GOUDSMIT UK

Magnetic Products

Technology at work for you

Goudsmit UK is part of the Goudsmit Group of companies based in Eindhoven, the Netherlands. Founded in 1960 the group manufactures and supplies a range of products from components through to capital equipment. The group has subsidiary companies across Europe and into Asia.

Goudsmit UK was founded in 1998 and specialises in the design, industrialisation and manufacture of custom industrial components. The company can also design and sub-contract manufacture entire products and offers a comprehensive and global logistics service.

TS16949 and ISO9001 qualified the company works in a wide range of market segments including Automotive, Oil and Gas, Aerospace, Medical Devices and Green Technology.

Logistics

Designing, industrialising and manufacturing components are only some of the issues which face us and our clients. Just as important is getting the correct number of components to the correct place at the right time. To do this we have a refined and complex logistics network which operates throughout the globe. Key capabilities of this network are:

- Demand planning system to predict and manufacture client requirements
- Frame contracts with multiple drops spanning up to 2 years
- Warehouses in Holland / USA / UK to allow ex stock delivery
- Buffer stock held locally to offer 3 day delivery
- Consignment stock capabilities
- JIT delivery for automotive volumes
- KANBAN delivery for regular use items
- Global tracking system to monitor orders and parts through production and shipping

We have adapted our logistics network to match the dispersed and global nature of our clients operations and can offer whatever service our clients require.

For further information please refer to our logistics brochure.

Quality Assurance

What our clients want are parts which are correct first time and every time. We endeavour to provide this and our QA aim is zero defects on deliveries and continual improvement in all our processes. In order to achieve this we have become TS16949 and ISO9001 certified and are constantly tightening our processes and QA controls to better control our final product. A short summary of the QA tools and documentation we use and can provide is shown below:

- Samples with ISIR submission
- Design and Process FMEA
- PPAP on pre-production parts
- APQP
- Inspection reports with all deliveries
- B/H Loops
- Helmholz coil measurements
- Thermal testing
- Environmental testing

We are happy to provide any custom QA structure our clients require right up to zero defect by measurement.

For further information please refer to our Quality Assurance brochure.

Neodymium Iron Boron

BACKGROUND

NdFeB is a rare earth magnetic material discovered in the early 1980's by both General Motors and Sumitomo Special Metals. The initial goal was to provide a replacement for SmCo magnets, which was a more expensive material at the time. It is a high energy product and is manufactured by a melt spun process or by sintering, which is now the most common processing route.

MAGNETIC PERFORMANCE

Progress is being made all the time in the performance of NdFeB, so any data given is going to be out of date almost as soon as it is printed. However the guide shows NdFeB delivers considerably more energy per cubic metre than any other magnetic material available on the market today.
For the full range of available magnet grades please see our website www.goudsmit.co.uk

	Br (T)	Hci (kA/m)	BH_{max} (kJ/m^3)	T_c (°C)
$Nd_2Fe_{14}B$ (sintered)	1.0 -1.4	850 - 2400	200 - 400	80 - 200
$SmCo_5$ (sintered)	0.8 - 1.1	1200 - 2000	120 - 420	300 - 400
Alnico (sintered)	0.6 - 1.4	40 - 150	10 - 60	450 - 550
Sr-ferrite (sintered)	0.2 - 0.4	150 - 350	10 - 40	200 - 250

ENVIRONMENTAL PERFORMANCE

NdFeB magnets do not perform well environmentally. They suffer from several issues which can limit their use in some applications. These are as follows:

- Poor thermal performance - They become less energetic as the temperature rises (Br reduces by 12%/100°C) but they are also prone to partial demagnetisation with temperature rise, eventually being completely demagnetised at the Curie temperature which is relatively low.
- Prone to corrosion - Uncoated NdFeB magnets will rust. There are a range of ways to protect the magnets, from electroplating with Ni or ZN, to using organic coatings such as epoxy. There are also a range of specialist coatings which can be applied at greater cost.
- Mechanically brittle - NdFeB is a sintered compact and does not perform well under impact. Typically the material will splinter and in some conditions the magnet will fracture in two.

