

# Applications Brief

Current information from Magnetfabrik Bonn

1/2013

## Angle sensor magnets

Manufacturing process: Injection molding  
Magnetization: 2-pole on face

### Introduction

Magnetfabrik Bonn has introduced a range of different shaped magnets for custom applications for measuring angles at the end of an axle.

The experience gained during this process has flowed into the standard solutions presented here. The critical situation with respect to rare earth materials has meant that the development of sensor magnets on the basis of inexpensive, freely available hard ferrites (Sprox®) has become particularly significant.

To allow the magnets to be secured, the rear (opposite the face) is designed with collars or feet in a way that allows them to be overmolded, glued or hot caulked. The magnets can be aligned using the flat surfaces or, in the case of magnets made from Neofer® p using the two holes in the feet.

Injection molds and magnetization equipment are available to manually magnetize angle sensor magnets manufactured from Neofer® p. If automatic magnetization is required, additional pro rata costs arise for the automation process.

We can supply angle sensor magnets manufactured from Sprox® (hard ferrite) as development samples. In the case of series quantities, we would be happy to provide a quotation for a multiple injection tool including automation.

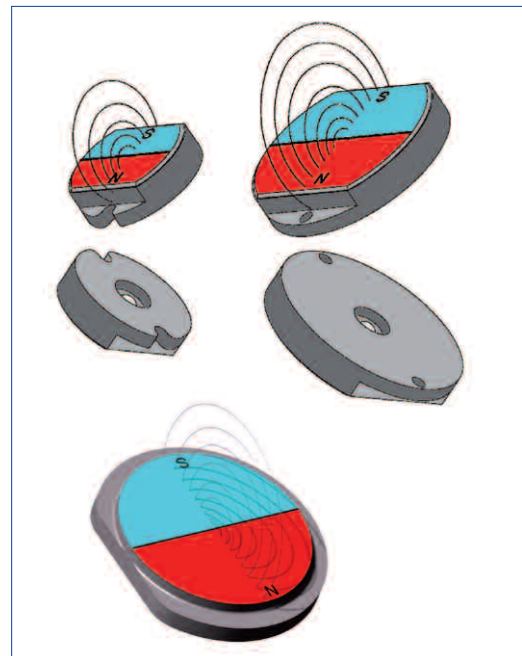


Figure 1: Geometry of magnets made from Neofer® p (top) and Sprox® (bottom)

## Example application

The magnets are suitable for detecting the angle of rotation in combination with a magnetic angle sensor. The magnet is secured to the end of a rotating shaft directly opposite the fixed sensor (Figure 2). The magnetization method means that the flux lines are concentrated on the front of the magnet, emanating in the direction of the sensor.

