

# Product Overview

## Inductive Power Transfer – IPT<sup>®</sup>





IPT® – stands for Inductive Power Transfer- a universal, contactless power and data transfer system. Contactless transfer offers a number of benefits in a variety of applications. In production, logistics, elevators or amusement parks, IPT® is the first choice as a modern systems solution.

**IPT**®  
Inductive  
Power  
Transfer

by Conductix-Wampfler

proven  
since 1997

# Advantages

## Safety and Availability

completely insulated, no galvanic contacts for transfer

## Maintenance-Free and Reliable

no mechanical or electrical contacts for power transfer

## High Power Transfer

up to 20 KW or more per vehicle

## Independent Loads

multiple loads can be operated independently of each other

## High Speed, Silent

due to the absence of sliding brushes and moving mechanical parts

## Suitable for Harsh or Sensitive Environments

such as the pharmaceutical industry, food production, etc.

## Transparent Interfaces

based on international norms, connects to most standard equipment

## Design Freedom

IPT® enables new innovative solutions

## Low Operating Costs

these benefits result in lower operating costs  
and greatly reduced maintenance costs

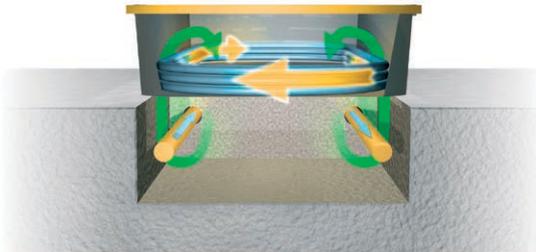




## IPT® Function

IPT® is based on the same principle as virtually all electric generation and transmission, as well as many other electrical and electronic devices: namely, electromagnetic induction.

Like a transformer, an alternating electric current in the primary circuit produces an alternating electromagnetic field. By the law of electromagnetic induction this field induces an alternating current in a secondary circuit nearby.



Unlike a classical transformer (with a primary and secondary part, both of which are closely coupled by a shared iron or ferrite core), IPT® consists of separate primary and secondary parts. The primary part does not generally consist of a primary coil, but rather of a conductor loop. This conductor loop is installed as a pair of cables along the travel path of the vehicles to be supplied with power. The primary and secondary parts are no longer coupled via a fixed core.

The secondary Pickup is able to move freely. It can be positioned with an air gap and sufficient tolerances in relation to the primary conductors and can also move at any speed.

The frequency of the alternating field around the primary conductor is a decisive factor for the function and efficiency of an IPT system. While the normal electrical supply operates at 50-60 Hz, IPT® works usually at a frequency of 20,000

Hz, or about 400 times as high. This makes it possible to transfer power effectively over large air gaps.

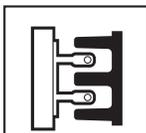
The induced alternating current must be regulated with a control circuit to make it usable. This patented control circuit is responsible for reducing unwanted feedback into the primary, thereby enabling operation of multiple independent varying loads on one primary track. This is a basic requirement for the operation of material handling applications with numerous independent vehicles in a single system.

In addition to power transfer, reliable data transfer is indispensable in a modern material handling solution. iDAT is an inductive data transfer system which ensures that signal spread is defined very precisely and does not interfere with other radio-controlled systems and is not effected by them. With continuous floor based inductive systems, iDAT can also provide vehicle guidance and positioning functions. For vehicle guidance, the field around the primary conductor is used to provide a precise digital signal for the vehicle controller. For position, Position Marks in the floor are powered by the magnetic field from the primary track and can therefore continuously transmit their position codes. There is no need for any activation electronics on the vehicle.



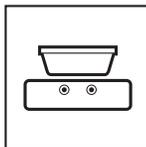
Electrified monorail system with IPT®-Rail and iDAT

There are two basic arrangements:



