Special Edition

DEPRAG

Preventive maintenance and repair of air-operated tools

Screwdriving technology

Automation

Air motors

Air tools

D 0090 E 2.2008

Content

1. In our own words

Dear customer,

by selecting a DEPRAG product, you have acquired a tool, which was developed and manufactured for use in a heavy industrial environment. Since 1931, we have amassed experience in manufacturing air-operated machines and screwdriving systems.

We produce a variety of air-operated machines such as screwdrivers, drills, grinders, motors, hammers and much more utilizing the most modern production machinery. To cover all imaginable screw joint applications, we offer, in addition to the standard screwdrivers, electric handheld screwdrivers as well as freely programmable electric screwdriver spindles.

Regarding special machinery technology, we design and manufacture semi and turnkey automatic screwdriving-systems, with and without screwfeeding, for screw-assembly and handling tasks of all types.

The practical use of our products extends from the simple hand tool to the complete screwdriving robotic cell as implemented in the automobile industry.

Since 1996, DEPRAG's Amberg facility has been certified according to DIN EN ISO 9001 in all operational areas. DEPRAG has branches in China, France, Scandinavia, the Czech Republic, the USA and the United Kingdom and sales offices in almost all industrial countries worldwide who provide distribution and customer service.

1.1 Preventive Maintenance - why?

The benefit of preventive maintenance is without question. An unforeseen machinery breakdown is accompanied by a production shutdown, a loss of income and may even force a delivery limitation.

Correct maintenance, as well as properly planned and precise implementation of necessary repair, saves time and money.

The following implementations regarding the operation and maintenance of air-operated tools can only serve as a general guide, because of the extensive spectrum of DEPRAG air tools.

Further information can be found in the operating manuals of the respective tools which are available from DEPRAG either in printed version or as pdf-files.

2. Air Preparation

2.1 Air Quality

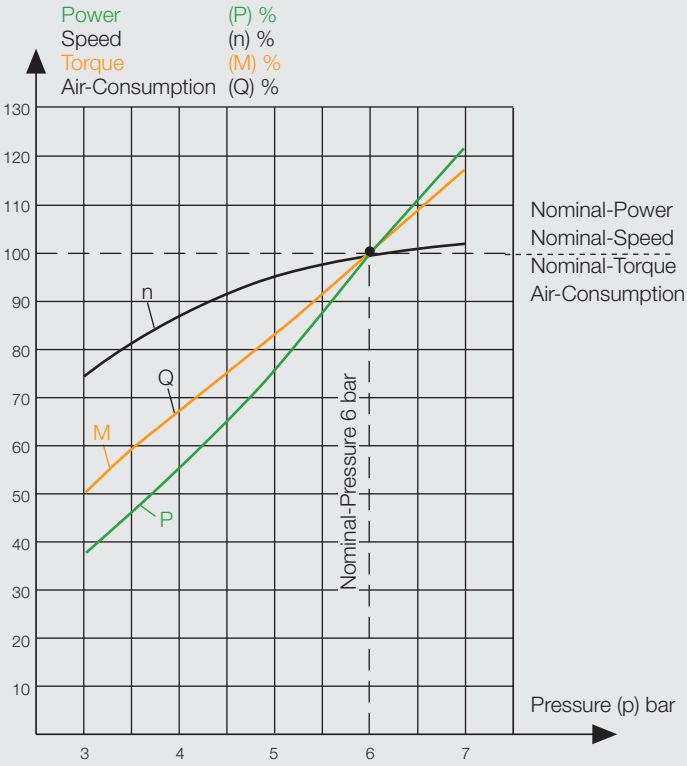
The quality of the compressed air is a critical factor for the lifespan of an air tool. The integration of a water separator as well as a central air dryer protects not only the air system, but also the airtool from corrosion.

The use of an air filter is just as important. Dirty air can block the vanes and damage the motor.

In regard to air-quality according to ISO 8573-1, we recommend:

	Class	Residue of Oil Content		Residue of Dust			Residue of Water		
		mg/m³	oz./cu.ft.	particle size mm	mg/m³	oz./cu.ft.	pressure dew-point °C	g/m³	oz./cu.ft.
Dry Air	3	1	$1.03 \cdot 10^{-6}$	0.005	5	$5.14 \cdot 10^{-6}$	-20	0,88	$0.90 \cdot 10^{-3}$
Lubricated Air	4	5	$5.14 \cdot 10^{-6}$	0.015	8	$8.22 \cdot 10^{-6}$	+3	6	$6.17 \cdot 10^{-3}$

To attain the proper air quality, we recommend the DEPRAG maintenance units with 1/4" to 1 1/2" connection threads and a corresponding airflow. A regular inspection of the air filter for impurities and a lubricator volume adjustment is necessary.