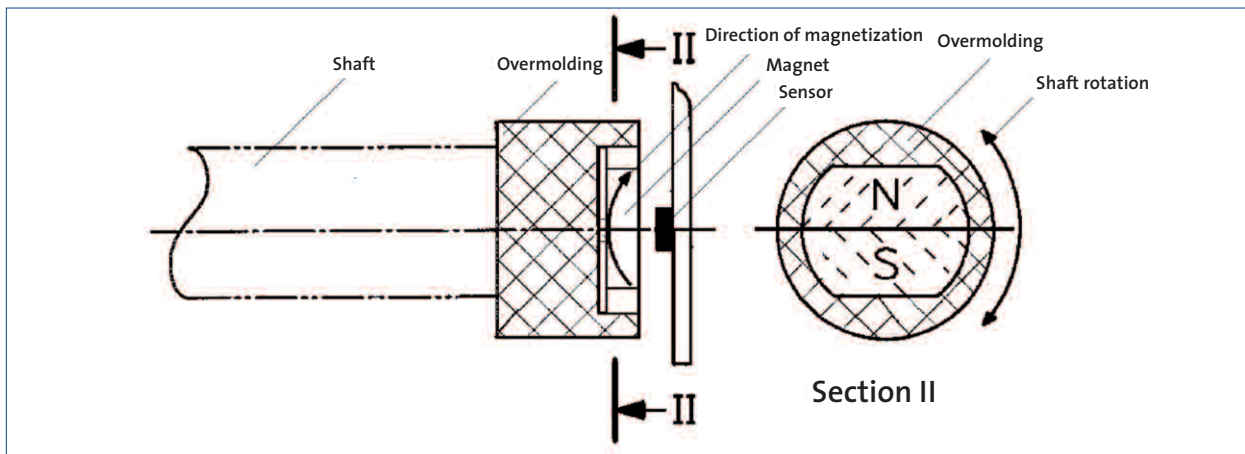


Figure 2: Schematic diagram of the axial arrangement of magnet and sensor

## Examples of sensors

Sensor	Manufacturer	Features
KMZ 60	NXP	AMR double bridge with analysis electronics
KMT 31	HL-Planar	AMR double bridge without analysis electronics
MLX 90316	Melexis	Hall sensors with flux guiding
AS 5040	Austriamicrosystems	Hall array with analysis electronics <sup>1</sup>
AA745	Sensitec	AMR double bridge with analysis electronics
TLE 501x	Infineon	GMR sensor with analysis electronics
IC-MH	IC-Haus	Hall encoder
AM512B	RLS	Hall array with analysis electronics <sup>1</sup>

<sup>1</sup> Hall arrays detect the vertical field component  $B_z$ ; special magnets for this kind of sensor are indicated in the next table.

## Available designs

Magnetfabrik Bonn GmbH can supply the following four models at short notice:

Drawing no.	Dimensions	Central field strength	Comment
67.043-1	9 mm dia. x 2.5 mm	$\geq 60$ mT at $z = 2$ mm	Specifically for Hall arrays <sup>1</sup>
67.043-2	9 mm dia. x 2.5 mm	$\geq 62$ mT at $z = 2$ mm	Standard small
67.044-1	14 mm dia. x 2.5 mm	$\geq 55$ mT at $z = 3$ mm	Standard large
69.572-2	18/15 mm dia. x 2.5 mm	$\geq 50$ mT at $z = 2$ mm	Standard hard ferrite, available as development sample

Note: With the 67.043-1 magnets, the magnetization is rotated by  $90^\circ$  to the D surface compared with Figures 1 and 2!

## Comparison of the technical benefits of sensor magnets manufactured from polymer-bonded hard ferrite and polymer-bonded NdFeB

### Benefits of magnets based on hard ferrite:

- greater dimensional stability as a result of the finer granularity of the magnetic filler
- corrosion resistance
- no irreversible magnetic loss at high temperatures up to 150 °C
- single-stage, reliable manufacturing process for long production runs

**Caution:** The material and the magnetization mean that the magnets can be weakened during handling. This can only be avoided if the magnets are packaged separately in suitable packages and remain separated during further processing. In order to achieve an economically viable process that delivers reliable quality, the magnets must be manufactured using a multiple injection tool that automatically places the units in their individual packaging. For this reason, it only makes sense to deploy these solutions with production runs of more than 100,000 units per year.

### Benefits of solutions based on rare earth materials (NdFeB):

- greater field strength, measuring distance for a comparable diameter is around 1-2 mm larger
- less susceptible to external manipulation (stronger coercive field)
- lower reversible temperature sensitivity (approx. 13 % per 100 K compared with 20 % per 100 K), at the same time, however, irreversible and structural loss occurs over time at high temperatures. For more details, refer to our Applications Brief 1/2008 "The Effects of Temperature on Permanent Magnets". This Brochure is available to download at [www.magnetfabrik.de](http://www.magnetfabrik.de) / Downloads / Praxis kompakt.

The charts below show the characteristic curves of measurements taken on unweakened magnets. Mechanical mounting inaccuracies giving rise to a tilt in the region of 0.1 mm have been deliberately accepted in order to represent the magnetic effects of tolerances such as those encountered in a series application.

