always occur in practice: grinding tolerance, coating thickness, surface condition of the steel and its grade.

Effect of ±0.1 mm dimensional tolerance

Dimension	Force change	Induction change	Force within tolerance
Outer diameter	-0,56% … +0,55%	-0,60% … +0,61%	**2,52 – 2,55 kg**
Inner diameter	-0,45% … +0,44%	+0,00% … +0,00%	**2,53 – 2,55 kg**
Height / thickness H	-4,69% … +4,67%	-2,84% … +2,79%	**2,42 – 2,65 kg**
All dimensions at limit	-4,78% … +4,80%	-2,24% … +2,18%	**2,42 – 2,66 kg**

For sintered NdFeB after grinding a tolerance of ±0.1 mm is standard. This gives an asymmetric conclusion: for flat shapes the force is set almost solely by height, which governs Pc, while changing the diameter achieves nothing — the extra pole area is offset by the drop in induction. Where force is a critical parameter, tighten the height tolerance, not the diameter.

Effect of coating and surface condition

Contact condition	Equivalent gap	Force	%
Ideal contact, uncoated magnet	0,000 mm	**2,54 kg**	100,0%
NiCuNi coating 15–25 µm	0,025 mm	**2,53 kg**	99,8%
Coating + rolled plate roughness	0,050 mm	**2,52 kg**	99,3%
Oil or preservative film	0,060 mm	**2,52 kg**	99,2%
Powder coating 60–80 µm	0,100 mm	**2,50 kg**	98,5%
Heavy paint or sprayed zinc	0,200 mm	**2,45 kg**	96,8%
Rust film and flaking corrosion	0,400 mm	**2,36 kg**	93,1%
Mill scale, heavy corrosion	0,800 mm	**2,16 kg**	85,3%

Effect of the substrate steel grade

Substrate material	Factor	Force
Soft magnetic iron (ARMCO, DT4)	1,03	**2,61 kg**
S235 / A36 — model reference	1,00	**2,54 kg**
S355	0,99	**2,51 kg**
Carbon steel C45	0,96	**2,44 kg**
Ferritic stainless 430	0,85	**2,16 kg**
Grey cast iron	0,75	**1,90 kg**
Austenitic stainless 304 / 316	0,00	**0,00 kg**

All surface conditions are reduced to a single measure — an equivalent air gap. The result is often counter-intuitive: a magnet with a low permeance coefficient is barely sensitive to a thin gap, because its operating point is governed by its own self-demagnetisation rather than by the gap reluctance. On a slender, high-Pc magnet the identical paint coat already costs well over ten percent of the force. This is why the table is computed for this specific geometry rather than copied from a generic one. An important caveat: the figures above describe the effect of the gap alone. Rust, mill scale and heavy paint act through a second mechanism as well — they destroy flatness and reduce full-face contact to a few bearing points. That second effect usually costs far more than the gap alone and does not follow from geometry — on corroded plate the capacity drops by half or more.

As long as the plate is thick enough not to saturate, its grade matters little: the circuit reluctance is already dominated by the magnet's own demagnetisation, so raising the steel permeability changes little. Differences become significant only for cast iron and ferritic steel, where the lower saturation induction genuinely limits the flux. The austenitic grades 304 and 316 are paramagnetic — a magnet will not grip them. The factors given are indicative.

Comparison of calculation methods

The same geometry calculated by different methods yields results that differ more than tenfold. This is not a dispute about physics but about assumptions. The table below shows the full spread, to make clear where the value published by dhit comes from and why it can be lower than figures quoted elsewhere.

Calculation method	Key assumption	Force	Relative to dhit
Maxwell at full remanence	Takes the induction across the whole gap to equal Br. An upper thermodynamic limit that cannot be reached.	8,82 kg	×3,48
Mirror circuit model	Doubles Pc and derives the force from the operating-point induction. Ignores side-wall leakage flux, so it underestimates.	1,25 kg	×0,49
Analytical model, uncalibrated	The same calculation route as dhit, with only the k_cal constant omitted. It reveals how much the calibration alone adds.	1,71 kg	×0,67
dhit model — published value	Calibrated against the catalogue; reference conditions: S235, full-face contact, 20 °C.	**2,54 kg**	×1,00
dhit model at the upper Br limit	The method is unchanged, only remanence is taken from the top of the band rather than the middle.	2,62 kg	×1,03
Same size in a higher grade (N42)	A frequent source of discrepancy: foreign catalogues work with N42 by default, not N38.	2,81 kg	×1,11