Pressure (p) bar / PSI	Power (P) %	Speed (n) %	Torque (M) %	Air-Consumpt. (Q) %
7 / 99	121	103	117	117
6 / 85	100	100	100	100
5 / 71	77	95	83	83
4 / 57	55	87	67	67
3 / 42	37	74	50	50

Picture 1: effect of the operational pressure

2.2 The correct operating air pressure

An often-underrated factor is the use of the correct operating pressure. All statements regarding power output, speed, torque and air consumption normally refer to a nominal pressure (air volume) of 6 bar/85 PSI or 6.3 bar/90 PSI. Deviating from the correct pressure affects this data.

2.2.1 Air pressure is too low

Often, it is determined that the required air quality is in fact available, but not the necessary air volume.

Air volume can be affected by fittings connected immediately following the maintenance unit, such as air manifolds, pneumatic valves, quick connect couplers or air hoses with too small internal diameter. No considerable pressure drop could be determined on the pressure gauge of the maintenance unit while operating a tool.

However, if a pressure gauge is connected directly ahead of the tool, airflow of only 3 bar/42 PSI is often the result. (In each case, the required hose I.D. can be found in your DEPRAG operating instruction booklet. The hose length should not exceed 3 meters/10 ft.).

A performance loss of the air tools is the consequence under these conditions. With screwdrivers, a ratcheting (stalling) occurs at limited airflow. Air pressure versus air tool performance is clarified in Picture 1.

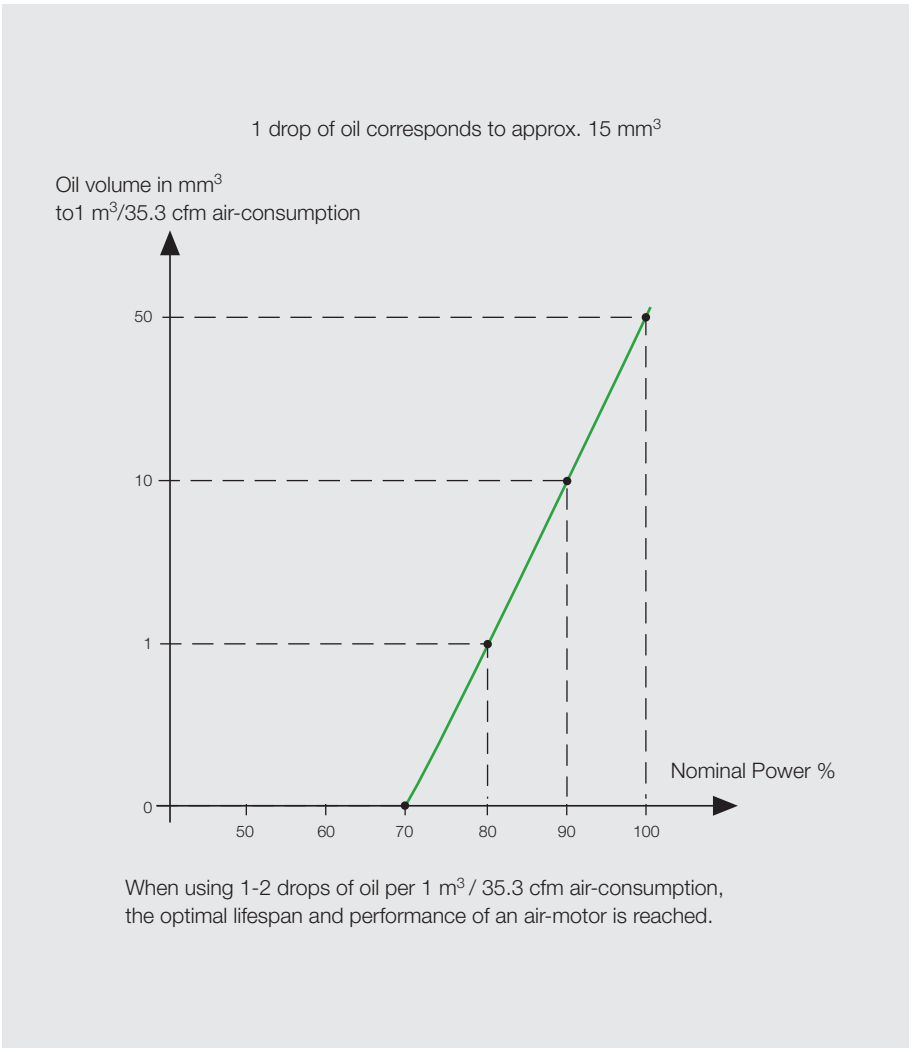
For example, just 55 % of the performance is reached when there is a pressure drop from 6 to 4 bar/85 to 57 PSI.

2.2.2 Air pressure too high

Air pressure over 7 bar/99 PSI leads to increased wear and tear of the air tool. A pressure regulator with sufficient airflow must be integrated.