APPLICATIONS

Due to its high performance NdFeB is widely used in a range of applications where high temperatures are not a concern. It allows many devices to be more efficient than they were historically plus the option to miniaturise older designs. A far from exhaustive list includes:

- Wind turbines
- Hard disk drive motors
- Filters
- Electric vehicles
- Couplings
- Loudspeakers
- Motors of all sorts from cordless drills to servo motors for positional control

OPTIONAL PROCESS ROUTES

Permanent magnets can also be manufactured from a combination of NdFeB powder and a polymer. The process routes for this are;

- The combination of the powder and a wet or dry epoxy, followed by pressing and thermal curing.
- The compounding of the powder with a thermoplastic which is then injection moulded.

The generic name for such magnets is "bonded magnets" and Goudsmit UK can supply these to meet client's requirements.

Samarium Cobalt

BACKGROUND

Samarium Cobalt is a rare earth magnetic material discovered in the early 1970's and was the first commercial rare earth material. It is manufactured by a milling, pressing and sintering process mostly carried out in an inert atmosphere. Two distinct alloy series are available Sm_1Co_5 and Sm_2Co_{17}.

MAGNETIC PERFORMANCE

As can be seen from the guide below, SmCo is less energetic than NdFeB but much more energetic than AlNiCo or Ferrite. The balance between performance and cost dictates whether a Sm_1Co_5 or Sm_2Co_{17} will be chosen for a specific application. The rise in rare earth material costs in 2011 meant the Sm_2Co_{17} alloy series became cheaper than the Sm_1Co_5 alloy series and as it has greater performance it has become the most commonly used alloy series.

	Br (T)	Hci (kA/m)	BH_{max} (kj/m^3)	T_c (°C)
$Nd_2Fe_{14}B$ (sintered)	1.0 -1.4	850 - 2400	200 - 400	80 - 200
$SmCo_5$ (sintered)	0.8 - 1.1	1200 - 2000	120 - 420	300 - 400
Alnico (sintered)	0.6 - 1.4	40 - 150	10 - 60	450 - 550
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For the full range of available magnet grades please see our website www.goudsmit.co.uk

ENVIRONMENTAL PERFORMANCE

Samarium Cobalt magnets have two distinct advantages when compared to NdFeB magnets which have largely replaced them since the 1990's:

- Excellent thermal performance - SmCo magnets perform well at both hot and cold extremes of temperature which NdFeB magnets cannot withstand.
- Highly corrosion resistant - The magnets do not need to be coated and will survive most normal industrial environments without any degradation.

Like NdFeB magnets, SmCo is a sintered compact and thus is mechanically brittle, chipping easily. Care should be taken to avoid contact either in the application or in the assembly of the product it is used in.

APPLICATIONS

In the 1970's SmCo was widely used where rare earth energy products were required. After the launch of NdFeB onto the market, the application range has shrunk but still includes applications which require extremes of temperature or no risk of corrosion. Examples include, medical implants and prostheses, high temperature pumps and motors and instrumentation where thermal stability is paramount. The magnets are generally found in specialised areas where no other material is suitable for use.

OPTIONAL PROCESS ROUTES

Permanent magnets can also be manufactured from a combination of SmCo powder and a polymer. The process routes for this are;

- The combination of the powder and a wet or dry epoxy, followed by pressing and thermal curing.
- The compounding of the powder with a thermoplastic which is then injection moulded.

The generic name for such magnets is "bonded magnets" and Goudsmit UK can supply these to meet client's requirements.

Alnico

BACKGROUND

AlNiCo (Aluminium Nickel Cobalt) magnets were developed during the 1930's to 1950's and were, at the time, the strongest magnetic material available. Made by either casting or sintering, a number of different grades exist with the principal alloy series being AlNiCo5 and AlNiCo8. Over time they have been displaced by ferrite and rare earth magnets however, they still remain in use today in specific applications.

