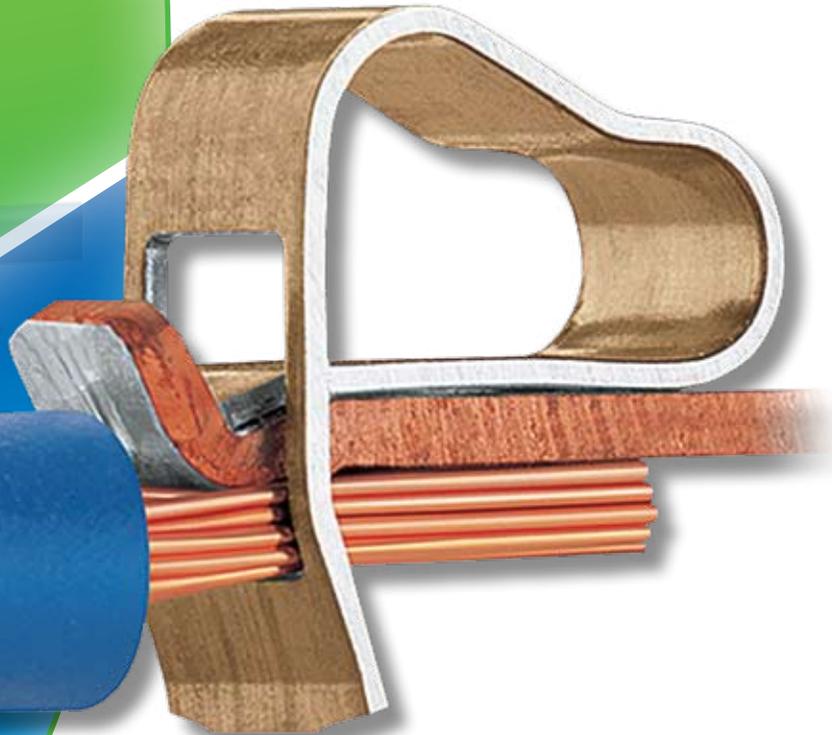


# The CAGE CLAMP® Connection System

Twenty of the Most Asked Questions



**WAGO**®  
INNOVATIVE CONNECTIONS

# The WAGO CAGE CLAMP®

## An Innovation...

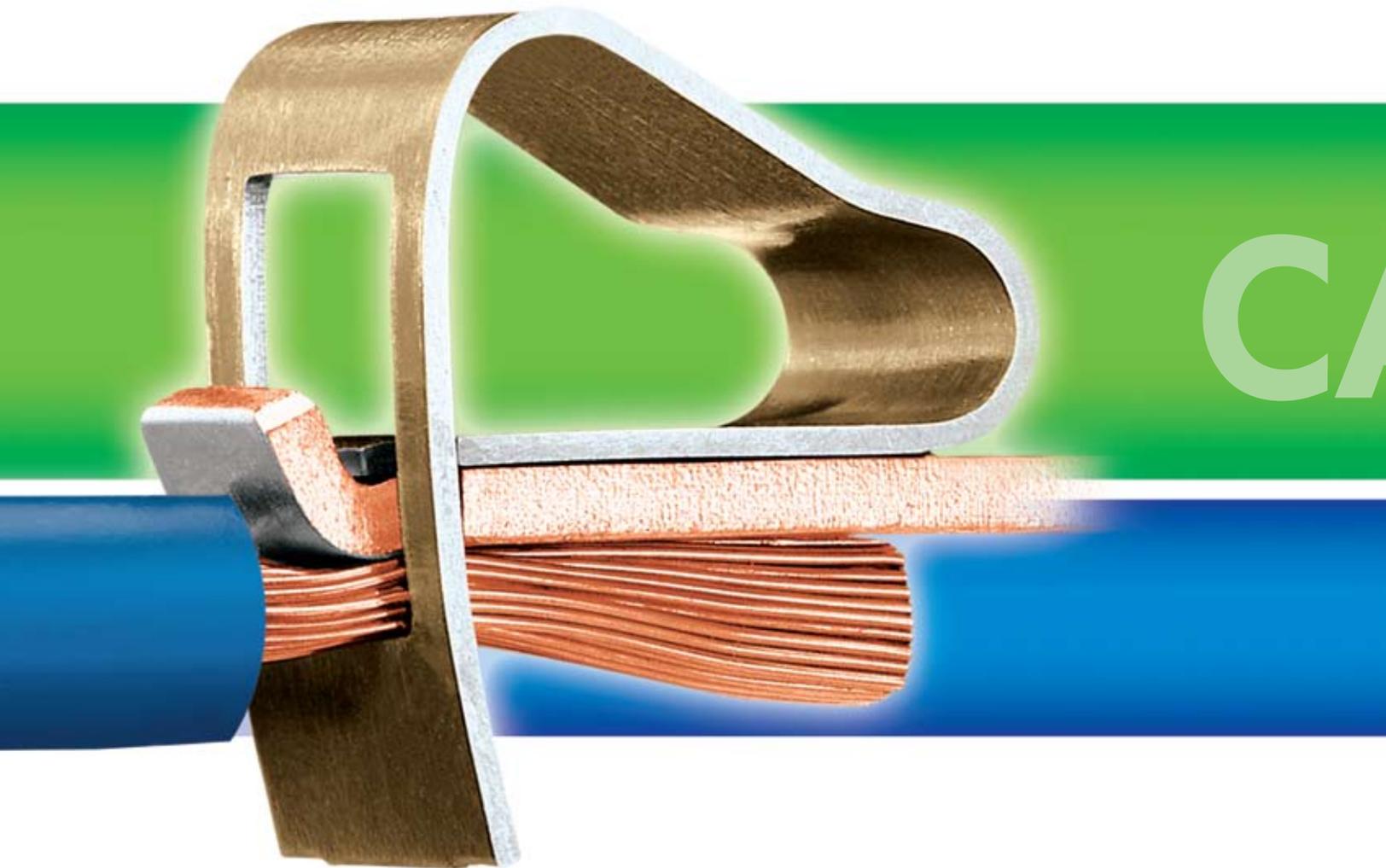
The rising cost of service calls and a company's desire to provide more reliable products has changed the way people think about terminal blocks.

