Dhit sp. z o.o.
Kościuszki 6A
05-850 Ożarów Mazowiecki, Poland
tel. +48 888 99 98 98
bok@dhit.pl
https://dhit.pl

Magnet calculation report

MPL 5x5x1.2 / N38
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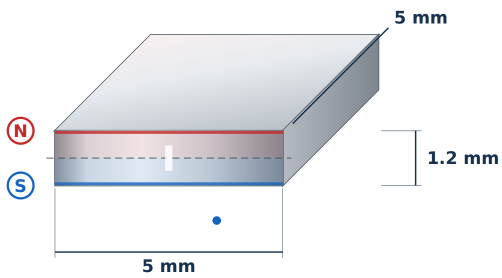
Scanning the code opens the interactive calculator with an identical set of parameters



magnetization (S → N)

Shape:	block
Dimensions:	5,0 × 5,0 × 1,2 mm
Grade:	**N38**
Br:	12.2-12.6 kGs
Hcb:	860-915 kA/m
BHmax:	287-303 kJ/m³
Temperature:	**≤ 80 °C**

Catalog data

MPL 5x5x1.2 / N38 - lamellar magnet

Catalog number	**020171**	Induction	**245,17 mT / 2 452 Gs**
GTIN / EAN	**5906301811770**	Coating	**[NiCuNi] Nickel**
Dimensions	**5,0 × 5,0 × 1,2 mm**	Grade	**N38**
Magnetization direction	**through thickness**		

https://dhit.pl/en/product/lamellar-magnet-5x5x1-2-n38-axial

Calculation result

0,44 kg PULL FORCE model value: 0,4370 kg	**2 450** Gs SURFACE INDUCTION	**0,22** g MAGNET MASS	**0,303** Pc PERMEANCE COEFF.

Range resulting from material tolerance: 0,42 – 0,45 kg

Key takeaways for the designer

1. The 0,44 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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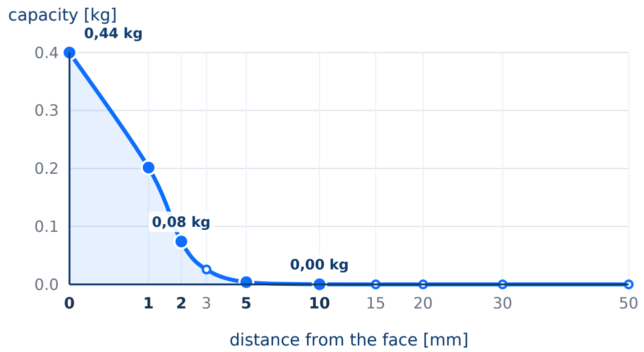
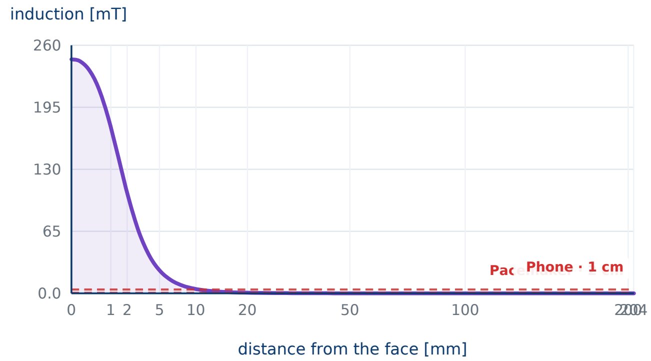


Force vs. distance



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

The figures in this report do not come from a finite element (FEM) field simulation, nor from a lookup table of catalogue values. They are produced by a closed-form analytical model: the on-axis field is derived from the potential of a uniformly magnetised body, and the pull force from the Maxwell stress equation at the magnet-to-steel boundary. The whole calculation path is set out below, so any result can be checked on paper.

