GOUDSMIT UK

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PRODUCTS AND SERVICES

GOUDSMIT UK

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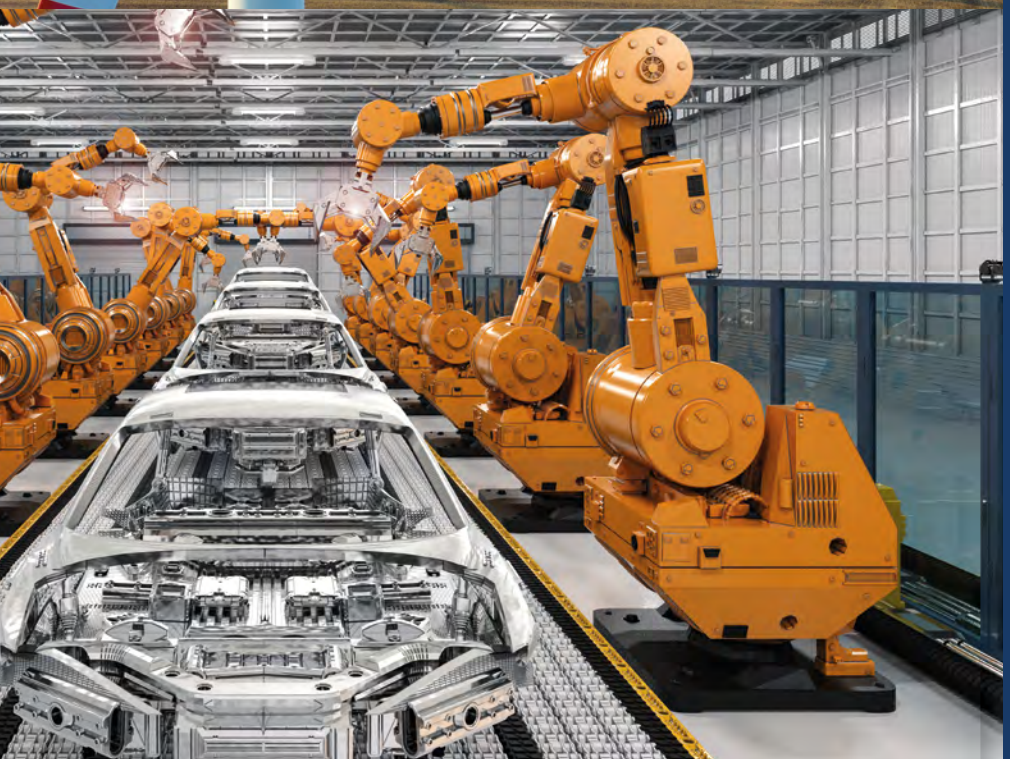
TECHNOLOGY
AT WORK FOR YOU

Goudsmit UK is part of the **Goudsmit Group** of companies based in Eindhoven, the Netherlands. Founded in 1959 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.

ISO 9001, **IATF 16949** and **AS 9120B** certified, Goudsmit UK supplies products into a diverse range of industries including Automotive, Oil & Gas, Aerospace, Medical and Renewable Energy.

We supply a diverse portfolio of **custom magnets & bespoke industrial components** across a range of industries



AUTOMOTIVE

AEROSPACE

RAIL

RENEWABLE ENERGY

OIL & GAS

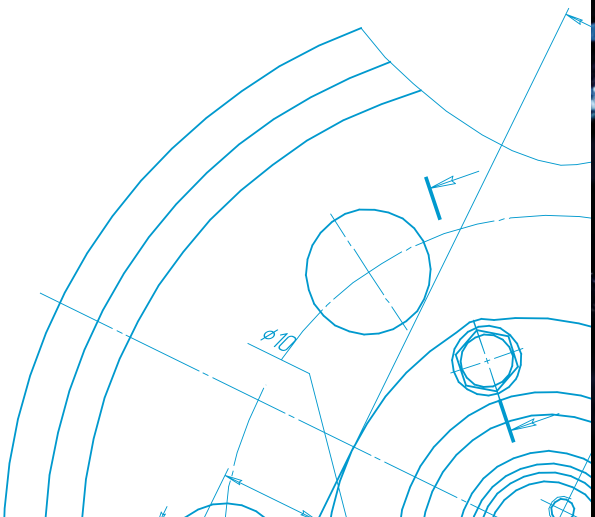
MEDICAL

LOGISTICS

A vast distribution network allows Goudsmit UK to transport your stock globally. We can help you manage your entire supply chain cost-effectively with a variety of logistics services tailored to the specific needs of your industry. To do this we have refined a complex logistics network which operates globally. Key capabilities of this network are:

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

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



QUALITY ASSURANCE

Our clients require parts which are correct first and every time. We endeavour to provide this with our QA aim of zero defects on deliveries and continual improvement in all our processes. In order to achieve this, we have become ISO 9001, IATF 16949 and AS 9120B certified and are constantly reviewing and adapting our processes and tightening our QA controls to better manage our final product. A short summary of the QA tools we use and documentation we can provide is shown below:

- APQP
- Material Certifications
- Environmental testing
- Design and Process FMEA
- First Article Inspection (FAIR)
- Samples with ISIR Submission
- PPAP On Pre-Production Parts
- Certificate of Conformity (CoC)
- Part Submission Warrant (PSW)
- Inspection Reports with All Deliveries

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

WORLDWIDE SERVICE

Operating globally, with offices in The Netherlands, France, UK, Czech Republic and joint venture facilities in China. At Goudsmit UK we pride ourselves in producing high quality products every time.

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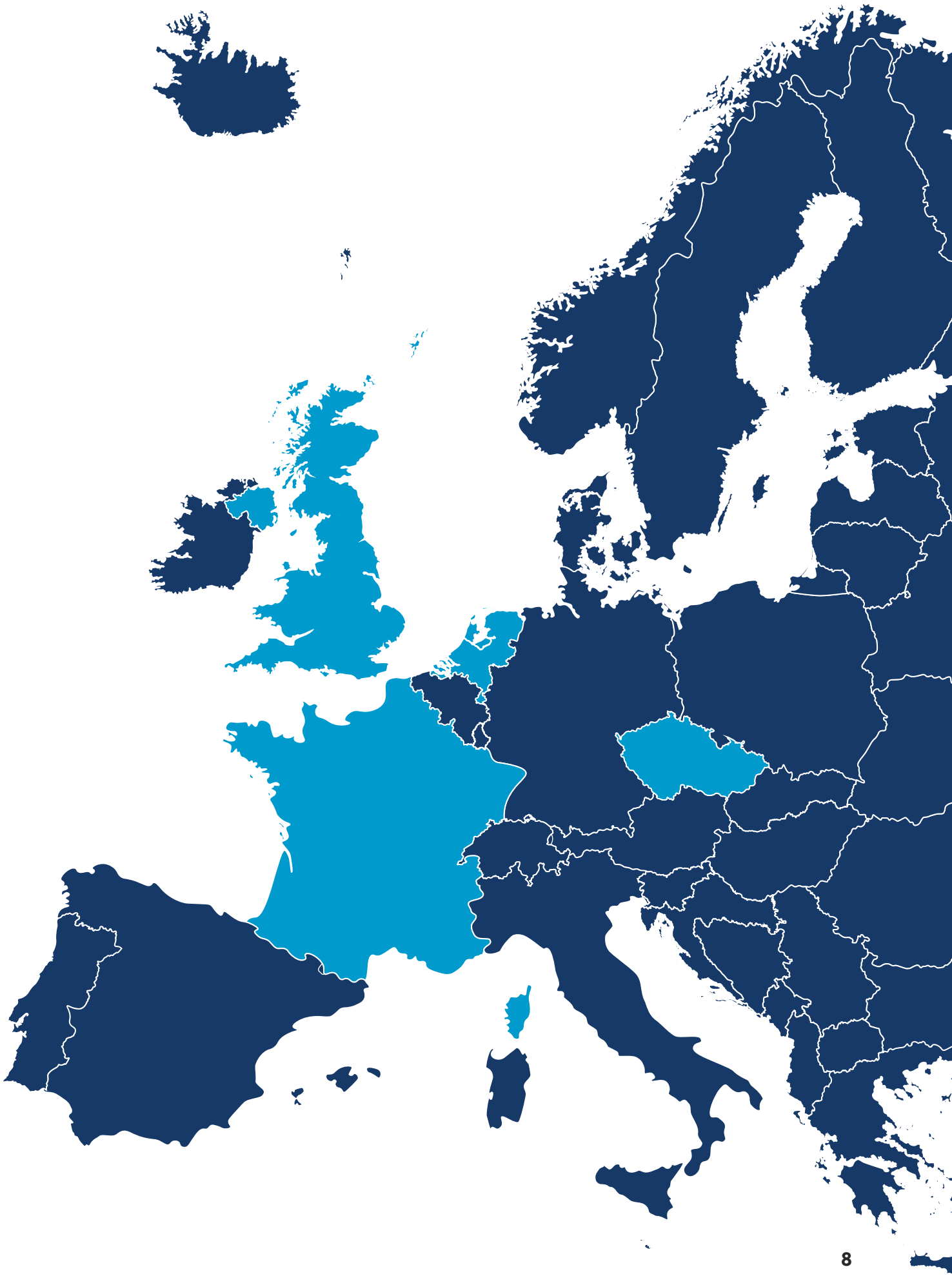


Over 60 years' experience in the design and manufacture of magnets and magnetic assemblies

Four permanent magnetic materials:

- Aluminium Nickel Cobalt (AlNiCo)
- Neodymium Iron Boron (NdFeB)
- Samarium Cobalt (SmCo)
- Ferrite

Extensive range of design capabilities

Specialists in magnetic assemblies, offering wide-ranging assembly techniques

PRODUCTS

MAGNETIC PRODUCTS

Goudsmit: Driven by Magnetism Since 1959

The Goudsmit Group have been supplying magnets and magnetic products since 1959. Quality is guaranteed by our team of experienced and skilled QA engineers. Our engineers make the most of advanced measuring systems to include:

- Permagraph
- Helmholz Coil
- Flux Meters
- CNC Controlled 2D Measuring Equipment
- GOM Laser Scanner

In addition, we also offer complementary guidance and advice in the design or redesign process of your product. With efficient order management, stock holding capabilities and cost-effective logistics network we can provide you with the right magnets, at the right time.

NEODYMIUM IRON BORON (NdFeB)

BACKGROUND

NdFeB is a rare earth magnetic material discovered in the early 1980's. The initial goal was to provide a replacement for SmCo magnets, which was a more expensive material at the time. The high energy product is manufactured by sintering. Other characteristics of NdFeB include:

- Maximal energy product of more than 50 MegaGauss-Oersted (MGOe) with an excellent coercivity.
- Standard tolerances are ±0.1 mm. If grinded ±0.05mm. Tighter tolerances are available on request.
- Processing is possible with diamond tools provided they are well cooled, as grinding residue can spontaneously ignite in combination with oxygen.
- They are always anisotropic which means that they can only be magnetised in preferential direction, axially and diametrically.
- By using special coils, they can be magnetised in a multipoled way.
- Can be manufactured in various shapes without additional costs, a clear drawing can avoid misunderstandings.
- Block magnet:
  - –Minimum dimension = 1 x 1 x 1mm.
  - –Maximum dimension = 160 x 150 x 50mm.
- Disc magnet:
  - –Minimum dimension = Ø 1.5 x 0.5mm.
  - –Maximum dimension = Ø 150 x 50mm.
- Ring magnet:
  - –Minimum dimension = Ø 3 x Ø 1 x 1mm.
  - –Maximum dimension = Ø 150 x Ø * x 50mm (*inside diameter in consultation).

MAGNETIC PERFORMANCE

Consistent progress is being made on 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.

Grade	Remanence		Coercivity				Max Energy Product		Temperature		
	Coefficient		Max Working Temperature		HcJ		(BH)max		(Br)	(Hcj)	TwMax
	T	kGs	kA/m	kOe	kA/m	kOe	KJ/m3	MGOe	%/°C	%/°C	°C
N35	1.17-1.22	11.7-12.2	≥860	≥10.8	≥955	≥12	263-287	33-36	-0.12	-0.750	80
N38	1.22-1.25	12.2-12.5	≥860	≥11.2	≥955	≥12	287-310	36-39	-0.12	-0.750	80
N40	1.25-1.28	12.5-12.8	≥860	≥11.5	≥955	≥12	302-326	38-41	-0.12	-0.750	80
N42	1.28-1.32	12.8-13.2	≥860	≥11.5	≥955	≥12	318-342	40-43	-0.12	-0.750	80
N45	1.32-1.37	13.2-13.7	≥860	≥11.0	≥955	≥12	342-366	43-46	-0.12	-0.750	80
N48	1.37-1.42	13.7-14.2	≥836	≥11.0	≥955	≥12	366-390	46-49	-0.12	-0.750	80
N50	1.39-1.44	13.9-14.4	≥836	≥10.5	≥955	≥12	376-408	47-51	-0.12	-0.750	80
N52	1.42-1.47	14.2-14.7	≥836	≥10.5	≥876	≥11	390-421	49-53	-0.12	-0.750	80
N54	1.45-1.50	14.5-15.0	≥836	≥10.5	≥876	≥11	406-438	51-55	-0.12	-0.750	80
N35M	1.17-1.22	11.7-12.2	≥868	≥10.9	≥1114	≥14	263-287	33-36	-0.11	-0.675	100
N38M	1.22-1.25	12.2-12.5	≥899	≥11.3	≥1114	≥14	287-310	36-39	-0.11	-0.675	100
N4OM	1.25-1.28	12.5-12.8	≥923	≥11.6	≥1114	≥14	302-326	38-41	-0.11	-0.675	100
N42M	1.28-1.32	12.8-13.2	≥955	≥12.0	≥1114	≥14	318-342	40-43	-0.11	-0.675	100
N45M	1.32-1.38	13.2-13.8	≥971	≥12.2	≥1114	≥14	342-366	43-46	-0.11	-0.675	100
N48M	1.36-1.42	13.6-14.2	≥995	≥12.5	≥1114	≥14	360-392	46-49	-0.11	-0.675	100
N50M	1.39-1.44	13.9-14.4	≥1035	≥13.0	≥1114	≥14	376-406	47-51	-0.11	-0.675	100
N52M	1.42-1.47	14.2-14.7	≥1056	≥13.3	≥1114	≥14	390-422	49-53	-0.11	-0.675	100
N35H	1.17-1.22	11.7-12.2	≥868	≥10.9	≥1353	≥17	263-287	33-36	-0.11	-0.605	120
N38H	1.22-1.25	12.2-12.5	≥899	≥11.3	≥1353	≥17	287-310	36-39	-0.11	-0.605	120
N40H	1.25-1.28	12.5-12.8	≥923	≥11.6	≥1353	≥17	302-326	38-41	-0.11	-0.605	120
N42H	1.28-1.32	12.8-13.2	≥955	≥12.0	≥1353	≥17	318-342	40-43	-0.11	-0.605	120
N45H	1.32-1.37	13.2-13.7	≥971	≥12.2	≥1353	≥17	344-366	43-46	-0.11	-0.605	120
N48H	1.36-1.42	13.6-14.2	≥1011	≥12.7	≥1353	≥17	366-392	46-49	-0.11	-0.605	120
N50H	1.39-1.44	13.9-14.4	≥1035	≥13.0	≥1353	≥17	374-406	47-51	-0.11	-0.605	120
N52H	1.42-1.47	14.2-14.7	≥1035	≥13.0	≥1353	≥17	390-422	49-53	-0.11	-0.605	120
N33SH	1.13-1.17	11.3-11.7	≥844	≥10.6	≥1592	≥20	247-272	31-34	-0.11	-0.535	150