Calculators published by overseas suppliers typically quote values 60–80% higher for the same geometry. The difference is nobody's mistake but the sum of assumptions: a default grade of N42 instead of N38, remanence at the top of the band, a lapped rather than rolled plate, zero gap computed on an uncoated magnet, and a field solver treating leakage flux more generously than an analytical model. Taken one at a time each assumption is defensible; added together they lead to a number no workshop can reproduce.

dhit deliberately quotes the lower end of that range. The published value is roughly 0.6 of the idealised one — precisely what you would arrive at after applying a safety factor. As a result the value in this report is from the outset closer to what a designer should carry into the calculations.

Safe distances (health & safety)

	Gs	cm
Pacemaker	< 5	**5,6**
Hearing aid	< 10	**4,4**
Watch	< 20	**3,4**
Phone	< 40	**2,8**
Payment card	< 400	**1,0**
HDD drive	< 600	**0,8**

Magnetic flux

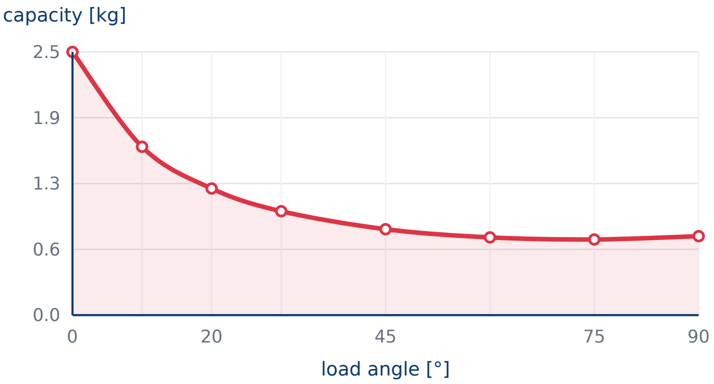
Φ	**4 060 Mx**
Φ (SI)	**40,6 µWb**
Bd	**2 872 Gs**
Pc	**0,316**
A	**1,41 cm²**
V	**0,42 cm³**

Attraction dynamics

Release distance	Speed	km/h	Energy	Risk
10 mm	6,98 m/s	25,1	**0,08 J**	Safe
30 mm	7,06 m/s	25,4	**0,08 J**	Safe
50 mm	7,06 m/s	25,4	**0,08 J**	Safe
100 mm	7,06 m/s	25,4	**0,08 J**	Safe

The speed at which the magnet meets the steel plate after being released from a given distance. From 5 J upwards the risk of crushing a finger is very real – hold the magnet at the side, not in its path.

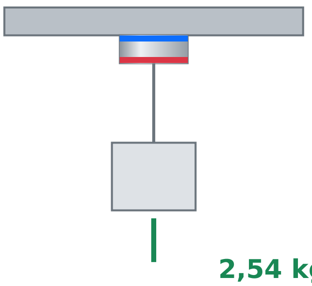
Force vs. load angle



Angle	Capacity	%
0°	**2,54 kg**	100%
10°	**1,62 kg**	64%
20°	**1,22 kg**	48%
30°	**1,00 kg**	39%
45°	**0,83 kg**	33%
60°	**0,75 kg**	30%
75°	**0,73 kg**	29%
90°	**0,76 kg**	30%

Read the real holding force for any angle of applied force from this chart. 0° is pulling straight off the surface (the catalogue value), 90° is dragging along the plate. The curve falls away fast — 30° already costs you half the capacity.

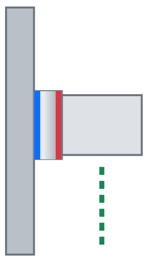
Typical mounting scenarios



2,54 kg

Ceiling

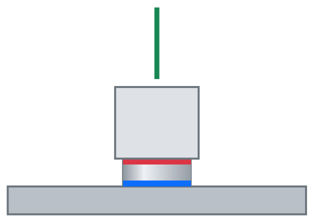
The weight hangs straight down under the magnet: perpendicular load, full catalogue value.



