

ENGINEERING REFERENCE

Magnet Design Guide

A practical framework for defining an application and agreeing the evidence needed for a project decision.

01 / Define the function

State the field, flux, pull force, torque or sensor response required at the working location. Include the air gap and mating parts.

02 / Map the environment

Record actual magnet temperature, opposing fields, humidity, chemicals, mechanical loads and failure cases.

03 / Select a material route

Compare candidate materials using catalogue properties, geometry, protection and the required operating margin.

04 / Define interfaces

Freeze orientation, pole pattern, datums, coating allowance, attachment and the assembled working position.

PROJECT CHECKLIST

Make the review actionable.

A measurable target

Use a property with units, a measurement location or fixture and an acceptance band. A grade name alone does not define assembly performance.

A representative sample

Agree the prototype or production construction, thermal and mechanical state, magnetization and sample quantity.

A validation sequence

Define baseline measurement, exposure, recovery conditions and post-exposure acceptance. Record deviations and repeat-test rules.

A controlled release

Approve the drawing, material specification, inspection plan and change-control requirements for the actual application.

Define the next step.

Share your drawing, application conditions and target quantity for a material or assembly review.

Empire Magnets | rfq@china-empire.com | +86 574 8791 5261

Contact: Ningbo Empire Advanced Material Co., Ltd.
No. 2432 East Baizhang Road, Ningbo 315040, Zhejiang, China

ABOUT THIS EDITION

New editorial reference edition 2026.09-R1, compiled 2026-09-27. Catalogue data and selection questions are reorganized for clarity. This edition does not record an engineering approval or certify a measured production result.

Source: Empire Magnets existing product catalogue and technical-library archive. For a project-controlled specification, request an engineering review.

GENERAL ENGINEERING REFERENCE

Temperature, with conditions.

A signed interval coefficient relates the change in a magnetic property to a stated reference value and temperature interval. Let Q be Br or HcJ. [S1]

Define the coefficient.

Reference relationship

$$cQ [\%/^{\circ}\text{C}] = 100 \times [Q(T_2) - Q(T_1)] / [Q(T_1) \times (T_2 - T_1)]$$

Use a nonzero $Q(T_1)$, with T_2 different from T_1 . State material condition, test method and the interval. A negative coefficient describes a decrease as temperature rises; the sign cannot be assumed for every material or property. [S1, S3]

Use the linear estimate carefully.

Reference relationship

$$Q(T) \approx Q(T_0) \times [1 + cQ \times (T - T_0) / 100]$$

This is a reversible approximation within the stated interval. It does not describe irreversible demagnetization or establish a product operating-temperature limit. A catalogue temperature class is not a measurement interval. [S3, S4]

Worked example.

Illustrative calculation - assumed inputs, not Empire measurements or acceptance limits.

Assume

Br at 20°C is 1.20 T. Assume $c_{Br} = -0.10\%/^{\circ}\text{C}$ is valid over 20-80°C and that the change is reversible.

Calculate

Br at 80°C $\approx 1.20 \times [1 + (-0.10/100) \times 60] = 1.128$ T.
Relative change: -6%.

This calculation is not a surface-field, force or temperature-qualification result. The coefficient is an assumed teaching input and is not assigned to an Empire grade. Formula reference: S4.

GENERAL ENGINEERING REFERENCE

Runout and balance.

Indicator range.

Reference relationship

$TIR = \text{maximum indicator reading} - \text{minimum indicator reading}$

Keep the datum, measured surface, probe direction and support conditions defined. The result is a nonnegative reading range; it does not reinterpret an ambiguous plus/minus tolerance. [S5]

Illustrative calculation - assumed inputs, not Empire measurements or acceptance limits.

At one assumed radial measurement station over one full rotation with unchanged support: maximum +0.007 mm; minimum -0.005 mm. $TIR = 0.007 - (-0.005) = 0.012$ mm. No acceptance limit is specified.

Rigid-rotor balance relationships.

Reference relationship

$\omega \text{ [rad/s]} = 2\pi \times n \text{ [rpm]} / 60$

$e_{\text{per}} \text{ [}\mu\text{m]} = 1000 \times G \text{ [mm/s]} / \omega$

$U_{\text{per}} \text{ [g}\cdot\text{mm]} = m \text{ [kg]} \times e_{\text{per}} \text{ [}\mu\text{m]}$

Use the specified G grade, mass and maximum service speed for a rigid-behaviour rotor. U_{per} is a total calculated allowance. Allocation to correction planes requires the relevant geometry and method; a calculated allowance is not a measured result. [S6, S7]

Illustrative calculation - assumed inputs, not Empire measurements or acceptance limits.

Assume a rigid rotor of 2.00 kg, maximum service speed 6000 rpm and a specified teaching grade $G = 2.5$ mm/s. Then $\omega \approx 628.3185$ rad/s, $e_{\text{per}} \approx 3.98$ μm and total $U_{\text{per}} \approx 7.96$ g·mm. No plane allocation or achieved balance is asserted. [S7]

REFERENCE SOURCES

Traceable methods.

The following sources support general definitions and calculation methods. They do not verify Empire product properties, qualify a factory or replace the project specification.

S1 / Arnold Magnetic Technologies / Magnetic Properties of Permanent Magnets & Measuring Techniques, pp. 4-5 and 8

S3 / Arnold Magnetic Technologies / TN 0303, Temperature Effects on Magnetic Output, pp. 1-2

S4 / Arnold Magnetic Technologies / Understanding and Using Reversible Temperature Coefficients, slides 12-13

S5 / Mitutoyo / Quick Guide to Precision Measuring Instruments E13007, printed pp. 40-41

S6 / ISO / ISO 21940-11:2016, official public abstract: rotors with rigid behaviour

S7 / Vibromera, Balanset manufacturer / Permissible Residual Unbalance Calculator, formula and unit explanation

The ISO reference is limited to the official public abstract; this document does not claim a clause-level review of the full standard. Rotor formula units are supported by the manufacturer explanation in S7.

Sources reviewed 2026-09-27. Examples use explicitly assumed inputs. No third-party grade values, fitted test curves or customer measurements are presented as Empire performance.