Grade	Remanence		Coercivity				Max Energy Product		Temperature		
	Coefficient		Max Working Temperature		HcJ		(BH)max		(Br)	(Hcj)	TwMax
	T	kGs	kA/m	kOe	kA/m	kOe	KJ/m3	MGOe	%/°C	%/°C	°C
N35SH	1.17-1.22	11.7-12.2	≥876	≥11.0	≥1592	≥20	263-287	33-36	-0.11	-0.535	150
N38SH	1.22-1.25	12.2-12.5	≥907	≥11.4	≥1592	≥20	287-310	36-39	-0.11	-0.535	150
N4OSH	1.25-1.28	12.5-12.8	≥939	≥11.8	≥1592	≥20	302-326	38-41	-0.11	-0.535	150
N42SH	1.28-1.32	12.8-13.2	≥955	≥12.0	≥1592	≥20	318-342	40-43	-0.11	-0.535	150
N45SH	1.32-1.37	13.2-13.7	≥979	≥12.3	≥1592	≥20	342-366	43-46	-0.11	-0.535	150
N48SH	1.36-1.42	13.6-14.2	≥995	≥12.5	≥1592	≥20	366-390	45-49	-0.11	-0.535	150
N50SH	1.39-1.45	13.9-14.5	≥995	≥12.5	≥1592	≥20	374-406	45-49	-0.11	-0.535	150
N52SH	1.42-1.47	14.2-14.7	≥995	≥12.5	≥1592	≥20	390-422	49-53	-0.11	-0.535	150
N3OUH	1.08-1.13	10.8-11.3	≥812	≥10.2	≥1990	≥25	223-247	28-31	-0.10	-0.465	180
N33UH	1.13-1.17	11.3-11.7	≥852	≥10.7	≥1990	≥25	247-271	31-34	-0.10	-0.465	180
N35UH	1.17-1.22	11.7-12.2	≥860	≥10.8	≥1990	≥25	263-287	33-36	-0.10	-0.465	180
N38UH	1.22-1.25	12.2-12.5	≥876	≥11.0	≥1990	≥25	287-310	36-39	-0.10	-0.465	180
N4OUH	1.25-1.28	12.5-12.8	≥915	≥11.5	≥1990	≥25	302-326	38-41	-0.10	-0.465	180
N42UH	1.27-1.32	12.7-13.2	≥955	≥12.0	≥1990	≥25	318-342	40-43	-0.10	-0.465	180
N45UH	1.32-1.37	13.2-13.7	≥995	≥12.5	≥1990	≥25	342-366	43-46	-0.10	-0.465	180
N48UH	1.37-1.43	13.7-14.3	≥995	≥12.5	≥1990	≥25	366-390	46-49	-0.10	-0.465	180
N50UH	1.39-1.45	13.9-14.5	≥995	≥12.5	≥1990	≥25	374-406	47-51	-0.10	-0.465	180
N3OEH	1.08-1.13	10.8-11.3	≥812	≥10.2	≥2388	≥30	223-247	28-31	-0.10	-0.420	200
N33EH	1.13-1.17	11.3-11.7	≥820	≥10.3	≥2388	≥30	248-272	31-34	-0.10	-0.420	200
N38EH	1.17-1.22	11.7-12.2	≥836	≥10.5	≥2388	≥30	263-287	33-36	-0.10	-0.420	200
N38EH	1.20-1.25	12.0-12.5	≥899	≥11.3	≥2388	≥30	287-310	36-39	-0.10	-0.420	200
N4OEH	1.25-1.28	12.5-12.8	≥915	≥11.5	≥2388	≥30	302-326	38-41	-0.10	-0.420	200
N42EH	1.27-1.32	12.7-13.2	≥971	≥12.2	≥2388	≥30	318-342	40-43	-0.10	-0.420	200
N45EH	1.33-1.38	13.3-13.8	≥971	≥12.2	≥2388	≥30	342-366	43-46	-0.10	-0.420	200
N28AH	1.05-1.09	10.5-10.9	≥780	≥9.8	≥2706	≥34	207-230	26-29	-0.10	-0.393	220
N30AH	1.10-1.14	11.0-11.4	≥812	≥10.2	≥2706	≥34	223-247	28-31	-0.10	-0.393	220
N33AH	1.14-1.17	11.4-11.7	≥812	≥10.2	≥2706	≥34	247-271	31-34	-0.10	-0.393	220
N35AH	1.17-1.22	11.7-12.2	≥883	≥11.1	≥2706	≥34	263-287	33-36	-0.10	-0.393	220
N38AH	1.20-1.25	12.0-12.5	≥923	≥11.6	≥2706	≥34	287-310	36-39	-0.10	-0.393	220
N40AH	1.25-1.30	12.5-13.0	≥923	≥11.6	≥2706	≥34	302-326	38-41	-0.10	-0.393	220
N42AH	1.28-1.34	12.8-13.4	>923	≥11.6	≥2706	≥34	318-342	40-43	-0.10	-0.393	220
N28VH	1.02-1.09	10.2-10.9	≥780	≥9.8	≥3104	≥39	207-230	26-29	-0.10	-0.393	250
N30VH	1.08-1.14	10.8-11.4	≥812	≥10.2	≥3104	>39	223-247	28-31	-0.10	-0.393	250
N33VH	1.13-1.18	11.3-11.8	≥812	≥10.2	≥3104	≥39	247-271	31-34	-0.10	-0.393	250
N35VH	1.17-1.22	11.7-12.2	≥883	≥11.1	≥3104	≥39	263-287	33-36	-0.10	-0.393	250
N38VH	1.22-1.27	12.2-12.7	≥923	≥11.6	≥3104	≥39	287-310	36-39	-0.10	-0.393	250

ENVIRONMENTAL PERFORMANCE

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

- 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.
- Mechanically brittle - NdFeB is a sintered material and does not perform well under impact. Typically, the material will splinter and in some conditions the magnet will fracture in two.
- 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 an increased cost. Specialist coatings include:
  - –Ni, Ni/Cu/Ni Plating
  - –Sn, SnCu Plating
  - –Epoxy Coating
  - –Zinc Plating
  - –Cu Plating
  - –Teflon Coating
  - –Au Plating
  - –Parylene Coating
  - –Al Coating

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. Some applications include:

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

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.

Also referred to as "bonded magnets", Goudsmit UK supply these to meet client's specific requirements.

Item	Grade	Remanence		Coercivity				Max Energy Product		Max Working Tempera-ture	Density
		Br		HcB		HcJ		(BH)max.		TwMax	P
		T	kGs	kA/m	kOe	KA/m	kOe	kJ/m³	MGOe	°C	g/cm3
Compression Moulding NdFeB Magnet	KBM-2	0.30-0.40	3.0-4.0	160-240	2.0-3.0	420-640	6.0-8.0	16-24	2.0-3.0	≤120	4.5-6.0
	KBM-4	0.40-0.50	4.0-5.0	240-320	3.0-4.0	560-720	7.0-9.0	32-44	4.0-5.5	≤120	5.2-6.0
	KBM-6	0.50-0.60	5.0-6.0	320-400	4.0-5.0	430"640	6.0-8.0	48-60	6.0-7.5	≤120	5.5-6.0
	KBM-8	0.60-0.68	6.0-6.8	360-440	4.5-5.5	640-800	8.0-10.0	64-72	8.0-9.0	≤150	5.8-6.1
	KBM-8H	0.60-0.65	6.0-6.5	400-480	5.0-6.0	1120-1280	14.0-16.0	60-68	7.5-8.5	≤160	5.8-6.2
	KBM-8L	0.65-0.68	6.5-6.8	400-480	5.0-6.0	900-1120	11.0-14.0	64-72	8.0-9.0	≤160	5.8-6.2
	KBM-9	0.60.0.68	6.0-6.8	400-480	5.0-6.0	640-800	8.0-10.0	68-72	8.5-9.0	≤150	5.8-6.2
	KBM-10	0.68-0.73	6.8-7.3	400-480	5.0-6.0	640-800	8.0-10.0	76-84	9.5-10.5	≤150	5.8-6.2
	KBM-12	0.71-0.75	7.1-7.5	440-520	5.5-6.5	720-800	9.0-10.0	84-96	10.5-12.0	≤150	6.0-6.2
	KBM-12L	0.72-0.76	7.2-7.6	400-480	5.0-6.0	480-640	6.0-8.0	84-96	10.5-12.0	≤140	6.0-6.2
Injection Moulding NdFeB Magnet	KBI-3	0.20-0.30	2.0-3.0	160-240	2.0-3.0	480-64.0	6.0-8.0	12-24	1.5-3.0	≤100	3.9-4.4
	KBI-4	0.35-0.45	3.5-4.5	240-320	3.0-4.0	560-720	7.0-9.0	24-36	3.0-4.5	≤120	4.2-4.9
	KBI-5	0.45-0.52	4.5-5.2	320-360	4.0-4.5	560-720	7.0-9.0	36-44	4.5-5.5	≤120	4.5-5.0
	KBI-5H (PPS)	0.48-0.52	4.8-5.2	400-480	5.0-6.0	380-1040	11.0-13.0	36-44	4.5-5.5	≤150	4.9-5.4
	KBI-6	0.50-0.55	5.0-5.5	320-440	4.0-5.5	640-800	8.0-10.0	44-52	5.5-6.5	≤120	4.7-5.1
	KBI-7	0.54-0.64	5.4-6.4	320-400	4.0-5.0	640-800	8.0-10.0	52-60	6.5-7.5	≤120	5.0-5.5
	KBI-8	0.64-0.74	6.4-7.4	400-480	5.0-6.0	640-803	8.0-10.0	68-76	8.5-9.5	≤120	5.5-5.9

SAMARIUM COBALT (SmCo)

BACKGROUND

The first commercial rare earth material, Samarium Cobalt is a rare earth magnetic material discovered in the early 1970's. It's manufactured by a milling, pressing and sintering process mostly carried out in an inert atmosphere. Two distinct alloy series are available Sm1Co5 and Sm2Co17. Other characteristics of SmCo include:

- Maximum energy product of 18 to 20 MegaGauss-Oersted (MGOe), a low temperature coefficient and high stability.
- The maximum temperature of use is 250°C depending on the specification, dimensions and system design.
- The cost price of SmCo magnets, in comparison with NdFeB is a lot higher due to the high, unstable Cobalt prices.
- Block magnet:
  - Minimum dimension = 2 x 2 x 1mm.
  - Maximum dimension = 120 x 52 x 52mm.
- Disc magnet:
  - Minimum dimension = Ø 2 x 1mm.
  - Maximum dimension = Ø 90 x 50mm.
- Ring magnet:
  - Minimum dimension = Ø 3 x Ø 1.5 x 1mm.
  - Maximum dimension = Ø 90 x Ø * x 50mm (*inside diameter in consultation).

MAGNETIC PERFORMANCE

SmCo is less energetic than NdFeB, but much more energetic than AlNiCo or Ferrite. The balance between performance and cost dictates whether a Sm1Co5 or Sm2Co17 will be chosen for a specific aplication.

Item	Grade	Remanence		Coercivity				Max Energy Product		Max Working Temp.
		Br		HcB		HcJ		(BH)max.		TwMax
		T	kGs	kA/m	kOe	KA/m	kOe	kJ/m³	MGOe	°C
Sm1Co5	Sm1Co5-20	0.89-0.93	8.9-9.3	684-732	8.6-9.2	≥1830	≥23	151-167	19-21	≤250
	Sm1Co5-22	0.92-0.96	9.2-9.6	710-756	8.9-9.5	≥1830	≥23	159-175	20-22	≤250
	Sm1Co5-24	0.96-1.00	9.6-10.0	740-788	9.3-9.9	≥1830	≥23	175-191	22-24	≤250
Sm2Co17	Sm2Co17-30L	1.08-1.10	10.8-11.0	541-796	6.8-10.0	636-955	8-12	223-239	28-30	≤250
	Sm2Co17-32L	1.10-1.15	11.0-11.5	541-812	6.8-10.2	636-955	8-12	231-255	29-32	≤250
	Sm2Co17-30M	1.08-1.10	10.8-11.0	676-835	8.5-10.5	955-1433	12-18	223-239	28-30	≤300
	Sm2Co17-32M	1.10-1.15	11.0-11.5	676-852	8.5-10.7	955-1433	12-18	231-255	29-32	≤300
	SM2Co17-28	1.63-1.06	10.3-10.8	756-812	9.5-10.2	≥1433	≥18	207-223	26-28	≤300
	Sm2Co17-30	1.08-1.10	10.8-11.0	788-835	9.9-10.5	≥1433	≥18	223-239	28-30	≤300
	Sm2Co17-32	1.10-1.15	11.0-11.5	812-860	10.2-10.8	≥1433	≥18	231-255	29-32	≤300
	Sm2Co17-28H	1.03-1.06	10.3-10.8	756-812	9.5-10.2	≥1990	≥25	207-223	26-28	≤350
	Sm2Co17-30H	1.08-1.10	10.8-11.0	788-835	9.9-10.5	≥1990	≥25	223-239	28-30	≤350
	Sm2Co17-32H	1.10-1.15	11.0-11.5	812-860	10.2-10.5	≥1990	≥25	231-255	29-32	≤350

ENVIRONMENTAL PERFORMANCE

Samarium Cobalt magnets have two distinct advantages when compared to NdFeB magnets:

- 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; they will survive most normal industrial environments without any degradation.

Like NdFeB magnets, SmCo is a sintered material 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 NdFeB was introduced into the market, the range of applications using SmCo reduced. However, it's still used in applications which require extreme temperatures and/or no risk of corrosion. Including:

- Medical implants and prostheses
- High temperature pumps and motors
- Instrumentation where thermal stability is paramount

These 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.

Also referred to as "bonded magnets", Goudsmit UK supply these to meet client's specific 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 which 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 material which is again sintered and then normally ground to size. Other characteristics of Ferrite include:

- Maximum energy product of 1 to ± 4.3 MegaGauss-Oersted (MGOe).
- Due to the possibility of shrinking during the sintering process, a tolerance of ±2% should be considered when determining the dimensions. If grinded ±0.1mm.
- Tighter tolerances are available on request.
- Can be supplied both isotropically and anisotropically.
- Block magnet:
  - –Minimum dimension = 2 x 2 x 2mm.
  - –Maximum dimension = 270 x 90 x 25.4mm.
- Disc magnet:
  - –Minimum dimension = Ø 2 x 1mm.
  - –Maximum dimension = Ø 156 x 25mm.
- Ring magnet:
  - –Minimum dimension = 8 x 2.5 x 3mm.
  - –Maximum dimension = Ø 256 x Ø* x 25mm (*inside diameter in consultation).

MAGNETIC PERFORMANCE

Ferrite magnets have some of the lowest properties of all the magnetic materials. However, they are also the cheapest with high energy product to cost ratios. Ferrite magnets do not perform well with fluctuations or extremities of temperature.

Grade	Remanence		Coercivity				Max Energy Product		Temp. Coefficient		Max Working Temp.	MMPA
	Br		Hcb		Hcj		(BH)max		Tk(Br)	Tk(HCj)	Twmax	
	KGs	T	KOe	KA/m	KOe	KA/m	MGOe	KJ/m3	%/K	%/K	°C	
Y10T	2.00-2.18	200-218	1.57-1.82	125-145	2.64-3.14	210-250	0.8-1.0	6.5-8.0	-0.2	0.3	250	C1
Y25	3.60-3.70	360-370	1.70-1.88	135-150	1.76-2.14	140-170	2.8-3.2	22.5-25.3	-0.2	0.3	250	C5
Y30	3.80-3.90	380-390	2.40-2.64	191-210	2.50-2.51	199-220	3.4-3.7	27.0-30.0	-0.2	0.3	250	
Y33	4.00-4.10	400-410	2.20-2.45	175-195	2.26-2.51	180-200	3.8-4.0	30.5-31.5	-0.2	0.3	250	
Y35	4.10-4.20	410-420	2.77-2.95	220-235	2.83-3.01	225-240	4.0-4.2	31.5-33.0	-0.2	0.3	250	
Y30BH	3.80-3.90	380-390	2.80-2.95	223-235	2.90-3.08	231-245	3.4-3.7	27.0-30.0	-0.2	0.3	250	C8
Y33BH	4.00-4.10	400-410	3.62-3.77	288-300	3.51-3.60	280-287	3.8-4.0	30.4-31.5	-0.2	0.3	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's a sintered material and so does not perform well on mechanical impact, care should be taken to avoid this in the design and 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
- Electric motors specifically arc magnets
- Magnetic filter
- Actuators
- Separation equipment
- Drives for pumps
- Microwave ovens

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.

Also referred to as "bonded magnets", Goudsmit UK supply these to meet client's specific requirements.

Item	Grade	Remanence		Coercivity				Max Energy Product		Max Working Temp.	Density
		Br		HcB		HcJ		(BH)max.		TwMax	P
		T	kGs	kA/m	kOe	KA/m	kOe	kJ/m³	MGOe	°C	g/cm3
Injection Moulding Ferrite Magnet	KBI-F1.5	0.22-0.24	2.2-2.4	160-167	2.00-2.10	231-240	2.90-3.00	11.6-12.4	1.45-1.55	≤120	3.25
	KBI-F1.9	0.27-0.29	2.7-2.9	180-186	2.25-2.33	216-228	2.70-2.85	14.8-15.6	1.85-1.95	≤120	3.63
	KBI-F2.0	0.28-0.29	2.8-2.9	184-200	2.30-2.50	216-246	2.70-3.10	15.6-16.4	1.95-2.05	≤120	3.7
	KBI-F2.1	0.28-0.29	2.8-2.9	190-204	2.38-2.55	224-249	2.80-3.12	16.4-17.2	2.05-2.15	≤120	3.75
	KBI—F1.7 (PPS)	0.25-0.26	2.5-2.6	167-175	2.10-2.20	208-216	2.60-2.70	13.6-14.0	1.70-1.75	≤160	3.55

ALUMINIUM NICKEL COBALT (AlNiCo)

BACKGROUND

AlNiCo (Aluminium Nickel Cobalt) magnets were developed during the 1930's to 1950's and at the time were the strongest magnetic material available. Made by either casting or sintering, several 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 remain in specific applications today. Other characteristics of AlNiCo include:

- Maximum energy product of 1 to ±9 MegaGauss-Oersted (MGOe).
- Casting AlNiCo can happen in complex forms such as horseshoes.
- Standard tolerance for grinded AlNiCo is ±0.1mm, depending on the size and shape.
- It is vital that the length/diameter ratio is kept, this will prevent demagnetisation.
- Block magnet:
  - –Minimum dimension = 2 x 2 x 2mm.
  - –Maximum dimension = 100 x 100 x 100mm.
- Disc magnet:
  - –Minimum dimension = Ø 1 x 2mm.
  - –Maximum dimension = Ø 100 x 100 mm.
- Ring magnet:
  - –Minimum dimension = Ø 5 x Ø 3.5 x 1mm.
  - –Maximum dimension = Ø 200 x Ø* x 50mm (*inside diameter in consultation).