0,76 kg

Vertical wall

The load tries to slide the magnet down the plate — only friction acts, capacity falls to about 30%.



2,54 kg

Floor / horizontal

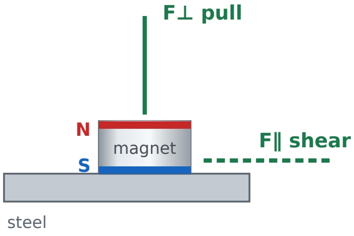
On a horizontal plate with an upward load the magnet delivers its full perpendicular capacity.

How many magnets do I need?

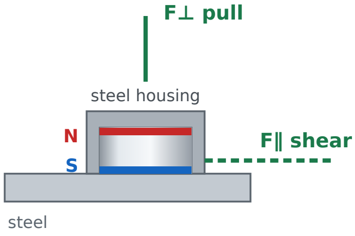
Mass to hold	**10,0 kg**	Load direction	**perpendicular (pull-off)**
Safety margin	**2,0×**	Capacity of one magnet	**2,54 kg**
Magnets required	**8**	Total set capacity	**20,29 kg (2,0×)**

The result takes into account the load direction and the selected safety margin. Where a mounting failure would be hazardous, apply a margin of at least 3×.

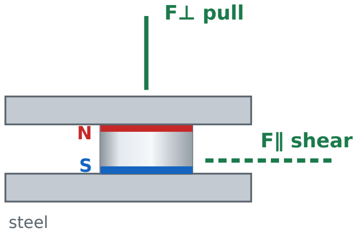
Load direction vs. real holding force



Bare magnet
magnet without housing
F⊥ pull: **2,54 kg**
F∥ shear: **0,76 kg**



Single-sided pot
magnet in steel housing
F⊥ pull: **6,45 kg**
F∥ shear: **1,94 kg**



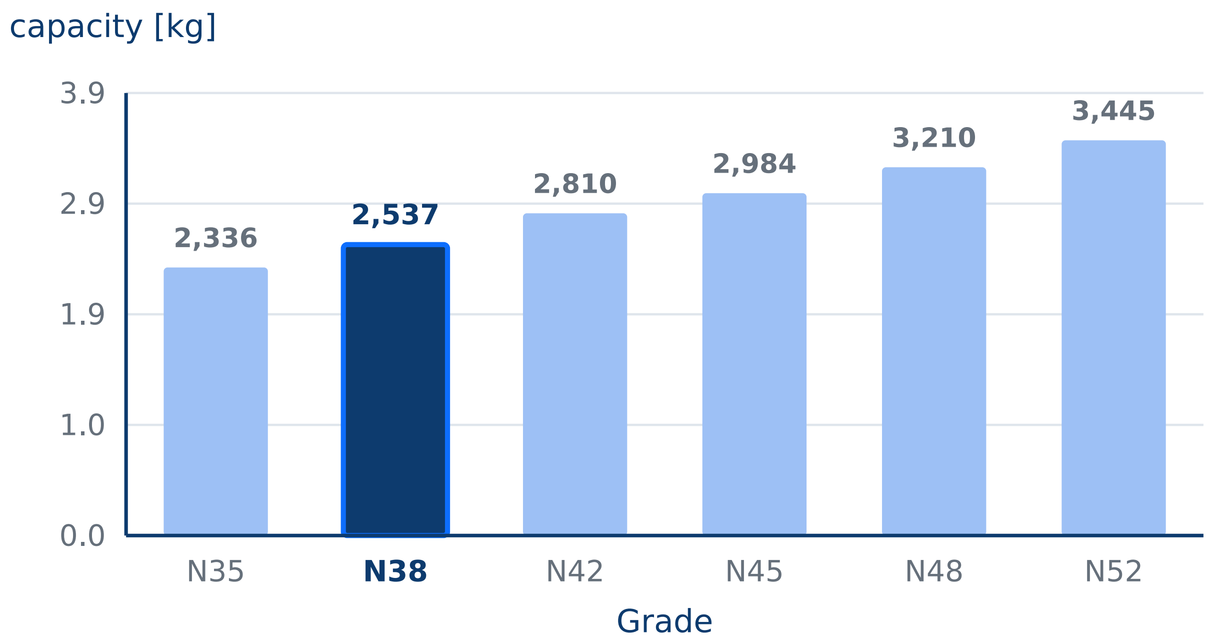
Double-sided pot
two magnets, shared housing
F⊥ pull: **5,81 kg**
F∥ shear: **1,74 kg**

