

FAG



FAG tools for thermal dismounting

Technical Product Information

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The designation system of the INA and FAG brands has been harmonised. This catalogue contains the new ordering designations, which are currently only valid for Europe. Customers outside Europe are requested to continue using the old ordering designations (please see the comparison on page 34).

Foreword · Safety guidelines

Foreword

Rolling bearings for which a tight fit is prescribed on the shaft, are usually heated and shrink fitted.

Complete bearings – including those which have been sealed and greased – and rotationally symmetrical parts made from steel are heated for mounting using FAG heating devices (see Technical Production Information TPI WL 80-54).

Heating rings are suitable for removing the inner rings of cylindrical roller bearings and needle roller bearings without ribs and inner ribs with one rib.

Heating rings are particularly advantageous for the occasional removal of small and medium-sized bearing rings.

Heat conducting paste is used as an aid during dismantling using heating rings in order to achieve optimum heat transfer to the inner ring.

Electric induction heating devices are suitable for removing shrink fitted inner rings and for mounting the rings. They work rapidly and cleanly. They are also used for batch dismantling.

Induction heating devices are primarily used to heat the inner rings of medium-sized and large cylindrical roller bearings and needle roller bearings. The devices are suitable for inner rings without ribs and inner rings with one rib. Special devices are used for labyrinth rings, shrink fitted couplings etc.

We supply induction heating devices in two designs. A design for mains voltage (with foot switch or switch cabinet) is available for sporadic dismantling. The second design works with low voltage (20 to 40 V). This comprises an induction coil and a transformer.

Safety guidelines

Electric induction heating devices may only be connected to the relevant prescribed, fused mains supply.

Due to safety reasons, alterations and changes are not permitted and invalidate any warranty.

The strong magnetic field generated by the device can have a negative effect on:

- pacemakers
- watches
- credit cards with magnetic strips
- disks and other data carriers
- electronic circuits in instruments

The safe distance is two metres.

Selection of equipment for thermal dismounting

Selection of equipment for thermal dismounting

Workpiece/ Requirement

Suitability of equipment for thermal dismounting

Heating rings

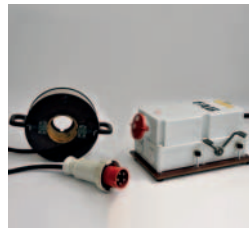
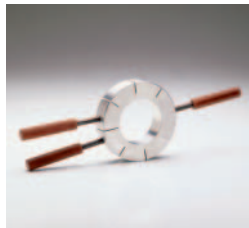
Electric induction heating devices for mains voltage

for low voltage

Foot switch
+ coil

Switch cabinet
+ coil

Transformer
+ coil



Small bearing inner rings	++	0	0	0
Medium-sized bearing inner rings	+	+	++	++
Large bearing inner rings	-	-	+	++
Labyrinth rings	-	-	+	+
Couplings	-	-	0	+
Rolls	-	0	+	+
Occasional dismounting	+	+	+	+
Large quantities	-	0	0	++
Handling	+	0	+	++
Heating time control	-	-	+	+

++ highly suitable

+ very suitable

0 less suitable

- not suitable

FAG heating rings

Application · Description · Handling

Application

FAG heating rings are suitable for dismantling the inner rings of cylindrical roller bearings and needle roller bearings without ribs and inner rings with one rib. Heating rings are particularly advantageous for the occasional extraction of small and medium-sized bearing rings (bore diameter 50 to 200 mm). Depending on the size of the ring, heating takes between 5 and 30 seconds.

Description

FAG heating rings are slotted rings made from a light metal alloy. Their bore diameters and widths

are designed such that the inner rings of several cylindrical roller bearing designs of equal size can be extracted using one heating ring, see page 7.

Several slots in the circumference reduce the rigidity of the heating ring and thus enable a good fit on the bearing ring. Heat-insulated handles make handling easier. Due to the favourable thermo-technical properties of the heating ring, the bearing ring quickly takes on the temperature required for extraction (80 to 120 °C).

The specific heat of the light metal alloy is twice the specific heat of steel and hence, due to the high thermal conductivity, only a moderate temperature loss occurs with significant heat emission. Since the alloy's coefficient of

thermal expansion is twice that of steel, contact is improved and the transmission of heat is intensified when the heating ring cools down and the inner ring is heated.

Handling

The heating ring is heated to between 200 and 300 °C by means of an electric heating plate. The temperature at the bore must be checked constantly. The bore diameter is designed so that the heating ring sits on the bearing ring with a slight interference fit at 200 to 300 °C. The heating ring must be pushed onto the bearing ring (wearing heat-insulated gloves) and clamped by means of the handles (or using a clamping device for large heating rings). In order to improve the heat exchange, the inner ring raceway must be coated with silicone-free heat conducting paste (see page 11) before sliding into place. The clamped heating ring is rotated to check whether the interference fit of the bearing ring has been eliminated; the heating ring can then be removed, together with the bearing ring, from the shaft. After removal, the bearing ring must be removed immediately from the heating ring in order to prevent overheating. Problems may arise during removal if there is fretting corrosion or cold welding in the inner ring seat as the heating ring may not generate a sufficient temperature difference between the bearing ring and shaft. In such instances, the inner ring must be heated using an annular burner (see Publication WL 80 100).



FAG heating rings

Handling · Comparison with other extractors · Product range, Information required for quotation

If the heating ring is used frequently, it may become out-of-round and the heat exchange may be impaired such that the inner ring cannot be removed. Two or more bearing rings shrink fitted side by side cannot be dismantled simultaneously using one heating ring. The bearing rings are heated individually and removed separately.

Comparison with other extractors

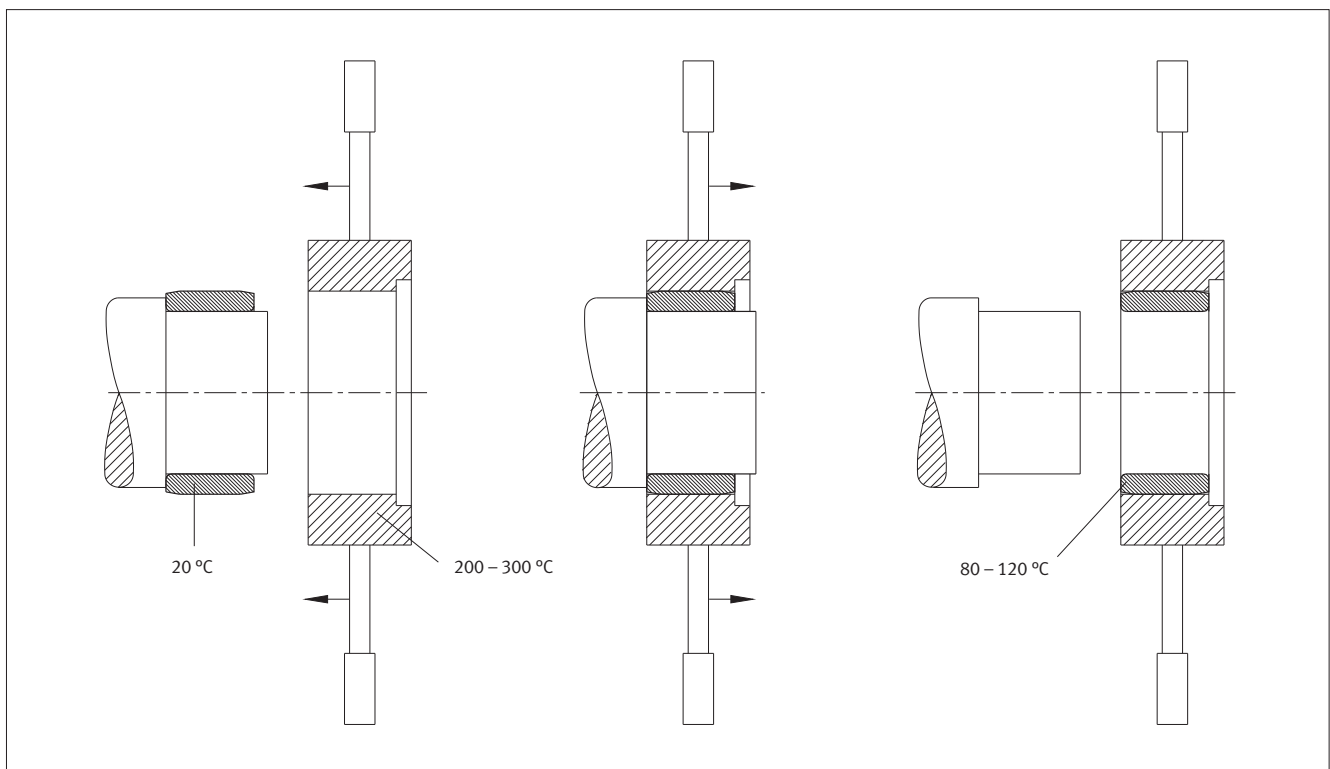
We recommend using the heating ring for dismantling cases where a small quantity of cylindrical roller bearing inner rings with bore diameters of up to approx. 200 mm have to be removed infrequently. In the case of larger quantities, the use of induction heating devices is recommended for bearing rings with a bore diameter of approx. 90 mm and above, see page 12. Mechanical extractors can also frequently be used to dismount small bearing rings with bore diameters of up to approximately 100 mm (see TPI WL 80-56).

Product range, Information required for quotation

The dimension tables in this brochure list the FAG heating rings for the most commonly used cylindrical roller bearing inner rings with bore diameters of 50 mm to 200 mm. Heating rings in other sizes can be supplied by agreement.

In order to prepare a quotation we require the following information:

- Bearing designation or inner ring dimensions
- Shaft fits
- Drawing of mounting position
- Approximate number of parts to be removed per day



FAG heating rings

Features

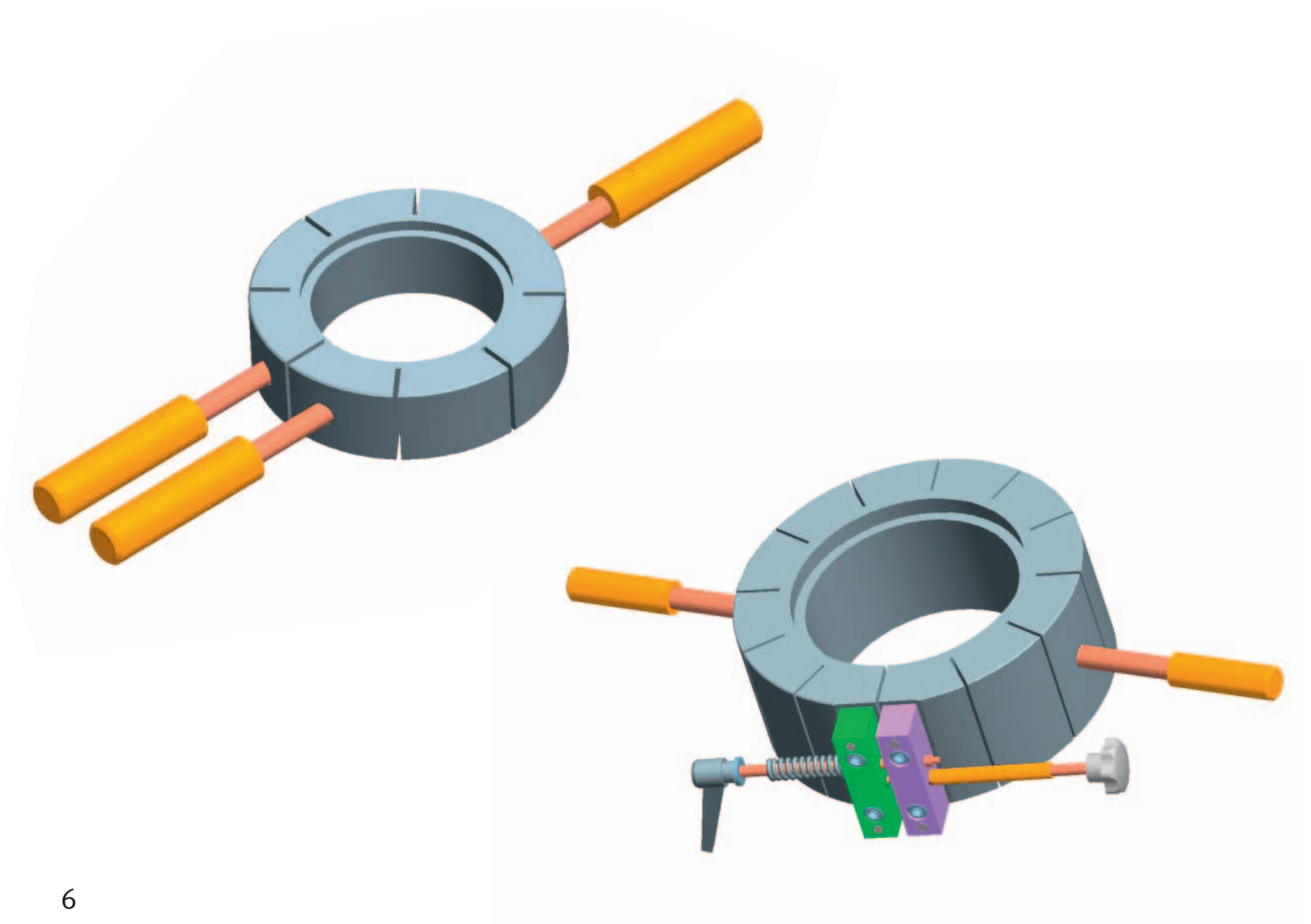
Features of FAG heating rings

Characteristics

- For workpieces with a bore diameter of approx. 50 to 200 mm
- For inner rings of cylindrical roller bearings with a maximum of one rib
- For inner rings of needle roller bearings by agreement
- For other rotationally symmetrical workpieces made from steel by agreement