MAGNETIC PERFORMANCE

Although AlNiCo magnets have high remanence 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.

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.

Also referred to as "bonded magnets", Goudsmit UK supply these to meet client's specific requirements.

Grade	Remanence		Coercivity				Max Energy Product		Temp. Coefficient		Max Working Temp.	MMPA
	Br		Hcb		Hcj		(BH)max		Tk(Br)	Tk(HCj)	Twmax	
	KGs	mT	KOe	KA/m	KOe	KA/rn	MGOe	KJ/m3	%/K	%/K	°C	
ISOTROPIC CAST ALNICO												
LN10	6.5	650	0.48	38	0.5	40	1.25	10	-0.035	-0.025	450	ALNICO 3
LNG12	7.5	750	0.56	45	0.58	46	1.5	12	-0.03	-0.02	450	ALNICO 2
LNGT18	5.5	550	1.13	90	1.21	97	2.25	18	-0.025	0.01	550	ALNICO 8
ANISOTROPIC CAST ALNICO												
LNG34	11	1100	0.63	50	0.65	52	4.25	34	-0.02	0.01	525	ALNICO 5
LNG37	11.8	1180	0.61	49	0.64	51	4.63	37	-0.02	0.01	525	
LNG40	12	1200	0.63	50	0.65	52	5	40	-0.02	0.01	525	
LNG44	12.5	1250	0.65	52	0.68	54	5.5	44	-0.02	0.01	525	

Grade	Remanence		Coercivity				Max Energy Product		Temp. Coefficient		Max Working Temp.	MMPA
	Br		Hcb		Hcj		(BH)max		Tk(Br)	Tk(HCj)	Twmax	
	KGs	mT	KOe	KA/m	KOe	KA/rn	MGOe	KJ/m3	%/K	%/K	°C	
ANISOTROPIC CAST ALNICO												
LNGT34	11.5	1150	0.73	58	0.75	60	3.5	28	-0.02	0.03	525	ALNICO 6
LNG52	13	1300	0.7	56	0.73	58	6.5	52	-0.02	0.03	525	ALNICO 5DG
LNG60	13.5	1350	0.73	58	0.75	60	7.5	60	-0.02	0.03	525	ALNICO 5-7
LNGT38	8	800	1.38	110	1.4	112	4.75	38	-0.025	0.01	550	ALNICO 8
LNGT40	8.5	850	1.44	115	1.46	117	5	40	-0.025	0.01	550	
LNGT44	9	900	1.44	115	1.46	117	5.5	44	-0.025	0.01	550	
LNGT36J	7.2	720	1.88	150	1.9	152	4.5	36	-0.025	0.01	550	ALNICO 8HC
LNGT6O	10	1000	1.38	110	1.4	112	7.5	60	-0.025	0.01	550	ALNICO 9
LNGT72	10.5	1050	1.44	115	1.46	117	9	72	-0.025	0.01	550	
LNGT80	10.8	1080	1.5	120	1.53	122	10	80	-0.025	0.01	550	
ISOTROPIC SINTERED ALNICO												
FLNG10	6.5	650	0.5	4.0	0.53	42	1.25	10	-0.03	-0.02	450	ALNICO 3
FLNG12	7.5	750	0.56	45	0.58	46	1.5	12	-0.035	-0.025	450	ALNICO 2
FLNGT18	6	600	1.19	95	1.23	98	2.25	18	-0.025	0.01	550	ALNICO 8
FLNGT20	6.2	620	1.25	100	1.31	105	2.5	20	-0.025	0.01	550	
ANISOTROPIC SINTERED ALNICO												
FLNG34	11.5	1150	0.6	48	0.63	50	4.25	34	-0.02	0.01	525	ALNICO 5
FLNGT28	11	1100	0.73	58	0.75	60	3.5	28	-0.02	0.03	525	ALNICO 6
FLNGT36J	7.2	720	1.88	150	1.9	152	4.5	36	-0.025	0.01	550	ALNICO 8HC
FLNGT38	8	800	1.38	110	1.4	112	4.75	38	-0.025	0.01	550	ALNICO 8
FLNGT44	8.5	850	1.5	120	1.53	122	5.5	44	-0.025	0.01	550	
FLNGT48	9.2	920	1.56	125	1.59	127	6	48	-0.025	0.01	550	
BONDED ALNICO (BEARING)												
B-LNG7	3.1	310	1.00	79.63	1.30	103.5	0.85	6.77	-0.02	0.01	200	
B-LNG8	3.4	340	1.05	83.612	1.35	107.5	1.00	7.96	-0.02	0.01	200	

ENVIRONMENTAL PERFORMANCE

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

APPLICATIONS

Containing a significant amount of Cobalt, AINiCo magnets have been largely replaced by cheaper and stronger alternatives. However, AINiCo 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 braking systems in cars and in reed switch based products such as fuel cut-off sensors.

PLASTIC INJECTED MAGNETS

Binder	Test Method	Magnetic Properties JIS C2501								Physical Properties				
	Grade	Br		bHc		iHc		Bhmax		Molded Density	Flexural Strength	Tensile Strength	IZOD Impact Strength	Flexural Temp.
		mT	G	kA/m	Oe	kA/m	Oe	kJ/m3	MGOe	g/cm3	Mpa	Mpa	kJ/m2	oC
PPS Base	BF-1607Y	169	1690	130	1630	284	3570	5.6	0.70	2.94	172	104	21.6	208
	BF-1610C	197	1970	146	1840	206	2590	7.6	0.96	3.04	130	-	15.0	205
	BF1610Y	205	2050	158	1980	260	3270	8.3	1.04	3.2	167	-	17.7	208
	BF-1613	234	2340	163	2050	195	2450	10.8	1.36	3.35	115	58	12.0	205
	BF-1616	259	2590	167	2100	191	2400	13.1	1.64	3.55	98	55	8.8	208
	BF-1617H	264	2640	167	2100	186	2340	13.8	1.74	3.60	98	50	7.8	208
	BF1619	273	2730	179	2250	203	2550	14.6	1.83	3.73	93	-	7.4	208
Nylon 12 Base	BF-1213	235	2350	179	2250	247	3100	11.0	1.38	3.22	127	59	28.0	118
	BF-1215	245	2450	183	2300	243	3050	11.9	1.5	3.30	131	59	26.5	122
	BF-1216	257	2570	187	2350	239	3000	13.1	1.64	3.41	130	59	23.0	127
	BF-1218	267	2670	188	2360	228	2870	14.2	1.78	3.51	129	59	18.0	130
	BF-1219H2	280	2800	199	2500	231	2900	15.5	1.95	3.60	124	-	14.5	130
	BF-1220S	287	2870	188	2365	214	2700	16.3	2.05	3.70	130	59	15.0	130
	BF-1221	297	2970	183	2300	207	2600	17.4	2.19	3.80	109	44	10.8	130
	BF-1222H	311	3110	167	2100	183	2300	18.6	2.34	3.87	105	42	9.2	130
	BF-1225K	319	3190	171	2150	191	2400	19.3	2.43	3.98	88	-	7.0	-
Nylon 6 Base	BF-1114	240	2400	177	2230	239	3000	11.4	1.43	3.27	177	-	25.0	168
	BF-1115	248	2480	183	2300	237	2980	12.2	1.53	3.37	194	78	29.4	168
	BF-1116	257	2570	187	2350	235	2950	13.1	1.65	3.46	194	74	24.5	172
	BF-1117	266	2660	187	2350	228	2860	14.0	1.76	3.53	190	81	21.6	174
	BF-1118H	277	2765	183	2300	215	2700	15.2	1.91	3.62	177	78	18.0	174
	BF-1119H	284	2840	183	2300	211	2650	15.8	1.98	3.67	171	71	14.7	173
	BF-1120	286	2860	183	2300	210	2640	16.2	2.04	3.72	188	74	14.7	173
	BF-1121H	288	2880	183	2300	207	2600	16.4	2.06	3.72	178	78	15.5	172
	BF-1122	297	2970	183	2300	203	2550	17.5	2.2	3.81	164	62	11.8	172
	BF-1123	303	3030	159	2000	179	2250	17.9	2.25	3.85	173	-	10.8	172

FLEXIBLE RUBBER MAGNETS

MATERIAL CHARACTERISTICS

Grade		Br(typ.)		bHc(typ.)		iHc(typ.)		(BH)max(typ.)	
New	Old	(mT)	(Gs)	(kA/m)	(Oe)	(kA/m)	(Oe)	(KJ/m3)	(MGOe)
RF5	NP5	170	1700	96	1200	191	2400	4.8	0.6
RF8	NP8	200	2000	143	1800	207	2600	8.0	1.0
RF12	NP12	245	2450	169	2120	247	3100	11.9	1.5

PHYSICAL PROPERTIES

Density (g/cm3)	3.5-3.7
Operating Temperature (°C)	-40 - +100
Hardness (D)	45-50
Tensile Strength (kg.f/cm2)	50
Rev. Temp. Coeff. (%/°C)	-0.18

DESIGN

Clients often require a pre-designed assembly, alongside some design work performed on their assembly, device or product. At Goudsmit UK our focus is mainly on engineering and design, enabling us to easily facilitate our clients with these requirements. Most often we are engaged to achieve one of the following goals:

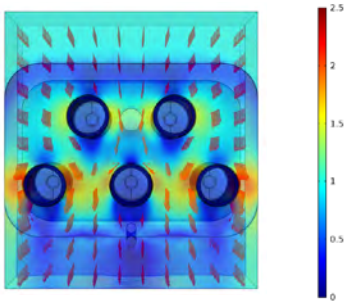
- Cost reduction
- Enhanced performance
- Material reduction or change
- Miniaturisation

Solenoid prototype

An outline of our design capabilities are as follows:

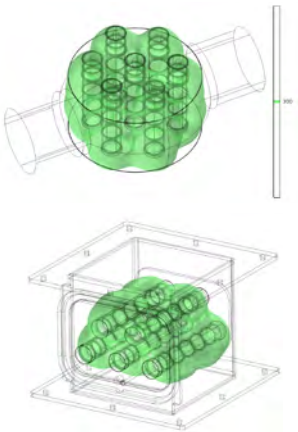
2D MAGNETIC MODELLING AND SIMULATION

For products which can be analysed in a single plane or which are rotationally symmetric, Goudsmit UK use 2D software and 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 also be used to look at the effect of changes in key dimensions or materials.



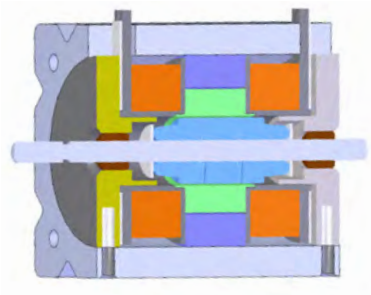
3D MAGNETIC MODELLING AND SIMULATION

For more complicated products which need to be modelled in three dimensions, Goudsmit UK use a 3D software package. A much slower process since it's data heavy and large matrices are required to find the numerical solution. However, when coupled with our in-depth design knowledge we can characterise and simulate an application without 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 initial design.



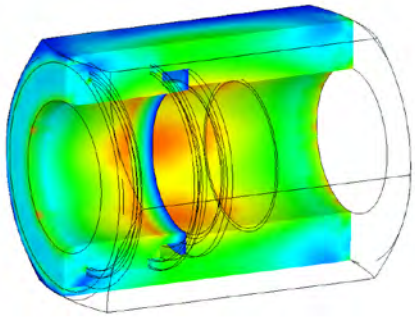
MECHANICAL ASSEMBLY SIMULATION AND ANALYSIS

Good mechanical design combined with extensive 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 accurately communicate the design to the manufacturing team. Goudsmit UK's insight into how the materials behave mechanically within their environment leads to better design, a better finished product and a more durable product in the application.



MECHANICAL ANALYSIS

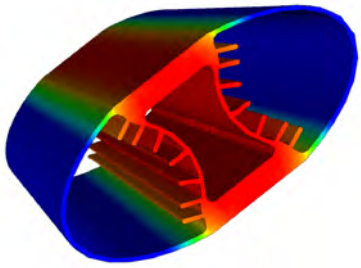
There are many parameters we often need to investigate during the design process, especially mechanical behaviour under load. Using FEA analysis we can load and fix a component in a multitude of different ways and look at how that component will perform or deform under that load. Often how a machine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



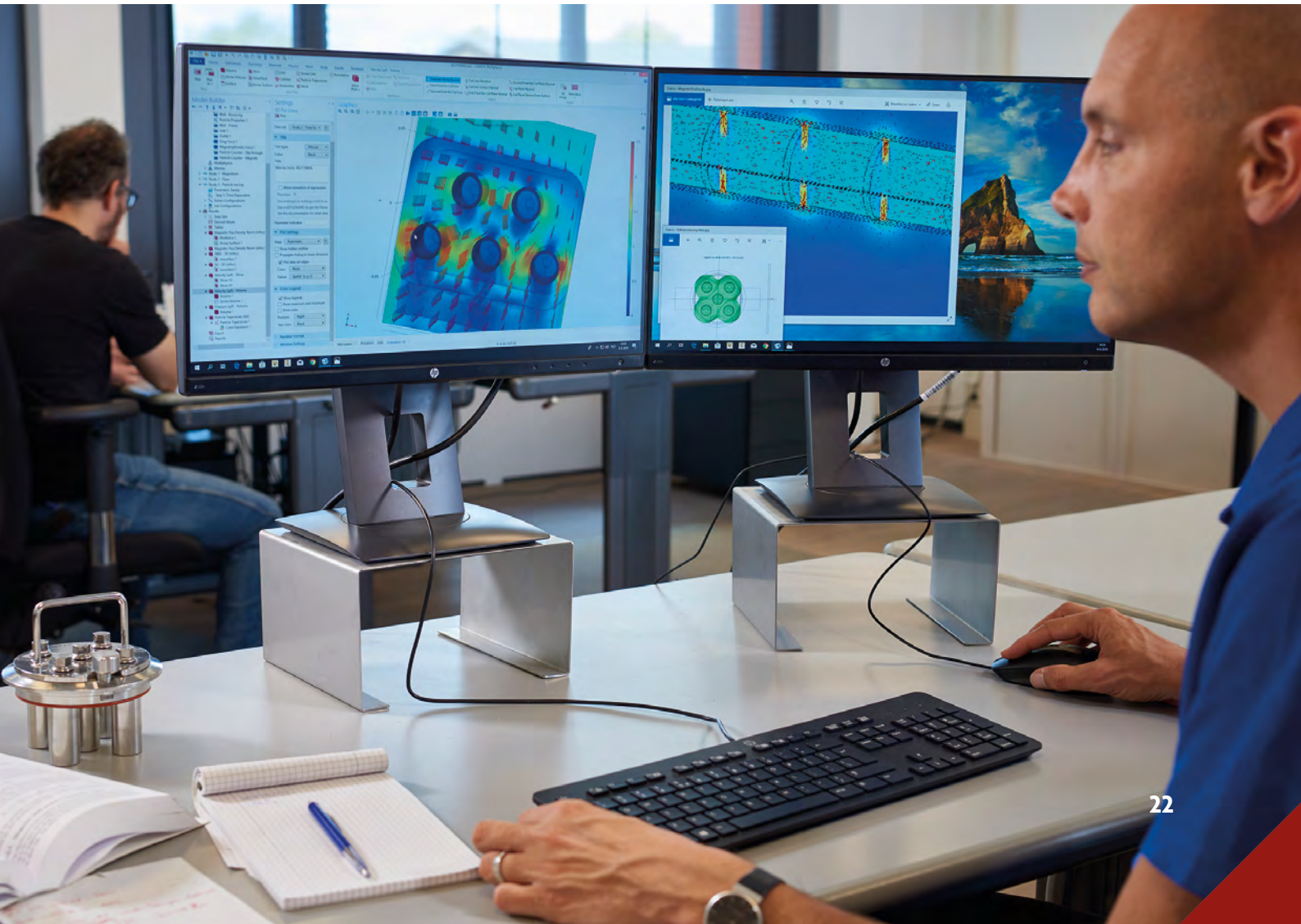
Hydraulic coupling under pressure

THERMAL SIMULATION AND ANALYSIS

As with mechanical analysis we need to ensure that the 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.