Mounting variant	Perpendicular force (pull)	Parallel force (shear)	Share
Bare magnet	**2,54 kg**	**0,76 kg**	30%
Single-sided pot	**6,45 kg**	**1,94 kg**	30%
Double-sided pot	**5,81 kg**	**1,74 kg**	30%

Perpendicular force is what the catalogue quotes: pulling straight off the face. Parallel force (shear) applies when the load tries to slide the magnet along the plate and is only a fraction of the former. Values for bare steel, friction coefficient 0.30.

> **When designing a mount, always check which way the load acts. A magnet rated at 100 kg will hold a vertically suspended load of around 30 kg, and that is without any safety margin.**

Grade comparison



The same body produced in successive NdFeB grades. A higher grade delivers more force without changing the dimensions.

Two magnets — attraction and repulsion

Gap	Attraction	Repulsion
0 mm	2,54 kg	2,28 kg
1 mm	2,06 kg	1,85 kg
2 mm	1,54 kg	1,38 kg
3 mm	1,08 kg	0,97 kg
5 mm	0,48 kg	0,43 kg
10 mm	0,06 kg	0,06 kg
20 mm	0,00 kg	0,00 kg
30 mm	0,00 kg	0,00 kg

Magnet stack

Quantity	Stack pull force	Gain
1	2,54 kg	×1,00
2	5,29 kg	×2,09
3	6,15 kg	×2,43
5	5,57 kg	×2,20
10	3,90 kg	×1,54

Building magnets into a stack raises capacity only up to a certain limit. The best result comes at a height of roughly 0.6–0.8 of the diameter — further up the force falls despite the growing volume. Measurements from our own stock confirm it: a ⌀10 mm magnet peaks at a height of 8 mm (3.39 kg), while at 15 mm it holds only 2.61 kg.

The saturation has a simple cause: the pole area does not change with stack height, and it is the pole area that enters the force equation. Adding material does raise the permeance coefficient and with it the operating-point induction, but that induction tends asymptotically towards the remanence and above a certain height stops rising appreciably. In addition, material at the end of the stack moves away from the working face and its flux increasingly closes through the side wall instead of the gap. From a height of around 0.7 of the diameter the two mechanisms act together and a further magnet barely raises capacity, but does raise cost, mass and assembly risk.

Additional parameters

0,05 N·m	0,08 J	1,40 kg	176 kPa
ROTATION RESISTANCE TORQUE	DETACHMENT WORK	CAPACITY AT PLATE EDGE	UNIT PRESSURE

A magnet placed right at the edge of the plate loses part of its flux and holds less. The resistance to rotating the magnet on a steel surface.

Engineering indicators

A set of quantities that characterise the magnet no matter what you attach it to. They come from the same calculations as the results above.

71 %	**0,42** A·m²	**0,797** kg/g	**84** mJ
SHAPE EFFICIENCY	MAGNETIC MOMENT	FORCE PER GRAM	DETACHMENT ENERGY

Shape efficiency: 207 / 291 kJ/m³ – of the material potential used

(BH)d = Bd · Hd, (BH)max = Br² / (4 · μ0 · μrec)

What percentage of the material's energy potential this geometry uses. The energy product at the operating point (BH)d referred to the material maximum (BH)max. The optimum lies at Pc ≈ 1.05 – taller magnets of smaller diameter come closer to it. A low figure does not indicate a defective product – a low-profile disc wins wherever build thickness is the constraint.

Consistency check: the calculated (BH)max should fall within the catalogue range for the grade. A result inside the range confirms that the Br and μrec assumed in the model agree with each other.

Magnetic moment

A quantity unaffected by the substrate, the air gap or the circuit geometry. The product of the magnetisation M = Br/μ0 and the volume of the body. It lets you estimate the field far from the magnet, where only the dipole approximation matters.

Force per gram

Pull force divided by mass – a measure of how much work each gram of material does. The taller the magnet at a given diameter, the higher the figure, because Pc increases. It helps judge the cost of force, because price depends mainly on the mass of material.

Detachment energy

Equivalent to lifting **9** g to a height of one metre.