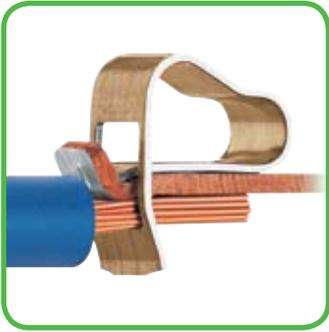
In the past, terminal blocks were often thought of as an insignificant part of the overall system, unless you were in field service. Field service technicians say that terminal blocks have always been significant since one of their first troubleshooting steps is to "check the connections".

They also indicate that connectors are the source of almost half of all system failures.

Checking connections as part of a regular maintenance schedule was the only preventive solution to this problem – until the invention of "CAGE CLAMP®".

CAGE CLAMP® reduces wiring time, eliminates routing maintenance and provides a reliable contact – every time!





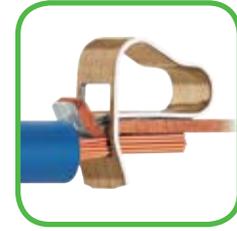
# CAGE CLAMP®

The brochure answers twenty of the most asked questions pertaining to the CAGE CLAMP®

# 1

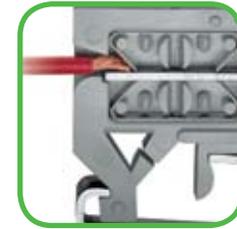
## What is CAGE CLAMP® and how is it different from other screwless systems?

CAGE CLAMP® is a unique, patented, stainless steel clamping mechanism designed to automatically connect solid or stranded wire. Various CAGE CLAMP® sizes are available to accommodate wire sizes AWG 28-12. Other than stripping the wire, no special wire preparation such as crimps, ferrules or tinning is necessary.



The WAGO CAGE CLAMP®

Most screwless systems offered by other manufacturers are based on the leaf-spring principle. This type of connection is found in the back of many electrical outlets. Leaf-spring is only recommended for larger, solid wire since it has no sides to contain the strands and because of the sharp angle in which the wire is contacted.



Leaf-spring

The CAGE CLAMP® is suitable for:



Solid



Stranded



Flexible



Flexible with Ferrule



Flexible with Pin Terminal

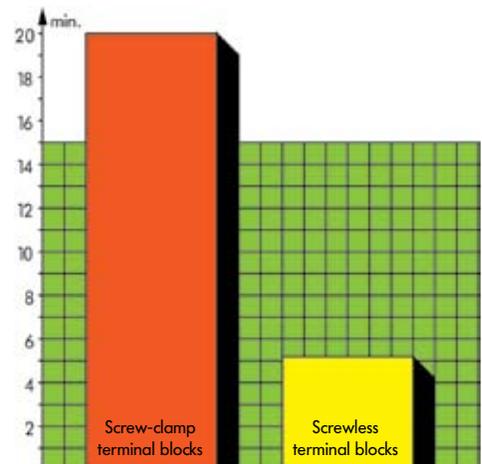
# 2

## How does the wiring time for CAGE CLAMP® compare to screw-clamp blocks?

Public wiring competitions and major customer time studies have proven a reduction of wiring time by 75% when comparing manual wiring of screw-type terminals with CAGE CLAMP® terminals.

Even when powered screwdrivers are used for tightening the clamping screws, there is still a time savings advantage for CAGE CLAMP®.

In cases where wire preparation such as crimps, ferrules or tinning can be eliminated, there are additional savings.