Model equations

Rectangular block — induction computed on the axis, where a = L/2, b = W/2

$$B(z) = (B_r / \pi) \cdot \left[\arctan\left(\frac{a \cdot b}{z \cdot \sqrt{a^2 + b^2 + z^2}} \right) - \arctan\left(\frac{a \cdot b}{(z + H) \cdot \sqrt{a^2 + b^2 + (z + H)^2}} \right) \right]$$

Pull force — Maxwell stress integrated over the pole face

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

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

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

Permeance coefficient — an indicator of how hard the magnet's shape works against its own magnetisation; De denotes the equivalent diameter of the pole face

$$P_c = k \cdot 1.7 / (1 + 0.9 \cdot k) \qquad k = H / D_e$$

Calibration constant — the uncorrected model systematically underestimates the force, because it ignores the leakage flux from the side wall, which also closes through the plate and carries part of the load. The coefficient was fitted by least squares to 127 dhit catalogue items

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

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	0,303
sf	Flux concentration factor	2,200
A	Pole face area	0,25 cm²
ρ	Sintered NdFeB density	7,50 g/cm³

The permeance coefficient is given to three decimal places throughout this report. Computation uses the unrounded value, which is why recalculating from the rounded figure may differ in the last digit.

Calibration and goodness of fit

Exactly one parameter is fitted across the whole model, k_cal; beyond it there are no correction factors at all. The value came from a least-squares regression over 127 dhit catalogue items. The calibration set was drawn from the bare-magnet catalogue described below; the full list of items is held in the internal fitting documentation.

The catalogue behind the calibration set contains bare magnets in three geometries — discs, rectangular blocks and rings. Characteristic dimensions run from a few millimetres to roughly 200 mm, and grades from N35 to N52 together with 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.

After calibration the deviations are distributed with a clear skew — median 0.09%, ninth decile 0.45%, maximum 1.9%. In practice, for the vast majority of items the model stays below half a percent of difference, and deviations of around two percent are isolated cases at the ends of the dimensional range. It is worth remembering what these numbers cover: agreement between model and training set, not the uncertainty of measuring a particular item. The true product spread comes out wider, since it combines material tolerance and contact quality; the separate sensitivity tables describe it.

The calibration constant compensates mainly for side-wall leakage flux, whose share of the total flux grows the flatter the body becomes. For low-permeance geometries the correction therefore contributes the most, and it is there that an uncalibrated model would err furthest. Magnets of this class appear in the calibration base, so the size described lies within the region the constant was fitted for rather than beyond it.

Assumptions built into the calculation

1. Magnetisation is taken as uniform across the whole volume, with the magnetisation vector parallel to the stated axis.
2. We assume a flat, clean, degreased steel plate at or above the full-flux-utilisation threshold (see the thickness table), working outside 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. Magnet and steel are at 20 °C, recoil permeability μrec = 1.05.
6. Remanence is taken from the middle of the grade band; what the limits give is 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. At the pole edge the induction distribution is different — a magnet at the plate edge loses roughly 45% of its force; a separate parameter covers this, not the field equation.
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 assumes linearity, valid at 20 °C but unreliable when heated — the actual loss may then exceed the computed one. For such shapes the report must be read together with the thermal analysis section.
3. The model covers axial magnetisation; with diametric and radial magnetisation the poles sit elsewhere, so no report is produced.
4. Closed-circuit assemblies, that is pot magnets, separators, bars and grippers, have a different flux topology. The pot magnet values given here rest on a gain factor and are an approximation, not a solved magnetic circuit.
5. Hysteresis, eddy currents and the dynamics of rapid separation fall outside the model. An impact raises the pull force above its static value.
6. The model contains no flatness or parallelism deviations — yet in practice these most often explain why a measurement falls below the calculation.

Force and induction vs. distance

Distance	Gauss	mT	kg	lbs	N	Force share
0 mm	2 450	245,0	**0,44**	0,96	4,3	100%
1 mm	1 739	173,9	**0,22**	0,49	2,2	50%
2 mm	1 054	105,4	**0,08**	0,18	0,8	19%
3 mm	622	62,2	**0,03**	0,06	0,3	6%
5 mm	241	24,1	**0,00**	0,01	0,0	1%
10 mm	45	4,5	**0,00**	0,00	0,0	0%
15 mm	15	1,5	**0,00**	0,00	0,0	0%
20 mm	7	0,7	**0,00**	0,00	0,0	0%
30 mm	2	0,2	**0,00**	0,00	0,0	0%
50 mm	0	0,0	**0,00**	0,00	0,0	0%