MAGNETIC PERFORMANCE

Although AlNiCo magnets have high remenance values their coercivity is low. They also have non-linear demagnetisation curves in the second quadrant. This makes them far from ideal to use, however they have excellent thermal performance and can be easily demagnetised in a controlled fashion to achieve a set magnetic output. This has made them invaluable in instrumentation applications. For the full range of available magnet grades please see our website www.goudsmit.co.uk

	Br (T)	Hci (kA/m)	BH_{max} (kj/m^3)	T_C (°C)
$Nd_2Fe_{14}B$ (sintered)	1.0 -1.4	850 - 2400	200 - 400	80 - 200
$SmCo_5$ (sintered)	0.8 - 1.1	1200 - 2000	120 - 420	300 - 400
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Sr-ferrite (sintered)	0.2 - 0.4	150 - 350	10 - 40	200 - 250

ENVIRONMENTAL PERFORMANCE

As stated above, AlNiCo magnets have excellent temperature performance with their output dropping by only 2% per 100°C temperature rise. They have a high Curie temperature which can be up to 800°C. They do not corrode and are chemically inert. As always they suffer from being fractious so mechanical impact should be avoided.

APPLICATIONS

Being composed of a significant amount of Cobalt, AlNiCo magnets have by now been largely replaced by cheaper or stronger alternatives. However, AlNiCo is still used mainly where a very stable field is required or where the magnet is demagnetised gently to achieve specific field strength. The magnets were used extensively in anti-lock breaking systems in cars and also in reed switch based products such as fuel cut-off sensors.

OPTIONAL PROCESS ROUTES

Permanent magnets can also be manufactured from a combination of AlNiCo powder and a polymer. The process route for this is;

- The combination of the powder and a wet or dry epoxy followed by pressing and thermal curing.

The generic name for such magnets is "bonded magnets" and Goudsmit UK can supply these to meet client's requirements.

Ferrite

BACKGROUND

Ferrites are chemical compounds consisting of ceramic materials with iron (III) oxide (Fe_2O_3) as their principal component. Many of them are magnetic materials and they are used to make permanent magnets and soft ferrite cores. Goudsmit UK specialise in the supply of hard ferrites which are permanent magnets.
The magnets are made by pre-sintering the required chemical components and then fine milling the resulting ceramic to domain size particles. This powder is then either dry or wet pressed to achieve a compact which is again sintered and then normally ground to size.

MAGNETIC PERFORMANCE

Ferrite magnets have some of the lowest properties of all the magnetic materials. However, as they are also the cheapest they have high energy product to cost ratios, this makes them the workhorse material of the magnetic industry. They do not perform well with change in temperature nor at extremities of temperature. For the full range of available magnet grades please see our website www.goudsmit.co.uk

	Br (T)	Hci (kA/m)	BH_{max} (kj/m^3)	T_c (°C)
$Nd_2Fe_{14}B$ (sintered)	1.0 -1.4	850 - 2400	200 - 400	80 - 200
$SmCo_5$ (sintered)	0.8 - 1.1	1200 - 2000	120 - 420	300 - 400
Alnico (sintered)	0.6 - 1.4	40 - 150	10 - 60	450 - 550
Sr-ferrite (sintered)	0.2 - 0.4	150 - 350	10 - 40	200 - 250

ENVIRONMENTAL PERFORMANCE

As a ceramic, the material is largely inert. It will not rust and can be used uncoated in almost all applications. As with most magnetic materials it is a sintered material and so does not perform well on mechanical impact, so care should be take to avoid this in the design or production process.

APPLICATIONS

Given their low cost, ferrite magnets are used in an extensive range of applications. The raw materials are plentiful, and with the rise in the cost of rare earth materials it is conceivable they will again take predominance in material choice.

Applications for the magnets include:

- Loudspeakers
- Magnetic filter
- Separation equipment
- Electric motors
- Microwave ovens
- Actuators
- Drives for pumps

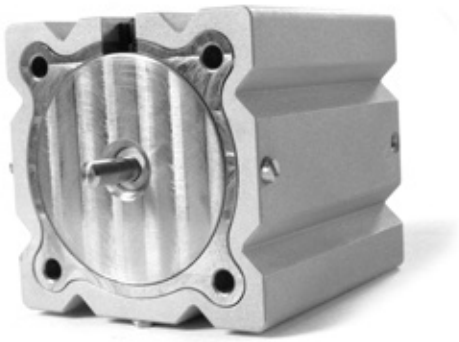
OPTIONAL PROCESS ROUTES

Permanent magnets can also be manufactured from a combination of ferrite powder and a polymer. The process routes for this are;

- The combination of the powder and a rubber which is then calendared.
- The compounding of the powder with a thermoplastic which is then injection moulded.