Average wiring time for 100 connections each

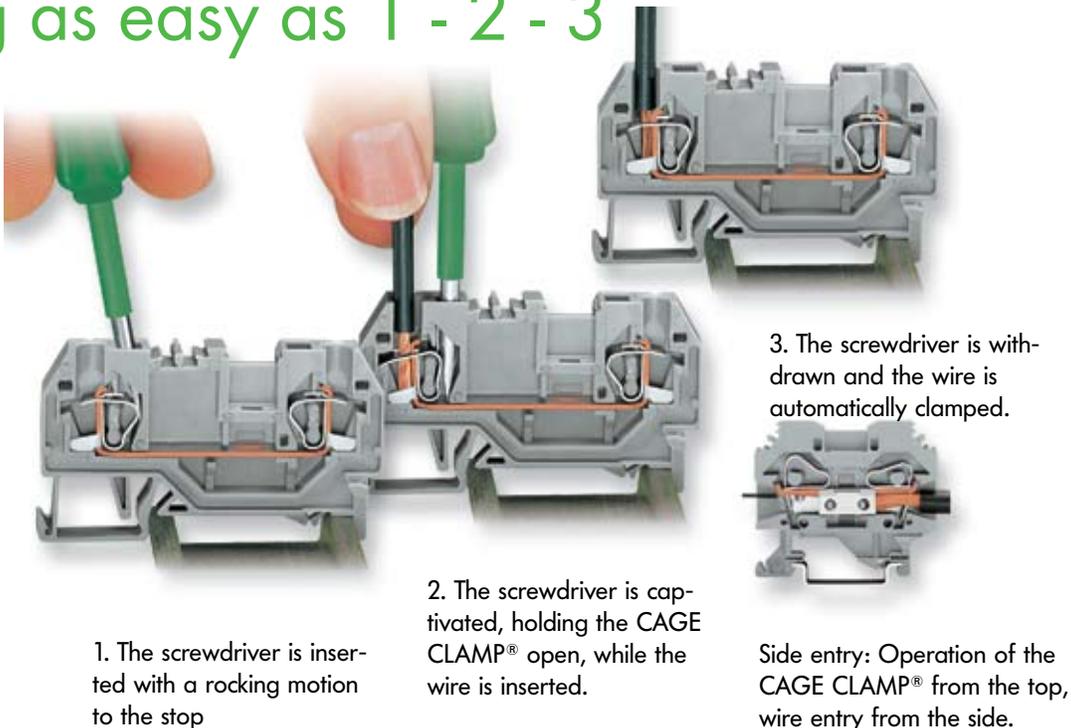
3

## How is the operation of CAGE CLAMP® different from screw-clamp blocks?

Screw connections are “operator-dependent”. In other words, they require judgment on the part of the installer as to the tightness of the screw. This can be somewhat controlled in a factory setting with trained personnel, or with special torque screwdrivers. With field wiring, proper screw connections are more difficult to ensure.

CAGE CLAMP®’s automatic clamping feature allows less skilled labor to make quality connections. CAGE CLAMP® requires no special tools and is operated with a standard straight-bladed screwdriver. Two styles of terminal blocks are available: side-entry and front-entry.

## WAGO’s CAGE CLAMP® system makes wiring as easy as 1 - 2 - 3



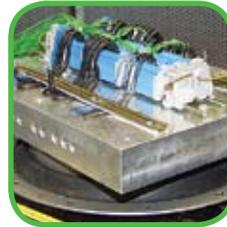
# 4

## Why won't the CAGE CLAMP® wear out, even after thousands of actuations?

The CAGE CLAMP® is computer designed for maximum reliability. Springs under permanent dynamic load, such as automobile and industrial springs work reliably and perform millions of operations during their lifetime. By comparison, the CAGE CLAMP® is typically operated only a few times and yet it is designed according to the same principles as springs under dynamic load.

WAGO has over forty years experience in the design and manufacture of high quality connec-

tions. State-of-the-art quality control insures that these high standards are maintained.

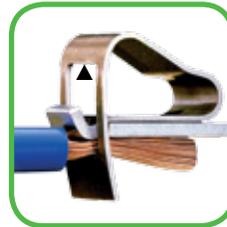


Spring testing device

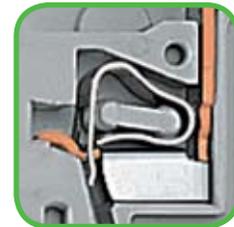
# 5

## Why can't the CAGE CLAMP® be damaged even when handled carelessly?

The travel of the spring is limited by the upper surface of the cage and by a positive stop on the insulation material of the housing to prevent overstressing of the spring. This makes damage to the CAGE CLAMP® impossible for even the most inexperienced operator.