Shear force (sliding)

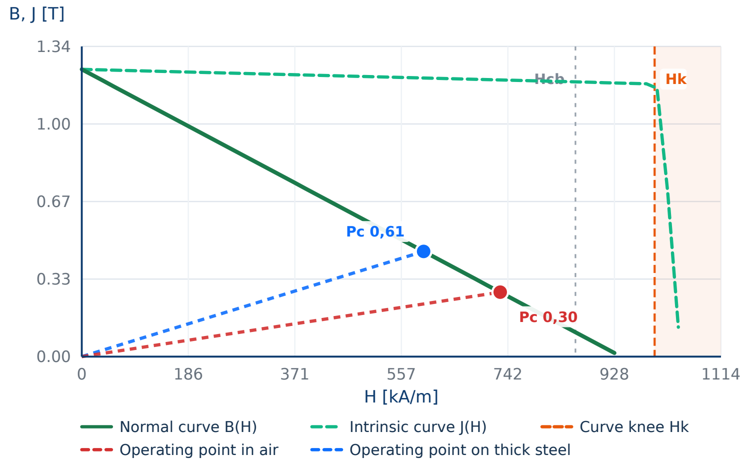
Surface	Friction	kg	N
Bare steel	0,30	**0,13**	1,3
Painted steel	0,20	**0,09**	0,9
Oily surface	0,10	**0,04**	0,4
Rubber coating	0,50	**0,22**	2,1

Effect of steel thickness

Thickness	Utilisation	Force
0,5 mm	10%	**0,04 kg**
1,0 mm	25%	**0,11 kg**
2,0 mm	50%	**0,22 kg**
3,0 mm	75%	**0,33 kg**
5,0 mm	100%	**0,44 kg**
8,0 mm	100%	**0,44 kg**
10,0 mm	100%	**0,44 kg**
12,0 mm	100%	**0,44 kg**

Demagnetisation curve and operating point

B(H) is the net induction inside the magnet, J(H) is purely the material polarisation. The intersection of the normal curve with the load line $B = \mu_0 \cdot Pc \cdot H$ marks the operating point. A lower position means working nearer the J(H) knee and a greater risk of permanent flux loss.



Working condition	Pc	Bd [T]	Hd [kA/m]
Operating point in air	**0,303**	**0,278**	729
Operating point on thick steel	**0,607**	**0,454**	596

	Margin to knee Hk/Hd	Irreversible loss risk
Operating point in air	**1,37**	none
Operating point on thick steel	**1,68**	none

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

A magnet set against a thick steel plate closes the magnetic circuit, which roughly doubles the permeance coefficient. The operating point climbs the curve: induction in the magnet rises and the margin to the knee becomes clearly larger. This is exactly why flat magnets are kept stuck to steel or in opposite-pole pairs, never loose.

The proportions of this magnet put the operating point high on the curve with a wide margin to the knee. In typical use the risk of permanent flux loss is negligible; the boundary is the grade's maximum operating temperature.

Force loss vs. temperature

Temperature	Loss	Force	%
20 °C	0,0%	**0,44 kg**	100%
40 °C	-2,2%	**0,43 kg**	98%
60 °C	-4,4%	**0,42 kg**	96%
80 °C	**-6,6%**	**0,41 kg**	93%
100 °C	**-28,8%**	**0,31 kg**	71%

This table is the abbreviated version — it covers only the loss of force from the change in remanence and is enough for a rough estimate. The extended thermal analysis in the next section splits that loss into reversible and irreversible parts, adds the margin to the knee of the J(H) curve and gives the force remaining after a return to room temperature. For selecting a magnet that will run hot, the extended table is binding — this one is indicative.

Extended thermal analysis

Temperature removes force through two mechanisms that must be distinguished. The reversible loss is caused by remanence falling 0.11% per kelvin; cooling cancels it completely. Only when the operating point drops below the knee of the J(H) curve does an irreversible loss appear, and it never returns. Intrinsic coercivity falls with temperature more than five times faster than remanence, so the boundary of safe operation is decided by the magnet's shape, not the grade's stated temperature.

