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Magnet calculation report

MPL 12x10x4 / N38
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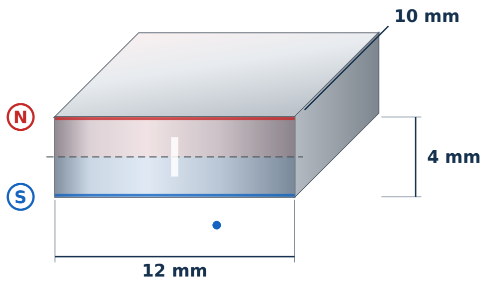
Scanning the code opens the interactive calculator with an identical set of parameters



magnetization (S → N)

Shape:	block
Dimensions:	12,0 × 10,0 × 4,0 mm
Grade:	**N38**
Br:	12.2-12.6 kGs
Hcb:	860-915 kA/m
BHmax:	287-303 kJ/m³
Temperature:	**≤ 80 °C**

Catalog data

MPL 12x10x4 / N38 - lamellar magnet

Catalog number	**020118**	Induction	**340,59 mT / 3 406 Gs**
GTIN / EAN	**5906301811244**	Coating	**[NiCuNi] Nickel**
Dimensions	**12,0 × 10,0 × 4,0 mm**	Grade	**N38**
Magnetization direction	**through thickness**		

https://dhit.pl/en/product/magnes-neodymowy-plytkowy-12x10x4-n38-osiowy

Calculation result

3,46 kg	**3 404** Gs	**3,60** g	**0,426** Pc
PULL FORCE model value: 3,4577 kg	SURFACE INDUCTION	MAGNET MASS	PERMEANCE COEFF.

Range resulting from material tolerance: 3,35 – 3,57 kg

Key takeaways for the designer

1. The 3,46 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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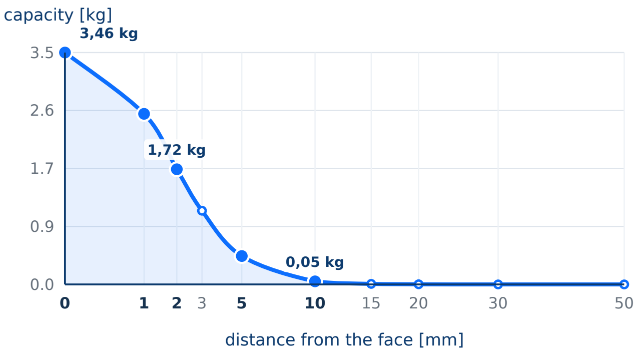
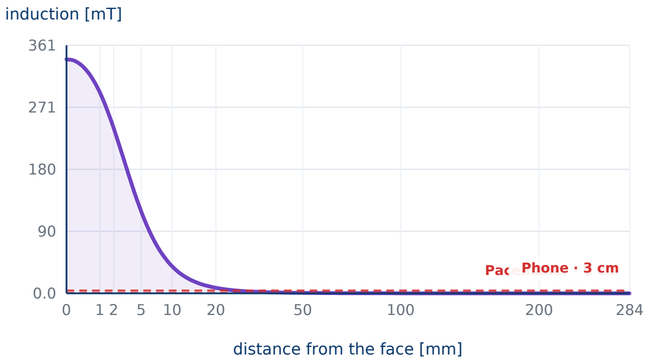


Force vs. distance



Magnetic field map B(z)

Induction measured on the axis, in air, with no steel plate. The horizontal scale is compressed near the surface so that one chart holds both the steep near-surface drop and the reach of the residual field. The horizontal lines mark safety-relevant thresholds.

Model methodology and validation

The numbers in this report are neither the output of a finite element (FEM) field simulation nor a reading from a catalogue table. Behind them stands a closed-form analytical model: the on-axis field follows from the potential of a uniformly magnetised body, the pull force from the Maxwell stress equation at the magnet-to-steel boundary. The full set of equations is given below, so every number can be reproduced independently.