Positive stop on CAGE CLAMP®



Positive stop on housing

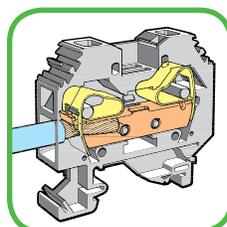
# 6

## What design features of WAGO blocks prevent the splaying of wire strands?

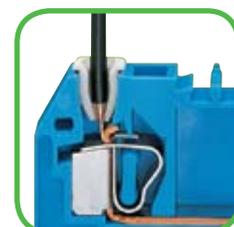
WAGO terminal blocks and connectors have a funneled wire entry which is closed on all sides. This is unlike some manufacturers' blocks which need the adjacent block to provide this feature. WAGO's housing design, in combination with the sides of the CAGE CLAMP® spring, insure that the wire is automatically positioned in the contact area.

The connection of very small wires such as in PLC or proximity sensor applications can be difficult with any terminal block. These fine wires

can deform when being inserted into the terminal block. This can result in the insulation being clamped, making troubleshooting difficult and time consuming. WAGO insulation stops easily solve these problems.



Funneled wire entry



Use of insulation stop

# 7

## How does the CAGE CLAMP® secure the wire without wire damage?

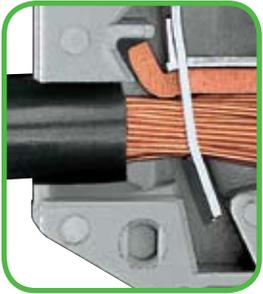
The CAGE CLAMP® is designed to give proportional clamping, dependent upon the wire size. The larger the wire, the higher the clamping force.

The flat surface area of the CAGE CLAMP® coupled with the uniquely curved current bar provides a secure connection without wire damage.

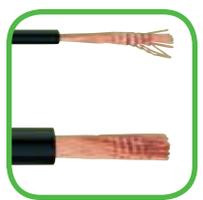
Also, the angle in which the CAGE CLAMP® is

positioned, increases the retention force when a pullout force is applied.

Each of the photos below show an AWG 24 and AWG 14 wire that was connected to the terminal block indicated. The tightening torque used for the screw-type terminal blocks was the torque specified by VDE 0609. In practical use this value varies and is dependent upon the operator, whereas, the CAGE CLAMP® connection is automatic and consistent every time.



CAGE CLAMP® terminal block



Pressure-blade, screw-type terminal block



Screw-type terminal block with wire protection



Screw-type terminal block without wire protection

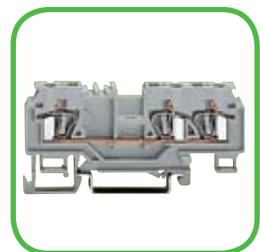
# 8

## What is the best way to connect multiple wires?

For the purposes of safety, reliability and ease of trouble-shooting, a number of industry and national standards specify "one wire per clamping point" (regardless of the type of connection used). WAGO has a variety of alternatives to meet these requirements.

Multiple wire terminal blocks are available in three- or four-wire front-entry versions. One-piece insulated jumpers easily common adjacent or alternate terminal blocks.

In both cases, each wire as its own CAGE CLAMP® and because of the front-entry feature, it requires no more space than a two-conductor terminal block.



Three conductor block



One-piece jumper

# 9

## What are the material specifications for WAGO terminal blocks?

**Insulation material:**

For over 30 years, Nylon 6.6 has been the preferred insulation material for the housing of current carrying parts and accessories of terminal blocks and connectors. It has been approved by almost all international test houses. Nylon 6.6 is well known for its elasticity, rigidity and resistance to fuels, most oils and fats, detergents, etc. It is a very durable material and is rated 94V-2 or 94V-0 (UL flammability rating) depending on parts selected.

**Contact materials:**

Pure electrolytic copper, hard and extra-hard, is the standard material used by WAGO for current carrying part. This material combines excellent conductivity and good chemical resistance

without risk of stress cracking.

**Contact surface:**

This tin surface is the standard contact surface of current carrying parts. This guarantees excellent long-term protection against corrosion.

**CAGE CLAMP® spring:**

All WAGO CAGE CLAMP® springs are produced from high quality carefully selected austhenitic chrome nickel spring steel (CrNi) with high tensile strength and excellent corrosion resistance.

Further material information can be found in the he WAGO full line catalog.

# 10

## How do the retention forces for CAGE CLAMP® compare to agency requirements?

Most agencies have minimum retention force requirements for both screw-type and screwless terminal blocks. As shown, the measured pullout values for CAGE CLAMP® meet and in most cases far exceed these values.