Advantages

- Simple design
- Easy to handle
- Cost-effective solution for occasional dismounting



FAG heating rings

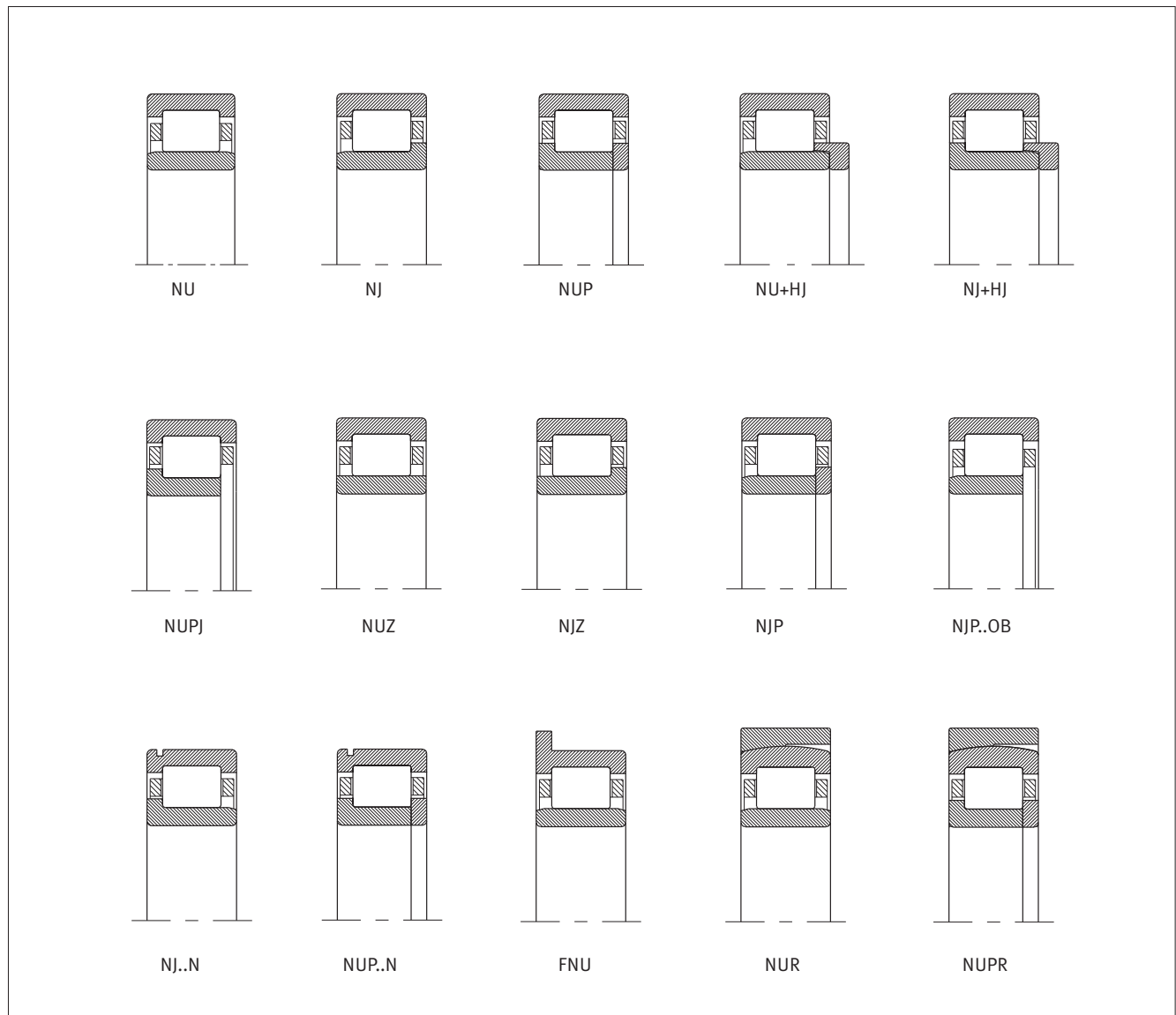
Cylindrical roller bearings with removable inner rings

Cylindrical roller bearings with removable inner rings

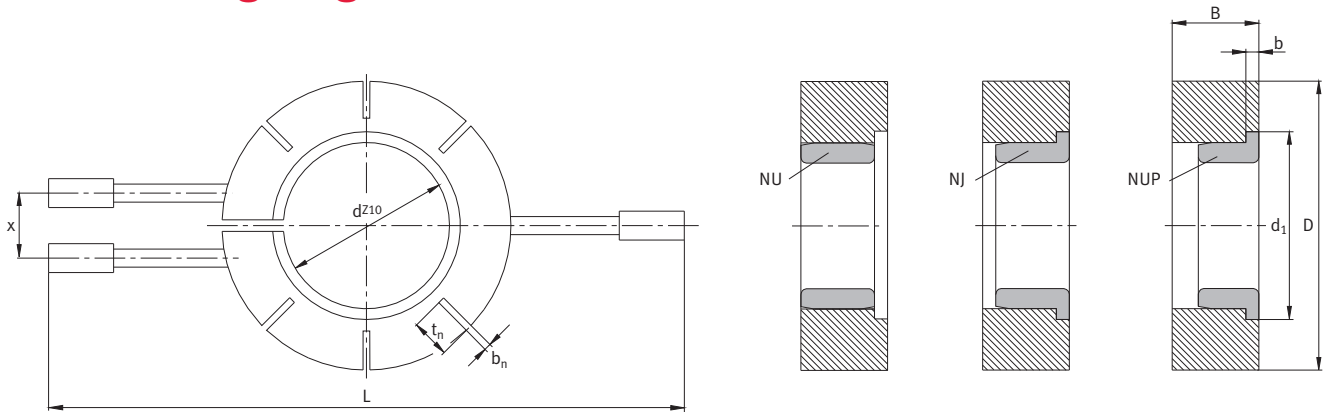
The dimensions of the heating rings are designed such they can be used to remove the inner rings of the

most commonly used cylindrical roller bearing designs NU, NJ and NUP as well as inner rings of other designs of the same bearing size. The following overview shows all

the suitable cylindrical roller bearing designs. Heating rings for needle roller bearing inner rings are available on request.



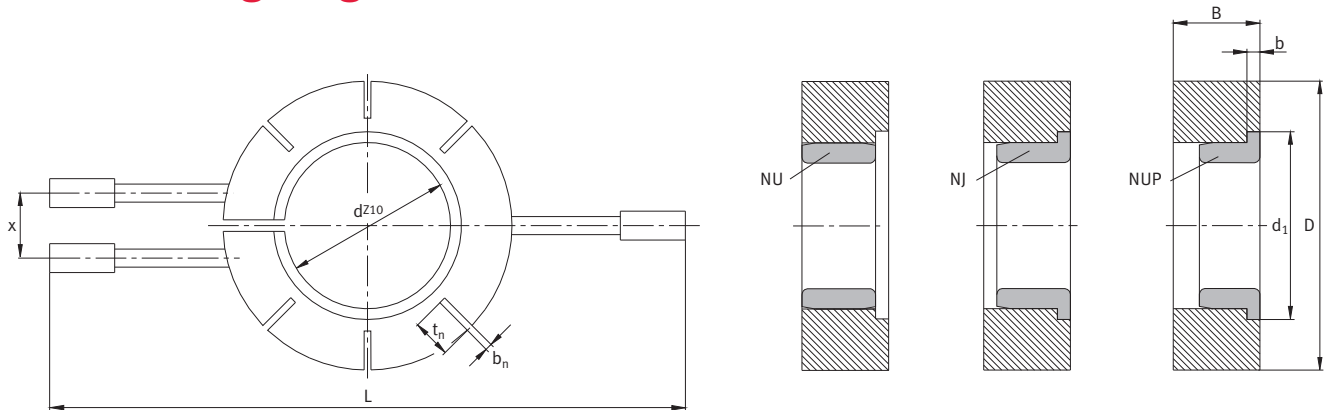
FAG heating rings



FAG heating rings for bearing bore diameter of 50–80 mm

Bearing bore mm	Heating ring Ordering designation FAG	Dimensions		B	d ₁	b	b _n	t _n	L	x
		d mm	D							
50	HEATING-RING-210E	59,5	90	24	64,5	4	2	10	390	35
	HEATING-RING-2210E	59,5	90	27	64,5	4	2	10	390	35
	HEATING-RING-310E	65	110	32	72	5	2	15	410	35
	HEATING-RING-2310E	65	110	46,5	72	6,5	2	15	410	35
	HEATING-RING-410	70,8	125	36,5	79,5	5,5	2	18	425	40
55	HEATING-RING-211E	66	100	24,5	71,5	3,5	2	11	400	35
	HEATING-RING-2211E	66	100	29	71,5	4	2	11	400	35
	HEATING-RING-311E	70,5	115	34	78,2	5	2	15	415	35
	HEATING-RING-2311E	70,5	115	49,5	78,2	6,5	2	15	415	35
	HEATING-RING-411	77,2	135	39,5	86	6,5	2	19	435	40
60	HEATING-RING-212E	72	110	26	78,5	4	2	12	410	35
	HEATING-RING-2212E	72	110	32	78,5	4	2	12	410	35
	HEATING-RING-312E	77	130	36,5	85	5,5	2	18	430	40
	HEATING-RING-2312E	77	130	53	85	7	2	18	430	40
	HEATING-RING-412	83	145	41,5	92,5	6,5	2	20	445	40
65	HEATING-RING-213E	78,5	120	27	85,5	4	2	14	420	35
	HEATING-RING-2213E	78,5	120	35,5	85,5	4,5	2	14	420	35
	HEATING-RING-313E	82,5	135	38,5	91,5	5,5	2	17,5	435	40
	HEATING-RING-2313E	82,5	135	56	91,5	8	2	17,5	435	40
	HEATING-RING-413	89,3	155	44	99,5	7	3	22	455	40
70	HEATING-RING-214E	83,5	130	28	90,5	4	2	15,5	430	40
	HEATING-RING-2214E	83,5	130	35,5	90,5	4,5	2	15,5	430	40
	HEATING-RING-314E	89	145	40,5	98,5	5,5	2	18,5	445	40
	HEATING-RING-2314E	89	145	59,5	98,5	8,5	2	18,5	445	40
	HEATING-RING-414	100	180	50	111,5	8	3	26	480	45
75	HEATING-RING-215E	88,5	135	29	95,5	4	2	15,5	435	40
	HEATING-RING-2215E	88,5	135	35,5	95,5	4,5	2	15,5	435	40
	HEATING-RING-315E	95	155	42,5	105,5	5,5	3	20	455	40
	HEATING-RING-2315E	95	155	63,5	105,5	8,5	3	20	455	40
	HEATING-RING-415	104,5	185	53,5	117	8,5	3	27	485	45
80	HEATING-RING-216E	95,3	145	30,5	103	4,5	2	16,5	445	40
	HEATING-RING-2216E	95,3	145	37,5	103	4,5	2	16,5	445	40
	HEATING-RING-316E	101	165	45	111,5	6	3	21,5	465	45
	HEATING-RING-2316E	101	165	67	111,5	9	3	21,5	465	45
	HEATING-RING-416	110	190	57	123	9	3	26,5	490	45