In addition, the danger of injury must be considered. With too high an air pressure, the idling speed of the tool increases, which in the case of unregulated grinders can result in exceedance of the allowable speed of the grinding insert.

A broken grinding insert can cause considerable harm to equipment and personnel!



Picture 2: effect of lubricated air

2.3 Lubricated or non-lubricated operation of tools

2.3.1 Dry Air

Generally, all DEPRAG air-operated Screwdrivers and Top Speed Grinders (gear motor) can be operated oilfree. However, utilizing dry air can cause the speed and performance of vane driven tools to be reduced by as much as 20 %. Under unfavorable conditions, the maintenance intervals may also be reduced when tool is operated with dry air.
With all other remaining air-tools, refer to the operating instruction booklet, to ascertain if oilfree operation is permissible.
On special request, all rotational tools can be equipped for oilfree operation.

2.3.2 Lubricated Air

If the application condition permits the use of lubrication, then an air tool should be operated with lubricated air. The following advantages can be stated:

- Lubrication prevents the direct contact, and therefore the wear of internal parts sliding against each other. Non-lubricated operation can lead to elevated wear of internal parts.
- Lubricated operation protects from corrosion. Because of the water content of the compressed air, air tools are particularly corrosion susceptible. An oil film coating on the internal parts protects from corrosion.
- Lubricated air improves the motor insulation. DEPRAG air-tools are machined to production quality standards and close tolerances. The smaller the gap, the smaller the air leak and performance loss. A lubricant in the gap assures high performance.

We recommend only the lubricant approved by us [special oil „DEPRAGOL" order no. 790081 E/F/G, available in 0.25/5/10 liters (0.07/1.3/2.6 gal.)] in connection with suitable oiler, supplying the compressed air with a fine oil mist or for point-of-use oilers.

With the use of point-of-use oilers best lifetime of screwdrivers at least necessary oil consumption is possible. Especially in cases where long operating durations are necessary but no oil leakage should happen, this system represents a very good compromise between the restrictions of perfectly oil-free use and the problems caused with regular oilers and the fine oil mist.

Here the oilers should be adjusted so that the oil volume is approximately 1 - 2 drops of oil per 1 m³/35.3 cfm air consumption. More oil is to no advantage; it only increases the oil usage and becomes an unnecessary burden for the environment.

Impact tools such as hammers and scalers should only be operated with lubricated air.

Picture 2 shows the effect of dry and lubricated air in comparison to the performance of an air tool.

3. Maintenance Intervals

Air operated machines are extremely robust. The inner overpressure prevents the penetration of dust and dirt. Normally, only the low cost vanes require exchanging as wear parts. An estimate of the time period of required maintenance intervals however, cannot be simply made. The following conditions have to be checked to determine the required interval of the maintenance intervals:

a) Have the requirements of chapter 2.1 "Air Quality" been fulfilled?
b) Does the air tool operate oilfree or is a lubricant used?
c) At which speed does the tool operate?
d) At which power level does the tool operate?
e) What is the duration of the cycle time of the air-tool?

An example of how to determine the required maintenance interval of a screwdriver spindle follows.

The screwdriver spindle is used under the following operational conditions:
– The air quality fulfills the demanded requirement.
– The screwdriver spindle is operated oilfree.
– The screwdriver spindle is operated at its medium power level.
– The cycle time for one assembly is two seconds.

Using the formula $\frac{C \times T}{3600}$ (see also below), a maintenance interval every 2 million cycles is necessary, which equals about 1100 operating hours.

$$\frac{2 \text{ million cycles} \cdot 2 \text{ seconds}}{3600} = 1111.11 \text{ hours}$$

The maintenance interval changes when operating conditions change. When lubricated air is used, the maintenance interval is extended considerably.

The air filter must be regularly checked for contamination and the oiler for the correct adjustment.

4. The repair of air-operated tools

4.1 DEPRAG Repair or Maintenance Procedure

a) The receipt of the tool is recorded and if no special request is made by the customer, the tool is designated as a ”normal” repair.
b) The air-tool is completely disassembled, cleaned and evaluated.
c) After complete evaluation of the tool, the sales department generates, if necessary, a cost estimate to be forwarded to the customer.
d) After receipt of confirmation, the repair and assembly of the tool is performed and a final inspection is carried out.
e) Upon satisfactory inspection, the tool is returned to the customer.

These measures provide a traceable database for repairs.

Upon completion of a DEPRAG repair, the air-tool is technically new. Reusable ”used” parts will only be exchanged if so requested by the customer.