Temperature	Reversible loss	Margin to knee Hk/Hd	Irreversible loss	Force at temperature	Force after cooling	Irreversible loss risk
20 °C	0,0%	1,37	0,0%	**0,44 kg**	**0,44 kg**	none
40 °C	-2,2%	1,23	0,0%	**0,42 kg**	**0,44 kg**	low
60 °C	-4,4%	1,09	0,0%	**0,40 kg**	**0,44 kg**	moderate
80 °C	-6,6%	**0,94**	**-11,9%**	**0,30 kg**	**0,34 kg**	**high**
100 °C !	-8,8%	**0,78**	**-32,7%**	**0,16 kg**	**0,20 kg**	**high**

For product life the 'force after cooling' column is what counts — it says what the magnet will hold permanently after a single overheating. The irreversible figures are a model estimate based on the position of the operating point relative to the curve knee, not the result of a thermal endurance test. 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 the effect of deviations that cannot be avoided in practice: grinding tolerance, coating thickness, steel surface condition and grade.

Effect of ±0.1 mm dimensional tolerance

Dimension	Force change	Induction change	Force within tolerance
Length L	-0,64% … +0,65%	-0,82% … +0,85%	**0,43 – 0,44 kg**
Width W	-0,64% … +0,65%	-0,82% … +0,85%	**0,43 – 0,44 kg**
Height / thickness H	-11,44% … +11,23%	-7,13% … +6,85%	**0,39 – 0,49 kg**
All dimensions at limit	-12,48% … +12,78%	-5,51% … +5,13%	**0,38 – 0,49 kg**

For sintered NdFeB after grinding a tolerance of ±0.1 mm is standard. The conclusion is asymmetric: in flat magnets the force is set almost entirely by height, which fixes the permeance coefficient; a diameter deviation makes no difference, as the larger pole area is cancelled by lower 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	**0,44 kg**	100,0%
NiCuNi coating 15–25 µm	0,025 mm	**0,43 kg**	99,4%
Coating + rolled plate roughness	0,050 mm	**0,43 kg**	98,3%
Oil or preservative film	0,060 mm	**0,43 kg**	97,8%
Powder coating 60–80 µm	0,100 mm	**0,42 kg**	96,0%
Heavy paint or sprayed zinc	0,200 mm	**0,40 kg**	91,2%
Rust film and flaking corrosion	0,400 mm	**0,35 kg**	**80,9%**
Mill scale, heavy corrosion	0,800 mm	**0,26 kg**	**60,0%**

Effect of the substrate steel grade

Substrate material	Factor	Force
Soft magnetic iron (ARMCO, DT4)	1,03	**0,45 kg**
S235 / A36 — model reference	1,00	**0,44 kg**
S355	0,99	**0,43 kg**
Carbon steel C45	0,96	**0,42 kg**
Ferritic stainless 430	0,85	**0,37 kg**
Grey cast iron	0,75	**0,33 kg**
Austenitic stainless 304 / 316	0,00	**0,00 kg**

All surface conditions are reduced to a single measure — an equivalent air gap. The outcome is not obvious — at low Pc a thin gap changes little, since the operating point is ruled by self-demagnetisation rather than gap reluctance. On a slender, high-Pc magnet the identical paint coat already costs well over ten percent of the force. For this reason the table is computed for this specific geometry instead of being copied from a generic one. An important reservation: the values above cover 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 is usually far more costly than the gap itself and cannot be derived from geometry; on corroded plate the real holding force can drop by half or more.

While the plate is thick enough and does not saturate, the steel grade means little — circuit reluctance is ruled by the magnet's own demagnetisation, so higher steel permeability adds little. Differences become significant only for cast iron and ferritic steel, where the lower saturation induction genuinely limits the flux. Austenitic 304 and 316 are paramagnetic — a magnet will not stick to them at all. Treat the factor values as 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	Rests on the assumption that gap induction equals Br. A thermodynamic upper bound, unattainable in practice.	1,56 kg	×3,57
Mirror circuit model	Assumes doubled Pc and takes the force from the operating-point induction. Flux escaping sideways is omitted, hence the low result.	0,21 kg	×0,48
Analytical model, uncalibrated	The same calculation route as dhit, with only the k_cal constant omitted. Shows how much the calibration alone contributes.	0,29 kg	×0,67
dhit model — published value	Calibrated against the catalogue; reference conditions: S235, full-face contact, 20 °C.	**0,44 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.	0,45 kg	×1,03
Same size in a higher grade (N42)	Discrepancies often arise because foreign catalogues quote N42 by default instead of N38.	0,48 kg	×1,11

