Consulting for contact technology
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DIN/VDE · EN · IEC

BIZON® press-fit technics

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Guide for determining the size of the contact, the circuit board and application guidelines

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1. BIZON-Contact

The BIZON contact meets DIN EN IEC 60352-5 as well as the higher requirements for applications in automotive applications. Almost all common sizes are SGS-tested and certified. Since the press-fit zone is the same for all contacts in principle, BIZON contacts are type-tested and the manufacturer can ensure function and quality for new contacts with the simple tests described below. Complete tests are not technically necessary. If a customer nevertheless insists on this, he should bear the costs.

The optimum initial cross-section for large BIZON contacts is square. I.e., the contact size and the drill hole result from the required or selected sheet thickness. For specified, larger drill holes (compatibility with competition), the BIZON contact can be adapted. (e.g. with 0.8 mm sheet thickness instead of hole 1.2 mm, hole 1.5 mm). Almost anything is possible.

Standard hole and grid dimensions for an optimal design can be found here:
For high-current applications, the sheet thickness results from the possible design dimensions of the supply line (busbar) and the conductance of the material. Any sheet thickness up to approx. 2 mm is possible, so that the electrically required conductor cross-section can be selected precisely and no material is wasted.

The number of BIZON contacts and their grid spacing per connection point should be selected according to the space available on the PCB so that the current is distributed over a wide area. It is better to have one contact more than one too few and it is better to have a large spacing. Example: if the space allows a pitch of 3 mm, this is better than a pitch of 2.54 mm. Multiple contacts per part also improve mechanical safety and cost little more.

The power dissipation in the contact feed should ideally be smaller than in the contact, or the conductor cross-section in the contact feed should be larger than the sum of the contact cross-sections. In a good press-fit connection, the heat dissipation does not occur in the transition to the copper sleeve, but in the lead-in and lead-out of the direct contact point. Therefore, a large cross-section is also important in the press-fit zone of the contact itself.

Particularly with large contacts, the position tolerances between several contacts and the LP holes generate considerable lateral forces during press-fitting. These forces cannot be avoided in practice and should be taken into account. An appropriately long, free-standing connection (neck) of the contacts up to the base point reduces these bending forces. They should be significantly smaller than the deformation forces of the contacts. In this way, each contact adapts to the printed circuit board and cannot damage it. These design dimensions should be agreed with the contact manufacturer.

The material strength and contact length (contact force) are matched by the manufacturer so that the contact pressure on the PCB hole is within the allowable range.

Functional prototypes can be quickly realized by laser or waterjet cutting followed by edge and tip embossing.

2. Materials

The BIZON contact allows the use of different materials. This choice is an important advantage. But the choice must be made carefully together with the manufacturer. In case of doubt it is better to ask.
Caution: The smaller the contact, the higher the strength must be. Not all alloys are therefore possible for all contact sizes. The temperature resistance must also be taken into account, e.g. brass up to max. 120 °C.

CuZn30, CuZn36, CuSn6, CuSn8, CuNiSi, CuNiSiMg, CuCrSiTi, CuNiSn.
CuSn0.15, CuFe2P (for contacts >1.2 mm).

3. Incoming inspection

The contacts are to be tested according to the drawing and specifications of the license manufacturer:

- general dimensional check
- specified flaring dimension
- contact length from reference edge
- flatness of the contact

4. Injection-molded contacts, specifications

Contacts integrated in plastic housings must be fixed in the mold in such a way that the dimensional tolerance is also maintained in the axial direction (press-fit direction). As a rule, a sufficiently wide shoulder is provided at the base of the contact. This shoulder corresponds to a stop in the tool. The press-in zone of the contact must not have any impermissible contact with the tool. This shoulder must be at least wide enough to provide secure support in the mold. It is the reference plane for the dimension "shoulder to center of PCB" and the support plane of the PCB in the housing. The housing designer determines these dimensions in consultation with the

contact manufacturer and the plastics processor.
If different contact sizes are used in an application, the tips must be at the same height so that all contacts are already in the holes before the press-in stroke begins.

5. Printed circuit board (PCB).

The printed circuit board should meet the requirements of IEC 60352-5.
If the power supply and power distribution are correctly designed, standard PCBs with 2 or more layers are sufficient even for very high currents. Here, too, the resistance in the feed lines is the bottleneck. The BIZON contact is particularly suitable for thinner PCBs.

The hole diameter (finished hole) results from the contact size. The determination of the hole diameter before metallization should be left to the experience of the PCB manufacturer, since a linear calculation is not possible with FR4. Only the final diameter and the thickness of the metal layers are relevant and should be checked.