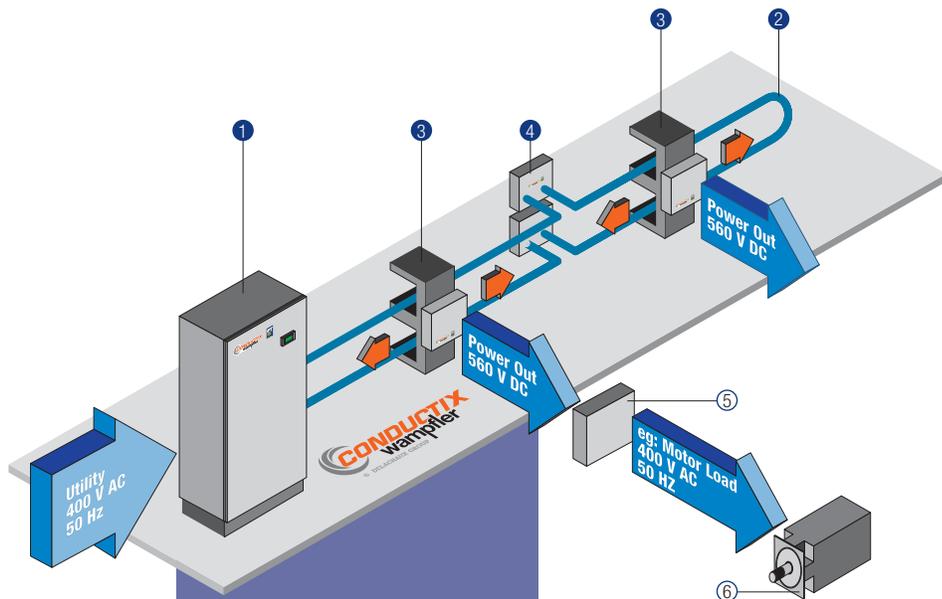
IPT®-Rail

systems have a protruding primary track arrangement, in which an E-Pickup envelopes both track cables from several sides. Used primarily in rail mounted applications.



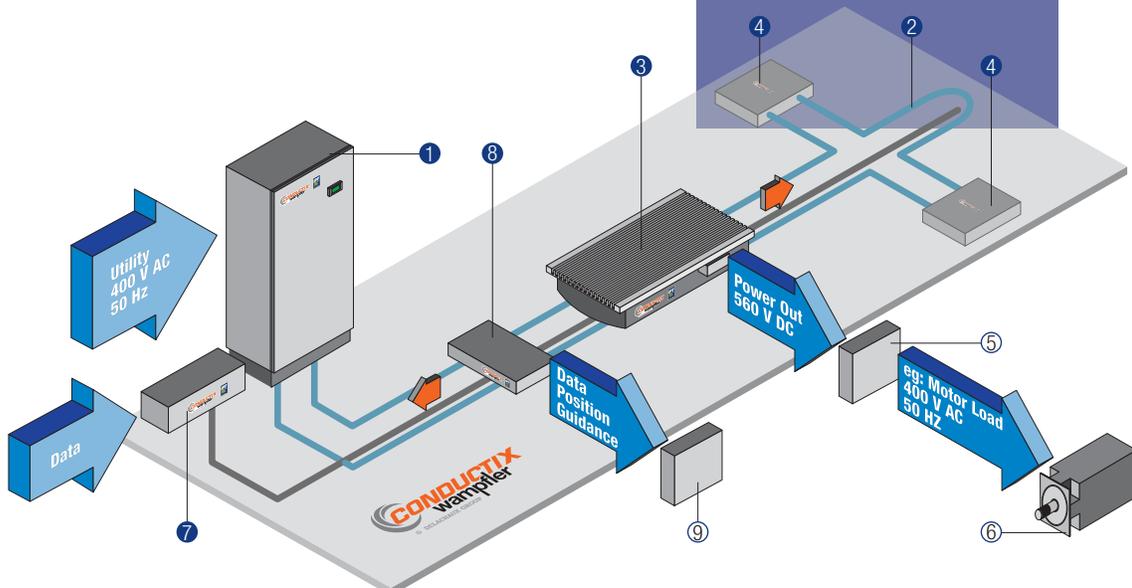
IPT®-Floor

systems with primary track cables embedded in the floor or other surface, and used with flat F-Pickups. Used primarily with surface running vehicles.



- 1 Track Supply
- 2 Primary Track
- 3 Pickup with Regulator
- 4 Track Capacitors
- 5 Frequency Inverter
- 6 Motor
- 7 iDAT Master
- 8 iDAT Pickup
- 9 PLC

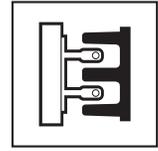
- Conductix-Wampfler
- Third party



AGV with IPT®-Floor and iDAT



## IPT®Rail



When supplying power to rail guided vehicles, a continuous inductive supply is generally required along the entire path of travel. The IPT® primary track is installed parallel to the rail. The pickup is attached to the driven vehicle itself. In some cases trailer vehicles may be used.

As in all continuous IPT® solutions, both cables are used for power transfer.