Calculators published by overseas suppliers typically quote values 60–80% higher for the same geometry. The discrepancy is not an error on either side but the sum of the assumptions — N42 instead of N38, remanence at the upper limit, a lapped rather than rolled plate, zero gap on an uncoated magnet, and a field solution more generous towards leakage flux than an analytical model. Individually every one of these assumptions is justified — together they give a value you will not reproduce on a workshop bench.

We deliberately publish 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. The figure in this report is therefore already close to what a designer should carry into their calculations.

Safe distances (health & safety)

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

Magnetic flux

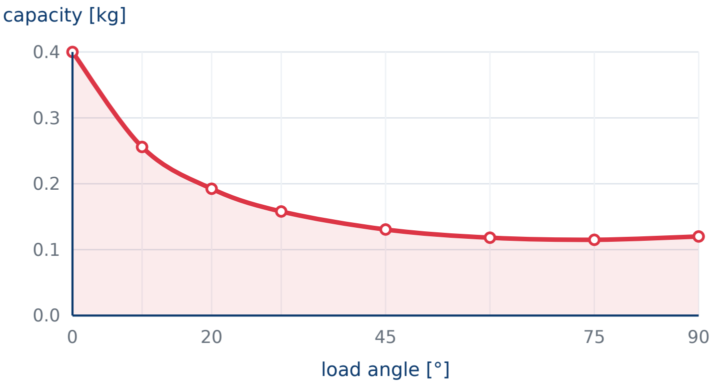
Φ	**695 Mx**
Φ (SI)	**7,0 µWb**
Bd	**2 780 Gs**
Pc	**0,303**
A	**0,25 cm²**
V	**0,03 cm³**

Attraction dynamics

Release distance	Speed	km/h	Energy	Risk
10 mm	6,95 m/s	25,0	**0,01 J**	Safe
30 mm	6,95 m/s	25,0	**0,01 J**	Safe
50 mm	6,94 m/s	25,0	**0,01 J**	Safe
100 mm	6,95 m/s	25,0	**0,01 J**	Safe

How fast the magnet will hit the steel plate if you release it from a given distance. Above 5 J the risk of crushed fingers is real – hold the magnet from the side, never between magnet and steel.

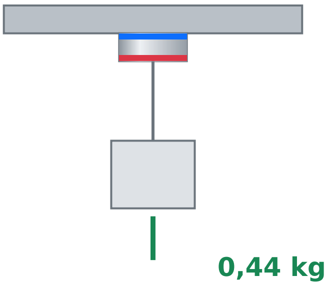
Force vs. load angle



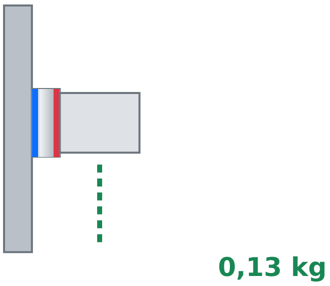
Angle	Capacity	%
0°	**0,44 kg**	100%
10°	**0,28 kg**	64%
20°	**0,21 kg**	48%
30°	**0,17 kg**	39%
45°	**0,14 kg**	33%
60°	**0,13 kg**	30%
75°	**0,13 kg**	29%
90°	**0,13 kg**	30%

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 fall-off is sharp: by 30° roughly half the force is gone.

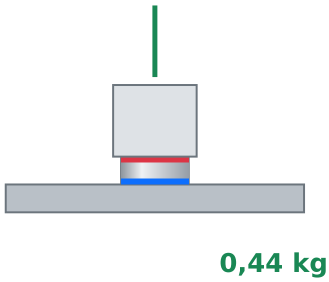
Typical mounting scenarios



Ceiling
A weight suspended vertically under the magnet gives perpendicular loading and full capacity.



Vertical wall
The weight drags the magnet down along the plate: friction alone works, leaving roughly 30% of capacity.