**Retentions Forces (LBS)**

Wire Size	UL 486E Table 14.1	VDE 0611 Part 1		Retention forces meatures on CAGE CLAMP® terminal blocks	
AWG	Screw-Type or Screwless Terminal Block	Screw-Type Terminal Block	Screwless Terminal Blocks	Type of Wire	
				Solid	Standed
20	6.75	4.5	3.4	> 6.75	> 6.75
18	6.75	4.5	4.5	> 7.9	> 6.75
16	9.0	6.75	9.0	> 13.5	> 9.0
14	11.5	6.75	11.5	> 20.5	> 13.5
12	13.5	11.5	11.5	> 31.5	> 20.5
10	18.0	13.5	13.5	> 38.5	> 23.0
8	20.5	18.0	18.0	> 69.0	> 41.0
6	21.0	20.5	20.5		> 50.0
4	30.0		23.0		> 64.0
2	42.0		27.0		> 80.5

# 11

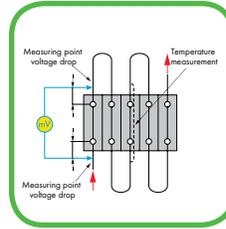
## What is the best way to determine the connection quality of a terminal block?

There are two common test methods used in laboratory testing: the voltage drop test and the temperature rise test.

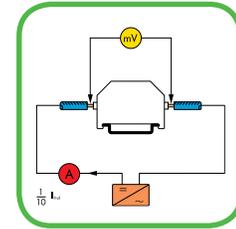
The voltage drop test is useful in determining the resistance of a through connection. It reflects the quality of the clamping point initially, when the wires are first connected, and also while under conditions of vibration, temperature cycling and corrosion.

The temperature rise test is also a reflection of the connection's resistance. It allows the com-

plete terminal block to be checked at nominal current, high current and short circuit conditions. The CAGE CLAMP® far exceeds the national and agency requirements relating to voltage drop and temperature rise.



Test arrangement of the temperature rise test



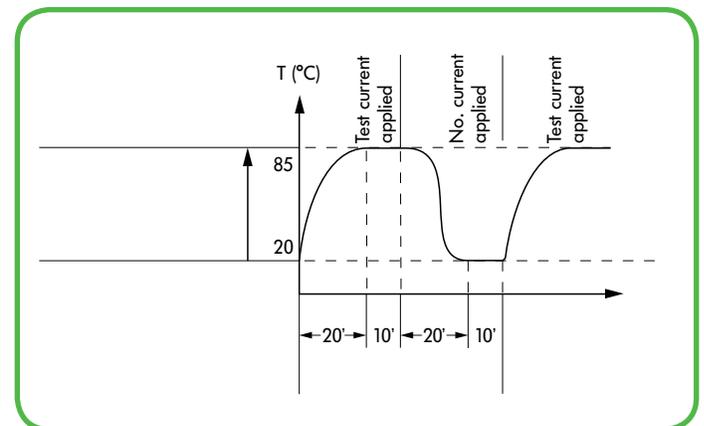
Test arrangement for the voltage drop test

# 12

## What effect does long-term temperature cycling have on the CAGE CLAMP® connection?

The voltage drop of a connection can change significantly over time, especially when changes in temperature exist. The heating and cooling expand and contract the contact parts, varying the contact pressure and deforming the wire. If this is not compensated for (i.e.: screws tightened) the contact will have a progressively higher voltage drop which can eventually impede the signal or cause arcing.

CAGE CLAMP® automatically adjust for settling strands and changes in wire size. As illustrated by the results of this temperature cycling test, the voltage drop remains virtually constant – insuring long-term reliability.



Temperature cycling test – long-term, series 281 (12 AWG, 35 A)  
The diagram includes fluctuations of the supply voltage

# 13

## Why is the CAGE CLAMP® connection resistant to corrosion?

The contact materials used in WAGO terminal blocks and connectors are inherently corrosion resistant.

The stainless-steel CAGE CLAMP® exerts a high specific pressure which embeds the conductors into the soft tin/lead plating of the current bar.

The resulting connection is “gas-tight”, not allowing corrosive gases to penetrate and degrade it.



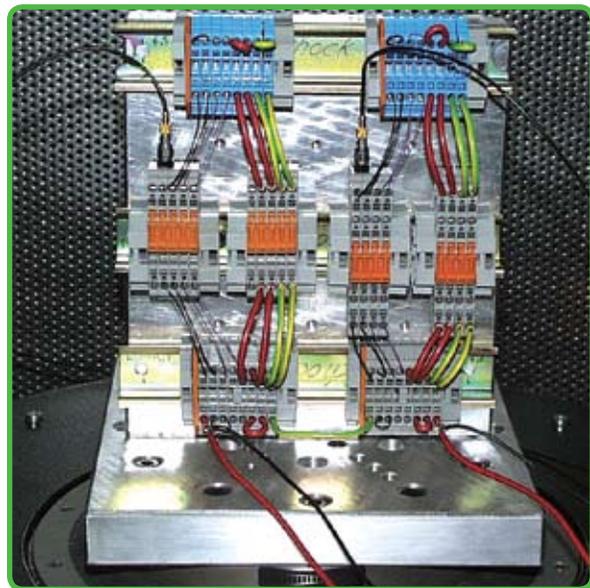
# 14

## Why is CAGE CLAMP® unaffected by shock and vibration?

The CAGE CLAMP® itself has very little mass in relation to the high force it produces. The way in which the CAGE CLAMP® is mounted on the current bar insures that a favorable division of masses (of current bar, conductor and CAGE CLAMP®) is obtained. These factors result in a connection which has high resistance to vibration and shock, without wire damage or measurable contact interruption.