## Typical properties at room temperature

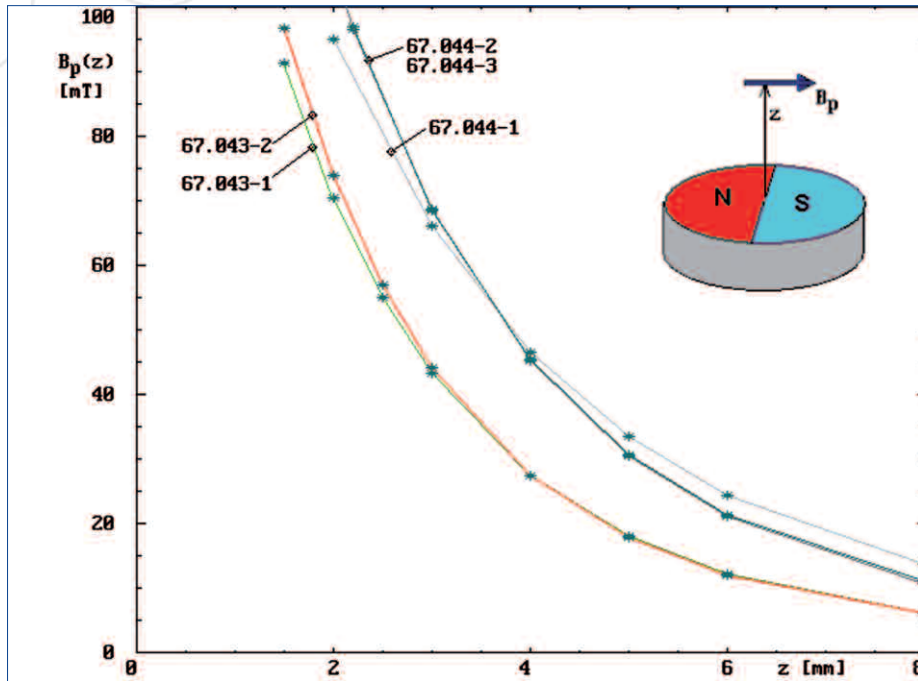


Figure 3: Planar field  $B_p$  at a distance  $z$  above sensor magnets made from Neofer® p