Model equations

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

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

Pull force — Maxwell stress summed across the whole pole face

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

Flux concentration factor — thick steel reflects the flux like a mirror: the circuit closes and gap induction rises above the value measured in air

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

Permeance coefficient — a measure of how strongly the magnet's own shape demagnetises it; 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 — 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 value of the correction came from a least-squares regression over 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	0,426
sf	Flux concentration factor	2,032
A	Pole face area	1,20 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. That set is a subset of the bare-magnet catalogue described below — the exact list of items remains 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). In the catalogue the permeance coefficient takes values from roughly 0.10 to 1.6, the median falls near 0.42, and about one tenth of the items drop below 0.2 — the region of distinctly flat bodies. All three geometries were fitted jointly under one constant — there are no separate coefficients for discs, blocks or rings.

The post-calibration deviations follow a skewed distribution: median 0.09%, ninth decile 0.45%, largest observed 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. One should know what these figures describe — agreement with the fitting base, not the measurement uncertainty of a real 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. 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. We assume a flat, clean, degreased steel plate at or above the full-flux-utilisation threshold (see the thickness table), working outside saturation.
3. We assume full-face contact, with a gap equal solely to the coating thickness.
4. The force is applied perpendicular to the contact face, slowly, without impact and without a twisting component.
5. The magnet and the steel are at 20 °C and the recoil permeability is taken as 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. No other magnetic sources or ferromagnetic parts are present in the field besides the plate described.

Limits of the model

1. The model computes the field on the axis of symmetry only. 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. At very low permeance — Pc below roughly 0.2, typical of flat shapes — the operating point sits close to the knee of the curve. The characteristic is taken as linear; true at 20 °C, but the assumption fails once heated and the real loss can exceed the calculated figure. For such proportions, read this report 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 circuits — pot magnets, separators, bars and grippers — have a different flux topology. The pot magnet numbers come from a gain factor — an approximation, not a solved magnetic circuit.
5. Hysteresis, eddy currents and dynamic effects of fast separation are not accounted for. An impact raises the pull force above its 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	3 404	340,4	**3,46**	7,62	33,9	100%
1 mm	2 920	292,0	**2,54**	5,61	25,0	74%
2 mm	2 399	239,9	**1,72**	3,79	16,8	50%
3 mm	1 919	191,9	**1,10**	2,42	10,8	32%
5 mm	1 190	119,0	**0,42**	0,93	4,1	12%
10 mm	392	39,2	**0,05**	0,10	0,4	1%
15 mm	162	16,2	**0,01**	0,02	0,1	0%
20 mm	80	8,0	**0,00**	0,00	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)

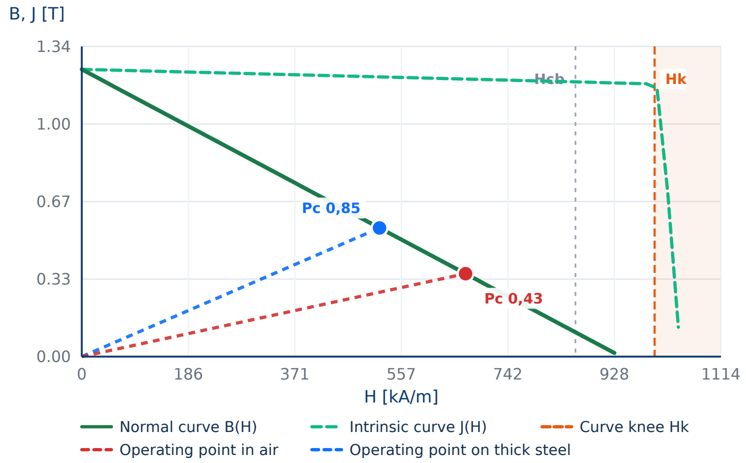
Surface	Friction	kg	N
Bare steel	0,30	**1,04**	10,2
Painted steel	0,20	**0,69**	6,8
Oily surface	0,10	**0,35**	3,4
Rubber coating	0,50	**1,73**	17,0

Effect of steel thickness

Thickness	Utilisation	Force
0,5 mm	10%	**0,35 kg**
1,0 mm	25%	**0,86 kg**
2,0 mm	50%	**1,73 kg**
3,0 mm	75%	**2,59 kg**
5,0 mm	100%	**3,46 kg**
8,0 mm	100%	**3,46 kg**
10,0 mm	100%	**3,46 kg**
12,0 mm	100%	**3,46 kg**

Demagnetisation curve and operating point

The normal curve B(H) shows the net induction in the magnet, while the intrinsic J(H) shows the material polarisation alone. The operating point falls where the normal curve crosses the load line of slope Pc: $B = \mu_0 \cdot Pc \cdot H$. 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	**0,426**	**0,358**	669
Operating point on thick steel	**0,852**	**0,555**	519