WAGO has tested CAGE CLAMP® for vibration up to 2000 Hz with accelerations up to 20 G's. Independent agencies have tested and passed CAGE CLAMP® for shock and vibration up to 2000 Hz with accelerations up to 109 G's in each of three axes. CAGE CLAMP® also meets the vibration test requirements of VDE 0611 which incorporates a pull test while vibration is present.

The UL “waggle” test also puts a rotational force on the wire while a pullout force is applied.



Shock/vibration test

# 15

## What effect does high current or a short circuit have on CAGE CLAMP®?

VDE specifications limit the temperature rise of terminal blocks to 45o Kelvin under continuous load at nominal current. After a current load of 1.6 times the nominal current over a period of one hour, WAGO terminal blocks don't show any signs of damage.

The short circuit-test according to IEC 17B specifies that 120 A per square mm has to be applied for a period of one second.

CAGE CLAMP® connections pass this test without damage or impairment of their function.

The impractical test shown (a fused circuit would limit such an occurrence) demonstrates the contact capability of CAGE CLAMP®. The current through a 12 AWG terminal block is increased until the conductor glows red. The block remains undamaged.



# 16

## How does CAGE CLAMP® perform well in dry-circuit or low voltage applications?

As long as the surfaces are clean and free of oxides at the time of wire insertion (low voltage signals can't "punch through" oxidation), the gas tight nature of CAGE CLAMP® will maintain the connection quality.

The CAGE CLAMP® system has also been used with excellent results for thermocouple connections.

# 17

## Why is CAGE CLAMP® maintenance-free?

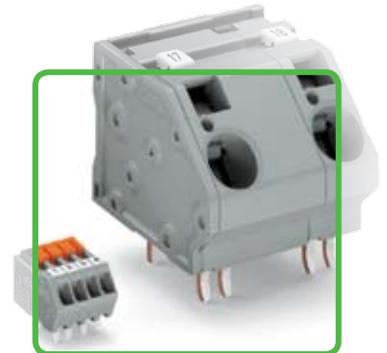
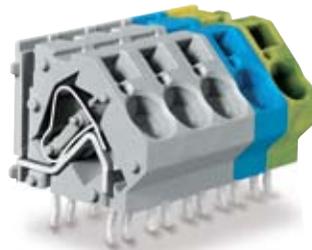
Unlike most screw-type terminal blocks, CAGE CLAMP® connections do not require checking or retightening the loose connections resulting from vibration, temperature cycling, settling strands, etc.

The built-in reliability of CAGE CLAMP® can reduce downtime and service calls for the customer. Most service departments estimate that 35-50% of all service calls are the result of poor connections. Considering the high cost of service calls and the loss of production time, the savings can be significant.

# 18

## Besides rail-mounted terminal blocks, what other applications does CAGE CLAMP® have?

WAGO offers a complete line of CAGE CLAMP® products. From chassis mount terminal strips to an extensive range of printed circuit board blocks with pin spacings as small as one tenth inch. Standard or custom component plugs, relay sockets and interface modules are also available.



# 19

## What worldwide recognition does CAGE CLAMP® have?

Besides the well known agencies of UL and CSA, WAGO products have passed the extensive tests of various agencies throughout the world. This is especially important to export manufacturers.



20

## In addition to CAGE CLAMP<sup>®</sup>, what other major design features do WAGO products offer?



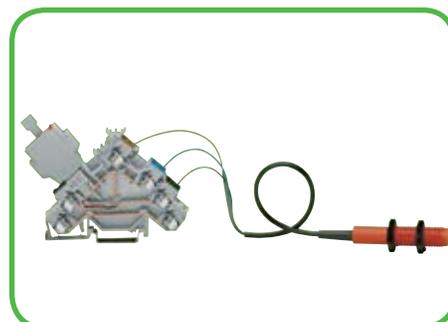
The rail-mounted terminal blocks have a fully touch-proof construction and accommodate one-piece insulated jumpers.



The front-entry series allow both the screwdriver and wire to enter from the top (front) of the block, saving space and simplifying wiring considerably.



The ground block makes an automatic connection to the rail when it is mounted. No center tap screw are required.



The sensor block line allows multiple-wire sensors or components (i.e.: photoelectric, relays, etc.) to be connected to their own dedicated, multi-level terminal block, allowing high density and easy troubleshooting.