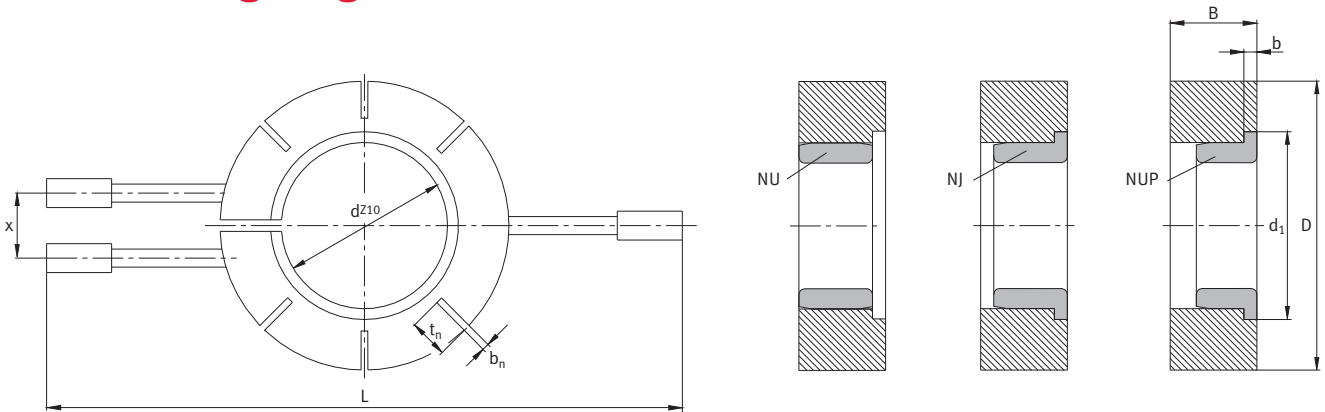
FAG heating rings



FAG heating rings for bearing bore diameter of 85–130 mm

Bearing bore mm	Heating ring Ordering designation FAG	Dimensions d mm	D	B	d ₁	b	b _n	t _n	L	x
85	HEATING-RING-217E	100,5	155	32,5	109	4,5	3	18	455	40
	HEATING-RING-2217E	100,5	155	41	109	5	3	18	455	40
	HEATING-RING-317E	108	175	47,5	119	6,5	3	22,5	475	45
	HEATING-RING-2317E	108	175	70	119	10	3	22,5	475	45
	HEATING-RING-417	113	195	62	127	10	3	27,5	495	45
90	HEATING-RING-218E	107	165	35	115,5	5	3	19,5	465	45
	HEATING-RING-2218E	107	165	46	115,5	6	3	19,5	465	45
	HEATING-RING-318E	113,5	185	49,5	125	6,5	3	24	485	45
	HEATING-RING-2318E	113,5	185	74	125	10	3	24	485	45
	HEATING-RING-418	123,5	215	64	138	10	3	30,5	515	45
95	HEATING-RING-219E	112,5	170	37	122	5	3	19,5	470	45
	HEATING-RING-2219E	112,5	170	49,5	122	6,5	3	19,5	470	45
	HEATING-RING-319E	121,5	200	52,5	133,5	7,5	3	26	500	45
	HEATING-RING-2319E	121,5	200	78,5	133,5	11,5	3	26	500	45
100	HEATING-RING-220E	119	185	39	129	5	3	22	485	45
	HEATING-RING-2220E	119	185	52	129	6	3	22	485	45
	HEATING-RING-320E	127,5	210	54,5	141	7,5	3	27,5	510	45
	HEATING-RING-2320E	127,5	210	83,5	141	10,5	3	27,5	510	45
105	HEATING-RING-221E	125,5	195	42	136	6	3	23	495	45
	HEATING-RING-321E	133	225	56,5	148	7,5	3	30	525	45
110	HEATING-RING-222E	132,5	205	44	143	6	3	24	505	45
	HEATING-RING-2222E	132,5	205	61,5	143	8,5	3	24	505	45
	HEATING-RING-322E	143	240	58	157	8	3	32,5	540	45
	HEATING-RING-2322E	143	240	92,5	157	12,5	3	32,5	540	45
120	HEATING-RING-224E	143,5	220	46	155	6	3	25,5	520	45
	HEATING-RING-2224E	143,5	220	67	155	9	3	25,5	520	45
	HEATING-RING-324E	154	250	63,5	170	8,5	3	32	550	45
	HEATING-RING-2324E	154	250	98	170	12	3	32	550	45
130	HEATING-RING-226E	153,5	230	46	166	6	3	25,5	530	45
	HEATING-RING-2226E	153,5	230	74	166	10	3	25,5	530	45
	HEATING-RING-326E	167	275	67	184	9	3	36	575	45
	HEATING-RING-2326E	167	275	107	184	14	3	36	575	45

FAG heating rings



FAG heating rings for bearing bore diameter of 140–200 mm

Bearing bore mm	Heating ring Ordering designation FAG	Dimensions								
		d mm	D	B	d ₁	b	b _n	t _n	L	x
140	HEATING-RING-228E	169	260	49	182	7	3	30,5	560	45
	HEATING-RING-2228E	169	260	80	182	12	3	30,5	560	45
	HEATING-RING-328E	180	295	72	198	10	3	38,5	595	45
	HEATING-RING-2328E-C	180	295	118	198	16	3	38,5	595	45
150	HEATING-RING-230E	182	285	52,5	195	7,5	3	34,5	585	45
	HEATING-RING-2230E-C	182	285	85,5	195	12,5	3	34,5	585	45
	HEATING-RING-330E-C	193	315	75	212	10	3	40,5	615	45
	HEATING-RING-2330E-C	193	315	124,5	212	16,5	3	40,5	615	45
160	HEATING-RING-232E	195	305	56	209	8	3	37	605	45
	HEATING-RING-2232E-C	193	300	92,5	208	12,5	3	36	600	45
	HEATING-RING-332E-C	204	335	78	224	10	3	44	635	45
	HEATING-RING-2332E-C	204	335	131	224	17	3	44	635	45
170	HEATING-RING-234E	207	325	60	222	8	3	40	625	45
	HEATING-RING-2234E-C	205	315	98	221	12	3	37	615	45
	HEATING-RING-334E-C	218	365	83	239	11	3	49	665	45
	HEATING-RING-2334EX-C	216	365	137,5	238	17,5	3	49	665	45
180	HEATING-RING-236E	217	335	60	232	8	3	40	635	45
	HEATING-RING-2236E-C	215	330	98	231	12	3	39	630	45
	HEATING-RING-336E-C	231	380	86,5	253	11,5	3	50	680	45
	HEATING-RING-2336EX-C	227	385	144	250	18	3	51	685	45
190	HEATING-RING-238E	230	355	63,5	246	8,5	3	42	655	45
	HEATING-RING-2238E-C	228	350	105,5	245	13,5	3	41	650	45
	HEATING-RING-338E-C	245	400	90	266	12	3	52	800	45
	HEATING-RING-2338EX-C	240	405	150,5	264	18,5	3	54	805	45
200	HEATING-RING-240E	243	380	67	260	9	3	46	680	45
	HEATING-RING-2240E-C	241	370	112	259	14	3	43	670	45
	HEATING-RING-340E-C	258	430	92	281	12	3	57	830	45
	HEATING-RING-2340EX-C	253	430	157	278	19	3	57	830	45

FAG heating rings

Ordering examples · Recommended accessories · Heat conducting paste

Ordering examples for FAG heating rings

HEATING-RING-312E

(for cylindrical roller bearing inner rings of the size 312E, overview of possible bearing designs, see page 7)

Heating rings for FAG special bearings are given the bearing code as the suffix, i.e. Z-500000 or F-800000.

Example:

HEATING-RING-F-801634

(for inner ring of an FAG cylindrical roller bearing F-801634)

Heating rings **with clamping device** are given the suffix C.

Example:

HEATING-RING-2330E-C

(for inner ring of an FAG cylindrical roller bearing NU/NJ/NUP2330-E)



FAG heating plate HEATER-PLATE-370C

Recommended FAG accessories

- Electric heating plate
Ordering designation: **HEATER-PLATE-370C**
- Temperature measuring device
Ordering designation: **TEMP-CHECK-CONTACT**
- Gloves
Ordering designation: **GLOVE2**
- Heat conducting paste
(see following section)



FAG temperature gauge TEMP-CHECK-CONTACT



FAG gloves GLOVE2

FAG heat conducting paste HEATING-RING.PASTE

The silicone-free heat conducting paste HEATING.RING.PASTE is used as an aid in the dismantling of bearing inner rings by means of heating rings.

The cylindrical outside surface of the bearing inner ring is coated with the heat conducting paste prior to removal. This achieves optimum heat transfer from the heating ring to the bearing inner ring.

Ordering designation (disposable syringe containing 20 ml silicone-free heat conducting paste):

HEATING-RING.PASTE-20ML



FAG heat conducting paste HEATING-RING.PASTE-20ML

FAG electric induction heating devices

Principles of induction heating

Principles of induction heating

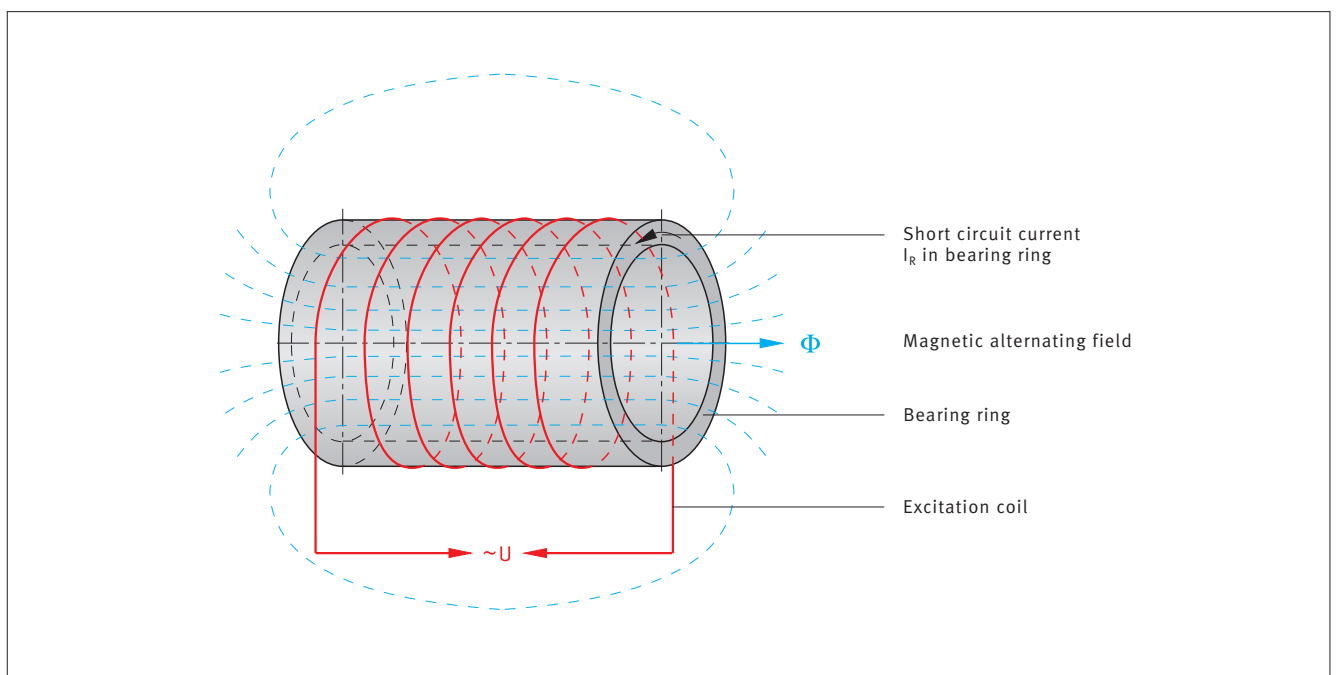
If an alternating current is applied to a coil, a highly magnetic alternating field is generated within it. When a bearing ring is introduced to this alternating field, a current is induced within it. A high short circuit current is generated, which heats the ring, Figure 1. Since this current flows predominantly at the surface as a result of the skin effect and good magnetic coupling, the ring surface heats up more quickly than the inside of the ring. This fact accommodates the requirement that the amount of heat transferred to the shaft when loosening shrink fits is kept to a minimum in order to produce sufficient clearance between the inner ring and shaft.