Radiator element



ASSEMBLY TECHNIQUES

Goudsmit UK specialise in assembling magnets, over the years we have developed substantial knowledge and skills 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. They also have the advantage of being easy to test and validate. Goudsmit UK 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, Goudsmit UK look to over moulding. Although requiring an extra mould tool, it is an excellent way to ensure parts remain firmly assembled. The polymer choice will often be dictated by the application's working conditions.

GLUING

This must 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. Goudsmit UK frequently use glue in our assembly products however, we do so with 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 Goudsmit UK use with greater frequency. 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 d area. Once perfected, repeatability is excellent, and can be easily tested by sectioning the welds. The magnets themselves in this case are not welded, but Goudsmit UK 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 several different techniques, with fillers and inert atmospheres used. This is rarely used on magnets, but it can be used in exceptional applications.

APPLICATION FOCUS

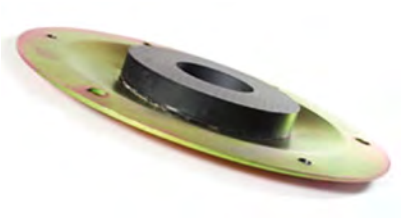
Examples with application backgrounds are illustrated below to demonstrate the assembly techniques Goudsmit UK offer.

ULTRASONIC WELDING REPLACES GLUING

In this application the client used two mouldings to house a magnetic assembly. Normally assembled by gluing, the parts 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 experiences 160°C in operation.

FDA COMPLIANCE WITH INSERT MOULDING

Having been tasked to combine a magnet with a shaft, while ensuring the magnet does not encounter drinking water. We chose to avoid glue, instead encapsulating the magnet and shaft while mechanically coupling them using insert moulding. Cheap, very repeatable and highly successful.

GLOSSARY

Anisotropic – Isotopic

When a magnetic material is pressed in a magnetic field this magnetic material is called preferentially oriented and anisotropic. When this magnetic material is not pressed in a magnetic field, it is called isotropic. Later on, isotropic magnetic material can be magnetised in all directions, anisotropic only in the preferential direction. The remanence (Br) of anisotropic magnetic material is (in preferential direction) about twice as high as the remanence isotropic magnetic material (see figure 1).

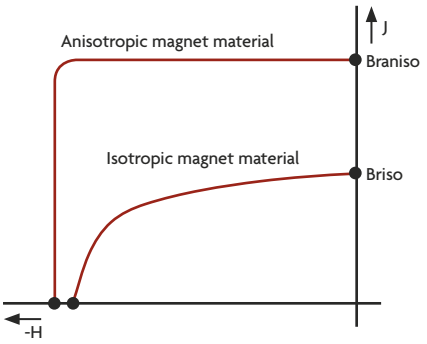


Figure 1: demagnetisation curve of isotropic and anisotropic magnetic material.

B

See magnetic induction.

(BH)max

See maximum energy density.

Br

See remanence.

Coercivity, Normal HcB

The necessary field strength to make the magnetic induction in a magnetic material (see demagnetisation curve). Unit A/m or Oe.

Coercivity, Intrinsic HcJ

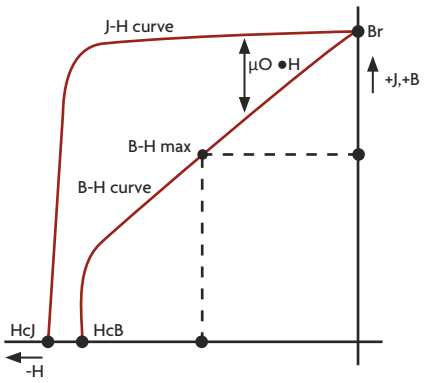
The necessary field strength to make the polarisation of a magnetic material (see demagnetisation curve). Unit A/m or Oe.

Curie Temperature

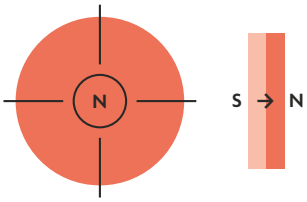
Temperature above which magnetism completely disappears. Units °C or K among others.

Demagnetisation Curve

(2nd quadrant of the hysteresis curve). The demagnetisation curve of a magnetic material is determined by putting the magnetic material in a closed system, and by generating a magnetic field by means of coils first magnetising the material to saturation (+H) and then demagnetising (-H). During this process the polarisation of the magnetic material (J) is measured. The magnetic induction B in the magnet is calculated by means of the following formula:
B= j + μO•H
in which J = polarisation of material (share of material)
μO•H = Share of field

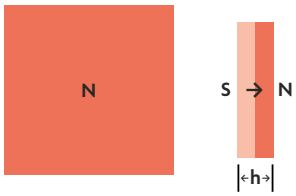


Common Options for Magnetism



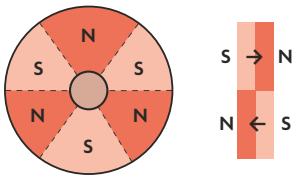
Axially magnetised

- speakers
- holding devices
- magnetic switches
- insert gas switches



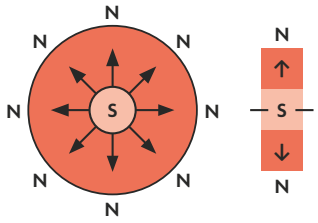
Magnetised through the height (h)

- filtering systems
- clamping devices
- magnetic chokes
- switches



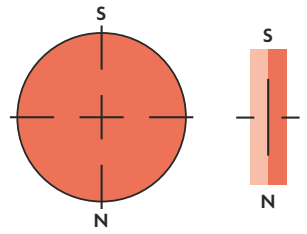
Axially magnetised in segments with alternating poles

- synchronous motors
- disc coupling



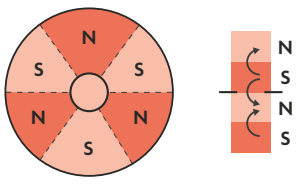
Radially magneised

- holding magnets
- couplings (limited sizes available)



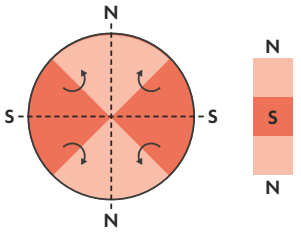
Magnetised through diameter

- synchronous motors



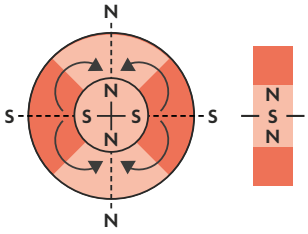
Laterally magnetised on surface picture shows 6-pole configuration

- disc coupling
- holding devices



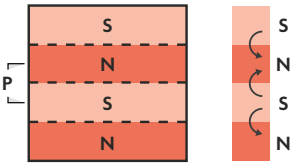
Multiple pole magnetised on outer surface picture shows 4-pole configuration

- dynamos
- motors
- concentric ring
- couplings



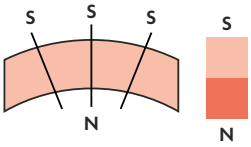
Multiple pole magnetised on outer surface picture shows 4-pole configuration

- concentric ring
- couplings
- motors



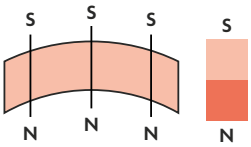
Laterally magnetised in lines on surface (P=pole distance)

- holding devices
- magnetic chokes



Radially magnetised

- motors



Diametrical magnetised

- motors

Flux Density

See magnetic induction.

General Properties

	Ferrite	NdFeB	SmCo	AlNiCo
Max. temperature of use Tw (°C)	225	80 -230	250	450
Reversible temperature coefficients; aBr (%/°C)	-0.20	0.9 - -0.12	-0.03 - -0.05	-0.03
Reversible temperature coefficients; aHcJ (%/°C)	+0.20 / +0.50	0.45--0.85	-0.03 --0.5	+0.02
Curie temperature Tc (°C)	460	310 - 380	700-800	850
Density (103 x kg/m3)	4.5 - 5.1	7.4 - 7.6	8-8.5	7.3

Quantities and Units

A few widely used quantities with their units used most used:

Quantity	Units	Relation Between Units
B	T (Tesla)	1T = 10000 G
Magnetic Induction	G (Gauss)	1KG = 0.1 T
BH	J/m^3 (Joule/$meter^3$)	7.96 kJ/m3 = 1MGOe
Energy Density	GOe (Gauss ◦ Oersted)	
H	A/m (Amps/meter)	79.6 KA/m = 1 kOe
Magnetic Field Strength	Oe (Oersted)	

HcB

See coercivity, normal.

HcJ

See coercivity, intrinsic.

Irreversible Loss, Recoverable

Permanent loss of magnetism due to too high temperatures. Only remagnetisation can restore the loss.

Irreversible Loss, Irrecoverable

Permanent loss of magnetism due to too high temperature or oxidation. This loss is irrecoverable and cannot be remagnetised.

Isotropic

See anisotropic.

J

See magnetic polarisation.

Magnetic Induction, B

Magnetic ordering in a material as a result of a magnetic field (H) and/or magnetic material (J) or: The number of magnetic field lines per unit area. Units: Including Tesla and Gauss.

Magnetic Polarisation, J

Share of material to the magnetic induction.
Units: Including Tesla and Gauss.

Magnetic Field Strength, H

Magnetic power resulting in magnetic induction.

Maximum Energy Density (BH)max

Biggest possible product of B and H on the demagnetisation curve (see demagnetisation curve). In general, the following holds: the bigger the (BH)max of magnetic material, the smaller might be the volume. The "-" mark is usually left out in specifications.
Units: kJ/m3 and MGOe.

Example: The volume of a GSN35 magnet can be +10 x smaller than the volume of a GSF33H magnet and still have the same application.

Maximum Application Temperature

Indication of the maximal temperature at which the magnetic material can be used with limited irreversible losses.

Permanent Magnet

A magnet which completely or partially keeps its magnetism after being magnetised.

Permeability

The capacity of material to conduct magnetism. The permeability of vacuum (μo) is 12.56•10-6 T/(A/m) or 1 G/Oe.

Remanence Br

Magnetic induction in magnetic material when the field strength is zero (H=0) and after saturation (see demagnetisation curve). Units: Including Tesla and Gauss.

Temperature Coefficient (Br and HcJ)

This indicates the reversible change (in percentage) of Br or HcJ in case of temperature change. The values depend on the kind of material, the quality and temperature among other things

Free Poles

The field lines leaving the magnet go back to the magnet through the air.

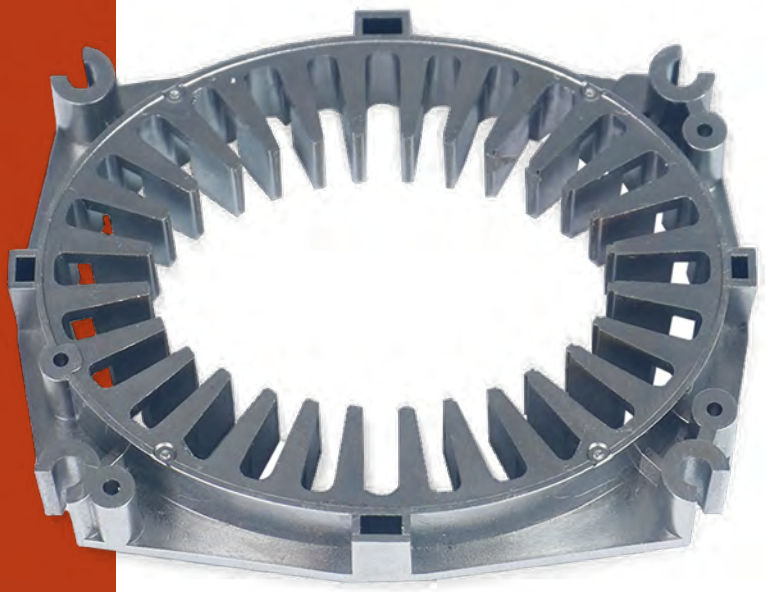
Specialists in the design and manufacture powder injection moulding products

Variety of raw materials available from Goudsmit UK

Range of design capabilities that can be implemented into the MIM operation

PRODUCTS

METAL INJECTION MOULDING



METAL INJECTION MOULDING (MIM)

Often, metal injection moulding is a natural progression from magnets to polymer injection moulding. Goudsmit UK specialise in the design and manufacture powder injection moulding products, including metal injection moulding (MIM) and ceramic injection moulding (CIM) technologies of complex, high volume, net-shaped components.

MIM involves manipulating metal powders to behave like a plastic by mixing them with polymer binders to form a feedstock. This feedstock is used to injection mould net shaped, precision components. Parts are then thermally processed to remove the binder system and then sintered to a high-density metal component.

Dimensional tolerances of ±0.3% are common and machining is required for closer tolerances. MIM can produce parts where it's difficult to professionally manufacture an item through other means of fabrication. Increased costs for traditional manufacturing methods essential to part complexity, such as internal and external threads, miniaturization, or identity marking, typically do not increase the cost in a MIM operation due to the flexibility of injection moulding.

Other design capabilities that can be implemented into the MIM operation include:

- Product codes
- Part numbers
- Date stamps
- Parts manufactured to their net weight reducing material waste and cost

The ability to combine several operations into one process ensures MIM is successful in saving lead times as well as costs, providing significant benefits to Goudsmit UK's customers.

MIM PROCESS

1. **Preparing the Feedstock**

   Primary MIM raw materials include metal powders and a thermoplastic binder. The binder is only an intermediate processing aid and must be removed from the products after injection moulding.

   The blended powder mix is worked into the plastified binder at an elevated temperature using a kneader or shear roll extruder. The intermediate product is the feedstock, which is granulated with granule sizes of several millimetres.

2. **Injection Moulding**

   A custom-made tool is fitted into the moulding machine and the feedstock is injection moulded into it to produce a net shaped 'Green' component. The 'Green' MIM parts are formed in an injection moulding process equivalent to the forming of plastic parts. The variety of part geometries that can be produced by this process is like the great variety of plastic components.

3. **Binder Removal**

   The moulded 'Green' component is transferred to the debind ovens where they are either thermally or solvent debound. Once debound the parts are very brittle and absorbent as only one binder remains, at this stage parts are referred to as a 'Brown' component.

4. Sintering

The 'Brown' component then reaches the final stage of the process where it is sintered in a controlled atmosphere. Temperatures are taken to just below melting point of the material, allowing menisci to form between the particles. Controlled, uniform shrinkage of on average 17% occurs at this stage and the component densifies to its finished size, shape and tolerance parameters. After sintering, the high density 'White' component has equivalent properties to wrought materials and can be heat treated, polished, plated or welded.

For certain applications, such as the automotive, medical and aerospace sectors, Hot Isostatic Pressing (HIP) can be used to completely remove any residual porosity. As MIM parts are typically small, this can be relatively cost effective for critical components.

5. Post Sintering Operations

Goudsmit UK's experience and attention to detail enables us to produce quality precision components that don't require costly secondary operations. The MIM process has a typical tolerance range of ±0.5%, depending on factors such as material, location of the injection point, thermal treatment and in general, the shape of the part. However, if requirements do exceed even our process capabilities, we work with our clients to develop the most cost-effective solution.

RAW MATERIALS AVAILABLE FROM GOUDSMIT UK

Stainless Steel	Soft Magnetic Alloy	Low Alloy Steel	Tool Steel	Special Alloy	Plastic	Ceramic
17-4PH	FeSi3	FN04	M2	Ti	PA	Al_2O_3
316L	FN50	FN08	SKD11	W	PPS	ZrO_2
304	FeCo35	G1010		F15	ABS	
420	FeCo50	8620		HX	PE	
430		8740		N90	PS	
440B		4340		GHS-4	POM	
440NB		100Cr6			LCP	
		42CrMo4				
		SCM415				

APPLICATIONS

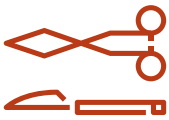
Automative Solutions

- Starting motor part
- Gearbox part
- Seat adjustment parts
- Reverse gear parts

Consumer Electronic Solutions

- SIM card tray
- Phone key
- Bracelet
- Camera deco rings

Medical Equipment and Devices



- Surgical forceps
- Tong heads
- Tweezers
- Surgical knife handles

Others

- Watch frame
- Nuts
- Electric tool parts

- Specialists in thermoplastic injection moulded components
- Extensive range of post moulding and assembly options available
- Finite Element Analysis available
- Variety of polymer materials offered
- Polyurethane (PU) foam available in a range of different product types

PRODUCTS

POLYMER ENGINEERING

INJECTION MOULDINGS

Goudsmit UK specialise in the volume manufacture of thermoplastic injection moulded components. Our specialisation is in the industrialisation of your component to ensure when it is moulded that it is dimensionally and visually right. We offer a wide range of post moulding options and can assemble multiple components to create your final product. FEA analysis is also offered for load and pressure bearing components to advise on how different polymers will perform in an application.