The generic name for such magnets is "bonded magnets" and Goudsmit UK can supply these to meet client's requirements.

Design

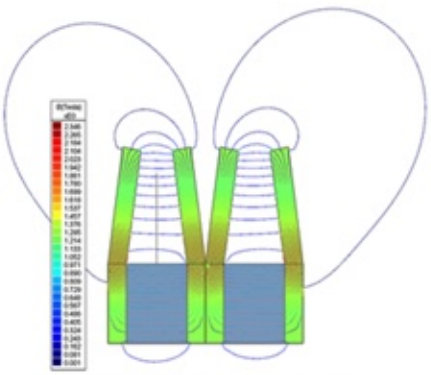


■ Solenoid prototype

Very often clients who approach us are looking not only for a pre-designed assembly but they also require some design work performed on their assembly, device or product. At Goudsmit UK our focus is mainly on engineering and design and so we are easily able to facilitate our clients with these requirements. Most often we are engaged to achieve one of the following goals:

- Cost reduction
- Enhanced performance
- Material reduction or change
- Miniaturisation

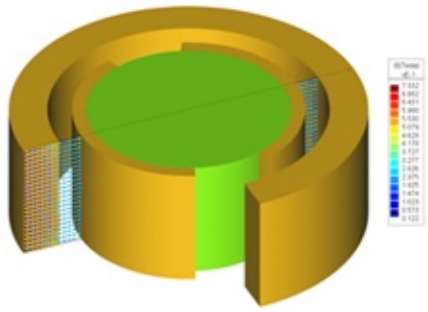
Whatever the brief we can normally achieve it. An outline of our design capabilities is as follows:



■ Magnetic Seperator

2D MAGNETIC DESIGN

For products which can be analysed in a single plane or which are rotationally symmetric, we can use 2D software and of course our design experience. We can look at characteristics such as field strength, flux density, saturation and force between objects to allow us to ascertain the optimal design for an assembly. Parametric analysis can be used to look at the effect of changes in key dimensions or materials.

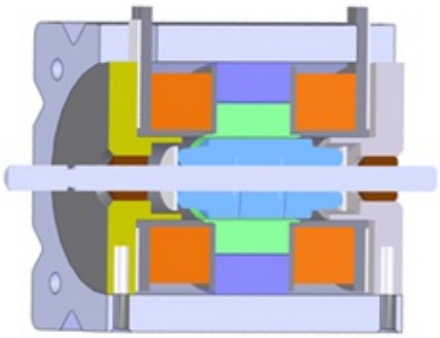


■ Moving coil meter stator

3D MAGNETIC DESIGN

For more complicated products, which need to be modelled in three dimensions, we use a 3D software package. This is a slower process as it is data heavy and large matrices are required to find the numerical solution. However, when coupled with our design know-how we can often characterise and simulate an application without ever having to build a prototype. Again we can look at characteristics such as field strength, flux density, saturation and force between objects to fine tune the design we have been given.