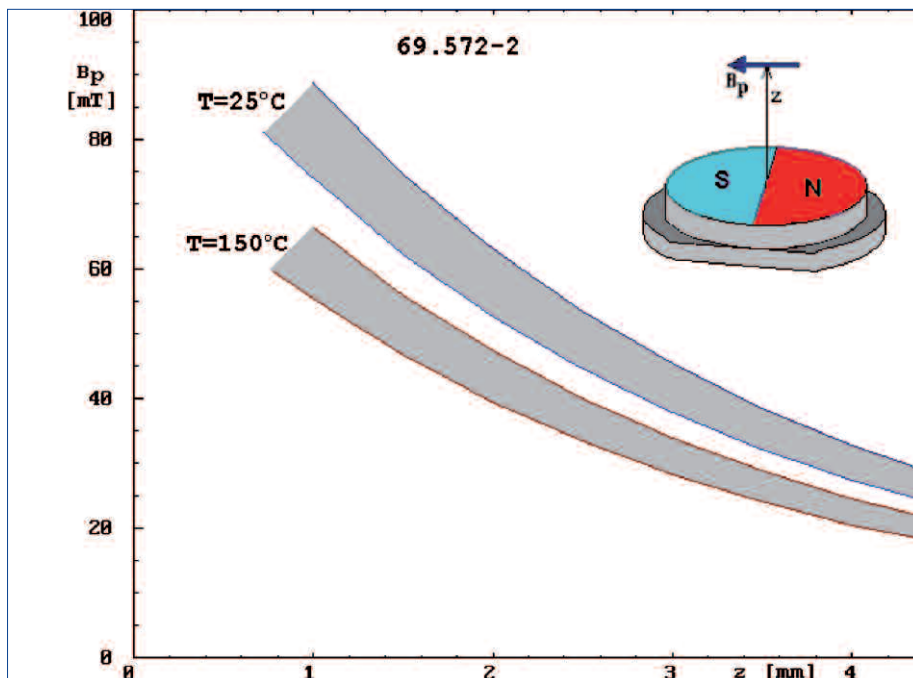


Figure 4: Planar field  $B_p$  at a distance  $z$  above sensor magnets made from Sprox® (hard ferrite)

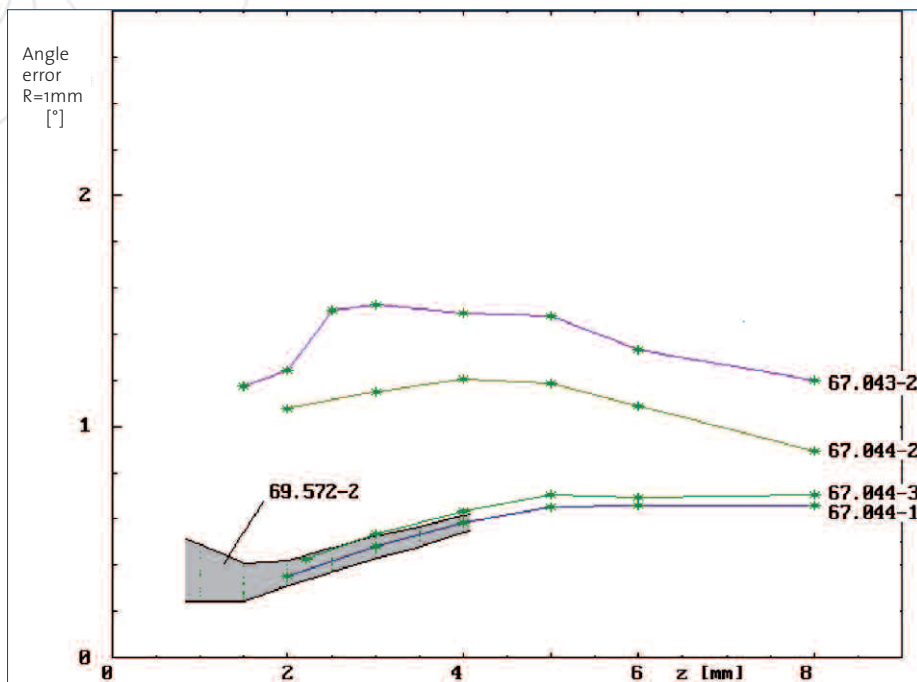


Figure 5: Typical angle error caused by sensor offset at  $R = 1 \text{ mm}$ , at  $R = 0.5 \text{ mm}$ , the error is approx. 25 % of the values shown