4.2 The do-it-yourself repair

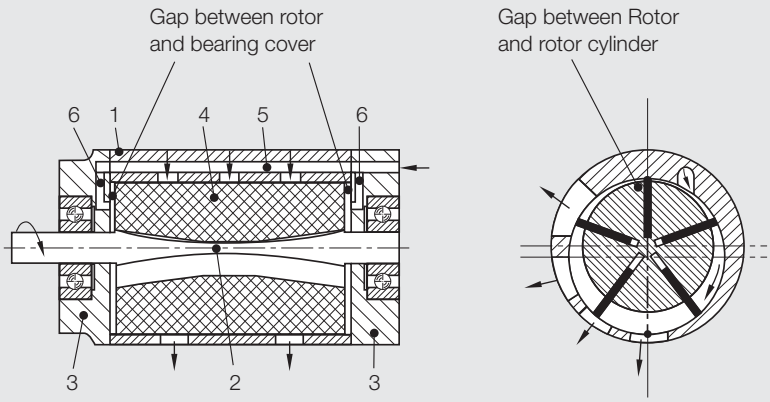
The disassembly and assembly of air-tools should only be performed by properly trained personnel. Faulty assembly can cause tool damage and personnel injury.

The following must be adhered to:
– It is absolutely necessary to disconnect the tool from the air supply when performing maintenance or repair. DANGER OF ACCIDENT OR INJURY!
– It is necessary to keep your work area tidy when performing maintenance or repair.
– Small lost parts such as balls, springs, etc. can delay the repair process considerably.
– Smoking or eating during maintenance or repair is not allowed!

Some general repair tools, which are necessary for a proper repair, are listed in the appendix. Required special repair tools are listed in the operating instruction booklet of each tool. Norm tools such as wrenches, punches, etc., are a prerequisite and are therefore not mentioned.

The first step is to completely dismantle the air-tool. All parts must be cleaned thoroughly (i.e. with petroleum), and subsequently tested for further usability. Bearing covers used in some air-tools (2Z or 2RS) may not be cleaned, since these bearings are continuously self-lubricating.

Generally, the air motor and the gearing are the main modules of most air-operated tools.



Pos. 1	Rotor Cylinder	Pos. 4	Vanes
Pos. 2	Rotor	Pos. 5	Air Inlet Channel
Pos. 3	Bearing Cover	Pos. 6	Exhaust Channel

Picture 3: The air-operated vane motor

4.2.1 The air-operated vane motor

All tools with an air motor as their drive are considered rotational tools. The air motor is almost solely developed as a vane motor. All vane motors essentially consist of the rotor, which moves in an eccentrically offset compartment in the rotor cylinder. Because of the eccentrically offset compartment, the vanes form an operating chamber, where volume increases in the rotational direction. Through the expansion of the condensed inlet air, the pressure energy changes into kinetic energy and consequently into the rotation of the rotor.

According to the type and application case of the air tool, the rotor contains from 3 to 9 vanes. With a particular requirement regarding start torque, suitable measures must be met in order to guarantee a forced start.

After the dismantling of the vane motor and thorough cleaning of all parts, the following parts must be evaluated closely regarding further usability:

– Rotor Cylinder:
  The rotor cylinder must be exchanged if deep grooves or indentations are found on the surface of the rotor cylinder, which are signs of polluted compressed air! The rotor cylinder can be used again, if its surface contains only slight, just visible tracks.
– Vanes:
  Generally, vanes are exchanged with each repair, since they are considered wear parts.
– Ball Bearings:
  Ball bearings can only be re-installed if they rotate perfectly. Usually, ball bearings are replaced after long-term use, in order to guarantee their functionality.

During reassembly of the vane motor, check to make sure that the new vanes move freely in the rotor slot. Also, observe that the vanes are ridge free and their height as well as length does not overrun the provided slot on the rotor.
If necessary, vanes must be carefully re-treated on a cushioned surface using 180 grit sandpaper.

Press the ball bearings into both bearing covers. Press the front bearing cover onto the rotor, using a punch (matched in size to the internal and external ring on the ball bearing) and then insert the vanes into the rotor slots. After the placement of the rotor cylinder, the rear bearing cover should be mounted. (Attention: between the rear bearing cover and the rotor cylinder there is a locking bearing pin). After this assembly, the bearing covers should not have any side-to-side movement. The motor package is put into a fixture; the rotor must move freely and be easy to rotate by hand when applying low axial pressure or axial pull. If necessary, carefully re-press the internal ring of the ball bearing, using an arbor, to reduce the side-to-side movement. If this is not guaranteed, the rotor may rotate top heavy.

An axial balancing of the rotor is not necessary in tools with integrated start rings.