If there are movable track sections, these can be electrified by several means. In addition to a direct flexible cable connection, inductive coupling is also possible. This method is used if safety zones are required before track switches. These are active depending the switch position. The track switch mechanically engages an inductive coupling unit, so that no separate control of the safety zone is required.

Complementing inductive power transfer, data can also be transferred inductively using iDAT. The method of purely inductive communication generates no radio waves. This means that the signal is contained within a small envelope and above all it does not interfere with or is susceptible to interference from any radio based networks. Commercially available position measuring systems are used for path measurements.





Skillet system  
with IPT®-Rail

# IPT®Rail components



## Track Supply

- 6 kW | Module 80 A
- 6 kW | Module 125 A
- 16 kW | Module 80 A
- 16 kW | Module 125 A
- 35 kW | Cabinet 80 A
- 35 kW | Cabinet 125 A



## E-Pickup/Regulator

- 750 W | 560V DC/24V DC | 4A
- 4 kW | 560V DC/24V DC | 4A



## Litz Cable

- 20 mm<sup>2</sup> (max. 80 A)
- 35 mm<sup>2</sup> (max. 125 A)



## Capacitor Boxes

- 80 A
- 125 A



## iDAT components

- iDAT Modem Box
- iDAT Pickup
- iDAT Master



## Intelligent components for ease of installation



Water ride at an amusement  
park with IPT®-Rail

## IPT®Rail - the benefits...

### ...for electrical monorail systems:

#### High Availability and Safety

- large mechanical traverse tolerances
- no exposed electrical contacts
- high traveling speeds
- unlimited forward and reverse movement
- not susceptible to environmental influences

#### • Low Maintenance and Operating Costs

- no wearing mechanical parts
- no collector dust generated

#### • Easy to install

- brackets clip into the rail
- double cable primary

### ... for skillet systems and slat conveyors:

#### • High Availability and Safety

- large mechanical traverse tolerances
- no exposed electrical contacts
- suitable for frequent engagement/disengagement
- no arcing
- not susceptible to environmental influences

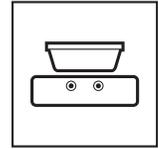
#### • Low Maintenance and Operating Costs

- no wearing mechanical parts

#### • Easy to install

- brackets clip into the carrier
- double cable primary

# IPT®Floor



For floor surface conveyors, the goal is to achieve a level floor with no obstacles for persons, forklifts or other equipment in the factory environment, to eliminate hazardous contact rails, and to render batteries in vehicles either superfluous or more efficient.

To achieve this, the primary track is installed in the floor or other surface along the path of travel. The IPT® system can be placed continuously along the entire path of travel or only in defined areas.

The advantage of continuous power transfer is the total elimination of energy storage devices on the vehicles. This cuts costs related to maintenance and replacement of batteries, and often fewer vehicles are required, since none are off-line for charging. Vehicles with on board energy storage are preferable when there are long paths that are infrequently traveled or if there are very complex or variable paths, which can make it unfeasible to put cables in the floor. Using inductive charging paths this way has the beneficial effect of permitting opportunity charging while travelling or at idle positions.

iDAT is the optimum addition to continuous inductive power transfer. iDAT makes it possible to guide vehicles precisely along the magnetic field produced by the power transfer, to give them position information via Position Marks, and to transfer bidirectional data without interference between vehicles and the master controller.





With IPT®-Floor powered vehicles in an axle assembly line

# IPT®Floor components



Track Supply

- 6 kW | Module 125 A
- 16 kW | Module 125 A
- 35 kW | Cabinet 125 A



F-Pickup with integrated Regulator

- 750 W | 560V DC
- 2.5 kW | 560V DC



Litz Cable

- 35 mm<sup>2</sup> (max. 125 A)



Capacitor Box

- 125 A



iDAT components

- iDAT Pickup
- iDAT Position Mark
- iDAT Master



Intelligent components for ease of installation



## IPT®Floor - the benefits...

### ... for vehicles without onboard energy storage:

- Reduced Maintenance and Operating Costs
  - no wearing mechanical parts
  - no energy storage such as batteries
  - no recurring costs
  - no disposal costs for power sources
- High Availability and Safety
  - no exposed contacts
  - not susceptible to environmental influences
  - no mechanical guidance tracks required
- Unobtrusive Installation
  - suitable for forklift and people traffic