Gold-plated PCBs are not ideal for press-fit technology because of the nickel-plating and various parameters must be observed. Consultation is recommended.

For MID applications, the correct contact pressure must be observed, which can be considerably lower than for FR4.
The insertion force of the BIZON contact can be continuously adjusted from manual plugging (connectors) to mechanical press-fitting.

The risk of whiskers is inherently low with the BIZON contact because it does not press the tin layers, but pushes them away. The less tin on the contact and in the bore, the lower is the whisker risk. BIZON contacts can be blank. Tin layer thicknesses should generally be in the range of 0.5 to 1.2 µm, i.e. they should only serve as oxidation protection. Since under-nickel plating is not common in printed circuit boards, whiskers are more likely to arise from the tin in the board.

6. Processing, contact insertion

The fixture for single contacts in the press-fit device must be designed in such a way that the contact is held as securely and without clearance as possible and is pressed in perpendicular to the printed circuit board.

If the component to be press-fitted is held firmly in the press-fit jig, it must be ensured that the printed circuit board is floating within the catch circle of the contact tips to the hole. The printed circuit board and the press-fit contacts should be able to freely align with each other.
The press-in force should not generate any torque or deflection at the contact, i.e. it should run in a straight line through the axis of the contact. In the case of bent contacts and also of molded-in contacts, you should come as close as possible to this ideal.

In the case of large and closely spaced high-current contacts, a high force is generated on a small area. In this case, the printed circuit board may only rest on the press pad in the paint-free area directly around the press-fit holes so as not to cause paint damage. The dimensions for the floating support of the PCB must be taken into account here. The projection of the contact in the press-fit direction on the LP must be taken into account. The fixture must have sufficiently deep holes or recesses.
A full-surface support of the PCB is only permissible if no paint damage is possible. The additional tolerance of the paint thickness must be taken into account.
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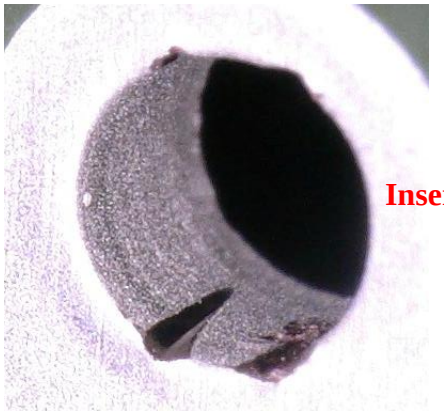
For the press-fit process itself, it is irrelevant whether the PCB is positioned at the bottom or pressed into a housing from above. In any case, the press-fit device must be designed in such a way that the housing and the printed circuit board are supported in such a way that the force path is as straight as possible. Deflections in the housing and especially in the printed circuit

board are not allowed. Such deflections regularly lead to faulty connections and can cause fractures, detachments and pre-damage of components on the printed circuit board.
A lead-in of the PCB with guide pins should only ensure that the press-fit contacts find their way into the hole. It should therefore not be narrower than the catch circle of the smallest contacts.

7. Insertion depth

For PCBs up to 1.6 mm thickness, the thickest point of the BIZON contact (contact center) should be in the middle of the PCB thickness plus 0.2 mm.

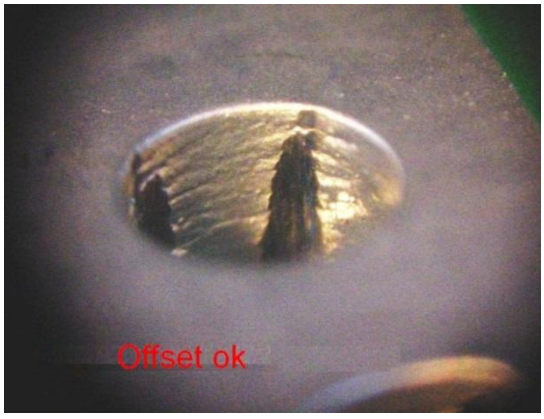


Insertion depth too low

The most reliable way to determine the correct offset is from a longitudinal section. But it can also be determined quite easily from the contact trace in the hole. If the midline of the printed circuit board is desired, the parallel area of the track should extend at least to the midline. This is followed by the wedge-shaped "plough tip" (see pictures). It is better to press in a little deeper than too less deep. If pressed in too less deeply, the contact still sits in a mechanically unsafe "cone" (left picture). The electrical connection and also a low resistance are already present, but the holding force and mechanical safety are reduced.