4.2.2 The Gearing

DEPRAG air tools mainly use planetary gear drives, to achieve a high torque capability. During repair as well as maintenance, the following parts must be tested for wear and if necessary replaced:

- Gear Support:
  The encased bearing pins in the gear supports must be surface tested for grooves. If the bearing pins show grooves or unevenness, then the complete gear support must be replaced. (Bearing pins may not be exchanged separately). If gear supports equipped with pinions show deep grooves on the pinion tooth, the complete gear support must be replaced as well.
- Planetary Gears:
  The play (gap) between the bearing pins and the bore of the planetary gear must be tested. If an existing "play" is perceptible, the planetary gear must be exchanged. As with the gear support, planetary gears must also be replaced, if the teeth show deep grooves.
- Tooth Ring:
  The internal tooth-arrangement must be evaluated. If the teeth are worn out, the tooth ring must be replaced.
- Ball Bearings:
  Ball bearings can only be re-installed if they rotate perfectly. Usually, ball bearings are replaced after long-term use, in order to guarantee their functionality.

In principle, all parts of the gear assembly should be replaced when one gear part is replaced, to prevent a worn gear part wearing out a new gear part prematurely. When evaluating gear parts, the use of a magnifying glass is very helpful in making judgements the naked eye cannot.

During assembly and greasing of gear parts or open ball bearings, it is important to only fill the available space with one third of capacity with grease. Over greasing leads to overheating. For gear lubrication, we recommend our special grease part no. 807293 (100 gr/0.22 lbs. tube).

4.3 General Repair Tips

– Before the dismantling or re-assembly of air tools, carefully read the respective operation instruction booklets. Observe assembly indicators and use the necessary repair tools.
– Before re-assembly, thoroughly clean and grease all parts, and then push parts together by hand.
– For press fit, use suitable arbor and presses.
– Tighten thread connections evenly to the required torque.
– After assembly completion, test for smooth rotation. Drive spindles of gearless machines must rotate freely by hand (this is no longer possible with tools containing a gear mechanism, especially strong reduction gears).
– Reconnect the tool to compressed air, turn tool and test the free speed. The measured value should be according to the operation instruction booklet ± 10 %. If the values agree, the tool is considered operational.

4.3.1 Functional test of a shut-off-driver

A functional test regarding the shut-off behavior of automatic screwdrivers is required after a completed assembly and speed test. If an audible ratcheting can be heard, the required valve pin measurement must be checked in accordance with the operating instruction booklet. If, despite proper valve pin length, there is no improvement, the clutch claw ring, the intermediate ring, the clutch shaft and the shut-off pin of the clutch must be checked for grooves as well as rounded off corners. After exchange of the worn out part, re-test the driver for proper shut-off behavior. A single unique shut-off sound (click) of the clutch should be audible (be aware that too little airflow causes a ratcheting of the clutch). Adjust the driver to the required torque. There are several ways to check torque.

DEPRAG manufactures highly accurate measuring systems. We offer extensive PC based measuring systems, where screw-joint analysis and angle measurements can be processed. To test the torque directly at the area where the driver is in operation, a portable battery operated measuring instrument can be used.
Please contact your DEPRAG representative to have an in-house demonstration of the different measuring systems, which can be used in any combination with each other.

5. Repair Training Courses

Several times annually, special repair training is offered in-house DEPRAG. In a three-day course, customer's personnel is trained in detail on the maintenance and repair of all air-operated tools as well as on the adjustment of screwfeeding machines. These repair-training courses are practically oriented. Repeatedly, the benefit of these training courses has been confirmed to us by positive trainee responses and through the high number of participant registrations.
If you have interest in participation of such a training course, please contact your closest DEPRAG facility for the next training dates. For training on the North-American continent, please contact DEPRAG USA directly at the Lewisville, Texas office for further details.

6. Closing Comments

DEPRAG produces a variety of air-tools and specialized assembly machines. This manual describes general repair procedures only. For particular tool repair, please follow the operating instruction booklet of the respective tool. If questions or clarifications are required for special repair tools or the repair process, please contact your DEPRAG representative (listed on the last pages) or DEPRAG directly. Our qualified technicians will answer all your questions and can be reached also via our service hotline +49 (0) 700 00 371 371.

7. Appendix

7.1 General Repair Tools

Picture 4: Lever Press

Picture 4:
Lever Press
Order no. 807417
maximum pressure 10 000 N / 2240 lbs.
Surface plate swivels and contains
4 recess areas.

Picture 5: Press Block

Picture 6: Press Block

Picture 5:
Press Block
Order no. 460477
with 4 thru-bores Ø 7 mm/$^{9}/_{32}$“ to
Ø 20 mm/$5^{1}/_{64}$”.
To be used as a base for pressure insertion or removal of parts.

Picture 6:
Press Block
Order no. 461429
Base with mounting bores, suitable for the different gear supports of motor size 0/1/ 2.5 and 3.
To be used as a base for the pressure insertion of ball bearings or pinions.

Picture 7:
Clamping Strip
Order no. 460228
To be used as a clamping device of cylindrical parts with different diameters (Ø 5 mm to Ø 15 mm).