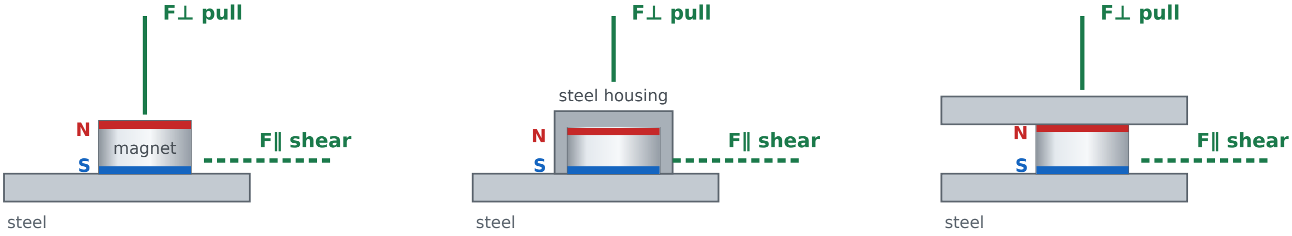
Floor / horizontal
The magnet rests on a horizontal plate and the load pulls upwards: full perpendicular capacity.

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	**0,44 kg**
Magnets required	**46**	Total set capacity	**20,10 kg (2,0×)**

The result takes into account the load direction and the selected safety margin. If a failed mount could cause an accident, the margin should be at least 3×.

Load direction vs. real holding force



Bare magnet
magnet without housing
F⊥ pull: **0,44 kg**
F∥ shear: **0,13 kg**

Single-sided pot
magnet in steel housing
F⊥ pull: **1,10 kg**
F∥ shear: **0,33 kg**

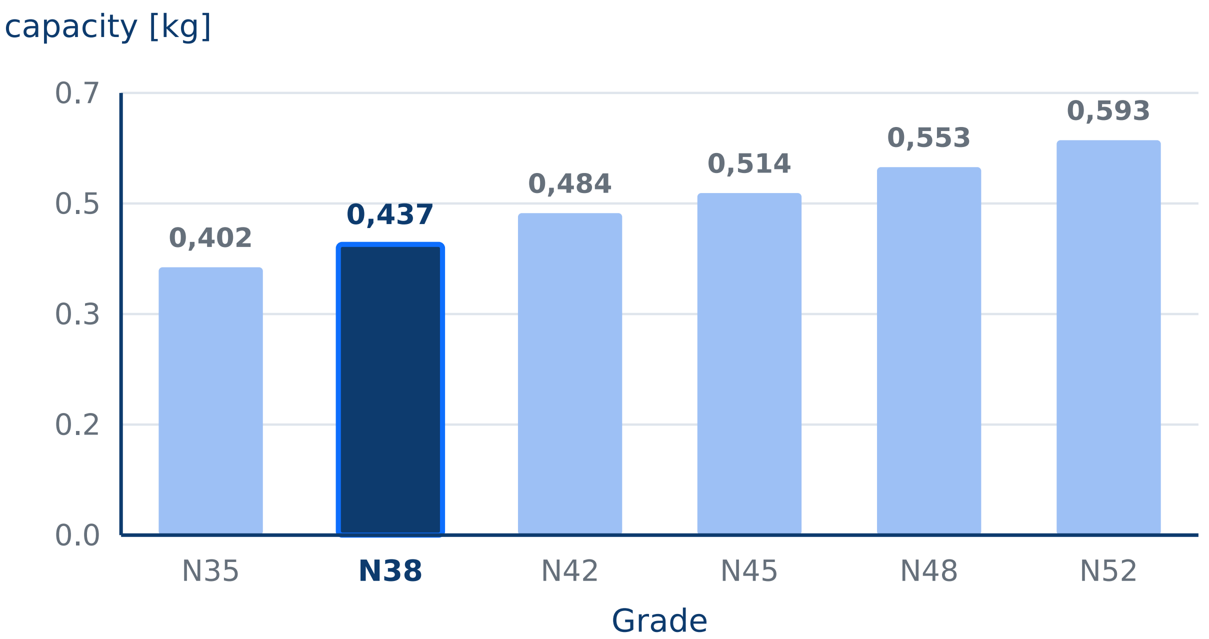
Double-sided pot
two magnets, shared housing
F⊥ pull: **0,99 kg**
F∥ shear: **0,30 kg**

Mounting variant	Perpendicular force (pull)	Parallel force (shear)	Share
Bare magnet	**0,44 kg**	**0,13 kg**	30%
Single-sided pot	**1,10 kg**	**0,33 kg**	30%
Double-sided pot	**0,99 kg**	**0,30 kg**	30%

Perpendicular force is the catalogue value — measured by pulling the magnet straight off the surface. 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.