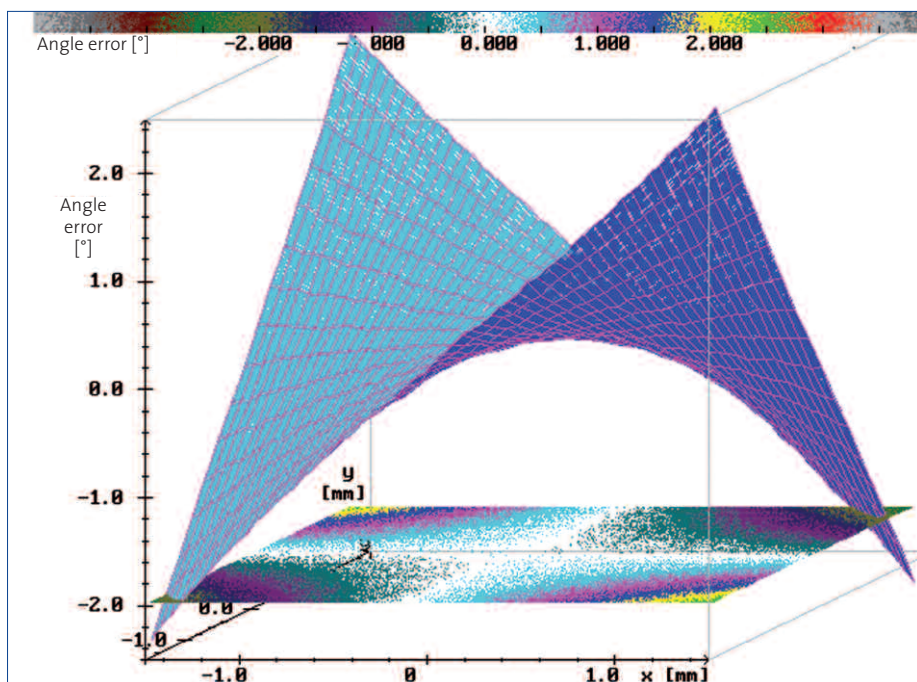


Figure 6: Angle inhomogeneity on the plane at a distance  $z$  of 4 mm Shown for a 67.044-1 type magnet

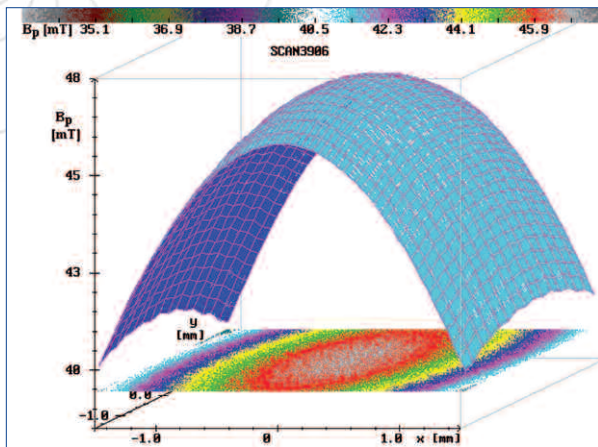


Figure 7: Planar field at a distance  $z$  of 4 mm above a type 67.044-1 magnet

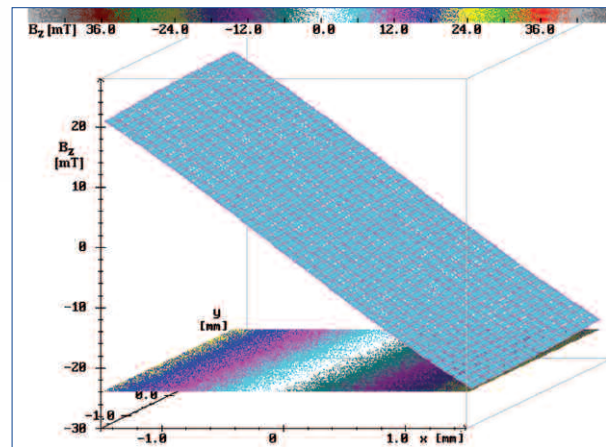
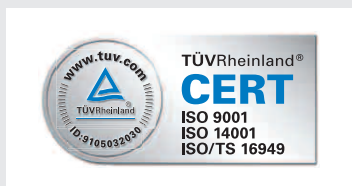


Figure 8: Vertical field at a distance  $z$  of 4 mm above a type 67.044-1 magnet

## The experts in permanent magnets

Magnetfabrik Bonn has 80 years of experience, and the extensive skills gained over these years in all aspects of materials, production techniques and applications have made us not only a leading provider of permanent magnets but also one of the leading experts in the field. We use these skills to find solutions to the complex tasks faced by our customers. Our range of products includes a wide spectrum of materials that we produce in our own facilities. Our highly automated production ensures cost-efficient manufacturing and provides our customers with additional advantages over the competition. Quality and environment management systems testify to our commitment to continuous improvement and to our sense of responsibility.