Picture 7: Clamping Strip

Picture 8:
Fixture
Order no. 461743
To be used as a positioning device of cylindrical parts with the same diameter (i.e. motor, gearing, air inlet parts, etc.) which thereafter will be pushed as a complete package into the suitable motor housing. The thru-bore is intended for the removal of a pin.

Picture 8: Fixture

7.2 Tachometer

Picture 9: Tachometer

Picture 9:
Tachometer
Order no. 830390
The measuring instrument for the touch free speed recording with a light ray (Measuring range 1 - 99 999 rpm) and for the mechanical speed recording with measuring tip or measuring wheel. (Measuring range 1 - 19 999 rpm). Additionally, speeds and lengths can be acquired mechanically.
A measurement unit selection (metric/ imperial) is possible.
The storage function indicates the last measurement (MIN/MAX). The compact measuring instrument possesses a digital display and is powered by two 1.5 V Mignon batteries.

DEPRAG WORLDWIDE

DEPRAG International

Algeria
EP-Technology Trading S.U.A.R.L.
29 Rue Ahmed Tlili - Zl Borj Cedria
TN-2055 Bir el Bey Tunis - Tunisia
Tel.: +216 / 79 / 412.889
Fax: +216 / 79 / 412.966
e.mail: info@ep-technologie.com
www.ep-technologie.com

Argentina
Erin s.a.
Av. Constituyentes 5751
RA-1431 Buenos Aires
Tel.+Fax: +54 (0) 11 / 4573.1313

Austria
Amersin Olschinsky GmbH
Kastnerwiese 1
A-2441 Mitterndorf a. d. Fischa
Tel.: +43 (0)1 / 8 69 87 66
Fax: +43 (0)1 / 8 65 16 97
Internet: www.amersin.at
e-mail: information@amersin.at

Australia
Assembly Technologies P/L
P.O. Box 4918
North Rocks N.S.W. 2151
Unit 32, 287 Victoria Rd.
Rydalmere, N.S.W. 2116 - Australia
Tel.: +61 / 1300 76 92 90
Fax: +61 / 2 / 8569 1721
e-mail: paul@assemblytech.com.au

Belgium
AWP
Parelhoenstraat 24
B-9080 Lochristi - Belgium
Tel.: +32 (0) 9232 0678
Fax: +32 (0) 9342 0678
Mobile: +32 (0) 473 345907
Internet: www.awp-p.com
e-mail: willems@awp-p.com

Brasil
Metalfema Ferramentas Pneumáticas e Eléctricas Ltda.
Rua Saõ Pedro, 786
Saõ Leopoldo - RS – BRAZIL
ZIP 93.010-260
Tel.: +55 (0) 51 / 3592.4050
Fax: +55 (0) 51 / 3590.1856
e-mail: metalfema@metalfema.com.br

China
DEPRAG Assembly Technologies Co., Ltd.
No. 111 Hong Ye Rd., Blk. 4 Unit D
Suzhou 215001, P.R. China
Tel.: +86 (0) 512-6251 2500
Fax: +86 (0) 512-6251 2700
Internet: www.deprag.com.cn
e-mail: biz@deprag.com.cn
e-mail: d.hua@deprag.com.cn

Czechia/Slovakia
DEPRAG CZ a. s.
ul. T. G. Masaryka 113
CZ-50781 Lázně Bělohrad
Tel.: +420 (0) 4 93 / 77 16 42
Fax: +420 (0) 4 93 / 77 16 23
Internet: www.deprag.com
e-mail: info@deprag.cz

Denmark
Herstad + Piper K/S
Jernholmen 48C
DK-Hvidovre
Tel.: 0045 36774000
Fax: 0045 36777740
Internet: www.herstad-piper.dk
e-mail: mail@herstad-piper.dk

Egypt
EP-Technology Trading S.U.A.R.L.
29 Rue Ahmed Tlili - Zl Borj Cedria
TN-2055 Bir el Bey Tunis - Tunisia
Tel.: +216 / 79 / 412.889
Fax: +216 / 79 / 412.966
e.mail: info@ep-technologie.com
www.ep-technologie.com

Estonia
Pneumacon OY
PK 2841, Kose PK
EE-12001 Tallinn
Tel.: +372 6 419491
Fax: +372 6 419492
GSM: +372 56505234
Internet: www.pneumacon.fi
e-mail: rauno.kolga@pneumacon.fi

Finland
Pneumacon OY
Kankurinkatu 4-6
FI-05800 Hyvinkää
Tel.: +358 10 7781400
Fax: +358 10 7781401
Internet: www.pneumacon.fi
e-mail: harri.lindroos@pneumacon.fi
e-mail: info@pneumacon.fi