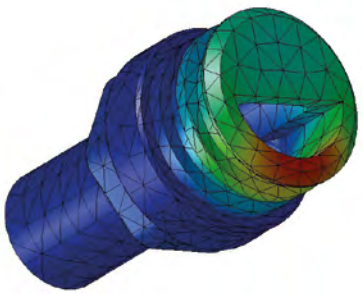
DESIGN/ DEVELOPMENT/ MANUFACTURABILITY

Helping to better industrialise your product, if required we will take your design and provide the following:

- 3D model, 2D tolerance drawings, analysis of fits, addition of assembly features, draft angles, tool finish
- Location of splits, ejector pins, gate positions, date wheels, part number
- Analysis of wall thickness, flow, sinkage

FINITE ELEMENT FOR BETTER DESIGN

For some products mould fill and mechanical performance are essential. We run a full FEA suite so we can firstly perform mould flow to see how a part will fill, and to see if it will sink post injection. Subsequently we can analyse how a part will behave if loaded, for example, with a simple mechanical load or under pressure perhaps in a hydraulic system. In addition, thermal analysis can also be carried out to identify how the part will react at temperature and how the polymer will perform. Completing this prior to making the tooling, we eliminate the risk of the part not behaving as it should in the application.



TOOLING

Tool design and construction are essential to the successful outcome of product development. Goudsmit UK maintains but does not manufacture its tools, we prefer to leave this to specialists. Rest assured that the tools are manufactured to a high standard, maintained for free and have a typical tool life of 200,000-500,000 shots. Made from hardened tool steel, complex tools are not an issue. Slides, rotating cores and hot runner systems are commonly used. Gating is typically sprue, but edge, film, diaphragm and tunnel are all possible. For ejection, pins are normally used, though sleeve, blade and stripper plates can be used where required. Cooling and venting the mould tool are important considerations, our team can advise on the design depending on the complexity of the part being moulded.

WHAT HAPPENS?

To manufacture any injection moulding, the first requirement is a 3D model of the component. If unavailable, Goudsmit UK have the ability to generate the model for our client to approve. From the model we will indicate cavity numbers, gates, ejector pins, drafts etc. If FEA is required, this will also be carried out. A tool will then be constructed, and the part can be moulded. These first-off parts will be checked, and some modifications might be made to the tool if necessary. The tool will then be re-run and the parts again analysed for dimension and appearance. Next, the tool is finished by either polishing or texturing the surface to a given specification. The tool will then be run for a third time and the parts produced will form our initial sample and will be supplied with the necessary QA documentation.

Once approved, we can proceed into manufacture with a pre-production batch and subsequently a production batch. To get to the approved samples stage, the process will take approximately 10 weeks depending on the complexity of the part and the polymer used.

POLYMERS

In today's marketplace, there is an array of polymers available. However, most polymers Goudsmit UK use are standards such as Nylons, ABS, LDPE, HIPS and Acetyl. More exotic polymers are available, and we can mould these without issue. In choosing polymers, we will assist by looking at environmental factors and mechanical loading, then use a compatibility matrix to define possible candidate polymers. Within certain limits it is possible to trial multiple types of polymer in the same tool and often we will look to direct clients to the best cost/performance ratio material we can find.

Goudsmit UK often mould FDA approved materials for the food industry and engineering polymers such as PEEK for very specific applications in high performance sectors. Polymers can be modified to make them UV stable, flame retardant or filled with glass fibre, bead or talc to alter mechanical performance. Goudsmit UK can manufacture clear products from highly polished tools using polymers such as PC and PS, and can mould rubber materials such as EPDM, silicone, nitrile rubbers and neoprene.

TWO SHOTS AND INSERTS

As well as multi-cavity moulding for individual components, Goudsmit UK have a range of both vertical and horizontal machines which we run for insert moulding and two shot components. Inserts are typically machined, or stamped components manufactured by us and then over moulded with a polymer. We also twin shot mould dissimilar polymers such as a structural part over moulded with a rubber material, for example in seals or castor wheels. Over moulding is an extremely flexible manufacturing process which provides fantastic results.

FINISHING

After moulding, there are a limitless number of post processing operations that can be carried out. Currently we offer the following:

- Mechanical operations - Annealing of some components to modify their behaviour. Ultrasonic welding, gluing and heat staking of components to allow assembly. Post machining to create very complex features that could not be moulded. Surface finishing to achieve high polish on components.
- Cosmetic operations - Pad and screen printing to apply logos and markings to components. Rumbling, painting and sandblasting to achieve a cosmetic finish.

EXTRUSIONS

EXTRUSION TYPES

Goudsmit UK supply the three basic types of extrusion commonly available:

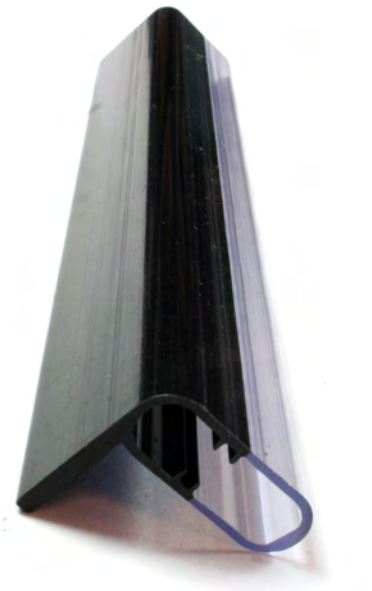
- **Flexible** - A rubber type polymer is extruded to leave a soft, flexible material to varying shore hardness. These are commonly used as seals.
- **Rigid** - A thermoplastic polymer such as PVC is extruded, and the resulting part has generally good rigidity and retains its mechanical form. Parts can be opaque, translucent or clear.
- **Co-extrusion** - A rigid and flexible material are run on side by side machines and the extruded material combined in a common die. This leaves a structural part with a flexible attachment.

APPLICATIONS

Extrusions are mostly used to provide cheap structural components or flexible seals. Typical applications include ducting, piping and trunking. Common uses include door frames and seal strips.

Goudsmit UK have become more involved in the lighting industry with extruded diffusers, while also manufacturing covers to a range of specifications.

In addition, extrusions can be fitted with self-adhesive strip or even magnetic strip to offer further application solutions.



MATERIALS

A wide range of polymers are available, and we have summarised them below:

- **Flexible** - Typical materials are PVC which can be modified in several ways. TPE which is a thermoplastic elastomer comes in a range of grades. We also extrude PVC/nitrile and TPR. Advice can be given on what best suits your application.
- **Rigid** - PVC is most common. Other polymers are ABS, HIPS, PP, PE, PC, PTEG, PMMA and PS. Materials can be further modified to make them UV resistant and flame retardant. They can be filled in order to modify mechanical properties or to change optical properties.

FOAMS

FOAM TYPES

Goudsmit UK can supply polyurethane (PU) foam in a range of different product types. These include:

- Semi rigid flexible foam - A reasonably firm, flexible foam which can be used in varying density for insulation, trim, seating and armrests.
- Integral skin foams - As the name suggests the foam has a full continuous skin around it, sealing off the open cell foam structure. Excellent for applications where an impervious coating is required. The tool can be finished to provide a textured part.
- Rigid foams - These have a higher density and can have some structural properties. Uses include insulation, cavity filling and noise reduction. These foams, if highly skinned, are very durable.
- Over moulded foams - These have a component placed in them and the foam is moulded around the component to increase mechanical stability and allow easy coupling to another component.

TOOLING

All our tools are made from aluminium. The moulds are 3D modelled to qualify the design, CNC machined and then finished to provide the required texture. The moulds are relatively inexpensive and highly durable.

WHAT HAPPENS?

To manufacture a foam the first requirement is a 3D model of the component. If unavailable, Goudsmit UK can generate the model for our client to approve. From the model a tool will be constructed, and the foam can be moulded. Various foam densities are available mostly from 0.1g/cc up to 0.4g/cc. Clients will be asked to specify skin type and colour plus any texturing required. For inserted foams we will generally make the insert part ourselves and typically this will be 6061T6 aluminium with an anodised finish. Foams may also be split to allow for them to be fitted on pipes as insulation. Colour can be specified as RAL or Pantone. Density requirements for foams can be hard to judge so it is not uncommon to require second samples with a density modification before moving to full production.

APPLICATIONS AND INDUSTRIES

Foams are principally used for insulation, soundproofing, impact absorption, filling and support. Goudsmit UK operates in a range of industries which include furniture, medical aides, plumbing insulation, high performance insulation and automotive industries. Our main goals are high dimensional and density stability for our products, with excellent quality finish on visual parts.

- Full design capability
- Finite Element Analysis available
- Goudsmit UK manufacture zinc and aluminium die castings
- Cosmetic finishes available
- Range of multi-axis CNC milling centres and CNC lathes

PRODUCTS

DIE CASTINGS

DIE CASTING

Pressure die casting is a very powerful method of making net shape metal parts without machining. Molten metal is injected into a die (or tool) and then ejected as it begins to cool, leaving a xerox of the cavity from which it came. The process is limited to materials which are molten at low temperatures, with zinc and aluminium being the most common materials to be cast. The process can be very cost effective for complex forms and the parts can be extensively post treated to provide cosmetic and high tolerance components for a range of industries including Aerospace, Medical and Automotive. Goudsmit UK has been supplying die castings for over 20 years, with significant experience in die design and the processing of die cast products.

DESIGN

Design is crucial for die casting, requiring an in-depth knowledge of the process and what it can do. Unfortunately, many designers apply the same rules as they would to injection mouldings and although the two processes share many similarities, they are also different.

As design is so crucial Goudsmit UK will work with you to define some of the following areas:

- Wall thicknesses and the likely effects on die fill
- The cosmetic finish likely on parts due to the gate, floods and split lines
- The issues concerning flash and how best to avoid it in visual areas

Many of our clients do not have a full design capability, thus we can carry out the following:

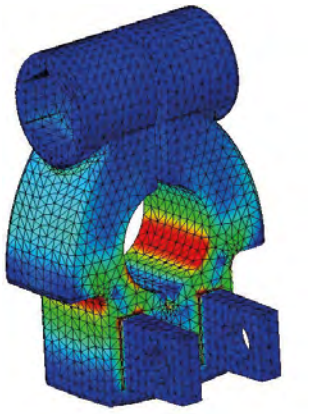
- Produce 3D models, 2D tolerance drawings, analysis of fits, addition of assembly features, draft angles and tool finish
- Location of splits, ejector pins, gate position, flood positions, date wheels and part numbers

FEA ANALYSIS

Die casting benefits highly from finite element analysis, two specific areas focused on include:

- Die fill - This is difficult to predict, if the design is wrong it can lead to cold welds, air pockets and cold castings
- Mechanical performance vs Ease of casting - It is often a trade-off between these two issues when designing a die casting. Pure FEA for mechanical strength may be undone by casting flaws which have not been predicted

Goudsmit UK strive to help clients who require a casting which not only performs as it should mechanically, but also possesses the correct tolerances and cosmetic finish.



ALL TOOLED UP

Pressure die casting tooling is more complex than injection moulding and is crucial to the performance of the product. They are made from hardened steel and are subject to extremes of both temperature and pressure. Due to the range of temperatures they are more likely to undergo non-linear expansion and features such as core-pins will have more open fits than on injection mould tools. Getting both the design and tool right first time is vital, the tools are not easily modified, and any modification's feasibility is subject to the constraints of injection pressure in the tool.

HOW DOES IT ALL WORK?

To make a die casting, the first requirement is a 3D model of the component. If only 2D drawings exist, Goudsmit UK will generate a 3D model. From the model we can establish the location of the gates, vents, split lines, moving cores and ejector pins etc. Feedback will also be given on expected surface finish as well as details such as cavity numbers, date wheels and part number. Once the die has been made it will be run in the tool for the first time.

At this stage molten metal is placed in the barrel of the machine and this is then injected into the die by a hydraulic ram. The molten metal solidifies in the tool and as the tool opens the part is ejected by the pins. These first-off parts will be checked, and some modifications will be made to the tool. The tool will then be re-run and the parts again analysed for dimension and any casting flaws such as cold casting or porosity. If everything is OK, the tool will then be run again and the parts which come from it will be submitted as samples and will come with all the necessary QA documentation.

Once the samples are approved, Goudsmit UK will proceed with a pre-production batch and finally the first production batch. Approved samples can take anything from 8-14 weeks depending on the complexity of the casting and its cooling profile.

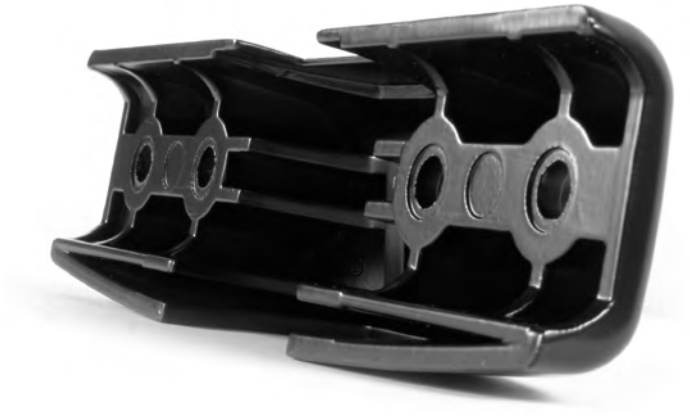
ALLOY

Goudsmit UK only manufacture zinc and aluminium die castings, however magnesium and brass alloys also exist. Raw material theory is complex but they are normally binary or ternary alloys with the addition of other materials to improve mechanical properties or to avoid undesirable casting characteristics.

Material choices are complex and although designers choose alloys for their mechanical properties it should be remembered that these may not be suitable for casting into the desired shape. We would advise that you contact us as early as possible to discuss alloy choice for each application.

A non-exhaustive list of the alloys we cast include:

- Aluminium Zinc
- Alloy 3
- Alloy 5
- Alloy 7
- A360
- 380
- A380
- ZA-8
- ZA-12



FINISHING

For cosmetic purposes it should always be remembered that we must get the metal in and the air out of the die and so witnesses of this will be left on the part. Other marks will also be left behind such as ejector pin witness and flash and these cannot be avoided. Finishing can be looked at in four sections.

DIE FEED SYSTEM

From the outset, this needs to be worked on together with Goudsmit UK. Normally there is quite a lot of metal which must be removed from the part after casting, impacting the cost. The amount of gating and venting will depend on the complexity of the part and any hard to cast features. In this example, this part is thin walled and must be gated in 4 positions, plus have multiple vents and floods to get it to be well cast. It also has quite a lot of flash from die blow.

CLIPPING

Clipping is one of the least considered aspects, yet highly crucial. The clipping tool will remove all the excess metal from the part, either mechanical or hydraulic. The clipping tool will try and remove the feed and vent system as cleanly as possible however this is not always the case and is dependent on the geometry of the part. Also, the alloys have a crystalline structure and so do not break as cleanly as say mild steel would, so there will be witness left. A solution is to leave some witness on the part after clipping and then CNC the part to optimise removal. On the attached part some witness of the clipping can be seen.

PRIMARY FINISHING

At this point we can begin to cover up some of the evidence left by the process up until now. Some of the residual flash can be removed as can the evidence of split lines and ejector pin marks. Although not removed completely they can be significantly reduced. Shot blasting, bead blasting and vibratory tumbling are common techniques we employ to modify the finish post cast.

SURFACE FINISHING

Coatings range from metal to organic. Forms of plating such as nickel are common. Generally, die castings do not anodise well but chromate conversions can be applied. Powder coat can form a very good cosmetic finish changing both colour and hiding some of the process witness. Finally, die castings do age with time and can become darker due to oxidation, therefore it's important to opt for a cosmetic finish of some description.

PRODUCTS

NEAR NET SHAPE

Technically die casting is about the quickest known route of getting metal to a given form. It is not always possible to get the product to perform as desired mechanically, and to not require any post cast modification. As such we offer a range of options to give you exactly what you need.

POST CAST MACHINING

The dies used to make the castings are extremely complex and heavily constrained by cooling rates and flow patterns. Some shapes are better not to be cast but to be machined post casting. Features such as this include:

- Holes which are neither parallel nor perpendicular to the split line
- Features with parallel sides - remember we need draft to get the part out of the tool
- Internal and external threads - especially for external threads when the axis is not along the split line
- Undercuts in the line of draw

Resolving these, we have a range of multi-axis CNC milling centres and a range of CNC lathes. This enables Goudsmit UK to achieve what cannot be cast and, in some cases, tight tolerances that the casting process cannot achieve. Virtually all our post cast machining is carried out by CNC as it provides better repeatability than normal manual machining.

INSERTS

Die cast alloys undergo rapid solidification to form a fine dense grain structure which is what inherently provides their mechanical properties. The skin (that being the surface which is in contact with the die and cools rapidly) is particularly strong, however the interior of the casting may have an inferior grain structure due to longer cooling. When designs call for a high torque and thus a heavily bossed, tapped zone, sometimes it is preferable to press fit a stainless-steel insert. Press fitting outside the tool is preferable to inserting within the tool and casting around the insert. Some features will not cast but can be added into the tool and cast around. An example of this would be a motor shaft.