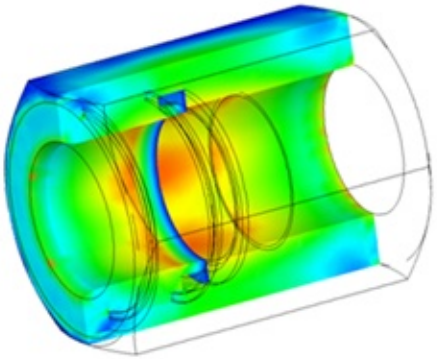
Design



■ Solenoid CAD

MECHANICAL DESIGN

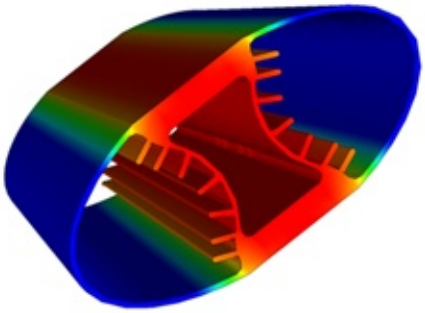
This is often an unappreciated discipline and one which is poorly practised on a wide scale. Good mechanical design, combined with knowledge of manufacturing techniques and costs is invaluable when it comes to assisting clients with the design of their assemblies. Knowing how to produce tolerance mating parts and how various assembly techniques are applied is key. Translating these into accurate 3D models and drawings is necessary to communicate the design to the manufacturing area. Finally, knowing how the materials behave mechanically within their environment will lead to better design, a better finished product and a more durable product in the field.



■ Hydraulic coupling under pressure

MECHANICAL ANALYSIS

There are many parameters we often need to investigate during the design process, and the most common is mechanical behaviour under load. Using FEA analysis we can load and fix a component in a multitude of different ways and look at how that component will perform, or more than often deform under that load. An illustration of his would be the high speed rotating machines we design at Goudsmit UK. Often how a machine behaves mechanically is more important and more difficult to predict than how it behaves magnetically. A good understanding of materials and manufacturing techniques is necessary to carry-out this type of work and combined with our expertise in component supply we can match up the design and production disciplines.



■ Radiator element

THERMAL ANALYSIS

As with mechanical analysis we need to ensure that any design works thermally, whether that be in a high temperature environment or generating thermal energy which needs to be dissipated. Radiation and convection patterns need to be understood to allow the design to be optimised to provide the heating or cooling function required.

Assembly Techniques

Goudsmit UK specialise in assembling magnets, and over the last few years we have developed substantial know-how relating to this field. A brief outline is listed below:

MECHANICAL ASSEMBLY

Press fits, interference fits, fasteners, threads and clips are some of the lowest risk methods of assembling magnets available and have the added bonus of normally being easy to test and validate. We will often look at mechanical assembly as a first choice solution.

INSERT MOULDING

Commonly used to combine magnets and plastics without gluing, this is a technically advanced solution which requires well designed moulds and precision made magnets. Other non-magnetic components can also be combined into the tool in more complex assemblies.

OVER MOULDING

When looking to completely cover a magnet, often for environmental reasons, we look to over moulding. Although requiring an extra mould tool, it is an excellent way to ensure parts remain firmly assembled. Polymer choice will often be dictated by the application's working conditions.

GLUING

This needs to be a well thought out and well tested solution. Gluing needs to be well controlled with proper dosing equipment, refrigerated storage, thorough application and curing instructions respected and complied to. Environmental and fatigue testing of samples is essential to ensure the correct functioning of the product over time. We do frequently use glue in our assembly products however, we do so with some caution and considerable testing cycles.

HEAT STAKING

This is when a polymer is heated to a temperature where it exhibits plastic behaviour and then is deformed to form a fastener. A powerful and repeatable technique, it is one we use with greater frequency within Goudsmit UK. Access needs to be left through the magnet for the heat stake up stand to be located.

ULTRASONIC WELDING

As the name suggests sound waves are used to weld two polymers together. Another specialised technique, it requires tooling to hold the parts and direct the sound waves to the required area. Once perfected, repeatability is good and it can be easily tested by sectioning the welds. The magnets themselves in this case are not welded, but we frequently use this technique to house or encapsulate magnets.

BRAZING

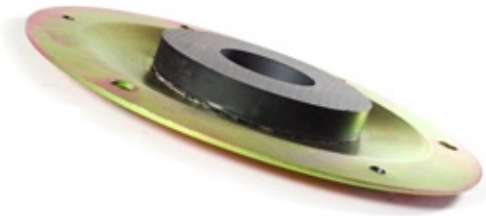
Two components can be brazed using a copper based alloy which melts and fills the gap between the two tightly fitting parts using capillary action. There are a number of different techniques, with fillers and inert atmospheres used. This is rarely used on magnets but it can be used in exceptional applications.