> **The direction of the load is the first thing to check when designing a mount. 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 magnet made from different NdFeB grades. A higher grade delivers more force without changing the dimensions.

Two magnets — attraction and repulsion

Gap	Attraction	Repulsion
0 mm	0,44 kg	0,39 kg
1 mm	0,22 kg	0,20 kg
2 mm	0,08 kg	0,07 kg
3 mm	0,03 kg	0,03 kg
5 mm	0,00 kg	0,00 kg
10 mm	0,00 kg	0,00 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	0,44 kg	×1,00
2	0,88 kg	×2,02
3	1,00 kg	×2,29
5	0,90 kg	×2,05
10	0,65 kg	×1,48

A stack of magnets adds force only up to a point. 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 ø10 mm magnet peaks at a height of 8 mm (3.39 kg), while at 15 mm it holds only 2.61 kg.

The cause of saturation is straightforward: stack height does not change the pole area, and the pole area is what governs the force. 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. Above a height of about 0.7 of the diameter both effects overlap and the next magnet contributes almost nothing to capacity, while adding cost, mass and assembly risk.

Additional parameters

0,00 N·m	0,01 J	0,24 kg	171 kPa
ROTATION RESISTANCE TORQUE	DETACHMENT WORK	CAPACITY AT PLATE EDGE	UNIT PRESSURE

At the plate edge part of the flux escapes the material and the holding force drops. The resistance to rotating the magnet on a steel surface.

Engineering indicators

Four numbers that describe this magnet regardless of how it is mounted. Derived from the parameters given above – they modify none of the results.

70 %	0,03 A·m²	1,942 kg/g	6 mJ
SHAPE EFFICIENCY	MAGNETIC MOMENT	FORCE PER GRAM	DETACHMENT ENERGY

Shape efficiency: 203 / 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 maximum falls at Pc ≈ 1.05 – the slenderer the magnet, the closer it gets. A low figure does not indicate a defective product – a low-profile disc wins wherever build thickness is the constraint.

Verification: the derived (BH)max should fall within the catalogue range for the grade. A match confirms that the assumed remanence and recoil permeability are mutually consistent.

Magnetic moment

The only quantity here that is independent of contact conditions and magnetic circuit geometry. The product of the magnetisation M = Br/µ0 and the volume of the body. Useful for estimating the field at long range, where the magnet behaves as a dipole.

Force per gram

How many kilograms of holding force fall on each gram of material. The taller the magnet at a given diameter, the higher the figure, because Pc increases. A helpful indicator when comparing the cost of obtaining force, since price usually follows material mass.

Detachment energy

Equivalent to lifting **1** g to a height of one metre.

The area under the force-versus-distance curve over 0–50 mm, integrated by the trapezoidal rule. Not to be confused with force – force decides whether the magnet holds the load, whereas energy tells you how much effort removing it costs.