	Margin to knee Hk/Hd	Irreversible loss risk
Operating point in air	**1,49**	none
Operating point on thick steel	**1,92**	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 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 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%	**3,46 kg**	100%
40 °C	-2,2%	**3,38 kg**	98%
60 °C	-4,4%	**3,31 kg**	96%
80 °C	**-6,6%**	**3,23 kg**	93%
100 °C	**-28,8%**	**2,46 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 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. For selecting a magnet that will run hot, the extended table is binding — this one is indicative.

Extended thermal analysis

Temperature takes force away in two distinct ways that must be told apart. The reversible loss comes from the remanence falling by 0.11% per kelvin and disappears entirely on cooling. The irreversible loss appears only once the operating point drops below the knee of the J(H) curve — and never comes back. Since intrinsic coercivity falls more than five times faster than remanence, it is the magnet's geometry that sets the limit of safe operation, not the catalogue temperature of the grade.

Temperature	Reversible loss	Margin to knee Hk/Hd	Irreversible loss	Force at temperature	Force after cooling	Irreversible loss risk
20 °C	0,0%	1,49	0,0%	**3,46 kg**	**3,46 kg**	none
40 °C	-2,2%	1,34	0,0%	**3,31 kg**	**3,46 kg**	none
60 °C	-4,4%	1,19	0,0%	**3,16 kg**	**3,46 kg**	low
80 °C	-6,6%	1,02	0,0%	**3,02 kg**	**3,46 kg**	moderate
100 °C !	-8,8%	**0,85**	**-24,0%**	**1,66 kg**	**2,00 kg**	**high**

The most important column for durability is 'force after cooling': it shows what remains for good after one 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 is that a flat magnet in air loses its margin far earlier than one attached to steel. If the application involves elevated temperature, the cheapest safeguard is not a higher grade but closing the magnetic circuit or making the magnet thicker.

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	-0,51% … +0,51%	-0,25% … +0,26%	**3,44 – 3,48 kg**
Width W	-0,45% … +0,45%	-0,38% … +0,39%	**3,44 – 3,47 kg**
Height / thickness H	-2,38% … +2,30%	-1,75% … +1,71%	**3,38 – 3,54 kg**
All dimensions at limit	-3,30% … +3,31%	-1,11% … +1,07%	**3,34 – 3,57 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. If force is a critical parameter, tighten the height tolerance rather than the diameter.

Effect of coating and surface condition

Contact condition	Equivalent gap	Force	%
Ideal contact, uncoated magnet	0,000 mm	**3,46 kg**	100,0%
NiCuNi coating 15–25 µm	0,025 mm	**3,44 kg**	99,6%
Coating + rolled plate roughness	0,050 mm	**3,42 kg**	99,0%
Oil or preservative film	0,060 mm	**3,41 kg**	98,7%
Powder coating 60–80 µm	0,100 mm	**3,38 kg**	97,7%
Heavy paint or sprayed zinc	0,200 mm	**3,29 kg**	95,0%
Rust film and flaking corrosion	0,400 mm	**3,10 kg**	89,7%
Mill scale, heavy corrosion	0,800 mm	**2,73 kg**	**78,9%**

Effect of the substrate steel grade

Substrate material	Factor	Force
Soft magnetic iron (ARMCO, DT4)	1,03	**3,56 kg**
S235 / A36 — model reference	1,00	**3,46 kg**
S355	0,99	**3,42 kg**
Carbon steel C45	0,96	**3,32 kg**
Ferritic stainless 430	0,85	**2,94 kg**
Grey cast iron	0,75	**2,59 kg**
Austenitic stainless 304 / 316	0,00	**0,00 kg**

All surface variants are converted to one 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. The same coat of paint on a slender, high-Pc magnet 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 caveat: the figures above describe the effect of the gap alone. With rust, mill scale and heavy coatings a second mechanism appears — loss of flatness reduces contact to a few bearing points. The second mechanism is often much more costly than the gap and cannot be computed from dimensions; on rusted plate the real capacity falls by more than half.