Application Focus

In order to illustrate the assembly techniques we use, we thought it best to show examples with some application backgrounds.

ULTRASONIC WELDING REPLACES GLUING

In this application the client used two mouldings to house a magnetic assembly. Normally assembled by gluing, the parts often separated due to thermal cycling. Goudsmit UK redesigned the assembly and substituted gluing with ultrasonic welding. The result is a better cosmetic finish and a more stable and durable assembly.



SIMPLE GLUE APPLICATION

The magnet needs to be held on the plate by more than attractive forces. We could have used a mechanical fixing or a heat stake, but the application is non-critical and the client had historically used glue.

RUBBER BOOTED MAGNET

These magpads are commonly used to hold objects to vehicles. Initial versions featured a rubber boot but later designs moved to a more robust elastomer over moulding.

TWO PART MOULDING ENCAPSULATING A MAGNET

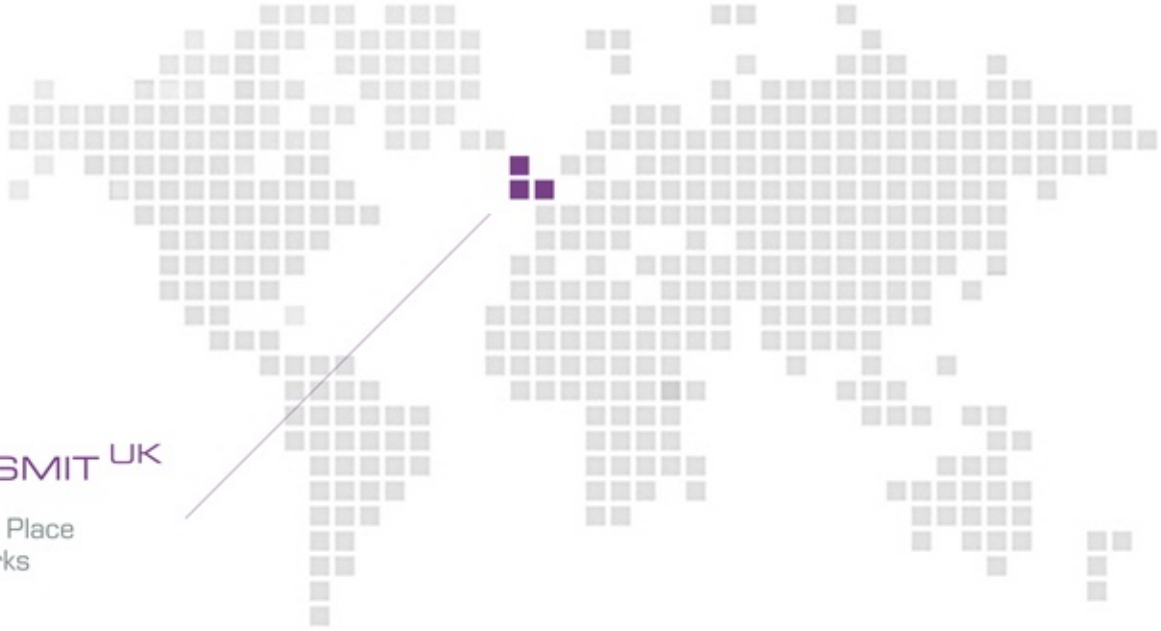
Using an engineering polymer and heat stable pigments, a thin magnet is encapsulated between the layers. The assembly sees 160°C in operation.

FDA COMPLIANCE WITH INSET MOULDING

Tasked to combine a magnet and a shaft but not have the magnet come into contact with drinking water, we chose to avoid glue and encapsulate the magnet and shaft, while mechanically coupling them using insert moulding. Cheap, very repeatable and very successful the assembly worked in the application with no issues at all.

Worldwide Service

- Goudsmit UK is part of the Goudsmit Group of companies. With two production facilities in China, one in the Czech Republic and two in Holland, the company has the reach to supply from Asia to Europe and on into the USA.



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