No matter whether you need a mass-produced product or tailored magnet systems as functional assemblies, just have a word with our experienced specialists.

**magnetfabrik**  **bonn**

Magnetfabrik Bonn GmbH  
 Dorotheenstrasse 215 • D-53119 Bonn  
 Phone 02 28 - 7 29 05 - 0 • Fax 02 28 - 7 29 05 - 37  
 verkauf@magnetfabrik.de • www.magnetfabrik.de

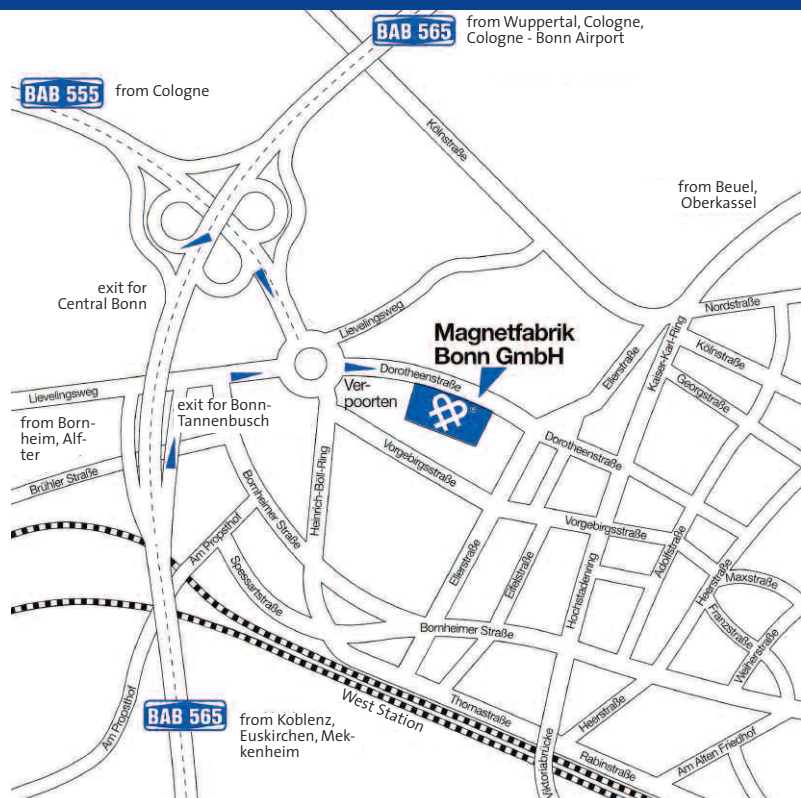


# How to reach us

magnetfabrik  bonn

Magnetfabrik Bonn GmbH  
Dorotheenstraße 215 • D-53119 Bonn

Tel. (+49) (0)2 28 - 7 29 05 - 0  
Fax (+49) (0)2 28 - 7 29 05 - 37  
E-Mail (for sales) [verkauf@magnetfabrik.de](mailto:verkauf@magnetfabrik.de)  
Internet [www.magnetfabrik.de](http://www.magnetfabrik.de)  
Registergericht Bonn, HRB 4774 • VAT-ID-No.: DE 122 117 630



## Representatives in Germany

### Bayern

D-80997 München  
Wolfgang Pfaff  
Technik & Vertrieb –  
Technical Support & Sales  
Zittauer Straße 32  
Tel. +49 (0) 89 - 14 90 22 73 - 11  
Fax +49 (0) 89 - 14 90 22 73 - 96  
Mobil +49 (0) 151 - 14 01 33 28  
E-Mail [wolfgang.pfaff@me.com](mailto:wolfgang.pfaff@me.com)