For induction heating, the penetration depth is dependent on the frequency of the alternating current. The usual frequency of 50 Hz in Germany (60 Hz in Anglo-Saxon countries) has proved to be sufficient for the most common wall thicknesses of inner rings in cylindrical roller bearings and needle roller bearings. The bearing rings become magnetic during induction heating. The necessary demagnetisation process is carried out using the same induction coil. Induction heating devices are suitable for dismantling cylindrical roller bearing and needle roller bearing inner rings, labyrinth rings, couplings and other rotationally symmetrical parts with a minimum bore diameter of 90 mm.

With smaller press fits, however, the shaft also heats up too quickly and consequently the interference cannot be eliminated. In these cases, good results have been obtained with aluminium heating rings, see page 4.

Induction heating devices can also be used to heat the parts for mounting.

Induction heating devices are usually only designed for one bearing size. However, the same device can be used for rings with only slight variations in raceway diameter and width.



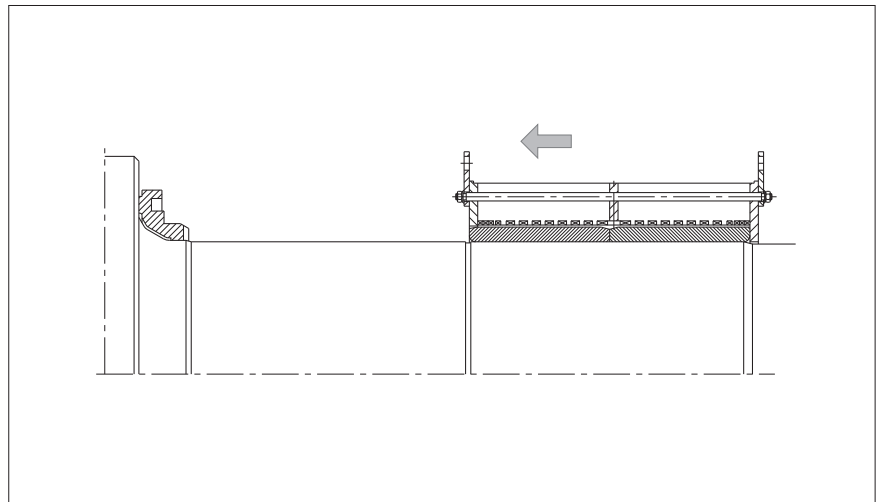
1: Principles of induction heating

FAG electric induction heating devices

Handling · Mounting

Handling FAG induction heating devices

The process is essentially the same for both the mains voltage and low voltage designs. Guide values for the required heating time can be found in the diagram on page 16. The exact heating time must be determined by means of tests. The cable connections for the power supply line and for monitoring the temperature must be checked prior to initial operation. In the case of the low voltage devices, it is also necessary to check that the water cooling system is functioning correctly.

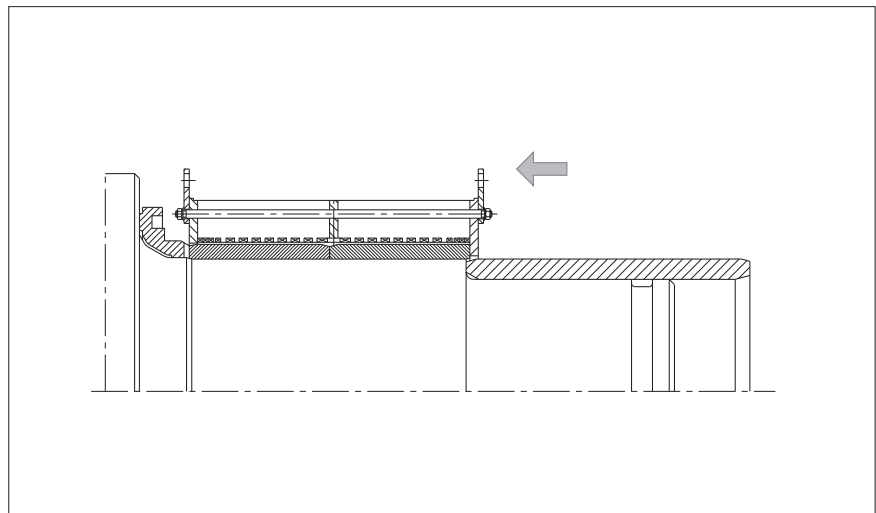


2: Mounting of two inner rings using the induction heating device.
Withdrawal takes place using the same procedure in reverse

Mounting

The bearing rings are placed in the bore of the FAG induction heating device for heating. Once heated to mounting temperature, inner rings with a bore diameter of up to approximately 300 mm are pushed onto the shaft by hand (use heat-insulated gloves GLOVE2) whilst larger bearing rings are pushed on using the device, Figure 2. If the front end of the shaft is stepped, a mounting ring should be used to guide the rings whilst they are being pushed onto the shaft, Figure 3.

During the cooling process, the rings which have been pushed onto the shaft must be axially clamped in order that they abut the labyrinth ring or the shoulder of the shaft once cooled.



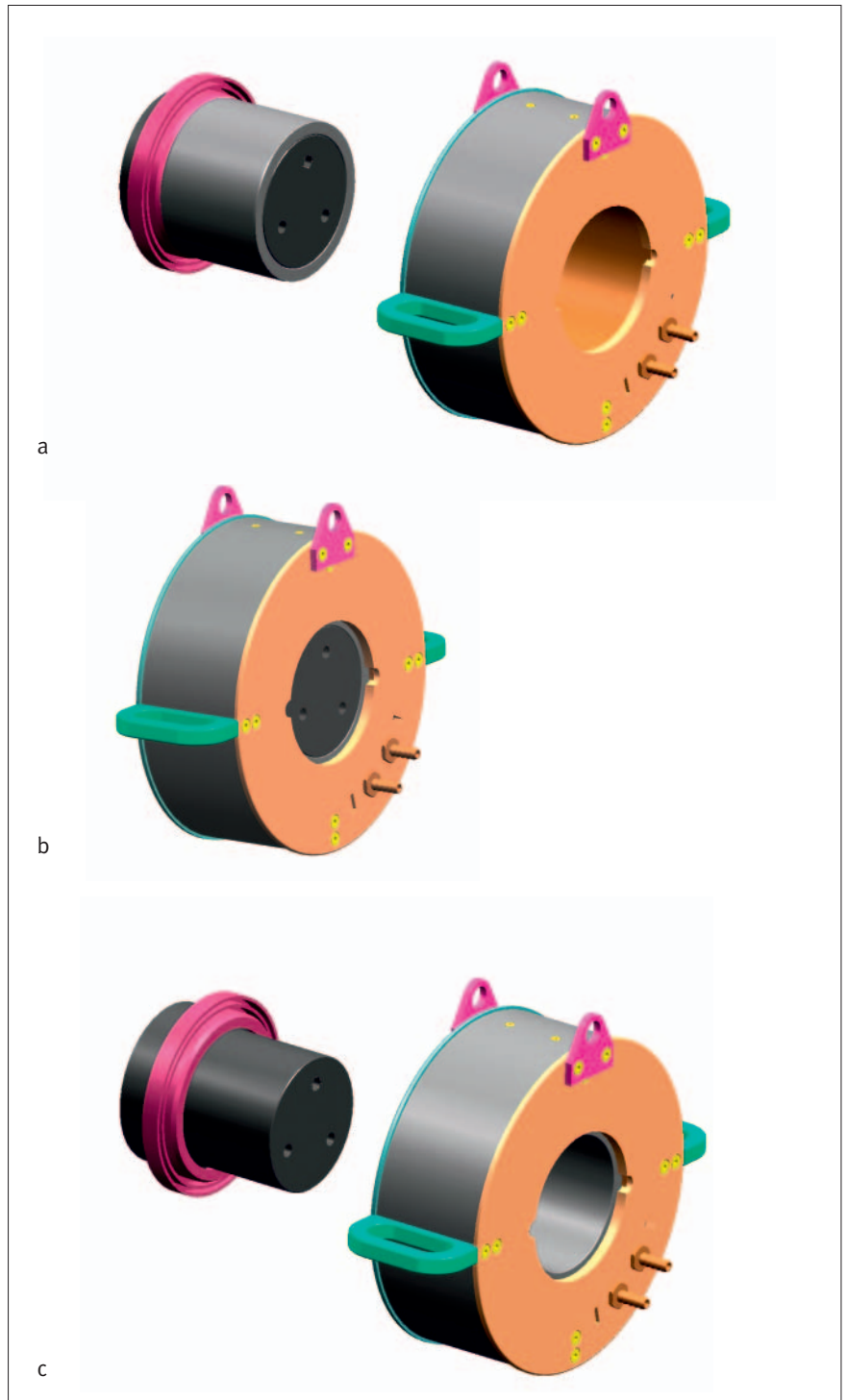
3: A mounting ring is used to guide the rings whilst they are being pushed onto the shaft

FAG electric induction heating devices

Dismounting

Dismounting

For withdrawal, the coil is pushed onto the cleaned inner rings, the catches are pressed into the recesses in the labyrinth ring and the bearing rings are heated. The heating temperature (usually 80...120 °C) is governed by the duty cycle (by a time relay in the case of larger devices). As soon as the inner rings have reached the required temperature, they are extracted from the shaft together with the coil. Larger devices are moved by crane.



4: Dismounting of an inner ring; a: Pushing the coil onto the inner ring, b: Heating the inner ring, c: Withdrawal of the inner ring from the shaft with the coil

FAG electric induction heating devices

Demagnetisation

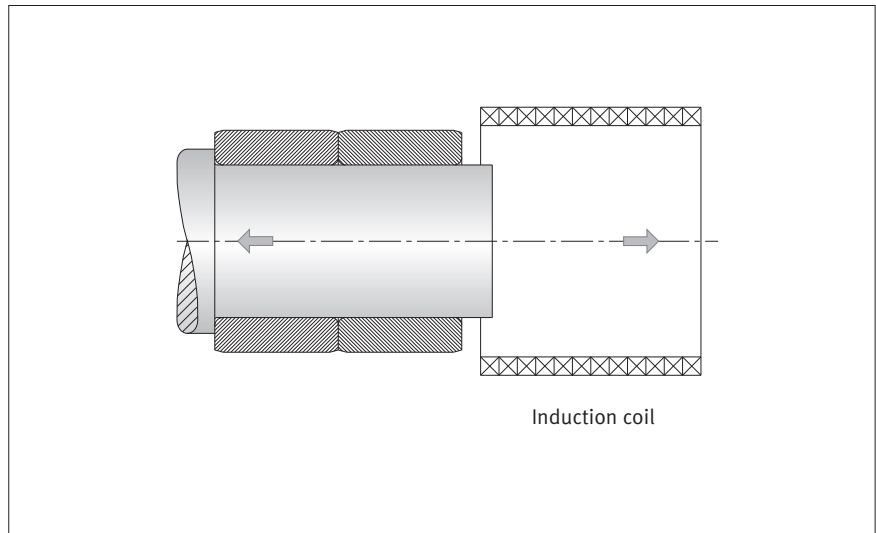
Demagnetisation

With induction heating, a lesser or greater level of residual magnetism remains in the heated parts. Parts which are to be reused, in particular rolling bearing rings, must be demagnetised.

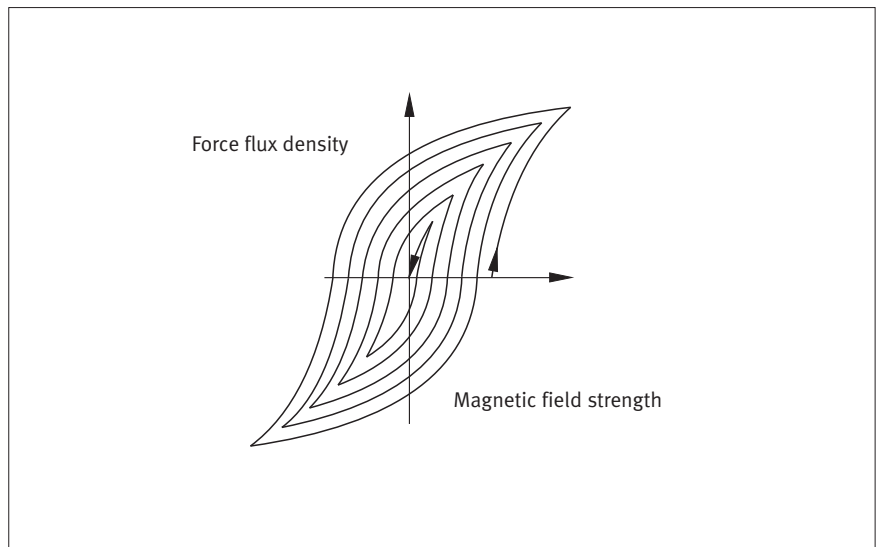
Demagnetisation is carried out using the same induction heating device that is used for heating. The coil is pushed onto the mounted rings in compliance with the instruction manual and withdrawn from the mounting parts while the current is switched on, Figure 5a.