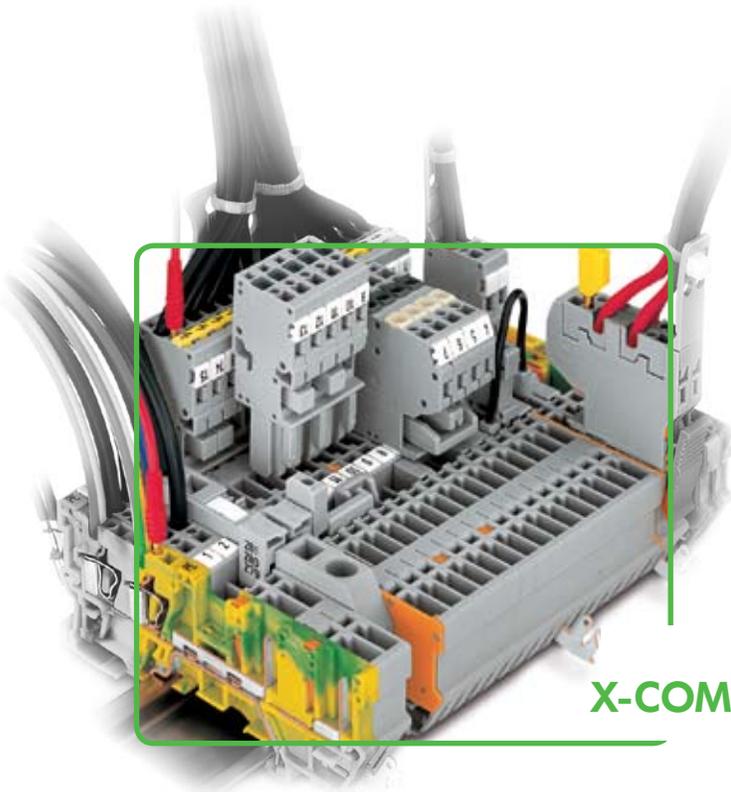


Touch-proof component plugs contain a variety of electronic configurations and plug into front-entry rail mounted blocks. This reduces space, labor and downtime.

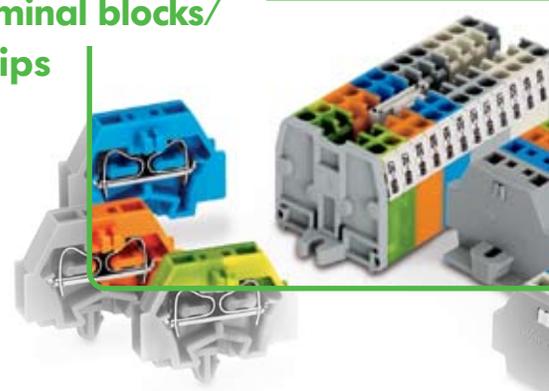


Custom marking is economical using WAGO's marking computer. ProServe software and hardware solutions with the TP-343 Printer.