Fundamentally die casting is a flexible and very effective manufacturing technology. What can be achieved is often surprising and depends as much on the imagination of the designer as it does on the process itself.

Finite Element Analysis available

Extrusions produced by Goudsmit UK are from the 6000 series

6000 series range of aluminium alloys is available in a wide variety of shapes, sizes and material grades

Range of post machining procedures available

Range of finishing available

Pantone colours can be supplied for both wet paint and powder coat finishes

Parts can be marked by either screen printing or pad printing

PRODUCTS

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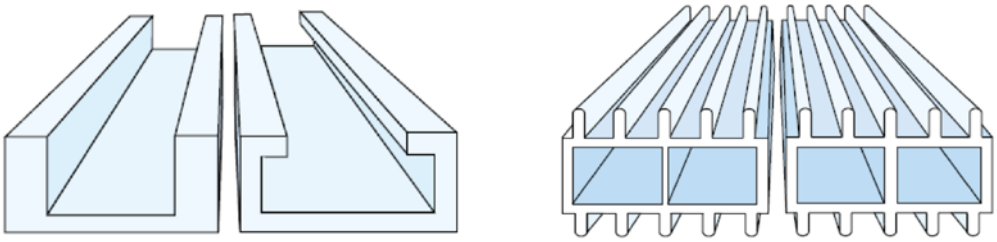
EXTRUDED PARTS

EXTRUSIONS AND DESIGN

Very often, with Aluminium extrusions, designers look at the required functionality of a part without considering if it can be manufactured. This can be a critical error leading to unstable dies and parts that cannot be extruded to drawing. Good design will avoid such issues and result in a better quality part. Although not exhaustive, the below design guide shows the basics of how aluminium extrusions should be designed.

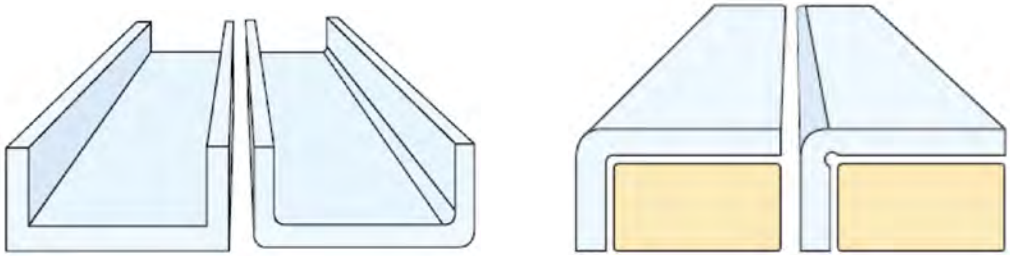
UNIFORM WALL THICKNESSES

It is acceptable to have a range of wall thicknesses within a single profile, however a profile with uniform wall thickness is easier to extrude. Keeping the internal and external walls the same thickness decreases die stress and improves productivity.



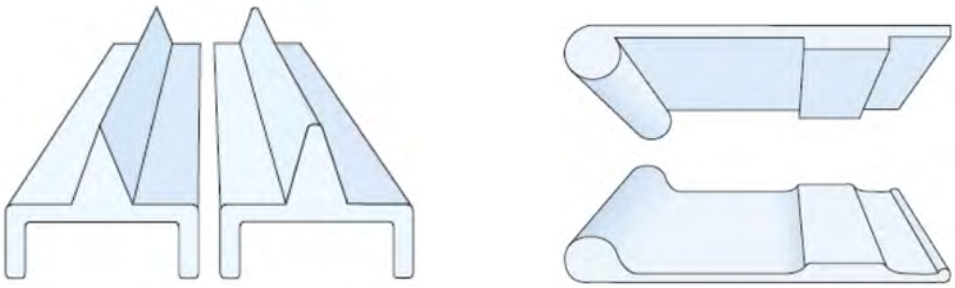
SOFT LINES

The extrusion process cannot achieve razor-sharp corners without additional fabrication. Corners should be rounded. A radius of 0.5mm to 1mm is often sufficient. Sharp corners internally can be accommodated using a small radius.



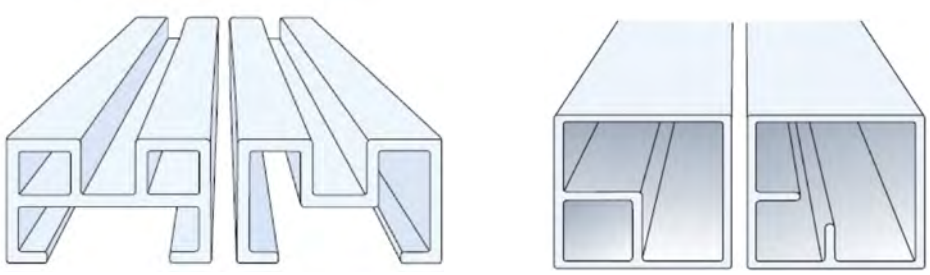
SMOOTHING

Sharp tips should be avoided. The tip can easily become wavy and uneven. Tips should therefore also be rounded. Smoothing profiles, especially those with uneven wall thickness, will reduce visible unevenness in the part.



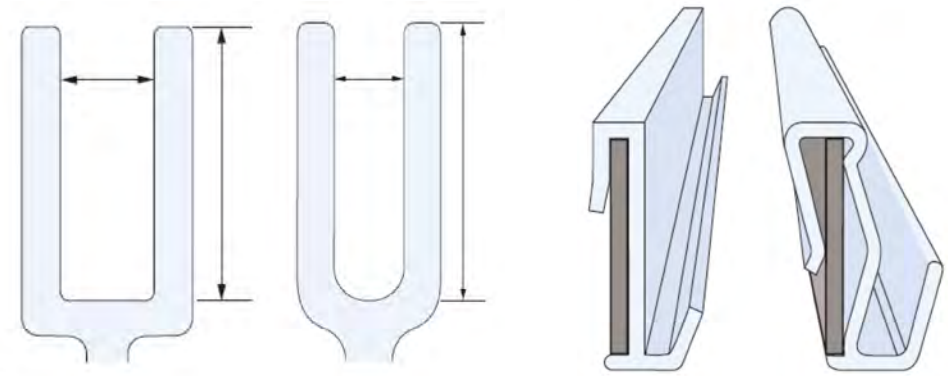
SOLID PROFILES IF POSSIBLE

Solid profiles reduce die costs and are often easier to produce. Efforts should be made to minimise the number of cavities and minimise small, detailed cavities.



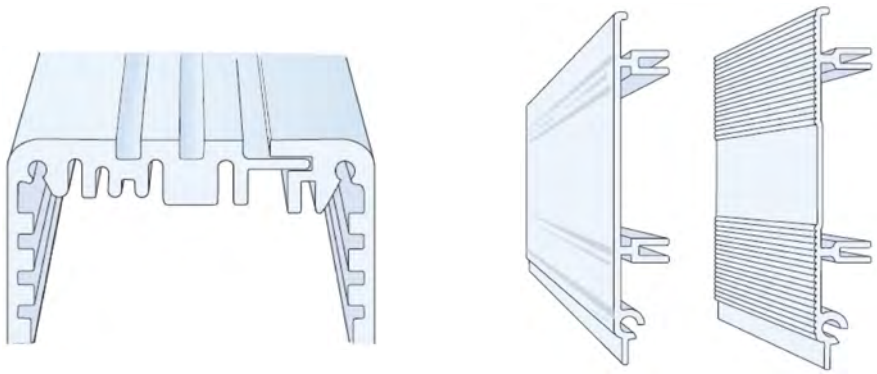
POCKETS OR CHANNELS

For profiles with pockets or channels, there is a basic rule that the width to height ratio should be approximately 1:3 to ensure die strength with slot widths >2mm. Clever design can offer the same functionality but increase the success rate of an extruded profile.



DECORATION

Decoration will mask imperfections and protect against damage during handling and machining. A decorative pattern can make a plain aluminium surface more attractive. It will also disguise internal features such as screw ports or arms.

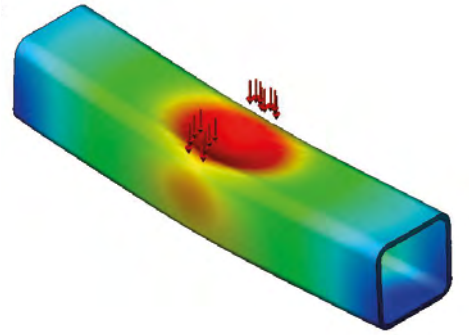


FEA ANALYSIS

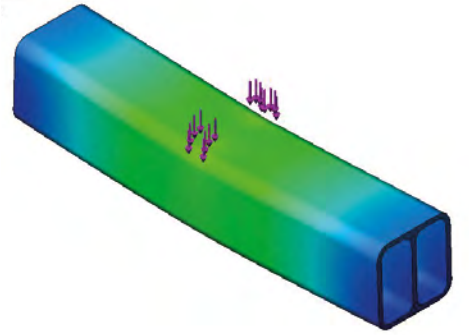
Often it is necessary to know how the extrusion will work mechanically, to do this we use FEA analysis. The example below shows a simple extrusion section which is loaded in the middle. As you can see, by adding internal ribs the section is strengthened and thus bends less under load. Finally, a stronger alloy is used reducing the bend even further. Such analysis is invaluable in determining how an extrusion will perform prior to producing a die and parts. Over the last 20 years we have used this capability repeatedly, assisting clients in minimising their material content and ensuring that the form once employed in the application will work below the maximum yield strength.

A client uses a solid Aluminium bar which is loaded in the centre. The bar does not deform however it is expensive, and the client wants to save money.

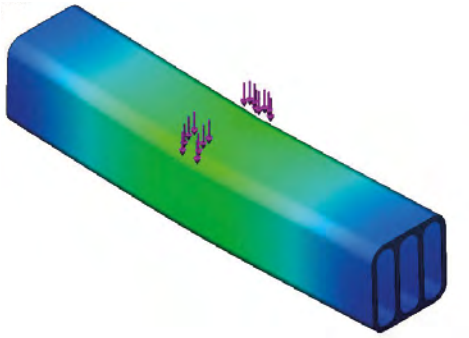
The initial suggestion from the client is to use a hollow section. Normally the only way to test this would be to manufacture a die, extrude the section and then run a test. With FEA we can predict what will happen. In this case the materials maximum yield strength is surpassed, and it will deform elastically. The solution would fail with either the section being very badly bent or indeed folding in two completely.



Looking at the design, a decision is reached to add an internal strengthening rib. This has the effect of distributing the load through the section and ensures that the maximum yield strength is not surpassed. The extruded section would bend but not break. The tool is a little more complex to make but still fairly simple.



A decision is made to try and improve on the slight bend the extrusion now shows. A second internal rib is added, but this only marginally improves the load bearing capability of the extruded section. Given the added complexity to the tool, it is decided not to pursue this option and the single rib is the preferred design choice.



There are other factors which could have been changed in this analysis, such as altering the wall thickness of the extrusion. Similarly, different alloys could be used with higher yield strengths and different tempering cycles employed. FEA analysis would also allow us to model such conditions. **Should you require any further assistance or support on FEA analysis please contact us on 02890 271001.**

PRODUCTION

Goudsmit UK use what is known as the direct extrusion process. Cylindrical aluminium alloy billets are heated to a temperature between 450°C and 500°C before being loaded into a container, and the billet squeezed through a die using ram pressures of up to 600MPa. The die is supported by a series of back dies and bolsters so that the main press load is transferred to a front platen.

On leaving the die, the temperature of the section is more than 500°C. With heat treatable alloys the quenching or solution heat treatment takes place in the production line. This is done using a water bath with an approximate temperature drop of 250°C across the quench box. To avoid distortion care has to be exercised in handling the extruded sections.

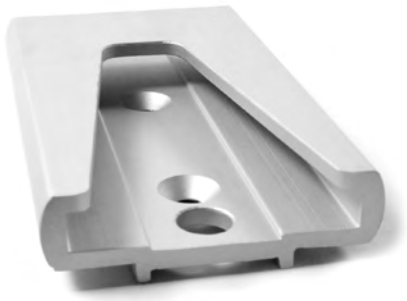
After extrusion, the section is guided down the table by a puller on to a slatted moving belt. Pullers are based on linear motor systems and operate on tables up to 30 metres long. On completion of an extruded length, the section is sheared at the press end and lifted from the slatted table. It is then transferred by a walking beam or multi-belt transfer table to the stretcher bay where it is given a controlled stretch to straighten and remove minor misalignments. The section is then taken and cut to length on high speed tungsten carbide tipped saws.

If the material is required in the solution heat treated condition T4, it is released at this stage. If the full-strength aged material T5 is required, it is given a precipitation treatment before release. In the case of the T5 temper, there is limited cooling at the press exit and the material goes directly to precipitation.

ALLOYS

Most extrusions produced by Goudsmit UK are from the 6000 series which combines the aluminium with magnesium and silicon. With regards material, the most important consideration is the ease of extrusion.

- The 6060 alloy offers medium strength and is easy to extrude even for complicated cross-sections. This is the most used extrusion alloy. It has exceptional formability during bending in the T4 condition and typical applications are extrusions for windows and doors, lighting, awnings, handrails and furniture. This material is highly suitable for anodising, both for decorative and protective reasons.
- The 6101 alloy offers virtually the same production possibilities as the 6060. It is especially suitable for electrical applications where high strength is required.
- The 6063 alloy has slightly higher strength than the 6060, but is also marginally more difficult to extrude, especially if the cross-section is complicated. Applications are for the most part the same as the 6060 alloy. This material is well suited for anodising, both for decorative and protective purposes.
- The 6005A alloy has higher strength than 6063 but is slightly harder to extrude. It is suitable for anodising for protective purposes, but the quality of the surface makes decorative finishing more difficult.
- The 6082 alloy has high strength and is suitable for extrusion of cross-sections that are not too complicated. Typical applications include load carrying structures in the ship, offshore, transport and building industries such as platforms, bridges, stairs, scaffolds and handrails. The material is suitable for anodising for protective purposes.

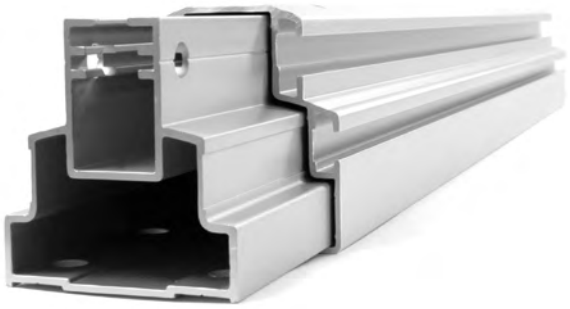


MACHINING

Almost all the extrusions manufactured by Goudsmit UK are in some way modified or post machined. Indeed, bespoke extrusions are often made as a starting point for a complex component that will be milled or turned to produce a final component.

The following post machining procedures are frequently carried out:

- Drilling and tapping of holes
- Milling of slots
- Pressing in of inserts
- Turning groves and more complex forms
- Inserting plastic mouldings to form telescopic slides



FINISHING

Finishing falls into the following categories; surface texture, surface finish/colour, painting and any printing or marking.

- The surface texture of an extrusion can be altered by bead blasting, sand blasting, grinding, rumbling in aggregate or full polishing. Each method will provide a different texture and the finish is normally driven by the needs of the application.
- The surface finish can be altered by anodising, painting or powder coating, although aluminium extrusions lend themselves to an array of finishing technologies from chromate conversions to polished chrome. Anodising is the most common finish. An electrolytic process, the aluminium is oxidised in sulphuric acid solution and then sealed to prevent any subsequent corrosion. Dye can be used during this process to give a range of colours, plus a matt or shiny finish can be achieved using different processing chemicals. Both durable and decorative, anodising is the most popular finish for extrusions.
- Paint can also be applied to the extrusion. Careful preparation of the aluminium extrusion is required with some chemical pre-treatment to prevent corrosion plus the application of priming coats. For a more durable finish powder coats can be used.

A full range of Pantone colours can be supplied for both wet paint and powder coat finishes.

Finally, the parts can be marked by either screen printing or pad printing. This allows for a high degree of customisation and the permanent application of product data and client logos.

Supplying basic stamped parts to precision and deep drawn presswork, right through to progression and multi-stage presswork

Extensive range of materials offered

Finite Element Analysis available

Wide range of finishes available

PRODUCTS

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PRESSED PARTS

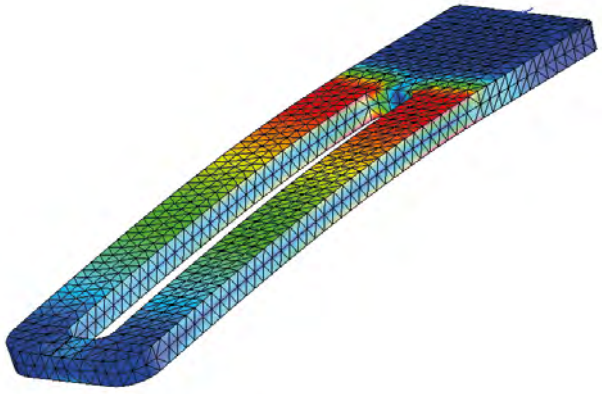
PRESSED PART MANUFACTURE

Goudsmit UK manufacture a wide range of pressed parts from small batches right up to large production runs. We can supply the needs from basic stamped parts to precision and deep drawn presswork, right through to progression and multi-stage presswork. Most of our work is run on mechanical presses with the tooling produced and maintained in-house.