The work of the force over the path from contact to 50 mm, obtained by numerical trapezoidal integration. Not to be confused with force – force decides whether the magnet holds the load, whereas energy tells you how much effort removing it costs.

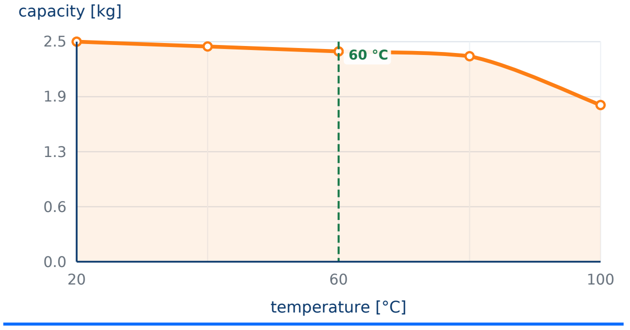
Three levels of the same number

Very different values are quoted for one geometry – depending on the assumptions made. Below are the three levels you will actually encounter.

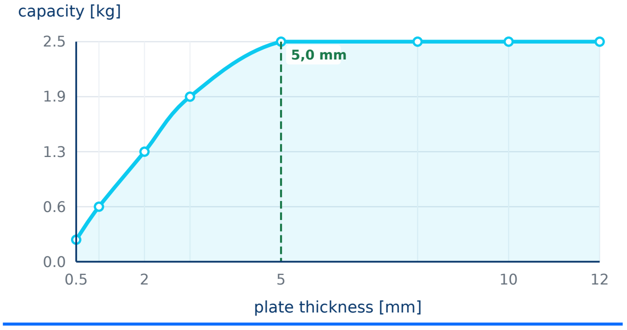
Level	What it is based on	Force
Typical online shop claim	N42 grade instead of N38, remanence at the top of the range, zero air gap, lapped plate	**4,06 – 4,57 kg**
dhit model – ideal laboratory conditions	S235 steel at least 10 mm thick, full contact, 20 °C, uncoated magnet	**2,54 kg**
Value for design calculations	The model divided by a safety factor of 2.0 for workshop mounting	1,27 kg

The 1.6–1.8 multiplier is not guesswork. It results from the sum of assumptions that inflate results published elsewhere – and because those factors act multiplicatively, the ratio stays valid for any geometry, unlike the absolute value. For structural design always take the last row.

Temperature derating curve



Steel thickness effect curve



Ageing and long-term stability

Service period	Flux loss	Force
1 years	-0,2%	**2,53 kg**
5 years	-0,5%	**2,51 kg**
10 years	-1,0%	**2,49 kg**
20 years	-1,8%	**2,45 kg**

Sintered NdFeB in a properly designed magnetic circuit is a stable material — spontaneous flux loss is measured in fractions of a percent per year and all but disappears after the first year. The values below assume room-temperature operation, a dry environment and unchanged circuit geometry.

Recommended safety factors

Type of duty	Recommended utilisation	Safety factor	Design force
Static load, controlled contact	70%	×1,4	**1,78 kg**
Static load, workshop assembly	50%	×2,0	**1,27 kg**
Shear load (sliding along the plate)	50%	×2,0	**0,38 kg**
Motion, acceleration, opening cycles	40%	×2,5	**1,01 kg**
Vibration, transport, continuous duty	33%	×3,0	**0,84 kg**
Work overhead or lifting	20%	×5,0	**0,51 kg**

It is corrosion, not ageing of the material itself, that governs a magnet's life in practice. The NiCuNi coating is sealed as long as it remains intact; a chipped edge, an impact or damp working conditions open a path to core rusting, and a corroded sinter crumbles and loses flux far faster than the table suggests. The second cause is thermal cycling — each crossing of the knee permanently costs part of the strength and the losses accumulate. This is an estimate based on the operating point position, not the outcome of long-term testing.

The catalogue capacity is a limiting value for ideal conditions and is not fit for direct use in design calculations. Because of wide manufacturing spread and extreme sensitivity to contact quality, a magnet is designed to a fraction of its nominal value. The table below gives shares proven in workshop practice.

Where a mounting failure endangers health, the magnet cannot be the only load-carrying element; an independent mechanical safeguard is required. A magnet is not treated as a lifting accessory or as lifting equipment.