### ... for vehicles with onboard energy storage:

- Lower Investment Costs with Charging while running
  - fewer vehicles required
  - smaller energy storage
  - no battery swap
- Flexibility
  - inductive paths may be limited to loading, high traffic or simple sections
  - complex or rarely-traveled sections do not require electrification
- High Availability and Safety
  - no exposed electrical contacts
  - no battery swap or plugging required

## IPT®- Endless Variety

... for floor conveyors in gearbox assembly lines



Customer: Daimler AG, Germany  
Solution: IPT®-Floor and iDAT  
System: 3 Track Supplies, 35 kW each  
330 m (1982 ft) transit path  
35 vehicles, 2.2 kW each  
Installed in 2005

... for electrified monorail systems in final assembly lines



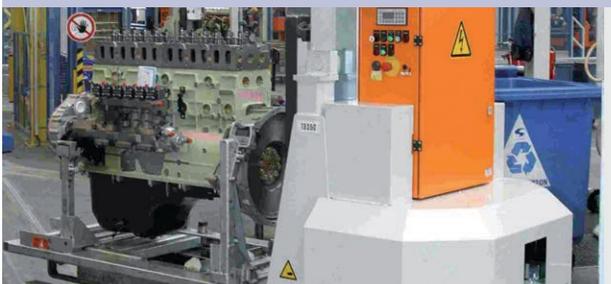
Customer: KIA Motors, Slovak Republic  
Solution: IPT®-Rail and iDAT  
System: 6 separate installations totalling 1500 m (4921 ft) in path length  
97 vehicles, each 750 W or 1500 W  
Installed in 2005

... for sorting facilities in mail-order houses



Customer: Carrefour, France  
Solution: IPT®-Rail  
System: Track Supply 10 kW  
160 m (525 ft) path length  
Installed in 2001

... for floor conveyors in truck engine assembly lines



Customer: DAF, Netherlands  
Solution: IPT®-Floor and iDAT-Control  
System: 3 installations with 30 kW Track Supply each  
Total path length 380 m (1247 ft)  
50 vehicles, 1.8 kW each  
Installed in 2002

... for electrified monorail systems to transport auto bodies



Customer: Mitsubishi, Australia  
 Solution: IPT<sup>®</sup>-Rail and iDAT  
 System: 7 Track Supplies, 30 kW each  
 500 m (1640 ft) path length  
 20 vehicles with 1.5 kW  
 Installed in 2004

... for inclined elevators in construction projects



Customer: Docklands, Germany  
 Solution: IPT<sup>®</sup>-Rail  
 System: 2 elevators, each 60 m (197 ft)  
 each with 1 car, supplied with 8 kW  
 Installed in 2005

... for electric buses



Customer: GTT, Torino, Italy  
 Solution: IPT<sup>®</sup>-Charge  
 System: 20 buses each charged  
 with 60 kW maximum  
 Installed 2003

... in amusement parks



Customer: Walibi World, Netherlands  
 Solution: IPT<sup>®</sup>-Rail  
 System: 180 m (591 ft) system with  
 10 vehicles, 4 kW each  
 Installed in 2005



# IPT® | Frequently asked questions

Can IPT® also be used in applications other than those described?

Yes, the range of applications for IPT® is virtually unlimited. The range of uses is restricted only by the ratings of the components, the compliance of the materials used or any construction details or dimensions.

Why does Conductix-Wampfler use special cables?

The cables used are known as "Litz cables." Due to skin effect, currents at 20 kHz only flow in the outer surface of a conductor and not through its entire cross section. This means that a standard cable must be significantly de-rated, or operates with very high losses. For IPT®, Conductix-Wampfler developed special Litz cables. These are made up of many individually insulated strands each with a diameter less than the skin depth. This structure creates a cable with a very large total surface area, so that in effect the entire cross section carries current.

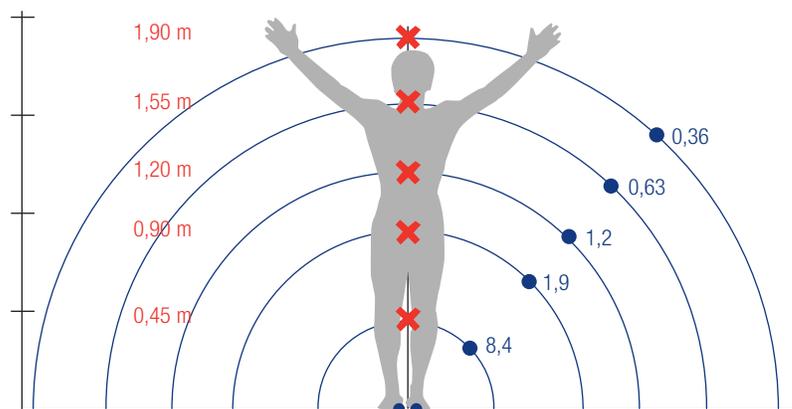
What effects do the fields produced by IPT® have on the human body?