The magnetic field strength draws closer to zero as the distance between the coil and the inner rings or shaft increases, Figure 5b.

As a rule, the parts are sufficiently demagnetised once a distance of 1 m or 2 m is reached. It may be necessary to carry out a second demagnetisation process. Larger and heavier rings that have been induction heated for dismantling purposes are placed on a board in front of the coil and rolled out of the magnetic field.



5a: Diagram showing demagnetisation process



5b: Flow of magnetic variables in the parts to be demagnetised

FAG electric induction heating devices

Heating temperature and heating time · Devices for cylindrical roller bearing and needle roller bearing inner rings

Heating temperature and heating time

Rolling bearings are usually heated to between 80 and max. 120 °C for mounting. This temperature is sufficient at a room temperature of approximately 20 °C for all conventional rolling bearing fits.

The heating process for the withdrawal of shrink fitted bearing rings or similar parts must be performed sufficiently quickly to ensure that the shaft is only slightly heated and the necessary clearance between the joined parts is achieved. The period after which the shrink fitted parts can be safely withdrawn is referred to as the heating time.

The permissible heating time is defined by the point at which there is still sufficient clearance to withdraw the parts.

In the case of FAG heating devices, the temperature is defined after the heating time. More detailed information can be found in the instruction manuals for the individual devices.

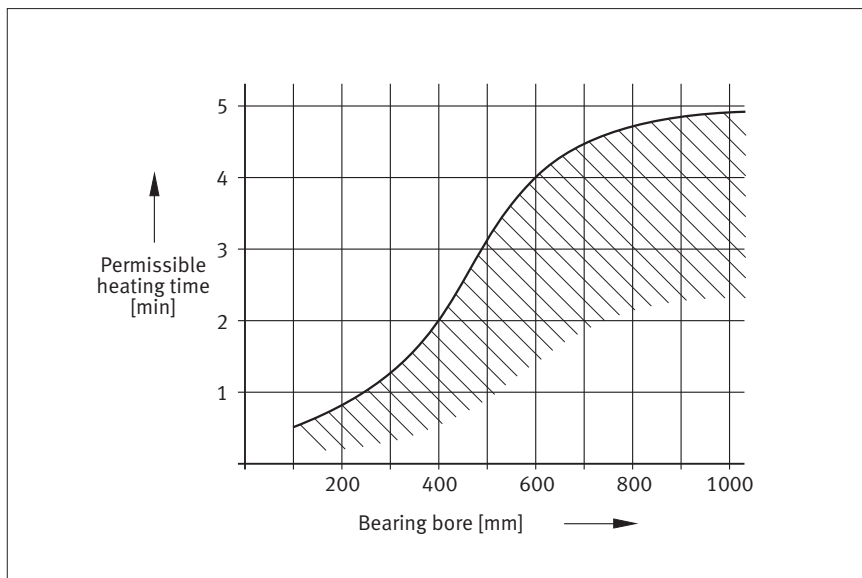
Guide values for the permissible heating time, based on the inside diameter of the shrink fitted parts, can be found in the diagram, Figure 6.

FAG induction heating devices for cylindrical roller bearing and needle roller bearing inner rings

Since 1930, when the changeover from using plain bearings to using cylindrical roller bearings as wheelset bearings in railway vehicles began, we have been involved in developing induction devices which serve primarily to heat cylindrical roller bearing inner rings.

Due to ease of mounting, an increasing number of cylindrical roller bearings were also used for roll arrangements after the Second World War. In the case of large roll arrangements, however, the conventional mains voltage devices used up to that point were found to be too heavy and difficult to handle. As a result, we developed the so-called low voltage devices for larger bearings. In the case of these devices, the winding is fed low voltage of 20...40 V rather than 400 V and cooled using water. As a result, the coil can be designed for a specifically higher current load. The actual heating device is lighter and offers increased efficiency. A further advantage of the low voltage devices is their high occupational safety.

Induction heating devices are suitable for heating inner rings without ribs (design NU) and inner rings with one rib.



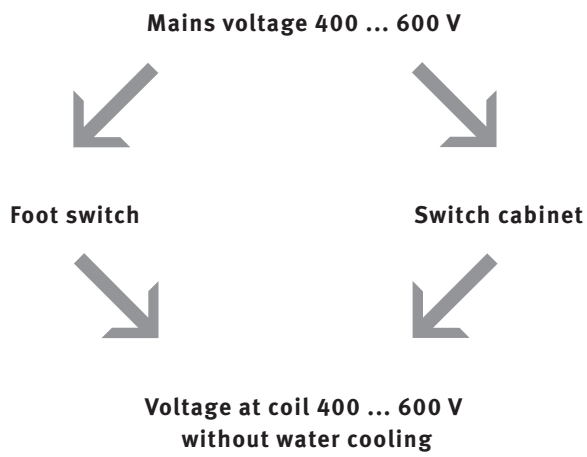
6: Permissible heating time, relative to bearing bore (guide values)

FAG electric induction heating devices

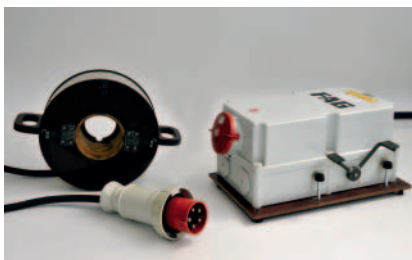
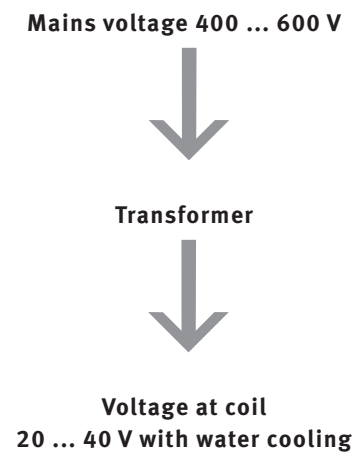
Designs of heating devices (overview)

Possible designs of electric induction heating devices

Mains voltage devices



Low voltage devices



FAG electric induction heating devices

Factors in selecting heating devices

Factors in selecting FAG induction heating devices

Induction heating devices are predominantly used to dismount cylindrical roller bearing inner rings in rolling mills or wheelset and traction motor bearing arrangements in railway vehicles.

Their purpose is to make the fitter's job easier and to reduce the time required to mount and dismount the rolling bearings. The heating devices should therefore be easy to operate and operationally reliable.

Induction heating devices are usually only designed for one size of cylindrical roller bearing, needle roller bearing, labyrinth ring or coupling.

Work time is reduced as a result of using induction heating devices, as dismounting work can be carried out rapidly, reliably and cleanly. Extended downtime can therefore be avoided.

Whether a mains or low voltage device is used depends on how the equipment will be used.

The low voltage system with water cooling is the preferred option for stationary equipment.

It is also advisable to use the low voltage device if the operating conditions are harsh.

When selecting the system, consideration should also be given to whether several bearing rings or just a few bearing rings are to be heated. A mains voltage device is unsuitable if the heating device is in almost continuous operation.

FAG electric induction heating devices

Mains voltage devices with foot switch

Mains voltage devices with foot switch

Mains voltage devices for medium-sized bearing rings ($d < 150 \text{ mm } \varnothing$, max. mass 9 kg) can be connected to a 125 A power socket on the 400 V three-phase supply network with a foot switch.

The heating device can be switched between 400 V (to heat the inner rings) and 230 V (for demagnetisation) using the foot switch.

The coil body is made of laminated fabric. All externally guided steel parts, such as the withdrawal catches for example, are connected to the protective conductor.

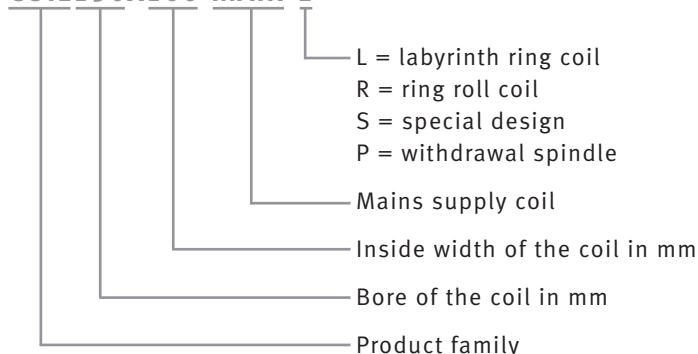
It takes approx. 35...40 s to heat the inner rings to the required mounting temperature of 80...120 °C. The induction heating device with foot switch must be switched off manually, as this does not have a time control system.

Since the windings for the low voltage devices are not cooled, a cooling phase of approximately 30 minutes should be scheduled in after 3 to 4 heating periods.

Ordering designation for coil used with mains voltage devices

Example:

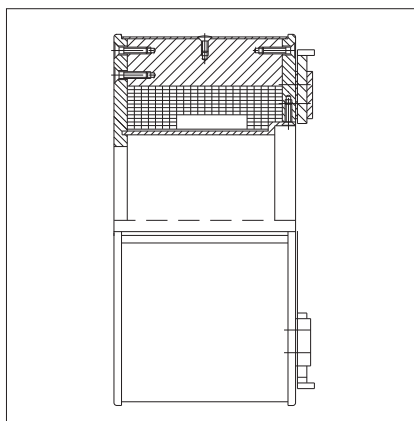
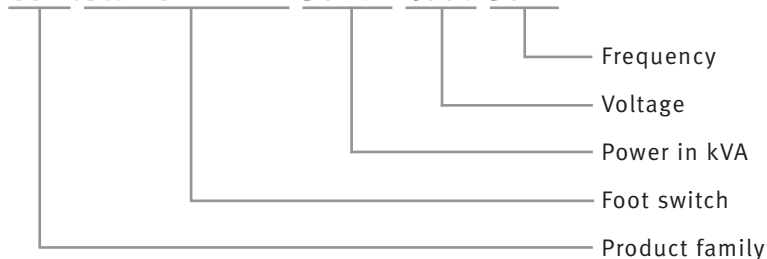
COIL150X100-MAIN-L



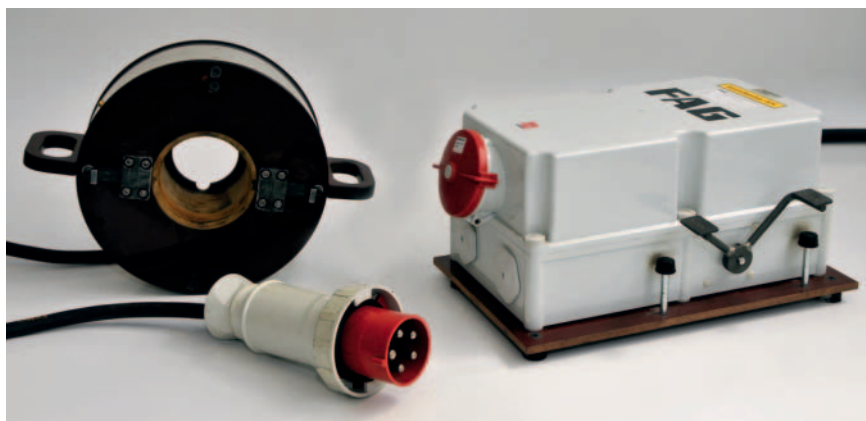
Ordering designation for foot switch used with mains voltage devices

Example:

COIL.SWITCH-PEDAL-50KVA-400V-50HZ



7: Coil of a mains voltage device



8: Mains voltage devices with foot switch

FAG electric induction heating devices

Mains voltage devices with foot switch · Features

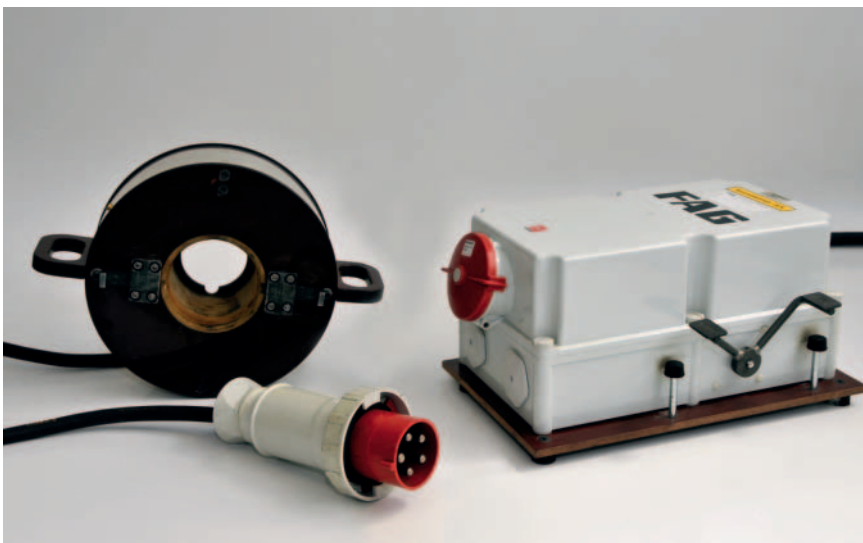
Features of FAG mains voltage devices with foot switch