MATERIALS The range of materials Goudsmit UK can supply parts from is extensive. The form of the part and its required performance in the application will define what material is used. We can help in recommending which is the best material for which form and which application.

Materials include:

- Stainless steel 304, 316, 430
- Mild steel and alloy steels
- Brass
- Copper
- Aluminium 6061, 6082



DESIGN As well as designing the press tooling and manufacturing the parts, we can also use FEA analysis to define how the finished part will perform. The FEA image shows a bracket which has been stamped and formed. The analysis allows us to predict the part's behaviour when it is under load, and if or where it will fail.

FINISHING Goudsmit UK offers a wide range of finishes to the pressed parts depending on the original material. A non-exhaustive list includes:

- Anodising
- Powder coating
- Electro-plating
- Alochroming
- Wet painting
- Shot blasting
- Bead-blasting
- Polishing
- Rumbling

POST MACHINING After pressing and forming, parts can be drilled and tapped to provide thread fixings. Intricate forms that could not be pressed can be added by CNC milling.

Ability to turn from a diameter of 4mm up to a diameter of 360mm

Capability to mill parts up to approximately 1m x 1m on our largest bed machine

3, 4 and 5-axis components supplied

Range of finishes and/or modifications available

Multiple automated Mitutoyo CMM machines

PRODUCTS

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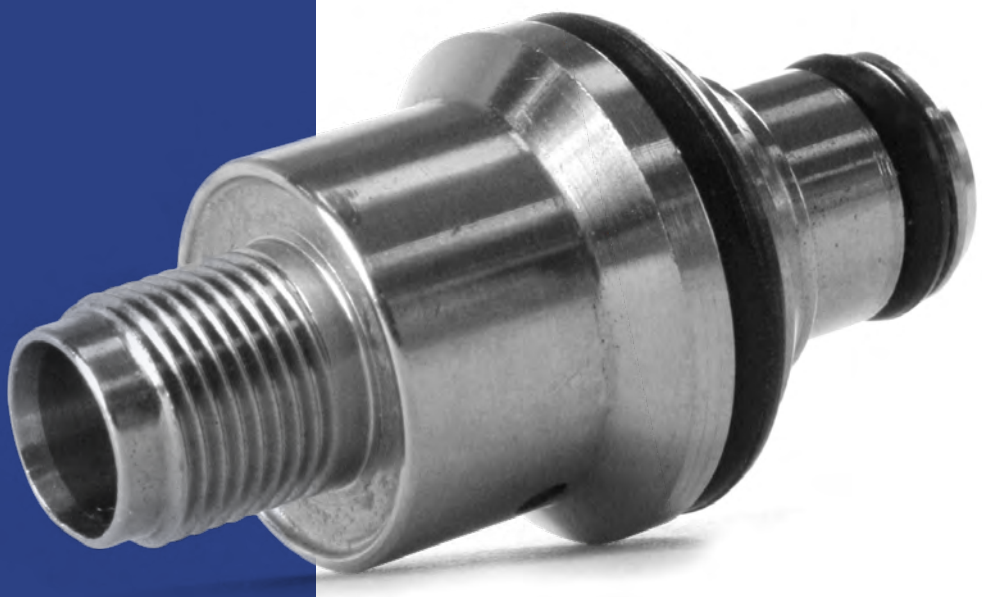
CNC MACHINING

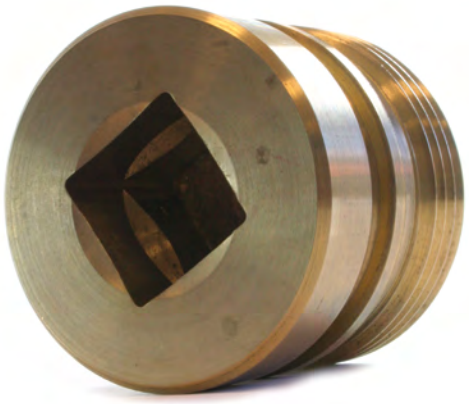


CNC TURNING AND MILLING

CNC turning is the industry standard technique of manufacturing components quickly, repetitively and cost effectively. Modern CNC machines are both accurate and quick, removing material stock at incomparable rates to the past. The high level of control of non-linear forms has allowed designers to become more imaginative with their parts and to move away from more traditional methods of manufacture such as casting. Goudsmit UK has been supplying CNC turned components for over 20 years now, building up significant expertise in the industry. Specialising in the supply of mid to high volumes of components to industries as diverse as automotive, oil and gas, aerospace and medical.

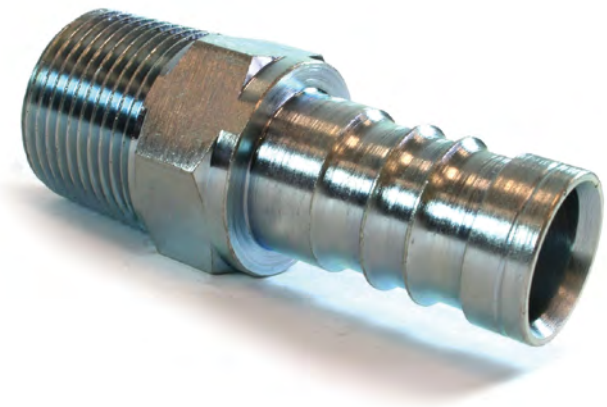
CNC TURNED CAPABILITIES

Goudsmit UK can turn from a diameter of 4mm up to a diameter of 360mm with varying degrees of precision depending on the part, material and form. Typical machines are single spindle, single turret each carrying 8 - 12 tools, all with increased coolant capacity, chip conveyors and parts catchers. These leading-edge machines enable us to manufacture excellent custom parts with runs from 5 - 15K components.



CNC MILLING CAPABILITIES

Goudsmit UK can mill parts up to approximately 1m x 1m on our largest bed machine. Most of our machines are 3-axis, with a range of bed sizes and spindle speeds. Depending on volume requirement, 4 and 5-axis components are also supplied. In terms of material the usual metals such as aluminium, mild steel, stainless steel and brass are used as feedstock as well as more specialised and harder materials which can be machined on request.



ADDED VALUE

Once our machines have been programmed and the cycle times optimised, the components are produced repeatably and accurately. Often components will need a range of finishes or modifications, we can add value by offering the following operations:

- Rumbling
- Polishing
- Bead blasting
- Sand blasting
- Electroplating
- Anodising
- Passivating
- Powder coating
- Painting
- Assembly

TESTING

We have multiple automated Mitutoyo CMM machines, plus several different computer-based vision systems in our metrology lab. Alongside this, other equipment is used to allow us to conduct hardness and tensile strength testing, composition testing and geometric tolerances.

Wide-ranging design capabilities

Substantial knowledge and expertise surrounding assembly techniques

Variety of assembly techniques available

SERVICES

ASSEMBLY AND DESIGN

DESIGN

Often client's approach us with a pre-designed assembly for some design assistance. Goudsmit UK's focus is engineering and design, so we are easily able to facilitate their requirements. Most often we are engaged to achieve one of the following goals:

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

Our design capabilities are summarised below:

MECHANICAL ASSEMBLY SIMULATION AND ANALYSIS

This is often an underappreciated 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 tolerance mating parts and how various assembly techniques are applied is key and translating these into accurate 3D models and drawings is necessary to communicate the design to the manufacturing arena. Finally knowing how the materials behave mechanically and within their environment will lead to better design, a better finished and more durable product in the field.

MECHANICAL SIMULATION AND ASSEMBLY

Often the magnetic performance of an assembly is just one of the functions. There are other parameters we often need to investigate during the design, the most common being mechanical behaviour under load. Using FEA analysis, Goudsmit UK can load and fix a component in a multitude of different ways to look at how that component will perform or deform under that load. For example, we design high speed rotating machines however, often how the machine behaves mechanically is more difficult to predict than magnetically. A good understanding of materials and manufacturing techniques is necessary, with our expertise in component supply we can also match up the design and production disciplines.

THERMAL SIMULATION AND 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.

2D MAGNETIC MODELLING AND SIMULATION

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, force between objects etc. 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.

3D MAGNETIC MODELLING AND SIMULATION

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. Coupled with our design know-how we have the ability to 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.

ASSEMBLY TECHNIQUES

As specialists in manufacturing assembly, Goudsmit UK have developed substantial knowledge and expertise related to several assembly techniques. A brief outline of these is listed below.

MECHANICAL ASSEMBLY Press fits, interference fits, fasteners, threads and clips are some of the lowest risk methods of assembling components available, with also having the ability to test and validate. Goudsmit UK will often look at mechanical assembly as a first-choice solution.

INSERT MOULDING Commonly used to combine metals and plastics without gluing, this is a technically advanced solution which requires well designed moulds and precision components.

OVER MOULDING When looking to combine two polymer parts Goudsmit UK often look to over moulding. Although requiring an extra mould tool it is an excellent way to ensure parts remain firmly assembled. Often the polymers are quite different with a rigid polymer being combined with an elastomer.

GLUING This needs to be a well thought out and well tested solution. Gluing must be well controlled with proper dosing equipment, refrigerated storage, thorough application and curing instructions respected and complied to. Environment and fatigue testing of samples is essential to ensure the correct functioning of the product over time. We 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. This powerful and repeatable technique is one we use with greater frequency at Goudsmit UK.

ULTRASONIC WELDING Soundwaves are used to weld two polymers together. Another specialised technique that requires tooling to hold the parts and direct the sound waves to the required area. Once perfected repeatability is exceptional, and it can be easily tested by sectioning the welds.

WELDING When two metal parts cannot be joined using a fastener, Goudsmit UK use metal welding. A manual skill that relies on the operator and testing is quite lengthy. However, it can be difficult to provide a good cosmetic finish.

BRAZING Like welding, two parts 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 several different techniques, fillers and inert atmospheres used.

APPLICATION FOCUS

In order to illustrate the assembly techniques used by Goudsmit UK, below are examples with some application backgrounds.

FDA COMPLIANCE WITH INSET MOULDING

Having been tasked to combine a magnet with a shaft, whilst ensuring the magnet does not encounter drinking water. Goudsmit UK chose to avoid glue, instead encapsulating the magnet and shaft while mechanically coupling them using insert moulding. Cheap, very repeatable and highly successful.

WELDED ASSEMBLY

A combination of pressed aluminium and formed plates are welded together to form a sub assembly, which was then anodised.

ULTRASONIC WELDING REPLACES GLUING

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

SIMPLE MECHANICAL ASSEMBLY

A series of components manufactured in our factory are assembled using some press fit pins. Simple, straightforward, yet extremely effective.

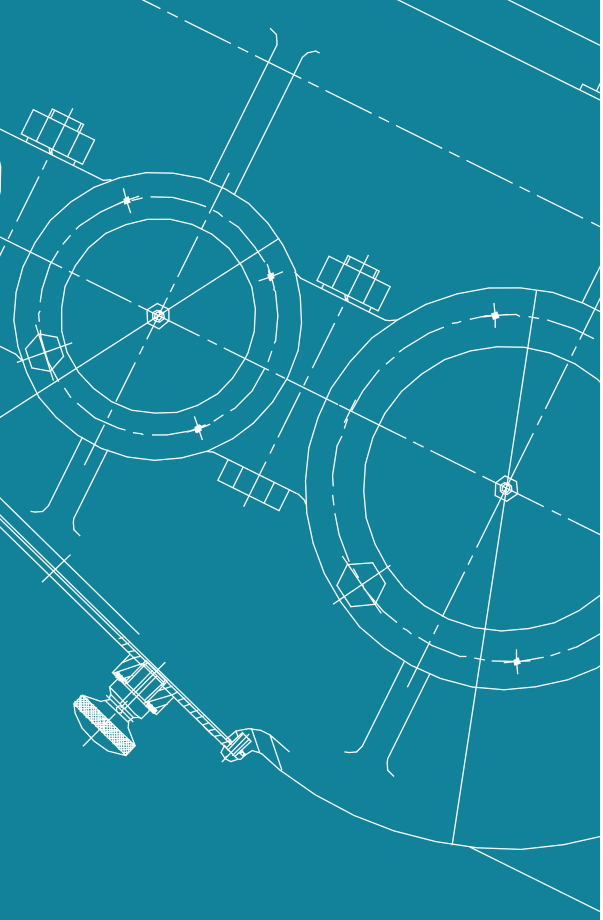
Sub-contract manufacturing has become increasingly popular since globalisation re-emerged as an economic trend in the early 1980's. It's a commonly misunderstood economic tool, often being referred to as low cost sourcing. However, true sub-contract manufacture and the reasons to use it are much more complex. The decision-making process to decide if sub-contract manufacturing is suitable for your company needs to be well considered.

Labelling and packaging solutions available

Global logistics and warehousing network

Demand planning software

Extensive manufacturing capabilities



SERVICES

SUB-CONTRACT MANUFACTURING

WHY SUB-CONTRACT MANUFACTURING?

Some highlights of sub-contact manufacturing include:

- Specialisation – Using a specialist sub-contract manufacturer gives you access to the skills needed to be a world class manufacturer.
- Capital costs - If you use a sub-contract manufacturer you do not need to invest in the plant and machinery needed to make the product.
- Increased cash flow - Generally less stock and WIP is required when using a sub-contract manufacturer saving interest costs on borrowing.
- Focus on core business - Increasingly companies want to focus on product design and development and meeting client needs. Not having to use resources on manufacturing and logistics lowers company headcounts, allowing for more focused and streamlined companies.
- Proximity to markets - As western markets stagnate and emerging eastern markets grow, companies want their manufacturing to be close to these growth markets. Moving entire plants is very difficult and costly. Therefore, it is cheaper to sub-contract manufacture to an Asian supplier.
- Flexibility - Fluctuations in demand when using a sub-contract manufacturer can be resolved by simply matching orders to demand. When a mismatch occurs in an owned plant, capacity, workforce, suppliers and many other factors must be managed to allow for an increase or decrease in supply.
- Start-up businesses - Most companies starting up do not have the capability to manufacture for themselves. Partnering with a sub-contract manufacturer shares the burden and allows them to ramp up supply quickly and efficiently.
- Asset utilisation - As a sub-contract manufacturer, we utilise our assets much more than a standalone manufacturer and can balance asset attribution between products. We sweat our assets harder to provide clients with cheaper prices.

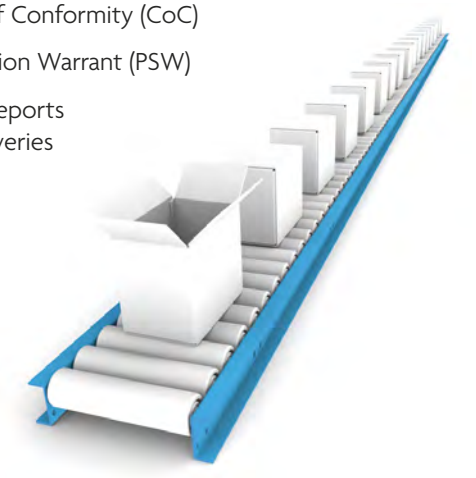
PRODUCTION AND ASSEMBLY SKILLS

Working within our competencies is very important when taking on any product. The key to getting the consumer/ industrial products we make right, is to ensure that the parts we receive are correctly designed and manufactured. Most of these components are manufactured in-house but occasionally we need to look out of house for additional supply from our approved supplier list. Provided the assembly techniques specified are adapted to the requirements of the product, assembly and testing normally proceed without issue. When it comes to assembly, we work in different ways depending on the size and volume of a product. High volume lines will go on an assembly line with multiple workstations and hourly delivery of parts to the assembly floor. Heavy, large or low volume products will often be kitted and assembled uniquely by a single person. Testing is hugely important, and we strive to provide quantifiable measurements to define the correct functioning of the products we manufacture. 100% product testing is common prior to the product being boxed and shipped.