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. 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. The difference is not in the physics but in the assumptions made. We give the full spread in the table — so it is clear what the dhit value rests on and why it can be lower than figures published 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.	7,49 kg	×2,17
Mirror circuit model	Assumes doubled Pc and takes the force from the operating-point induction. Flux escaping sideways is omitted, hence the low result.	1,50 kg	×0,43
Analytical model, uncalibrated	The same calculation chain as dhit but without the k_cal constant. It reveals how much the calibration alone adds.	2,33 kg	×0,67
dhit model — published value	Calibrated against the catalogue; reference conditions: S235, full-face contact, 20 °C.	**3,46 kg**	×1,00
dhit model at the upper Br limit	The same method but with remanence at the top of the grade band instead of the mid-range value.	3,57 kg	×1,03
Same size in a higher grade (N42)	A frequent source of discrepancy: foreign catalogues work with N42 by default, not N38.	3,83 kg	×1,11

Calculators from overseas suppliers give values for identical geometry that are most often 60–80% higher. The difference is not an error on either side but the sum of assumptions: grade N42 assumed instead of N38, remanence taken at the top of the band, a lapped rather than rolled plate, zero gap computed on an uncoated magnet, and a field solution that credits leakage flux more favourably 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.

dhit deliberately publishes 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 assume anyway.

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

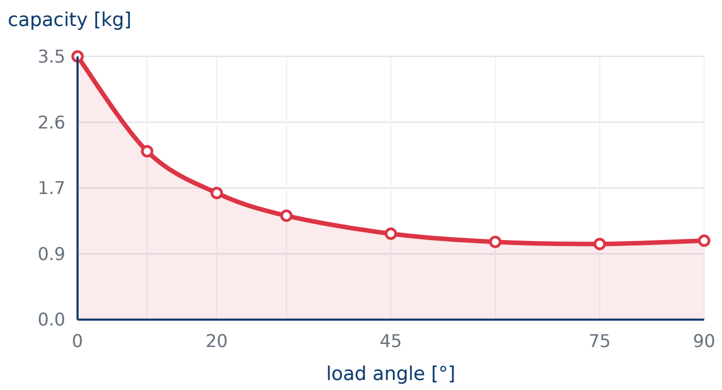
Φ	**4 295 Mx**
Φ (SI)	**42,9 µWb**
Bd	**3 579 Gs**
Pc	**0,426**
A	**1,20 cm²**
V	**0,48 cm³**

Attraction dynamics

Release distance	Speed	km/h	Energy	Risk
10 mm	8,75 m/s	31,5	**0,14 J**	Safe
30 mm	15,04 m/s	54,1	**0,41 J**	Safe
50 mm	19,41 m/s	69,9	**0,68 J**	Safe
100 mm	27,45 m/s	98,8	**1,36 J**	Safe

How fast the magnet will hit the steel plate if you release it from a given distance. Above 5 J you can genuinely crush a finger – grip the magnet from the side, never from the steel side.

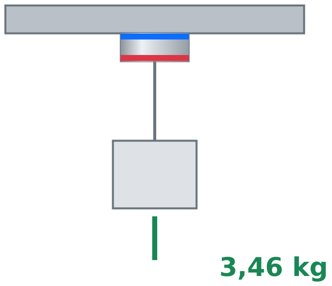
Force vs. load angle



Angle	Capacity	%
0°	**3,46 kg**	100%
10°	**2,21 kg**	64%
20°	**1,66 kg**	48%
30°	**1,37 kg**	39%
45°	**1,13 kg**	33%
60°	**1,02 kg**	30%
75°	**0,99 kg**	29%
90°	**1,04 kg**	30%

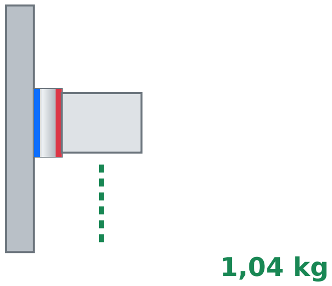
Read the real holding force for any angle of applied force from this chart. 0° is pulling straight off the surface (the catalogue value), 90° is dragging along the plate. The curve falls away fast — 30° already costs you half the capacity.