Characteristics

- Device operated using mains voltage
- Two power steps incl. demagnetisation
- Mass of device e.g. for WJ/WJP120×240 approximately 30 kg
- Monitoring of inner ring temperature when heating performed with FAG temperature gauge TEMP-CHECK-CONTACT

Advantages

- Clean
- Rapid
- Cost-effective induction-based dismounting solution

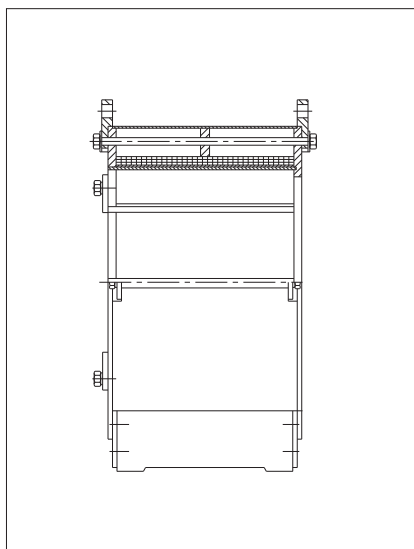


FAG electric induction heating devices

Mains voltage devices with switch cabinet

Mains voltage devices with switch cabinet

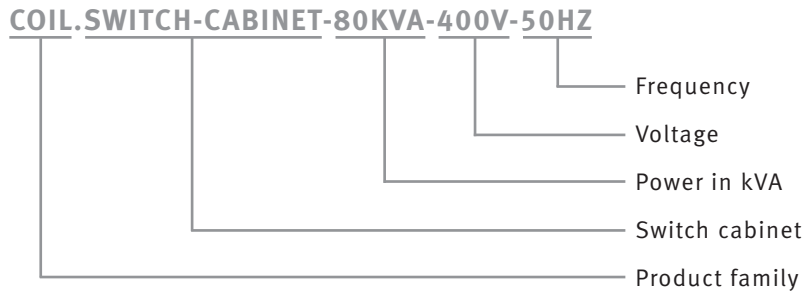
The switch cabinets are fitted with a time relay to control the heating time. Once the required heating time has been determined in the test, this value can be set on the time relay for all subsequent heating processes. This prevents overheating of the bearing inner rings. The switch cabinet also has a connection socket for monitoring the temperature of the coil. If there is an imminent risk of the coil overheating due to consecutive heating processes, the device will automatically switch off. The coil is connected to a switch cabinet using a 10 m cable. Only one coil can be connected at any one time. We supply switch cabinets for current consumptions of 160, 200 and 400 A, depending on the size and mass of the workpiece, Figure 10.



9: Induction coil for connection to 400 V with switch cabinet 400 A

Ordering designation for switch cabinet used with mains voltage devices

Example:



The switch cabinet has the following controls:

- Main switch
- Control keys “On”, “Off”, “Demagnetise”, “Emergency shut-off”
- Ammeter
- Time relay



10: Mobile switch cabinet (can also be used as a wall box if the rollers are removed)

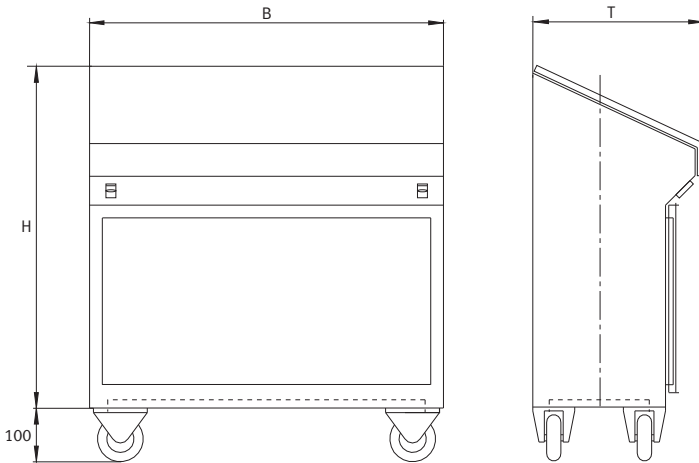
FAG electric induction heating devices

Mains voltage devices with switch cabinet

Coils for larger bearing inner rings are fitted with a hanging device. This allows them to be suspended from the crane along with the bearing rings and slid onto or removed from the roll neck. For small bearing bores, particularly when used in combination with hollow shafts, we recommend using an induction coil with a withdrawal spindle, Figure 11.



11: Induction coil with withdrawal spindle (on request)



12: Dimensions, technical data and designations for FAG switch cabinets used with induction heating devices for mains voltage

Switch cabinet Designation	Current consumption (Fuse protection)*	Cross section of connecting cable*	Dimensions and mass of switch cabinet			Ring mass	
			W	D	H	Mass ≈ kg	≈ kg
FAG		mm ²	mm				
COIL.SWITCH-CABINET-64..	160 A	4×25	600	480	960	80	30
COIL.SWITCH-CABINET-80..	200 A	4×35	600	480	960	80	100
COIL.SWITCH-CABINET-160..	400 A	4×95	1000	480	960	100	250

* The data only apply at 400 V and with cable routing performed in accordance with VDE 0100 Part 410 and 430.

FAG electric induction heating devices

Mains voltage devices with switch cabinet

Features of FAG mains voltage devices with switch cabinet

Characteristics

- Device operated using mains voltage
- Two power steps incl. demagnetisation
- Mass of coil e.g. for WJ/WJP120×240 approximately 30 kg
- Heating time controlled by means of timer

Advantages

- Clean
- Rapid
- Cost-effective induction-based dismantling solution
- Convenient handling characteristics when dismantling performed using timer
- Heating time controlled by means of timer



FAG electric induction heating devices

Low voltage devices

FAG induction heating devices for low voltage supply

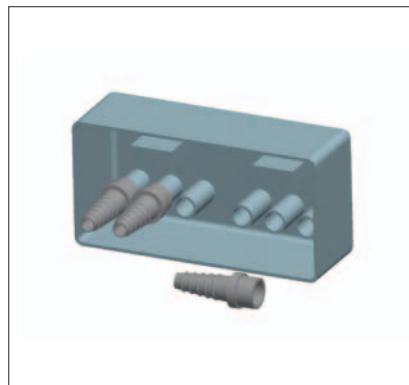
FAG induction heating devices that operate in the range 20 ... 40 V/ 50 Hz have water-cooled hollow copper windings. As a result, they are significantly lighter than mains voltage devices. Due to the more favourable magnetic coupling of the single-layer or, as a maximum, dual-layer coil, they also have a greater level of efficiency.

The coil is connected up to a mobile single phase dry transformer using a 3 m long flexible cable loom, Figure 13. In the case of transformer COIL.TRAFO-45KVA the connection is made using instant plug-in couplings, Figure 14, in the case of larger transformers copper lugs are used, Figure 15.

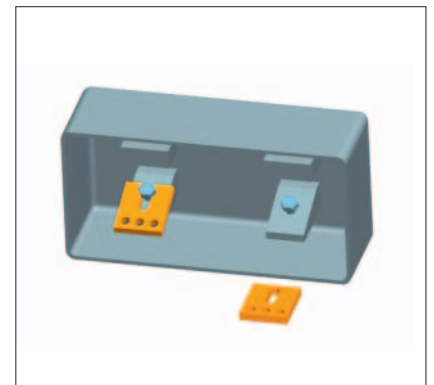
The secondary voltage, i.e. the operating voltage for the heating device, can be adjusted between 20 V and 40 V in 5 V graduations. As a result, the power can be matched to the relevant requirements. A monitoring device prevents both thermal overloading of the transformer winding and damage to the coil winding in the absence of sufficient cooling water. A load break switch is installed as a master switch.



13: FAG induction heating device for low voltage with transformer for dismantling the inner rings of cylindrical roller bearings



14: Instant plug-in coupling



15: Copper lugs

FAG electric induction heating devices

Low voltage devices

Where required, the voltage can be increased by 5 V per work stage by changing the connections at the terminal blocks on the primary side.

The transformers are designed for a duty cycle of 20 %, based on one hour. Taking account of breaks inherent to the mounting process, the mounting device for low voltage can be run almost continuously. As a result, these devices are particularly suitable for dismantling large quantities.

The use of low voltage devices is also beneficial for very heavy workpieces such as, for example, larger inner rings and coupling members for rolling trains.

The transformer has the following controls:

- Ammeter for primary current consumption
- Time relay for controlling the heating times
- “On” and “Off” keys
- Mode switch for the individual work stages (demagnetisation, heating for mounting, heating for withdrawal)

Ordering designation for coil used with low voltage devices

Example 1:

COIL152X145-LOW no suffix
for cylindrical roller bearing inner rings

Example 2:

COIL825X130-LOW-L

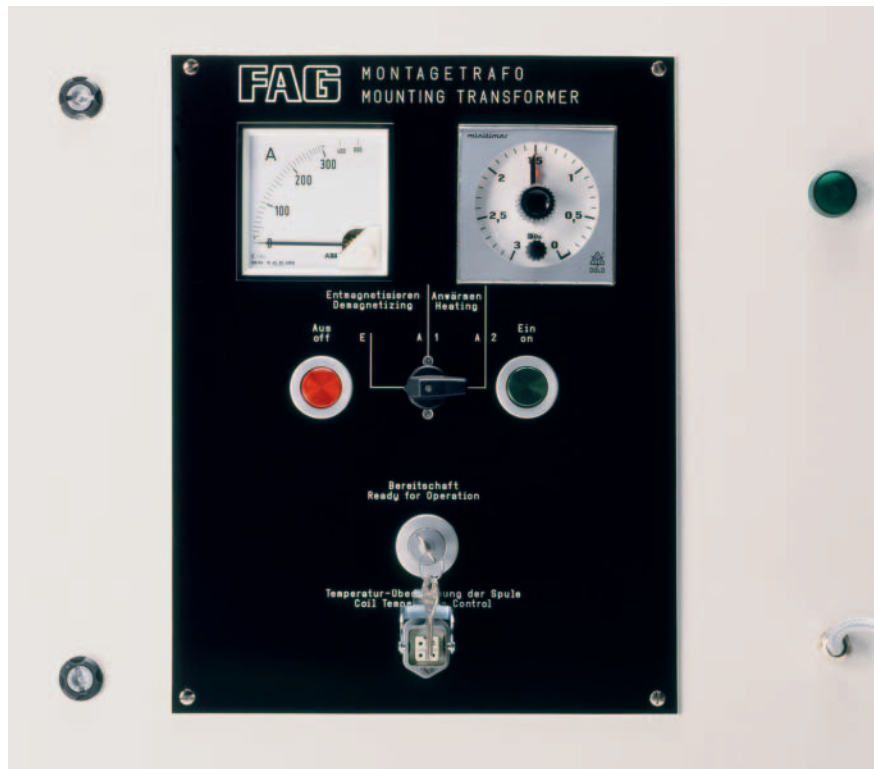
- L = labyrinth ring coil
- C = coupling member coil
- S = special design
- p = withdrawal spindle

Low voltage coil

Inside width of the coil in mm

Bore of the coil in mm

Product family



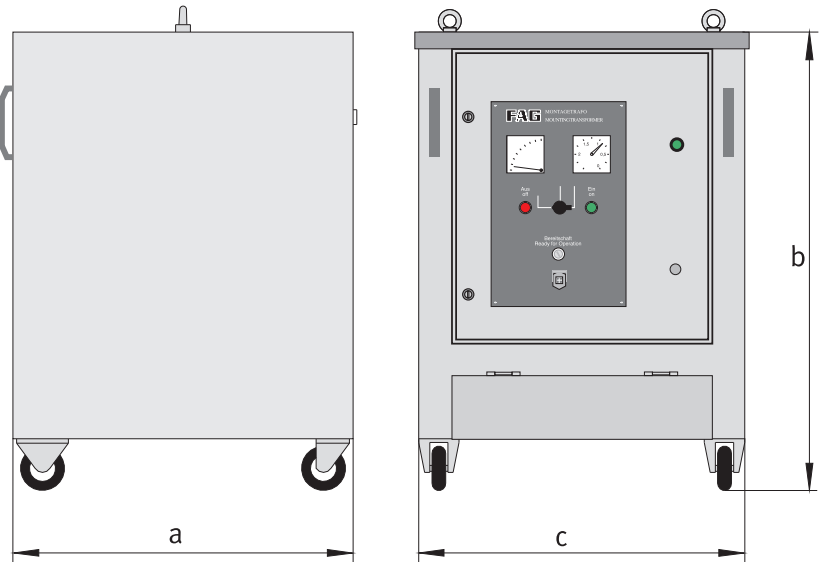
16: Transformer control panel

FAG electric induction heating devices

Low voltage devices

We supply transformers for induction heating devices in various sizes for every requirement (COIL.TRAFO-45KVA... to COIL.TRAFO-400KVA...).