Fundamentally, the fields generated by IPT® are very localized, unlike the electromagnetic fields from mobile telephone systems, which are designed to radiate over a large area. The fields are further limited by the dual cable configuration of IPT®. As a result of the opposing current directions between the outward and return cables, two opposing fields are created. These combine cumulatively only in the space between the cables and differentially elsewhere. Thus, the magnetic field strength decreases with the square of distance.

With a single-cable installation, the decrease would be only proportional to the distance.

The permitted regulatory limits vary from country to country. In Germany, the limits are determined by the Employers' Liability Insurance Association (Berufsgenossenschaft). The fields generated by IPT® were independently assessed and judged to be compliant with the regulations.

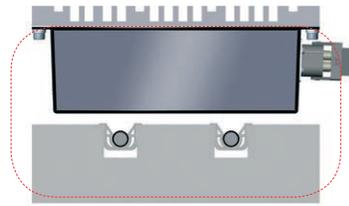
Because threshold limit values and methods of assessment vary widely between jurisdictions, we have presented a more substantial review of this topic in our document PRB9000-0007 "Health & Safety Aspects of IPT®."



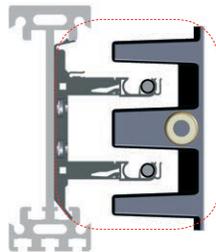
Excerpt from PRB9000-0007:  
Magnetic field strength [µT] near an IPT® track  
with 125 A track current and 100 mm cable separation.

**Why pay attention to iron free areas?**

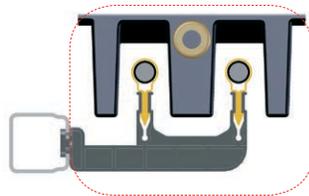
Every current carrying conductor produces a magnetic field. This is a necessary condition for inductive power transfer to occur. Unfortunately any ferromagnetic materials that are located within this field will have eddy currents generated in them. These cause heating and undesirable losses because of their material internal electrical resistance. These effects should be minimized by maintaining sufficient clearance and by bundling of the track cables. Bundling is where a pair of Litz cables is brought as close together a possible, in all feed and sections of track where power transfer is not required. For further information regarding clearances and installation requirements please refer to our installation instructions for the various applications.



Iron free area with floor conveying systems



Iron free area with electrified monorail systems



Iron free area with skilnet systems

**What is the purpose of Capacitor Boxes?**

With IPT® both the primary and the secondary circuits are configured for resonance. Power transfer occurs particularly well when the primary and secondary circuits resonate with each other at the same frequency. The secondaries are independently tuned systems. Surroundings and track lengths have a variable influence on the primary side. Depending on the track inductance  $L$ , additional capacitance  $C$  may be needed to achieve resonance. Also, there is a voltage drop along the track. The track capacitors compensate for this. Capacitor Boxes are placed at regular intervals along the track so that the voltage drop at any point does not exceed the prescribed values.





# IPT® Service

## Industry Specific Competence

The range and scope of Conductix-Wampfler's customer service focuses on customers' requirements and requests. Everything from project planning to long term service contracts is possible. The greater the complexity of a system and the expectations for lifetime and operation, the more important the involvement of our trained service team becomes.

## Project planning

- Review of application parameters
- Selection of the most appropriate solution in consultation with the customer, taking into consideration the conditions on site, surroundings and the usage.

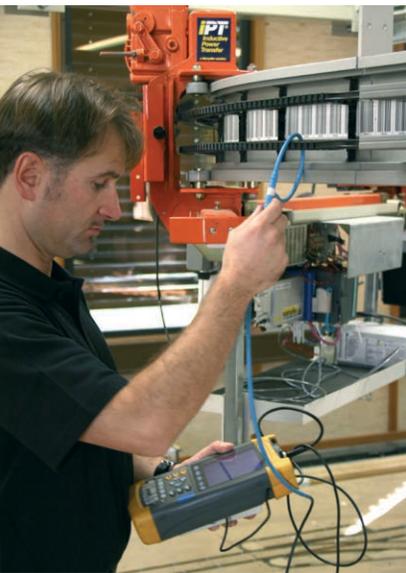


## Installation | Supervision

- Complete installation or installation supervision by our trained personnel
- Joint acceptance
- On site training