# Examples of products with CAGE CLAMP® techn

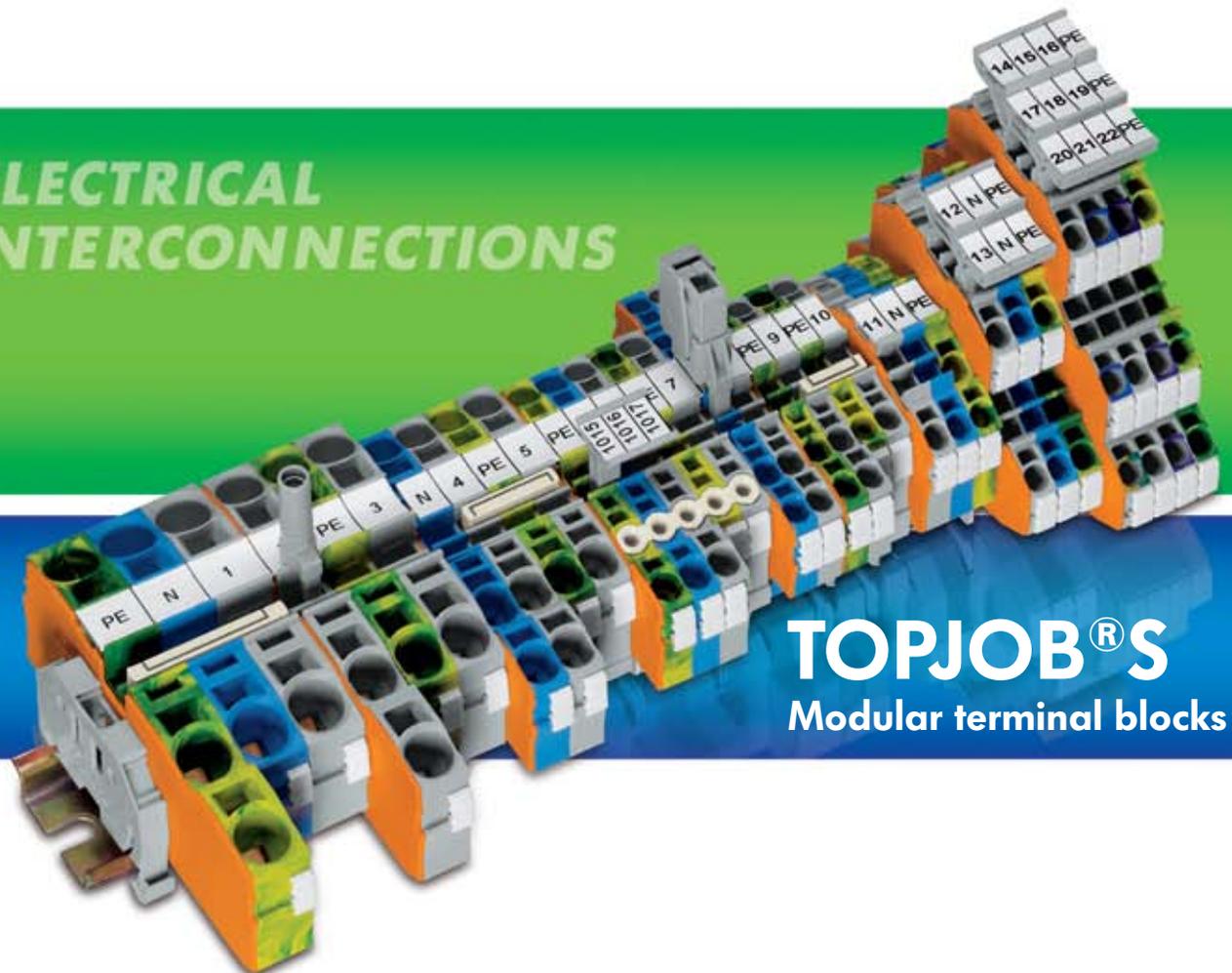


Modular terminal blocks/  
terminal strips



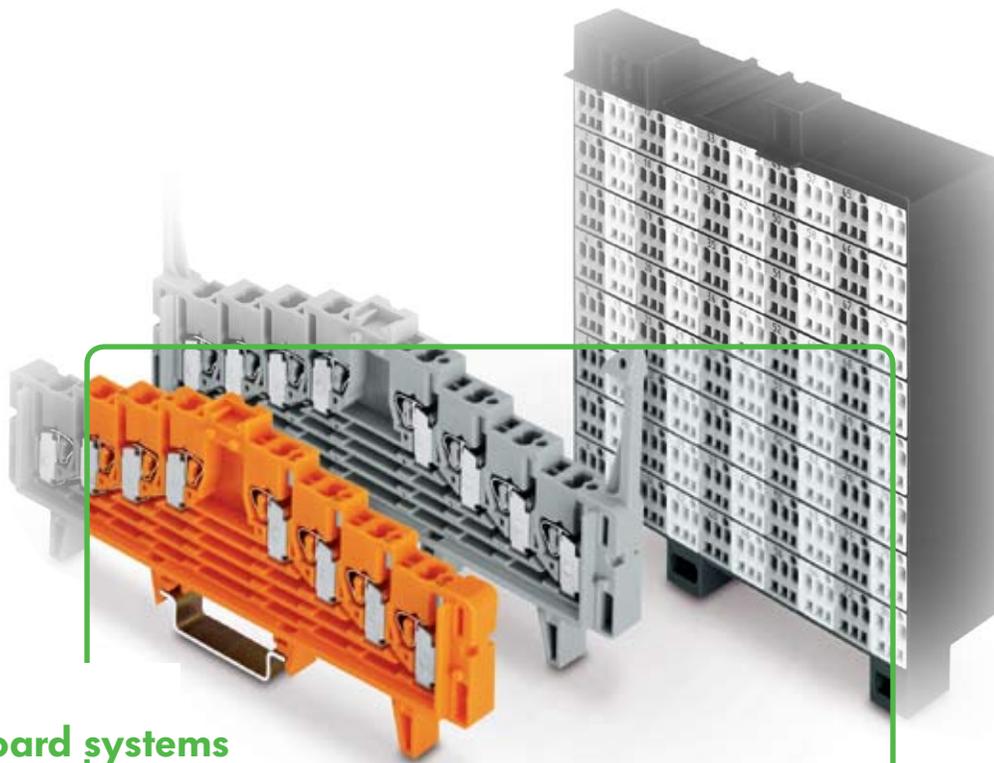
X-COM-SYSTEM

ELECTRICAL  
INTERCONNECTIONS



**TOPJOB® S**  
Modular terminal blocks

ology



Patchboard systems



**WINSTA**®  
Plug-in connector system

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