The largest transformer with ventilator cooling – intermittent power 400 kVA – is sufficient to heat inner rings with a ring mass of 1200 kg to the required mounting temperature of 80...120 °C within the required heating time (for couplings, max. mass of 600 kg).
 Technical data, Figure 17.



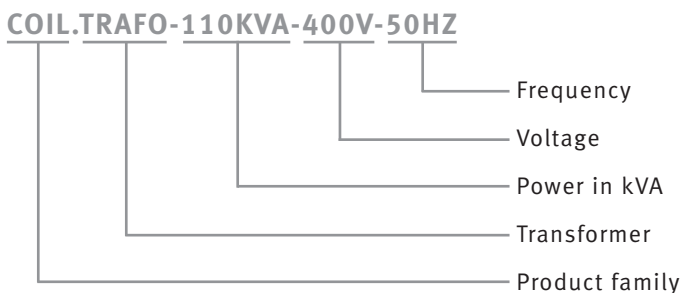
17: Dimensions, technical data and designations for FAG single phase dry transformers used with induction heating devices

Transformer Designation	Intermittent power kVA	Primary current consumption* (Fuse protection) A	Cross section of connecting cable* mm ²	Dimensions and mass			Ring mass max. kg	Coupling member mass max. kg	
				a mm	b mm	c mm			
COIL.TRAFO-45KVA...	45	112,5	3×25	970	1150	660	280	20	–
COIL.TRAFO-75KVA...	75	188	3×35	970	1150	660	300	35	–
COIL.TRAFO-110KVA...	110	275	3×70	970	1150	660	410	90	–
COIL.TRAFO-180KVA...	180	450	3×95	1200	1350	790	650	250	200
COIL.TRAFO-290KVA...	290	725	3×150	1200	1350	790	780	750	400
COIL.TRAFO-400KVA...	400	1000	3×185	1200	1600	790	1000	1200	600

* The data only apply at 400 V and with cable routing in accordance with VDE 0100 Part 410 and 430.

Ordering designation for transformer used with low voltage devices

Example:



FAG electric induction heating devices

Low voltage devices

Features of FAG low voltage devices

Characteristics

- Water cooled induction coil
- Operated with low voltage 20 ... 40 V
- Mass of coil e.g. for WJ/WJP120×240 only approximately 7 kg
- Heating time controlled by means of timer
- Five different power steps possible, incl. demagnetisation
- High level of efficiency
- Thermal protection for transformer winding and coil winding
- Connection between transformer and coil:
 - instant plug-in coupling for COIL.TRAFO-45KVA..
 - copper lugs for larger transformers

Advantages

- Easy handling for dismantling
- Easy to handle as a result of reduced weight compared with mains voltage devices
- Easy operation, with very low risk of changes in material structure due to time control
- Flexible adjustment for adverse dismantling conditions, e.g. unfavourable fit conditions, fretting corrosion
- Rapid and efficient operation
- Coil can be easily and rapidly replaced
- Automatic shut-off where there is an imminent risk of overheating



FAG electric induction heating devices

Special designs

FAG induction heating device for labyrinth rings

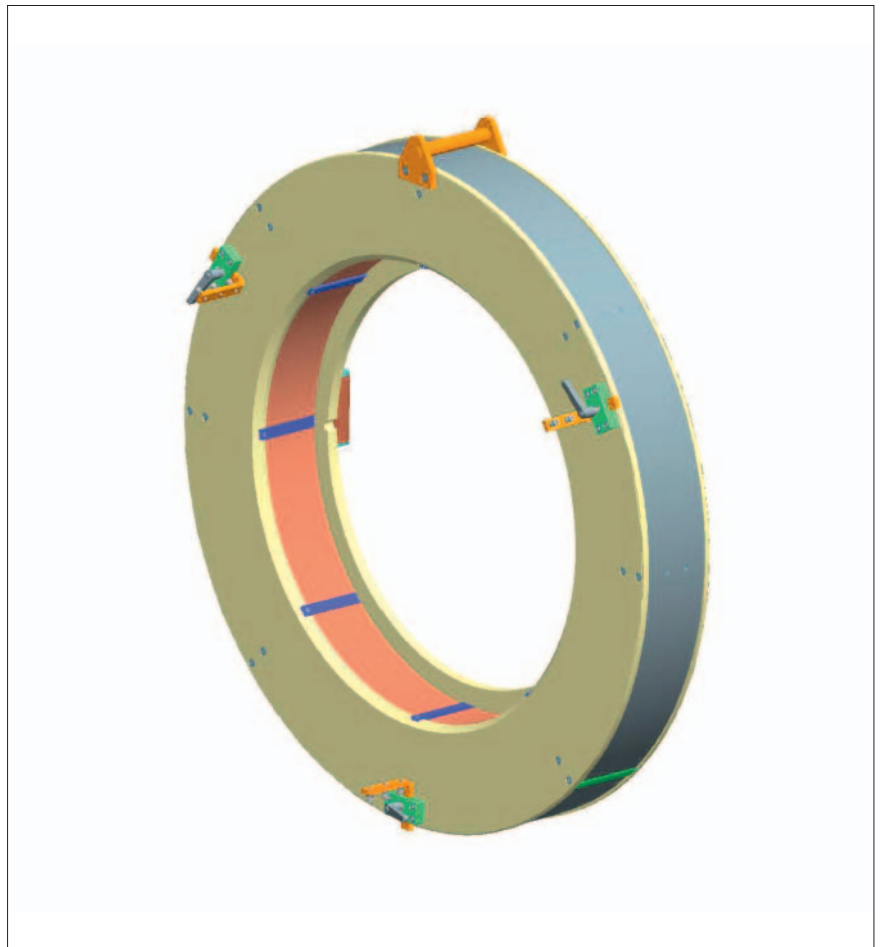
We also supply mains and low voltage devices for the purposes of heating labyrinth rings.

Labyrinth rings are usually shrink fitted with a significant amount of interference so that they do not come away from the shaft when heated by the contact seal.

The withdrawal of labyrinth rings with a tight fit frequently causes problems.

With the aid of such a device, labyrinth rings can be heated to 150...200 °C within a few minutes (depending on the fit) and the interference thereby removed.

The structure of the induction heating devices for labyrinth rings basically matches that of the induction systems for bearing rings. An FAG induction coil for labyrinth rings is illustrated in Figure 18.

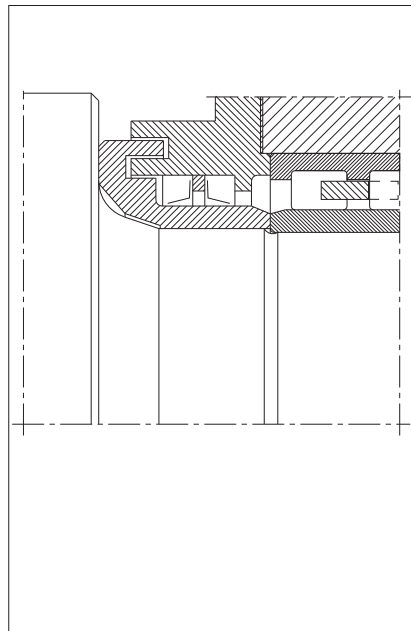


18: Induction coil for use with mains voltage of 400 V, for heating labyrinth rings

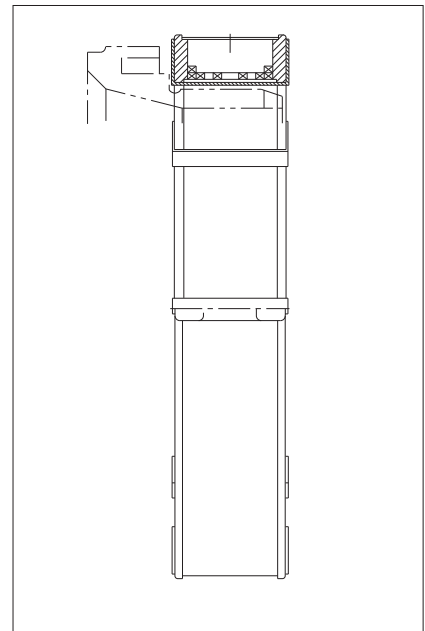
FAG electric induction heating devices

Special designs

The equipment shown in Figure 20 is used to heat the labyrinth rings on the work rolls of a 4,2 m heavy plate line (Figure 19). This is connected up to the transformer that is present for dismantling the bearing rings.



19: Work roll bearing arrangement of a 4,2 m heavy plate mill



20: Induction coil for use with low voltage, for connecting to a transformer
COIL.TRAFO-180KVA-400V-50HZ

FAG induction heating device for roll couplings

In the case of high speed finishing stands for wire and light section steel lines, it is sometimes the case that not only the bearing rings but also the coupling members are tightly fitted on the roll necks.

The coupling members must be removed and mounted onto other rolls each time the rolls are replaced. In the case of the hydraulic method previously used, this was a laborious process and often associated with problems, particularly following repeated mounting and removal. We therefore developed induction heating

devices that are similar to the devices used for inner rings. These allow considerable shorter mounting times.

The coupling members are generally located on the roll neck with an oversize of 1,5 to 1,8 ‰. In order to eliminate the oversize between the coupling member and the roll neck, a mounting temperature of 170...200 °C is necessary. The dismantling temperature is based on the size and mass of the coupling members.

Induction heating devices have so far been constructed for coupling members with a mass of 485 kg. The devices have proved effective

for many years in various rolling mills.

The FAG heating devices for couplings are designed for connection to a transformer and thus for the low-voltage system.

The largest available transformers COIL.TRAFO-400KVA... with a fan (intermittent power 400 kVA) can be used to run devices for heating coupling members up to a mass of 600 kg.

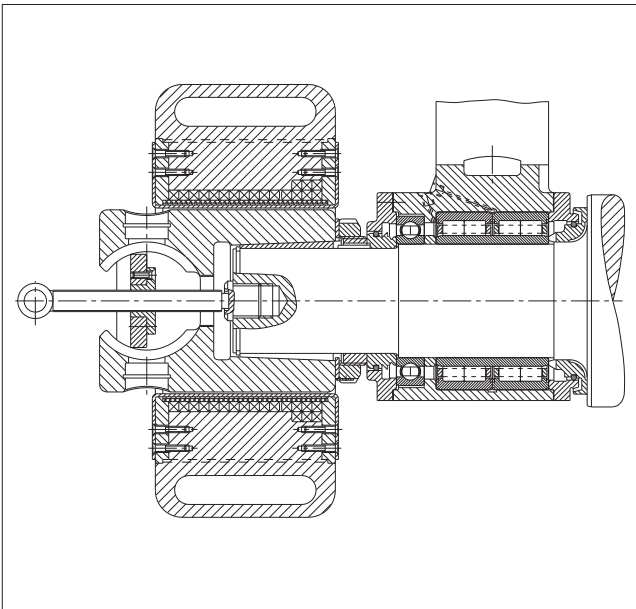
Couplings with a cylindrical seating can of course be subjected to induction heating for mounting and dismantling.