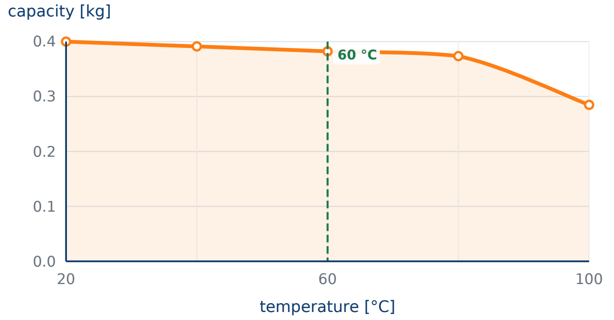
Three levels of the same number

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

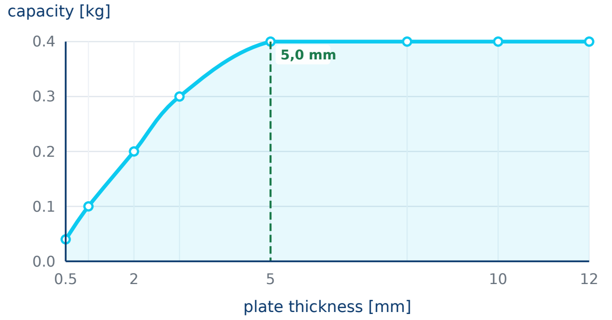
Level	What it is based on	Force
Typical online shop claim	N42 grade instead of N38, remanence at the top of the range, zero air gap, lapped plate	**0,70 – 0,79 kg**
dhit model – ideal laboratory conditions	S235 steel at least 10 mm thick, full contact, 20 °C, uncoated magnet	**0,44 kg**
Value for design calculations	The model divided by a safety factor of 2.0 for workshop mounting	0,22 kg

The 1.6–1.8 range is not a rough approximation. It is made up of several result-inflating assumptions; they act multiplicatively, so the ratio itself is valid for any geometry – unlike the absolute value. Base design calculations on the last row only.

Temperature derating curve



Steel thickness effect curve



Ageing and long-term stability

Service period	Flux loss	Force
1 years	-0,2%	**0,44 kg**
5 years	-0,5%	**0,43 kg**
10 years	-1,0%	**0,43 kg**
20 years	-1,8%	**0,42 kg**

Sintered NdFeB in a well-designed circuit is stable — it loses fractions of a percent of flux per year and practically stops after the first year. The values given refer to 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	**0,31 kg**
Static load, workshop assembly	50%	×2,0	**0,22 kg**
Shear load (sliding along the plate)	50%	×2,0	**0,07 kg**
Motion, acceleration, opening cycles	40%	×2,5	**0,17 kg**
Vibration, transport, continuous duty	33%	×3,0	**0,14 kg**
Work overhead or lifting	20%	×5,0	**0,09 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 factor is thermal cycling — every episode that crosses the curve knee removes a permanent share of the strength, and the losses accumulate. This is an estimate based on the operating point position, not the outcome of long-term testing.

Pull force is a limiting value achieved under ideal conditions and must never be carried into design calculations directly. A magnet is a component with wide manufacturing spread and extreme sensitivity to contact quality, so it 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 a lifting accessory and is not certified as lifting equipment.

How to use this data in practice

1. Establish the load direction first, then look at the kilograms. On bare steel shear gives about 30% of the pull force, on painted steel distinctly less; a vertical wall mount is sized from the shear table, not the catalogue value.

2. Scale the result by the share from the safety factor table matched to the duty. Only that number is the design force.

3. Make sure 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. Calculate the magnet's operating temperature, not merely the ambient. An enclosed magnet, one sitting next to a motor or in a sun-exposed machine, can run tens of degrees hotter than the hall.

5. Stacking magnets stops adding force above a height of roughly 0.7 of the diameter. Increasing the diameter or spreading the load over several mounting points is cheaper and safer.

6. Take care over surface preparation. Degreasing and removing rust usually deliver more than raising the grade by two steps, at a fraction of the cost.

7. Store flat magnets on steel or in pairs set with opposite poles. 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 adopted for the calculations come from the sinter supplier's data sheet and lie within the ranges set by the documents below. We name them so that each adopted value can be compared with 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) — test method for the magnetic properties of high-coercivity materials using a hysteresigraph; covers 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 listed standards are sources of methodology and reference values; the report is neither an accredited test document nor a certificate of conformity.

Production repeatability

We publish no process capability statistics (Cp, Cpk) for individual sizes, hence the general nature of the notes below. Sintered NdFeB shows a wider spread in magnetic than in dimensional properties — industry practice assumes a remanence tolerance of roughly ±5%, with intrinsic coercivity given only 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: through thickness · The poles are on the end faces and the field runs along the dimension **1,2 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 (304, 316) is not magnetic — a magnet will not attach 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.

Every value in the report is the result of a model calculation, not a measurement of a specific unit. They are intended for design and comparison. Before using them in a safety-critical design, run a trial on the actual part and apply the margin from 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.