QUALITY ASSURANCE

We are accredited to IS0 9001D, IATF 16949 and AS 9120B, aiming to supply our clients with zero defect products. A short summary of the QA tools we use and documentation we can provide is shown below:

- APQP
- Material Certs
- Environmental testing
- Design and Process FMEA
- First Article Inspection (FAIR)
- Samples with ISIR Submission
- PPAP On Pre-Production Parts
- Certificate of Conformity (CoC)
- Part Submission Warrant (PSW)
- Inspection Reports with All Deliveries



PACKING AND LABELLING

The packaging and labelling of the product as your client receives it is as vitally important as the product itself. Therefore, we concentrate strongly on getting the print and packaging right. We work uniquely from digital formats and can design print and packaging where none exists. Typical labelling and packaging solutions we can provide include:

- Carton
- Box
- Printed box
- Printed box with internal instructions
- Blister packing
- Packaging can be produced to pantone and recycling specifications

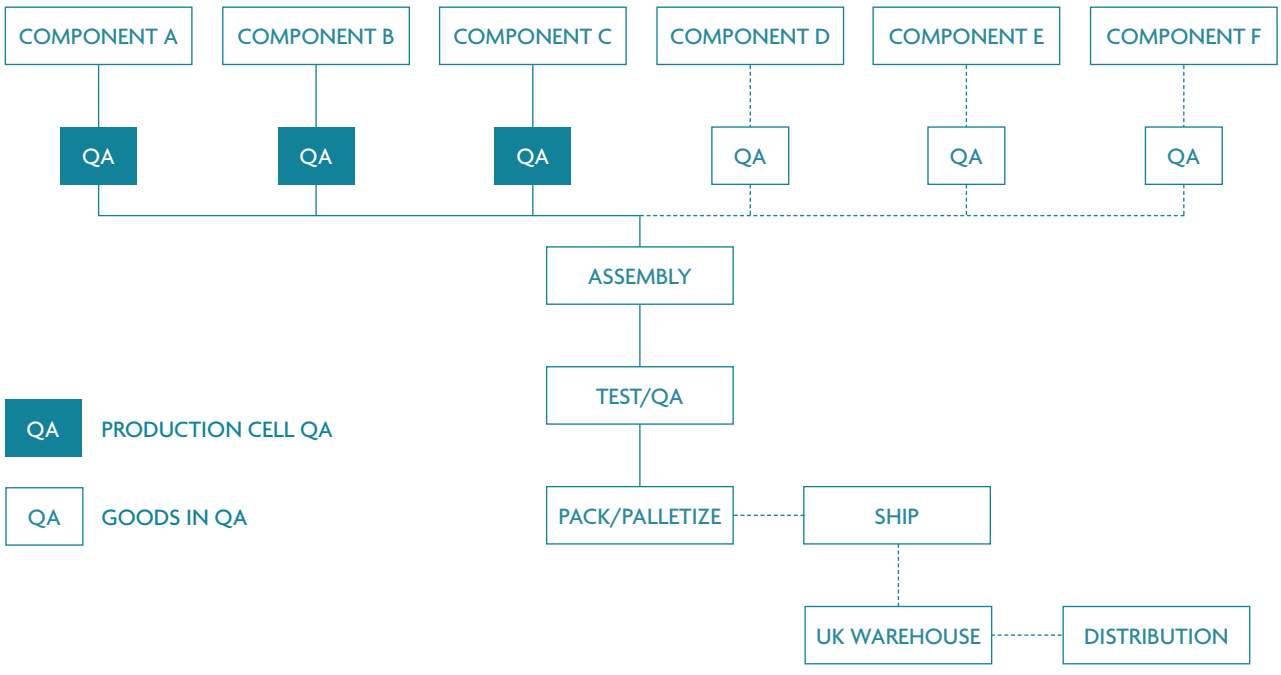
LOGISTICS

Products must be shipped matching supply to your client demands. We do this through a global logistics and warehousing network which allows us to hold stock in the UK. Demand planning software is used to ensure the supply chain is sufficiently full to meet the stocking levels desired in each location. We can also offer other options, including:

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

THE PROCESS

We currently sub-contract manufacture a range of consumer and industrial products in various market sectors such as building products, oil and gas, HVAC, consumer products and industrial filters. Each product, although very different and bound for very different markets goes through the same process. This process is outlined below and consists largely of the manufacture or purchase of all the components which are then QA approved and assembled. The assembly is tested, approved, packed and then shipped globally. There are of course some variations, for example some clients will free issue components, in some cases distribution may not be carried out by Goudsmit UK, or sometimes further testing or third-party testing will be done. However, the process will be the same resulting in a sub-contract product being supplied to your clients.



CASE STUDIES

CASE STUDY 1
CLIENT A

This client is involved in the air movement business and is a long-established company based in the UK. The decision to outsource was driven by several factors:

- A desire to release leased space thus saving expensive rental costs
- The cost saving from actual unit price of the product
- A reduction in stock and WIP
- Being released from capital expenditure on manufacturing equipment
- Savings derived from a reduction in headcount

The client has long since successfully outsourced manufacture to Goudsmit UK, who have been stocking and supplying an entire product range for over 19 years.

CASE STUDY 2
CLIENT B

A small client with a very low head count, Client B wanted to grow but had limitations in terms of headcount and finance. Their product is a combination of machined, stamped and CNC turned parts boxed and delivered to the USA, Asia and Europe. They choose Goudsmit UK for sub-contract manufacture for the following reasons:

- They had restricted access to funding so could not lease factory space and machinery
- They did not want to expand their low headcount
- Their internal expertise was in product design and not manufacture
- With a global client base, they needed global production and a global distribution network
- Help was needed with the industrialisation of their products
- Working capital requirements were reduced by having Goudsmit UK hold stock

This client has seen their business expand greatly in the last 13 years, and Goudsmit UK have been sub-contract manufacturing their product for 15 years.

CASE STUDY 3
CLIENT C

This client is a large multi-national, making a product used in the building trade. With the launch of their product they decided not to manufacture in-house as it was a departure from their normal business area. They had several reasons to use Goudsmit UK as a sub-contract manufacturer:

- Competing in a global market price was everything. They could benchmark Goudsmit UK against several other suppliers
- Given the global use of the product they wanted a high-quality manufacturer who would warranty the product
- They wanted to piggyback the distribution onto a pre-existing proven global supply chain
- As is often the case, the company wished to reduce working capital requirements so they needed a partner who could stock globally for them

The partnership is now in its 11th year and the product is in global distribution.

MANUFACTURING CAPABILITIES

As previously stated, we like to work within our core capabilities when subcontract manufacturing products. We also like to produce as many of the components that make up the product ourselves, in-house. Therefore, we tend to work within our core product areas to ensure we supply the best quality product.

MAGNETIC PRODUCTS

Supplying over 10 million magnets annually we can easily integrate any magnet into a subcontract manufactured product. We manufacture the full range of magnetic materials and have extensive test facilities to approve their performance.

POLYMER ENGINEERING

We manufacture thermoplastic injection mouldings using multi-cavity tools and can work with a range of different polymers from engineering plastics to elastomers. Further to this we also make extruded plastic and PU foam parts.

EXTRUDED PARTS

We manufacture and finish aluminium extrusions from a range of press capacities. Often, we will modify the extrusions by machining before they are finished, either by anodising or using a range of other techniques such as powder coating or wet painting. We can also provide laser marking or printed logos on the extrusions.

DIE CASTINGS

We have a wide range of press tonnages and make both high pressure die cast aluminium and zinc components. Post machining is common, and the parts will be finished in a range of cosmetic and industrial processes. Surface finish can be modified by bead or sand blasting.

PRESSED PARTS

We can press and form a range of materials in our factory from a deep drawn part to a simple stamping. Often the parts are post machined and tapped and then electroplated or finished with a powder coat or paint.

CNC MACHINING

We have multiple CNC milling centres and CNC lathes from which we make millions of components annually. We can work in several materials, the most common being aluminium, stainless steel, mild steel and brass. On top of machining we also have extensive surface finishing and plating capabilities.

As part of our IATF 16949 certification we implement Advanced Product Quality Planning (APQP) to ensure that products and production processes meet market requirements and client expectations. APQP is a disciplined process which works to ensure that a structured sequence of activities is completed. At Goudsmit UK our main objective is to produce a product quality plan which will support the design and development of your product.

- Six project development stages
- Optimum project control through our project control systems
- Variety of supporting software
- Open and regular communication with clients

SERVICES

PROJECT MANAGEMENT

GOUDSMIT UK AND PROJECT MANAGEMENT

For Goudsmit UK Project Management simply reduces risk and increases the chance of success. We recognise the importance of Project Management in ensuring that your project is delivered within cost and scope, on time and meets your quality requirements.

Customers' expectations vary broadly, which is why a key element of our approach is the building of partnerships with our customers. We rely on open and regular communication with our customers to ensure that all aspects of the project are transparent.

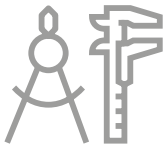
PROJECT DEVELOPMENT STAGES

1 DEFINITION:
Defining the goals, objectives and critical success factors for the project

2 PLANNING:
Detailed plans of how the work will be carried out including time, cost and resource estimates

3 INITIATION:
Everything that is needed to set-up the project before work can commence

4 EXECUTION:
Doing the work to deliver the product and desired outcome



5 MONITORING & CONTROL:
Ensuring that a project stays on track and taking corrective actions, where necessary

6 CLOSURE:
All activities will be finalised across each step of the process to formally close the project. Administrative activities include the archiving of files and documenting any lessons learned

PROJECT CONTROL SYSTEMS

As part of our project management process, project control has been established as an independent function. We place specific emphasis on project control as it keeps the project on track, on time and within budget. With carefully structured planning, project control is implemented from the beginning of a project right through to completion with the post-implementation review. This in turn allows us to have thorough involvement in each step of the process.

We achieve optimum project control using various methods and instruments, to include:

- GANTT Charts
- CPA
- PERT
- SWOT Analysis
- Grid Analysis
- Risk Analysis

With access to a variety of supporting software, we have the ability to implement the tools and methodologies within our planning both efficiently and effectively.

Local, regional and worldwide logistics solutions offered

Wide-ranging logistics services

Global shipping via Air, Sea or Express Courier

Warehouses around the UK

SERVICES

LOGISTICS

GOUDSMIT UK AND LOGISTICS

Goudsmit UK's modern distribution network guarantees your parts where you want them, when you want them. We have established relationships with several logistics partners drawing on a wealth of experience and expertise to offer our customers a range of local, regional and worldwide logistics solutions.

Our supply chain management system has been developed with an orientation to customer satisfaction. We focus our competencies on understanding and supporting our customers, seeking to provide the most cost effective and efficient logistics solution for their business.

The logistics service we offer can include the following:

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

WORLDWIDE SHIPMENT

Meeting the varied needs of our customers, we offer worldwide shipping via Air, Sea or Express Courier.

Production and Sea Freight 16-18 Weeks

Production and Air Freight 12-14 Weeks

Production and Express Courier 10-12 Weeks

KEY

 Production

 QA Inspection

 Sea Cargo

 Customs

 Air/Courier Cargo

 Customer Delivery

CONSIGNMENT STOCK/ WAREHOUSING

We understand that in a busy marketplace, items can often be required at short notice. Where this is a requirement, we have the capability to hold consignment stock in our warehouses in the UK ready for immediate dispatch.

DIRECT DELIVERY

Goudsmit UK can deliver directly to your clients at any address worldwide. We can supply custom made packaging, including your instructions and delivery documents to ensure confidentiality of manufacture.

CONTROL AND TRACEABILITY

Through our computerised system, we will keep you informed as your order progresses. From confirmation of your order and expected delivery dates, through to dispatch information and delivery tracking.

ISO 9001, IATF 16949 and
AS 9120B certifications

Rigorous QA system

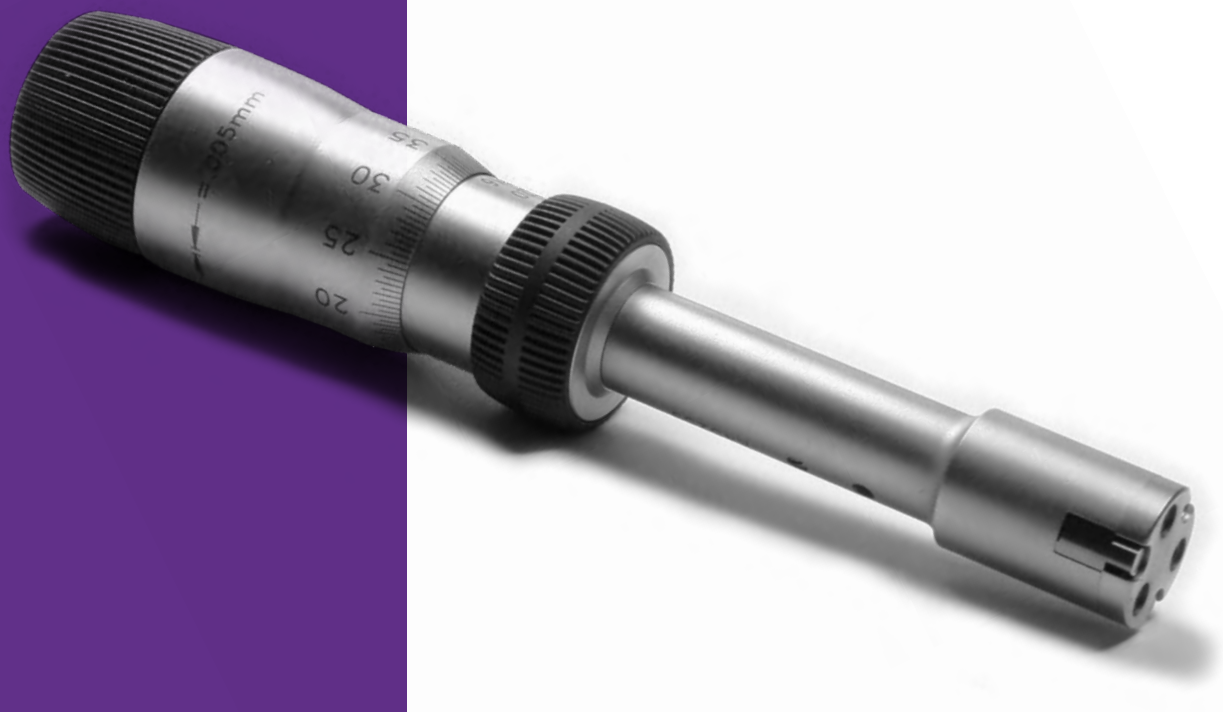
Paperwork and traceability provided

Measurement in Production

Post-Manufacture Measurement

SERVICES

QUALITY ASSURANCE



OUR PRINCIPLES

Our company QA philosophy is built on two principles:

- To gain and maintain a level of QA certification commensurate with our clients' needs and to work within this certified system efficiently and rigorously.
- To implement rolling programs of continuous improvement, endeavouring to supply better quality products and services year on year.

QUALITY SYSTEM

The quality system at Goudsmit UK serves as the backbone structure for the product quality and operational sides of the business. By strictly adhering to this system we endeavour to supply high quality products to our clients, whilst ensuring all the paperwork and traceability exceeds the required standard. With our ISO 9001, IATF 16949 and AS 9120B certifications, we have continued to significantly improve our product development and industrialisation procedures over the years. Furthermore, monitoring of key performance indicators enables us to respond rapidly to any developing QA trends.

PRE-MANUFACTURE QA

Prior to the manufacture of a new product, Goudsmit UK puts the product through a rigorous QA system for two main reasons:

- Check its suitability for manufacture
- Ensure no details in the design have been omitted

Tools used include; Advanced Product Quality Planning, Failure Mode Effect Analysis, Quality Assurance Specification Sheets and Historical Statistical Data to assess projected dimension capabilities. These tools highlight any shortcomings in either the process or design which will inhibit the product from being manufactured to the correct standard.

MEASUREMENT IN PRODUCTION

During production parts are measured dependent on the process and the criticality of the given dimension. These measurements are inputted into a Statistical Process Control system which monitors and guarantees the repeatability of good parts from the production process. For batch manufacture and low production volume other techniques, such as gauging, will be used.

POST-MANUFACTURE MEASUREMENT

After manufacture the parts are measured. We record the results and submit our parts with either an Initial Sample Inspection Report or a Production Inspection Report. We have a range of QA equipment which is calibrated annually, including:

- Manual and automatic CMM machines
- Permeameter, helmholz coils and gauss meters for magnets
- Surface roughness, plating depth and hardness meters for finish
- Thread gauges
- Shadowgraph and microscopes for optical checks
- Mass spectrometer for compositional checks

COMPOSITION AND MATERIALS

Often our clients require material performance, and this is often linked to the composition and processing of a material. To this end we can provide composition, charpy impact tests, hardness tests and tensile strength tests all certificated by a UK test house.

CORRECTIVE ACTION

With manufacturing there's always a possibility of a problem arising, often historic or something which was not foreseen during the pre-manufacturing QA assessment. In the unlikely event that this should happen, Goudsmit UK have a clear system of quarantine, non-conformance reporting, 8D resolution and a strong engineering team. Together, this ensures that when there is a problem, the precise root cause is identified, and the correct control is put in place to prevent reoccurrence.

GOUDSMIT UK

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"We have been working with Goudsmit for several years and their service is never less than exemplary. Whilst always maintaining the highest level of professionalism they still manage to provide a personal touch to their service.

The team are all great and we have answers to our questions quickly with the utmost detail. A great company to work with throughout."

Simon Goodchild
Owner & Managing Director
Magnatech Technology Limited

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