FAG electric induction heating devices

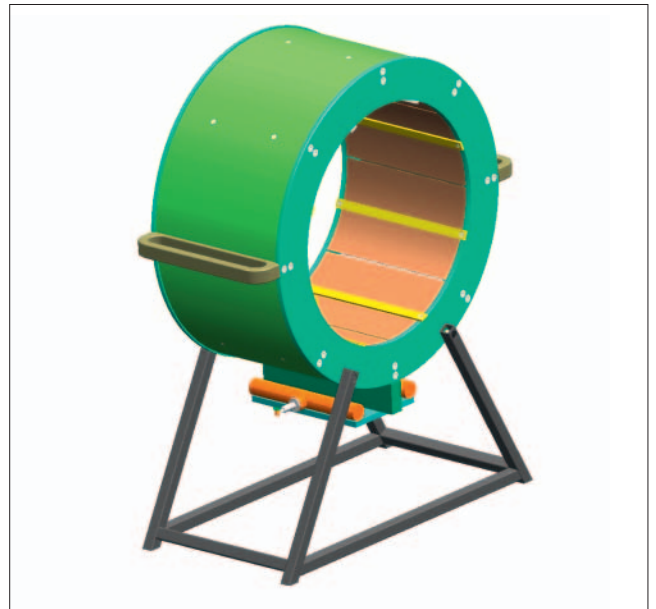
Special designs

Figure 21 shows in schematic form the heating of a coupling member using an induction coil. The interchangeable conical sleeve between the roll neck and coupling member, which was necessary for hydraulic mounting, was slotted and retained as a wear part. Coupling members without a sleeve and with a cylindrical seat were also heated by induction.

When removing a shrink fitted coupling member, it is advisable to suspend the roll vertically so that the coupling becomes detached through its own weight as soon as the required overtemperature is reached. Coupling members located on a conical sleeve are dismantled using a withdrawal device while the roll is in a vertical position.



21: Heating of a coupling member using an induction coil (schematic)



22: Induction coil for coupling members

FAG electric induction heating devices

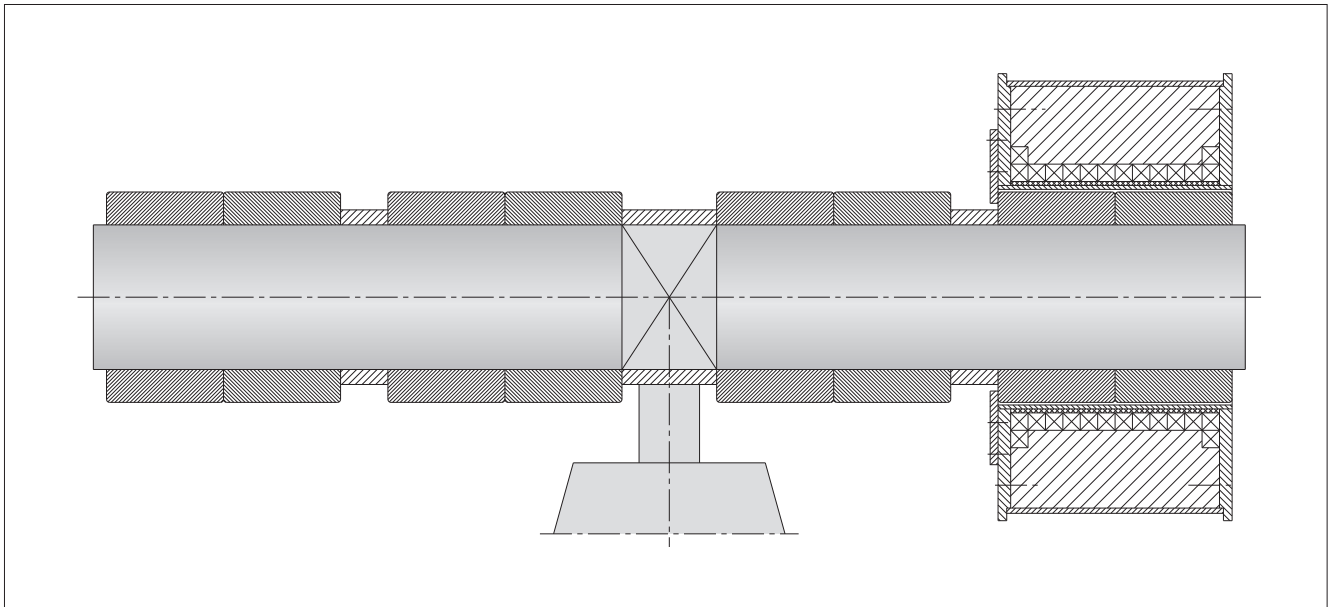
Special designs

FAG induction heating device for back-up rollers in cluster type cold rolling mills

The outer rings of the back-up rollers in cluster type rolling mills must be reground from time to time. For regrinding, all the outer rings of one back-up roller set must have the same wall thickness. The outer rings are therefore shrink fitted together onto a grinding mandrel.

In order to facilitate the mounting of the rings on the grinding mandrel and their removal, we manufacture appropriate induction heating devices.

The design corresponds in principle to that of the devices for the inner rings of cylindrical roller bearings. Figure 23 shows in schematic form the loading of the grinding mandrel and the induction coil.



23: Heating and removal of the outer rings from the grinding mandrel

FAG electric induction heating devices

Special designs

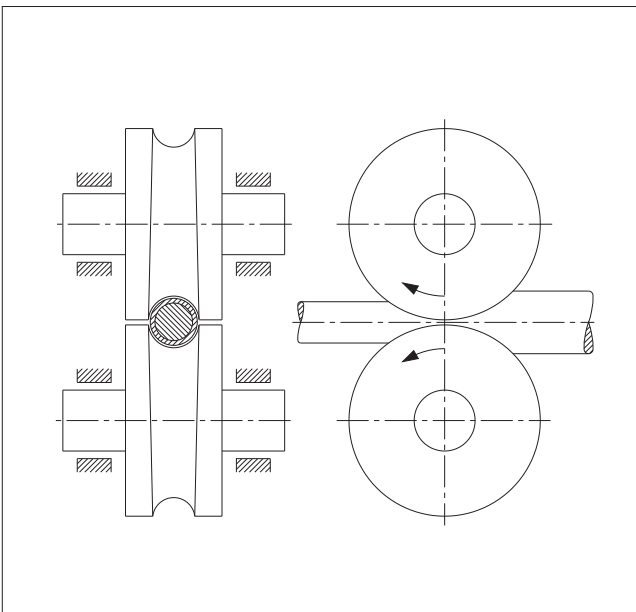
FAG induction heating device for work rolls in cold pilger machines

In tube rolling by the cold pilger process, the work rolls operate against each other in pairs. Figure 24 shows the arrangement of the rolls.

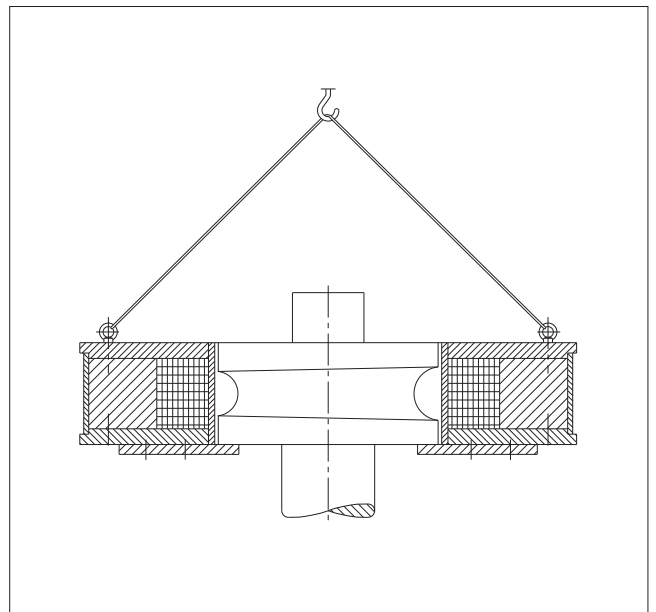
After a certain service life, the profile of the rolls acquire a concave taper and must be reworked. The rolls, which are shrink-fitted with an H6/s6 fit, are heated and removed from the shafts.

We manufacture appropriate induction heating devices for this purpose. Heating is carried out while the axis is vertical. The coil suspended from the crane must support the mass of the roll and shaft. This high load requires a heavy-section coil former, see Figure 25.

The required dismantling temperature of 140 °C is achieved in a few minutes, dependent on the workpiece size and mass. For this application, mains and low voltage devices are used.



24: Arrangement of the work rolls in the cold pilger process (schematic)



25: Heating and removal of the roll using an FAG induction coil

FAG electric induction heating devices

Information required for quotation

FAG induction heating devices are always produced as one-off items.
In order to prepare a quotation, we require the following information:

1. Contact details

Company name	_____	Contact person	_____
Street/building number	_____	Telephone	_____
Town, postcode	_____	Fax	_____
Country	_____	E-mail	_____

2. Technical data on the workpieces to be heated (especially if these are not FAG rolling bearings)

Precise designation of the bearing for bearing rings	_____	_____	_____
Bore diameter in mm	_____	_____	_____
Raceway diameter in mm	_____	_____	_____
Ring width in mm	_____	_____	_____

3. Approximate number of parts to be removed per day, namely ...

Inner rings	_____
Labyrinth rings	_____
Couplings/others	_____

4. Drawing of the bearing position indicating the fits

(e.g. mounting situation and detailed representation of the adjacent parts; position and number of withdrawal slots in the labyrinth rings, in the case of couplings and labyrinth rings, a dimensional diagram and fit data; drawing with dimensional data for the shaft shoulder)

5. Power grid available at the mounting station

Mains voltage in V	_____
Frequency in Hz	_____
Max. current capacity of the grid in A	_____

6. Type of three-phase grid

Three-wire network: 3 Outer conductor L1-L2-L3, protective conductor PE without neutral conductor N	<input type="checkbox"/>
Four-wire network: 3 Outer conductor L1-L2-L3, protective conductor PE with neutral conductor N	<input type="checkbox"/>

7. Details of the operating location (e.g. type of operation, climatic conditions, pictures of the workstation)

8. Miscellaneous

Comparison of ordering designations

Comparison of ordering designations	
Ordering designation for Europe	Ordering designation for countries outside Europe
COIL.SWITCH-PEDAL-50KVA-400V-50HZ	FS125A.400V.50HZ
COIL.SWITCH-CABINET-80KVA-400V-50HZ-MD	SSK200A.152491.400V.50HZ
COIL.TRAFO-45KVA-400V-50HZ	EFB20.45KVA.400V.50HZ
COIL.TRAFO-45KVA-480V-60HZ	EFB20.45KVA.480V.60HZ
COIL.TRAFO-75KVA-400V-50HZ	EFB33.75KVA.400V.50HZ
COIL.TRAFO-75KVA-440V-60HZ	EFB33.75KVA.440V.60HZ
COIL.TRAFO-110KVA-400V-50HZ	EFB50.110KVA.400V.50HZ
COIL.TRAFO-180KVA-400V-50HZ	EFB80.180KVA.400V.50HZ
COIL.TRAFO-290KVA-400V-50HZ	EFB125.290KVA.400V.50HZ
COIL121X110-MAIN-P	EIM176573.N121SP
COIL152X145-LOW	EIM171147.K152
COIL166X157-MAIN	EIM176439.N166
COIL335X155-MAIN-S	EIM131439.N335-S
COIL465X84-LOW-L	EIM176574.KL465
GLOVE2	HANDSCHUH2
HEATER-PLATE-370C	HEATER.PLATE.370C
HEATING-RING-...	HEATING.RING...
HEATING-RING.PASTE-20ML	HEATING.RING.PASTE.20ML
TEMP-CHECK-CONTACT	TEMP.MG

Example of dismounting of inner ring using low voltage device

The inner rings of the wheelset bearings WJ/WJP120/240 and WJ/WJP130/240 are to be dismounted in large quantities in the repair shops of Deutsche Bahn AG, for example in Neumünster (Germany). Rapid, operationally secure and economical dismounting can be carried out using an FAG induction heating device for a low-voltage supply. The dismounting process is shown here.



1. The main switch is set to "ON".



2. The bearing inner rings and adjacent parts are cleaned.



3. The initial temperature of the bearing and shaft journal are monitored using the FAG temperature gauge TEMP-CHECK-CONTACT.

Example of dismantling of inner ring using low voltage device



4. The induction coil is slid onto the inner rings.



5. The catches on the rear side of the coil are locked.



6. The operator puts on heat-insulated gloves.



7. The required heating time is set on the time relay.
The transformer is started.

Example of dismantling of inner ring using low voltage device



8. During the heating operation, the temperature is measured on the end face of the inner ring.



9. Once the set heating time has elapsed, the device automatically switches off. The induction coil is removed together with the bearing inner rings.



10. The inner rings should be removed promptly from the coil.



11. The temperature of the inner rings should be checked and, if necessary, the rings should be demagnetised.

Notes

Notes

Notes

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Internet www.fis-services.com

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