*Berlin, Brandenburg*  
D-14532 Stahnsdorf  
Horst Seifert Industriervertretungen  
Inhaber Sascha Seifert  
Mucheweg 6  
Tel. +49 (0) 33 29 - 63 48 90  
Fax +49 (0) 33 29 - 63 48 51  
E-Mail [h.s.i@web.de](mailto:h.s.i@web.de)

*Sachsen, Sachsen-Anhalt (Süd), Thüringen*  
D-99425 Weimar  
Technisches Büro Dr.-Ing. Rathsack  
Carl-Ferdinand-Streichhan-Straße 1  
Tel. +49 (0) 36 43 - 90 24 90  
Fax +49 (0) 36 43 - 5 32 02  
E-Mail [dr.rathsack@t-online.de](mailto:dr.rathsack@t-online.de)

*Bremen, Hamburg, Mecklenburg-Vorpommern, Sachsen-Anhalt (Nord), Schleswig-Holstein*  
D-22587 Hamburg  
Heinrich J. Merck e.K.  
Hasenhöhe 40 b  
Tel. +49 (0) 40 - 87 08 63 - 0  
Fax +49 (0) 40 - 87 08 63 33  
E-Mail [info@hj-merck.de](mailto:info@hj-merck.de)

*Nordrhein-Westfalen, Rheinland-Pfalz*  
D-40885 Ratingen-Lintorf  
Heyderhoff GmbH Elektrotechnik  
Rehhecke 25  
Tel. +49 (0) 21 02 - 91 81 36  
Fax +49 (0) 21 02 - 1 77 14  
E-Mail [kontakt@heyderhoff.de](mailto:kontakt@heyderhoff.de)

*Baden-Württemberg / Schweiz*  
D-72116 Mössingen  
Dieter Schönheinz  
Technik und Vertrieb  
Lembergweg 18  
Tel. +49 (0) 74 73 - 78 77  
Fax +49 (0) 74 73 - 78 99  
E-Mail [tb-disch@t-online.de](mailto:tb-disch@t-online.de)

*Hessen, Nordrhein-Westfalen, Rheinland-Pfalz, Saarland*  
D-53119 Bonn  
Magnetfabrik Bonn GmbH  
Dorotheenstraße 215  
Tel. +49 (0) 2 28 - 7 29 05 - 0  
Fax +49 (0) 2 28 - 7 29 05 - 37  
E-Mail [verkauf@magnetfabrik.de](mailto:verkauf@magnetfabrik.de)

## Foreign Representatives

*Austria, Hungary, Croatia, Slovenia, Slovakia, Czech Republic*  
A-1150 Wien  
Dieter Pelzel Industriervertretungen  
Plunkergasse 22  
Tel. + 43 - 664 - 504 89 91  
Fax + 43 - 1 - 985 64 75  
E-Mail [dpi@pelzel.at](mailto:dpi@pelzel.at)

*Switzerland*  
D-72116 Mössingen  
Dieter Schönheinz  
Technik und Vertrieb  
Lembergweg 18  
Tel. +49 (0) 74 73 - 78 77  
Fax +49 (0) 74 73 - 78 99  
E-Mail [tb-disch@t-online.de](mailto:tb-disch@t-online.de)

*France*  
F-78320 Le Mesnil St Denis  
TECHNA France SARL  
Jean-Pascal Aner  
3 bis Rue de Rodon  
Tel. + 33 - (0)1 - 39 38 60 96  
Fax + 33 - (0)1 - 34 61 01 92  
E-Mail [jp.aner@techna-france.com](mailto:jp.aner@techna-france.com)

*Turkey*  
TR-34306 Basaksehir-Ikitelli / Istanbul  
MUTLU Müh. Ltd. Sti.  
Ikitelli Organize San, Bölgesi Metal  
Is Sitesi, 20 Blok No:21  
Tel. + 90 - 212 - 671 07 92  
Fax + 90 - 212 - 671 07 94  
E-Mail [hamzamutlu@abkarltd.com](mailto:hamzamutlu@abkarltd.com)

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