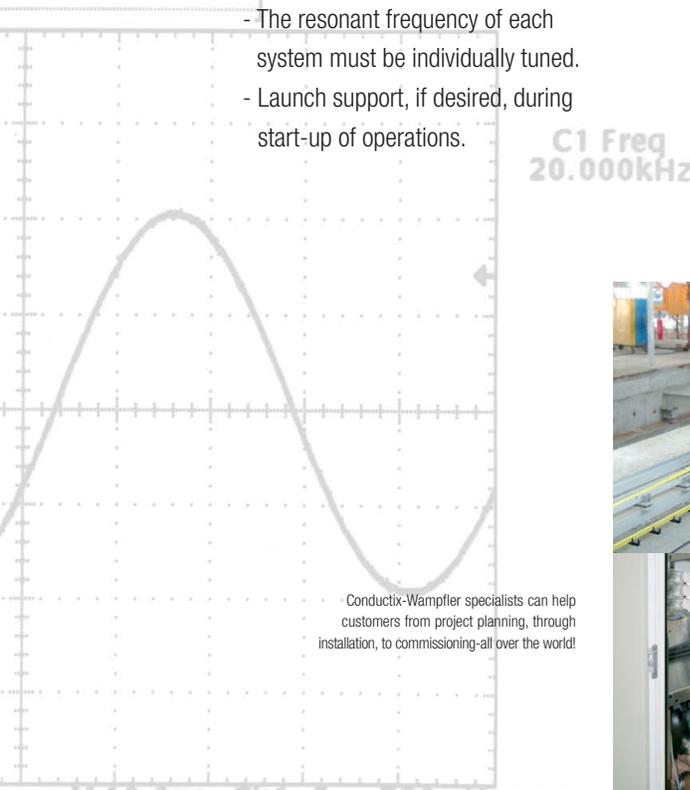
## Maintenance & Service

- Regular maintenance and inspections increase the lifetime of a system and ensure its long term operational availability.
- Conductix-Wampfler service agreements, the "Totally Worry-Free Packages"



## Commissioning

- The resonant frequency of each system must be individually tuned.
- Launch support, if desired, during start-up of operations.



Conductix-Wampfler specialists can help customers from project planning, through installation, to commissioning-all over the world!



# Your Applications - Our Solutions

IPT® by Conductix-Wampfler is only one of the many solutions made possible by the broad spectrum of Conductix-Wampfler components for the transport of energy, data and media supply systems. The solutions we deliver for your applications are of course based on your specific requirements.

In many cases, a combination of several different Conductix-Wampfler systems can prove advantageous. You can count on all of Conductix-Wampfler's Business Units for hands-on engineering support - coupled with the perfect solution to meet your energy management and control needs.



### Cable reels

Motorized reels and spring reels by Conductix-Wampfler hold their own wherever energy, data and media have to cover the most diverse distances within a short amount of time - in all directions, fast and safe.



### Festoon systems

It's hard to imagine Conductix-Wampfler cable trolleys not being used in virtually every industrial application. They're reliable and robust and available in an enormous variety of dimensions and designs.



### Conductor rails

Whether they're enclosed conductor rails or expandable single-pole systems, the proven conductor rails by Conductix-Wampfler reliably move people and material.



### Non-insulated conductor rails

Extremely robust, non-insulated conductor rails with copper heads or stainless steel surfaces provide the ideal basis for rough applications, for example in steel mills or shipyards.



### Energy guiding chains

The "Jack of all trades" when it comes to transferring energy, data, air and fluid hoses. With their wide range, these energy guiding chains are the ideal solution for many industrial applications.



### Slip ring assemblies

Whenever things are really "moving in circles", the proven slip ring assemblies by Conductix-Wampfler ensure the flawless transfer of energy and data. Here, everything revolves around flexibility and reliability!



### Inductive Power Transfer IPT®

The no-contact system for transferring energy and data. For all tasks that depend on high speeds and absolute resistance to wear.



### Reels, retractors and balancers

Whether for hoses or cables, as classical reels or high-precision positioning aids for tools, our range of reels and spring balancers take the load off your shoulders.



### Jib boom

Complete with tool transporters, reels, or an entire media supply system - here, safety and flexibility are key to the completion of difficult tasks.



### Conveyor systems

Whether manual, semiautomatic or with Power & Free - flexibility is achieved with full customization concerning layout and location.

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