Typical mounting scenarios



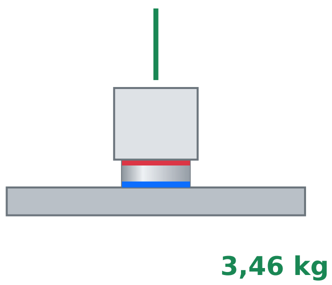
Ceiling

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



Vertical wall

The load slides the magnet down the plate — only friction carries it, and capacity drops to about 30%.



Floor / horizontal

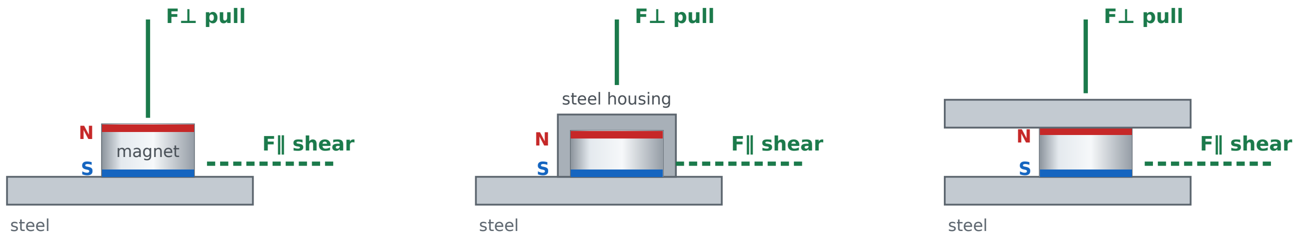
The magnet rests on a horizontal plate and the load pulls upwards: full perpendicular capacity.

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	**3,46 kg**
Magnets required	**6**	Total set capacity	**20,75 kg (2,1×)**

The result takes into account the load direction and the selected safety margin. For applications where a mounting failure is dangerous, use a margin of at least 3×.

Load direction vs. real holding force



Bare magnet
magnet without housing
F⊥ pull: **3,46 kg**
F∥ shear: **1,04 kg**

Single-sided pot
magnet in steel housing
F⊥ pull: **8,17 kg**
F∥ shear: **2,45 kg**

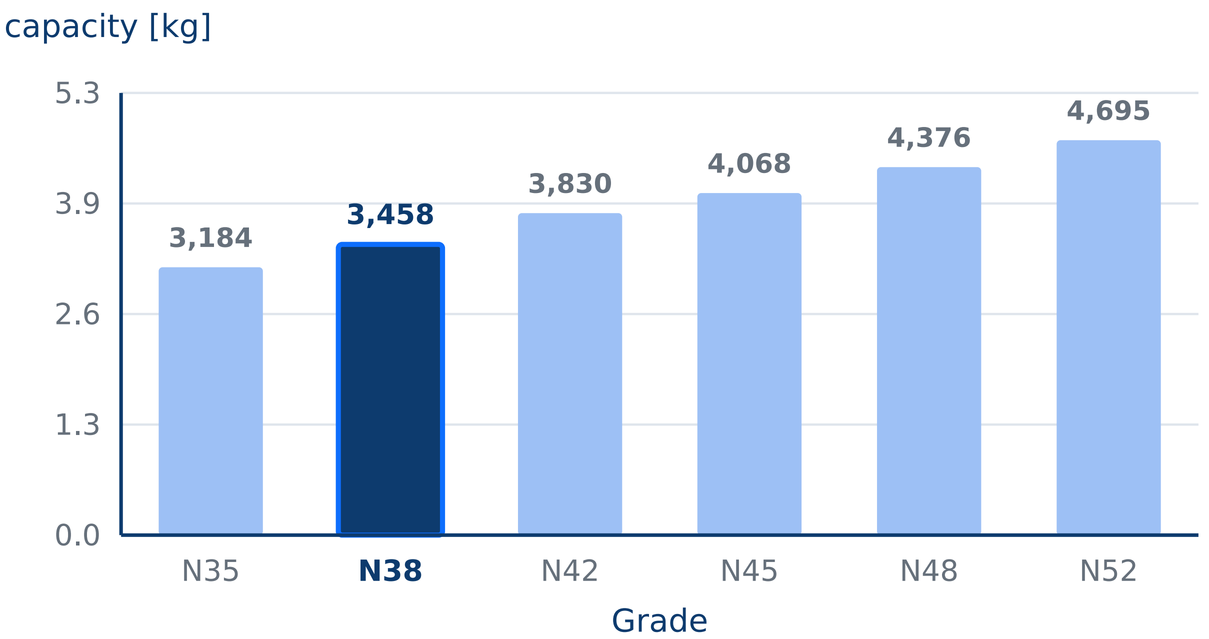
Double-sided pot
two magnets, shared housing
F⊥ pull: **7,35 kg**
F∥ shear: **2,20 kg**