France
DEPRAG S.A.R.L.
30 Z.I. du Ried
F-67590 SCHWEIGHOUSE sur Moder
Tel.: +33 388 / 06.14.17
Fax: +33 388 / 93.01.08
e-mail: info@deprag.fr

Germany
HQ Amberg
Kurfürstenring 12-18
D-92224 Amberg
Postfach 1352
D-92203 Amberg
Tel.: +49 (0) 96 21 / 3 71-0
Fax: +49 (0) 96 21 / 3 71-1 20
Internet: www.deprag.com
e-mail: info@deprag.de

Great Britain
DEPRAG Ltd
Unit B4 Pegasus Court
Ardglen Industrial Estate
Whitchurch
Hants
RG28 7BP
Tel. +44 (0) 1256 895 074
Fax +44 (0) 1256 895 274
Internet: www.deprag.co.uk
e-mail: sales@deprag.co.uk

Hungary
ADLER '91
Export/Import Kereskedelmi
Takarék u. 18/B
H-8800 Nagykanizsa
Tel./Fax: +36 (0) 93 / 314 633
e-mail: adler91adlovits@chello.hu

Nóniusz Tool Trading House Ltd.
Kőbányai út. 47/b
H-1101 Budapest
Tel.: +36 (0) 1 / 2603030
Fax.: +36 (0) 1 / 2606083
Internet: www.noniusz.hu
e-mail: noniusz@noniusz.hu

India

LEAPTECH Corporation
Mumbai office:
812 Cosmos, sector - 11
CBD Belapur
New Mumbai 400 614
Tel.: +91 / 22 / 2756.2822/2849
Fax: +91 / 22 / 2756.2881
e-mail: leaptech@vsnl.net
Internet: www.leaptech.in

Delhi office:
C-332, Sector-10
Noida - 201 301
Tel.: +91 / 120 / 253.1393
Fax: +91 / 120 / 253.1060
e-mail: leaptech@vsnl.net

Bangalore office:
53, Anchor
Suddagundapalaya
C.V. Raman Nagar
Bangalore - 560 093
e-mail: leaptechbg@vsnl.net

Iran

NACCARSON AIR TOOLS Co., Ltd.
Azadi Ave. No. 625
IR-Tehran 14 588
Tel.: +98 (0) 21 / 66006602 + 66015656
Fax: +98 (0) 21 / 66009451

FARA SANAT Co.
No. 117, Abzar & Yaragh passage
Imam Khomeyni Ave.
Postcode 1136748173
Tehran - IRAN
Tel.: +98 (0) 21 / 673.2918 / 670.6340
Fax: +98 (0) 21 / 673.4757
e-mail: fara_sanat@yahoo.com

Italy

ATAX s.r.l.
Via Carolina Romani, 23
IT-20091 Bresso (MI)
Tel.: +39 02 / 61.03.48.61
Fax: +39 02 / 61.03.48.60
e-mail: info@atax.it
Internet: www.atax.it

Japan

NIPPON GESCO Ltd.
P.O. Box 255 Kyobashi Tokyo
Ginza Matsuyoshi Bldg.
17-8,7-Chome, Ginza,
Chuo-Ku – Tokyo
Tel.: +81 (0) 3 / 3542.2400
Fax: +81 (0) 3 / 3542.2420
e-mail: mail@gesco.co.jp

Jordan

EP-Technology Trading S.U.A.R.L.
29 Rue Ahmed Tlili - ZI Borj Cedria
TN-2055 Bir el Bey Tunis - Tunisia
Tel.: +216 / 79 / 412.889
Fax: +216 / 79 / 412.966
e.mail: info@ep-technologie.com
www.ep-technologie.com

Korea (South)

Screwdriving / Assembly Technology / Automation / Air motors
FAtec Co., Ltd.
717 LG Palace B/D
165-8 Dongkyo-dong
Mapo-gu Seoul – KOREA
Tel.: +82 (0) 2 / 2688.2152
Fax: +82 (0) 2 / 2688.2893
Internet: www.fatec.co.kr
e-mail: fatec@fatec.co.kr

Lithuania

HIDROTEKA
Engineering Services
Chemijos 29E
LT-51333 Kaunas
Tel.: +370 (0) 37 452.969
Fax: +370 (0) 37 760.500
Internet: www.hidroteka.lt
e-mail: hidroteka@hidroteka.lt

Luxembourg

AWP
Parelhoenstraat 24
B-9080 Lochristi
Belgium
Tel.: +32 (0) 9232 0678
Fax: +32 (0) 9342 0678
Mobile: +32 (0) 473 345907
Internet: www.awp-p.com
e-mail: willems@awp-p.com