How to use this data in practice

1. Start from the direction of the load, not from the number of kilograms. Shear force is roughly 30% of pull force on bare steel and distinctly less on painted steel — a vertical wall mount is designed from the shear table, never from the catalogue value.

2. Multiply the result by the share from the safety factor table appropriate to the type of duty. Only that number is the design force.

3. Check that the plate is thick enough. Below the full-flux-utilisation threshold the capacity falls in direct proportion to thickness, because thin plate goes into saturation. For this magnet the threshold is 5,0 mm.

4. Work out the operating temperature, not just the ambient. In an enclosure, beside a motor or in a machine standing in the sun, a magnet can be tens of degrees hotter than the shop air.

5. Do not count on gains from stacking magnets: above a height of about 0.7 of the diameter the gain essentially disappears. It is cheaper and more reliable to increase the diameter or spread the load over several mounting points.

6. Surface preparation matters. Degreasing and removing rust usually deliver more than raising the grade by two steps, at a fraction of the cost.

7. Keep flat magnets attached to steel or in opposite-pole pairs. Kept loose, they work close to the curve knee and lose their thermal safety margin.

8. If the mounting is critical, run a trial on the actual material in its actual surface condition. One force-gauge measurement on the real part is worth more than any calculation report, this one included.

Material data sources

The grade parameters used in the calculations come from the sinter supplier's material data sheet and fall within the ranges described by the documents below. We list them so that every adopted value can be checked against an independent source.

IEC 60404-5:2015 — methods of measuring the magnetic properties of hard magnetic materials in a closed circuit: flux density, polarisation and field strength, and determination of the demagnetisation curve and recoil line · https://webstore.iec.ch/en/publication/22142

IEC 60404-8-1:2023 — specification of minimum magnetic properties and dimensional tolerances for hard magnetic materials, supplemented with densities and chemical composition ranges · https://webstore.iec.ch/en/publication/68440

ASTM A977/A977M-07(2020) — hysteresigraph method for high-coercivity materials, covering remanence, coercivity, knee field, energy product and recoil permeability · https://store.astm.org/a0977_a0977m-07r20.html

MMPA Standard No. 0100-00 — industry specification covering the magnetic, thermal, physical and mechanical properties of commercial permanent magnets and typical production tolerances · a Magnetic Materials Producers Association standard, available to association members

dhit grade data sheet — the source of the Br, Hcb, Hcj, BHmax and maximum operating temperature ranges used in this report as model inputs. · available on the product page in the dhit catalogue

The standards are cited as sources of methodology and reference values; this report is not an accredited test document and does not constitute a certificate of conformity with any of them.

Production repeatability

We publish no process capability statistics (Cp, Cpk) for individual sizes, hence the general nature of the notes below. In sintered NdFeB the spread of magnetic properties exceeds the dimensional spread; the industry assumes a remanence tolerance of about ±5% and declares intrinsic coercivity as a minimum. Since force depends on the square of induction, a remanence tolerance of this order means roughly ±10% of force: more than the dimensional tolerance and many times more than the model uncertainty. The conclusion for the designer is unambiguous: when sizing a mount it is material spread, not calculation accuracy, that sets the required safety margin.

A spread of about ±10% in force arising from remanence tolerance is typical of the entire sintered neodymium magnet industry, which is why safety margins are necessary regardless of how accurate the calculation model itself is.

Reference conditions

Magnetization direction: axial · The poles fall on the end faces and the field passes along the dimension **3,0 mm**

The pull force was computed for a plate of non-alloy structural steel (S235 / A36) of at least 10 mm thickness, smooth, clean and degreased, with no air gap and force perpendicular to the surface. Austenitic stainless steel (304, 316) is non-magnetic — a magnet will not stick to it.

Values are calculated from a physical model calibrated against 127 measured products. They are estimates for design purposes — always apply a safety margin.

All values in this report are the result of model calculations, not a measurement of this particular item. They are intended for design and comparison. Before using them in a safety-relevant design, run a trial on the actual part and always apply a safety margin in line with the safety factor table.

The report is produced in two language versions. The Polish version sits at the same address without the /en/ prefix and with the Polish route segment, for example https://dhit.pl/raport-magnesu/magnes-neodymowy-walcowy-38x3-5-n38-osiowy/. The calculations, assumptions and all numerical values are identical — only the descriptive layer changes.