Mounting variant	Perpendicular force (pull)	Parallel force (shear)	Share
Bare magnet	**3,46 kg**	**1,04 kg**	30%
Single-sided pot	**8,17 kg**	**2,45 kg**	30%
Double-sided pot	**7,35 kg**	**2,20 kg**	30%

Perpendicular force is the catalogue value — measured by pulling the magnet straight off the surface. Parallel force, or shear, arises when the magnet slides along the plate and amounts to only a fraction of it. Values for bare steel, friction coefficient 0.30.

> **Before choosing a mount, establish the direction of the load. At a 100 kg catalogue rating, a vertically hung load means about 30 kg, with no margin applied.**

Grade comparison



The same body produced in successive NdFeB grades. A higher grade means more holding force at identical dimensions.

Two magnets — attraction and repulsion

Gap	Attraction	Repulsion
0 mm	3,46 kg	3,11 kg
1 mm	2,54 kg	2,29 kg
2 mm	1,72 kg	1,55 kg
3 mm	1,10 kg	0,99 kg
5 mm	0,42 kg	0,38 kg
10 mm	0,05 kg	0,04 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	3,46 kg	×1,00
2	4,84 kg	×1,40
3	4,48 kg	×1,30
5	3,51 kg	×1,02
10	2,81 kg	×0,81

A stack of magnets adds force only up to a point. The optimum normally lies at a height of 0.6–0.8 of the diameter; above it the force drops although material is added. 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 reason for saturation is simple — the pole area does not grow with stack height, yet it is the pole area that appears in the force equation. Each further magnet raises the permeance coefficient and with it the operating-point induction — but that tends towards the remanence and above a certain height barely increases. At the same time the material added at the end of the stack is ever further from the working face, so more and more of its flux closes sideways rather than through the gap. Above a height of roughly 0.7 of the diameter both effects combine and a further magnet adds practically nothing to the capacity — while adding cost, mass and assembly risk.

Additional parameters

0,06 N·m	0,09 J	1,90 kg	283 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

A set of quantities that characterise the magnet no matter what you attach it to. Derived from the parameters given above – they modify none of the results.

82 %	0,47 A·m²	0,960 kg/g	92 mJ
SHAPE EFFICIENCY	MAGNETIC MOMENT	FORCE PER GRAM	DETACHMENT ENERGY

Shape efficiency: 239 / 291 kJ/m³ – of the material potential used

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

The degree to which this geometry exploits the energy potential of the material. 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.

Verification: the derived (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. Useful for estimating the field at long range, where the magnet behaves as a dipole.

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

That is the energy needed to lift **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.

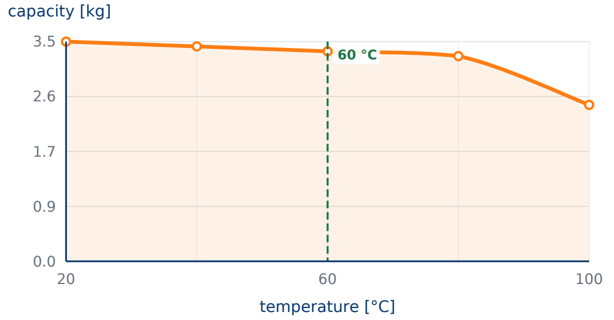
Three levels of the same number

The same body is described by several different numbers; the difference lies in the assumptions. Below are three levels that are easy to confuse.