Malaysia

FI INNOVATION RESOURCES SDN. BHD
175, MK D Jalan Bahru
Balik Pulau 11000
Penang – MALAYSIA
Tel.: +60 / 13 / 449.0386
Tel.: +60 / 16 / 403.6797
Fax: +60 / 4 / 866.9560
e-mail: asiaingenieur@gmail.com

Morocco

EP-Technology Trading S.U.A.R.L.
29 Rue Ahmed Tlili - ZI Borj Cedria
TN-2055 Bir el Bey Tunis - Tunisia
Tel.: +216 / 79 / 412.889
Fax: +216 / 79 / 412.966
e.mail: info@ep-technologie.com
www.ep-technologie.com

Netherlands

Zumpolle b.v. Montagetechniek
Postbus 29
NL-5306 ZG
Brakel/Niederlande
Tel.: +31 (0) 418 / 67 18 16
Fax: +31 (0) 418 / 67 32 17
Internet: www.zumpolle.net
e-mail: info@zumpolle.net

Norway

DEPRAG Scandinavia AB
Gap Sundins väg 3
SE-63346 Eskilstuna
Universal Import
Tel.: +47 / 513 / 20203
Fax: +47 / 514 / 82553

Poland

INTEGRATOR – RHC AUTOMATYZACJA I ROBOTYZACJA PROCESÓW PRODUKCYJNYCH
ul. Wielki Rów 40B
PL-87-100 Toruń
Tel.: +48 / 56 / 66 93 841
Fax: +48 / 56 / 66 93 805
Internet: www.integrator-rhc.pl
e-mail: leszek.wojtowicz@rhc.com.pl
e-mail: marek.sobocinski@rhc.com.pl

Portugal

IberoAir – Unipessoal, Lda.
Mourisca do Vouga
Apartado 30
P-3754-907 Trofa AGD
Tel.: +351 (0) 234 690 080
Fax: +351 (0) 234 690 090
Internet: www.iberoair.pt
e-mail: iberoair@iberoair.pt

Slovenia

MB-NAKLO D.O.O.
Toma Zupana 16
SLO-4202 NAKLO
Tel.: +386 (0) 4 / 277 17 00
Fax: +386 (0) 4 / 277 17 17
e-mail: mb-naklo@siol.net

Spain

ALCOTAN Sistemas s.a.
pº de la Direccion, nmro. 95,
local
E-28039 Madrid
Tel.: +34 91 / 311.17.84 + 311.18.01
Fax: +34 91 / 311.60.53
e-mail: alcotansis@jazzfree.com

Barcelona office:
Passeig de la Mare de Déu del
Coll, 122-124
E-08023 Barcelona
Tel.: +34 93 / 2 85 50 34

Sweden

DEPRAG Scandinavia AB
Gap Sundins väg 3
SE-63346 Eskilstuna
Tel.: +46 (0) 16 / 12 61 10
Fax: +46 (0) 16 / 13 31 88
Internet: www.deprag.se
e-mail: info@deprag.se

Switzerland

AFAG AG
Geschäftsbereich LIMATEC
Burgunderstr. 13
CH-4562 Biberist
Tel.: +41 (0) 32 / 6542900
Fax: +41 (0) 32 / 6542901
Internet: www.limatec.ch
e-mail: office@limatec.ch

Taiwan

I HEN MACHINE Co. Ltd.
6F-9, No. 12, Lane 609, Sec. 5
Chung-Hsin Road,
San-Chung City
241 Taipei Hsen
Tel.: +886 (0) 2 / 2999.6766
Fax: +886 (0) 2 / 2999.6236

Tunisia

EP-Technology Trading S.U.A.R.L.
29 Rue Ahmed Tlili - ZI Borj Cedria
TN-2055 Bir el Bey Tunis - Tunisia
Tel.: +216 / 79 / 412.889
Fax: +216 / 79 / 412.966
e.mail: info@ep-technologie.com
www.ep-technologie.com

Turkey

MEKA LTI.STI
Tepecik Mah. Ziya Gökalp Cad. No:3
41135 Köseköy-IZMIT -
KOCAELI - TÜRKEI
Tel: 90 262 373 65 03 - 373 65 04
Fax: 90 262 373 65 05
Gsm: 0.532.201 71 06
Internet: www.me-ka.com

USA, Mexico and Canada

DEPRAG Inc.
640 Hembry St. / P.O. Box 1554
Lewisville, TX 75057-4726
Phone: +1 / 972 / 221-8731
Fax: +1 / 972 / 221-8163
Toll Free: (800) 4 DEPRAG
Internet: www.deprag.com
e-mail: deprag@depragusa.com

DEPRAG SCHULZ GMBH u. CO.
P.O. Box 1352, D-92203 Amberg, Germany
Kurfürstenring 12–18, D-92224 Amberg
Phone (0 96 21) 371-0, Fax (0 96 21) 371-120
www.deprag.com
info@deprag.de

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