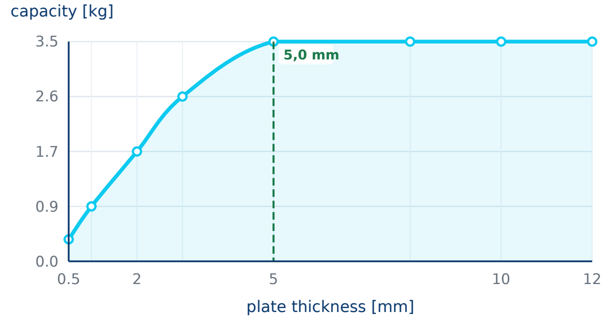
Level	What it is based on	Force
Typical online shop claim	N42 grade instead of N38, remanence at the top of the range, zero air gap, lapped plate	**5,53 – 6,22 kg**
dhit model – ideal laboratory conditions	S235 steel at least 10 mm thick, full contact, 20 °C, uncoated magnet	**3,46 kg**
Value for design calculations	The model divided by a safety factor of 2.0 for workshop mounting	1,73 kg

The 1.6–1.8 factor is not an estimate. It is the product of several assumptions that raise the result. Because they multiply, the ratio remains valid for any geometry, though the absolute value does not. When designing a structure, always use the last row.

Temperature derating curve



Steel thickness effect curve



Ageing and long-term stability

Service period	Flux loss	Force
1 years	-0,2%	**3,44 kg**
5 years	-0,5%	**3,42 kg**
10 years	-1,0%	**3,39 kg**
20 years	-1,8%	**3,33 kg**

In a properly designed magnetic circuit sintered NdFeB behaves stably: spontaneous flux loss runs to fractions of a percent per year and all but stops after the first year. The values below assume room temperature, dry surroundings and unchanged circuit geometry.

Recommended safety factors

Type of duty	Recommended utilisation	Safety factor	Design force
Static load, controlled contact	70%	×1,4	**2,42 kg**
Static load, workshop assembly	50%	×2,0	**1,73 kg**
Shear load (sliding along the plate)	50%	×2,0	**0,52 kg**
Motion, acceleration, opening cycles	40%	×2,5	**1,38 kg**
Vibration, transport, continuous duty	33%	×3,0	**1,14 kg**
Work overhead or lifting	20%	×5,0	**0,69 kg**

In practice a magnet's life is governed not by ageing of the magnetic material but by corrosion. As long as the NiCuNi coating is intact it stays sealed; a chip, an impact or damp working conditions let moisture into the core, and a corroded sinter crumbles and loses flux much faster than the table predicts. The second factor is thermal cycling: every crossing of the curve knee permanently removes part of the strength, and the losses add up. The figures given are estimated from the operating point position; they are not long-term test results.

Pull force is a limiting value from ideal conditions — it must never be carried straight into design calculations. A magnet has wide manufacturing spread and reacts sharply 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 neither a lifting accessory nor lifting equipment and is not certified as such.

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 utilisation share from the safety factor table matching your type of duty. That is the only figure you may carry into calculations.

3. Check that the plate is thick enough. Below the full-flux-utilisation threshold the magnet loses force in proportion to thickness — thin plate saturates and stops carrying flux. 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. Increasing the diameter or spreading the load over several mounting points is cheaper and safer.

6. Take care over surface preparation. Degreasing and grinding off rust usually raises the force more than jumping two grades, at a fraction of the cost.

7. Store flat magnets stuck to steel or in opposite-pole pairs. Loose, their operating point sits close to the curve knee and the thermal margin disappears.

8. Where the mounting is critical, verify it by trial on the real material in its real 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 data used in the calculations were taken from the sinter supplier's material data sheet; they fall within the ranges defined in the documents listed 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 — minimum values of the principal magnetic properties and dimensional tolerances for technically important hard magnetic materials, together with densities and ranges of chemical composition · 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 compilation of the magnetic, thermal, physical and mechanical properties of commercial permanent magnet materials and their typical production tolerances · a Magnetic Materials Producers Association standard, available to association members

dhit grade data sheet — the Br, Hcb, Hcj, BHmax and maximum operating temperature ranges adopted in this report; the model input values come from it. · available on the product page in the dhit catalogue

The standards are given as sources of methodology and reference values — this report is not an accredited test document, nor a certificate of conformity with any of them.

Production repeatability

We do not publish process capability statistics (Cp, Cpk) for individual sizes, so the notes below are general in nature. 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 simple: the required safety margin is set by material spread, not by calculation accuracy.

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 fall on the end faces and the field passes along the dimension **4,0 mm**

The value refers to a plate of non-alloy structural steel (S235 / A36) no thinner than 10 mm, smooth, clean and degreased, at zero gap with the force acting perpendicular. 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 design and comparison figures. 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.