For thicker PCBs, such as 2.4 mm or thicker, the center of the contact should be at least 0.8 mm from the lower or upper surface. The press-in tolerance increases accordingly.

For large contacts, do not press in too deeply. The limit depth is reached when the contact track in the hole reaches the edge of the hole (Fig. 2). A shoulder for protection can be helpful. As in general, however, it must not sit on.



The press-in is too deep if bulges appear on the PCB underside.
The maximum depth is reached when the contact track ends with the hole (picture 2).

8. Presence inspection of contacts inserted

There are two ways to prove that all contacts are present and properly press-fitted: Optically with camera and tactile with test pins.

With test probes it is necessary that the contact tips protrude over the PCB surface. In the case of small contacts, this protrusion may not be present or may be too short. In this case it is possible to press the contacts deeper beyond the midline of the PCB or, in the case of thicker PCBs, beyond 0.8 mm, until a sufficient protrusion is achieved. When using the BIZON contacts with tip, the tip length can also be easily adjusted. In addition, a small mirror surface can also be easily stamped on the tip for clear camera recognition.

9. Holding force of the contact in the printed circuit board

The holding force is a significant value for the quality of the contact. From experience we can say: If the holding force is OK after the test procedure, all other values are OK as well.
The holding force after all load tests must not be less than the initial value after 24 hours. Therefore, the initial value does not have to be higher than the value after load, as is sometimes required.

The desired holding force must therefore be determined in advance. In most cases, the user wants the lowest possible press-in force and the highest possible holding or press-out force. This physical contradiction can actually be achieved with a good press-fit contact. The trick here is **cold welding <u>after</u> press-fitting** and **form-fit embedding** after relaxation of the printed circuit board. It has also been shown that the **printed circuit board has a significant influence** on the holding force.

Since the application usually involves pressing into already soldered circuit boards, the test boards should also be subjected to the same temperature treatment. In tempered circuit boards, the tinning with the copper forms an alloy (bronze) which reduces the welding.
To ensure that the holding forces are reliably maintained, the contact properties, the PCB and the press-in speed should be coordinated and documented.
BIZON contacts have a significantly higher holding force after passing through all test loads than at the beginning of the test.

10. Press-in speed

The press-in speed influences the press-in force and the process time. In order to avoid welds already occurring during the press-fit process, which are then torn loose again and again, press-fit must be sufficiently fast.

At a not really high speed of 3000 mm/min (50 mm/s), the press-in force drops to the level of sliding friction.

However, at the very low speeds commonly used to date, welds during press-fitting are hardly avoidable (visible in the force-displacement diagram). These increase the press-in forces with a large dispersion. For this reason, some manufacturers even propagate the questionable use of organic lubricants in addition to tinning as a "lubricant". BIZON contacts require neither tin nor lubricants.
To take advantage of all the benefits, the press-in speed for the BIZON contact should be as high as possible (e.g. 1500 mm/min (25 mm/sec) or higher). This significantly shortens the manufacturing process, especially for large contacts.
With bare contacts, welding is better than with tinned contacts. Therefore, bare contacts should be pressed in as quickly as possible. The possible speed is only limited by the press-fit device.

Although the DIN EN IEC 60352-5 standard specifies very low press-in speeds (25 - 50 mm/min), the contact manufacturer is free to specify other speeds.

Of course, BIZON contacts can also be pressed in at the standard speeds if technically required.
See also: https://bizon-kontakt.de/schnelles--einpressen.html

11. Catch circle of the contact tip

The tip of the press-fit contacts is designed to ensure that the contact is securely inserted into the press-fit hole even with small positioning errors.

The allowable dimension of this positioning error is called the "Catch Circle" of the contact tip. This circle is calculated from the smallest hole and the circumference of the contact tip at a contact angle of 45° (tip circle) according to the formula Smallest hole - Tip circle = Catch circle (e.g. BIZON 060-100.1: 0.95 - 0.25 = 0.70). However, this relatively large positional deviation between the hole and the contact can only be used if the entire contact and the hole are not fixed against each other before being pressed in.
In the case of contacts fixed in a carrier, it is important to consider the position of the base and tip separately. For example, if the contacts are molded into a plastic body, a maximum position tolerance of 0.1 mm is allowed at the base (mold shoulder, sealing area).

If there are higher requirements for the position tolerance and the engagement range, the contact can be adapted within reasonable limits (agreement between user/manufacturer).
If both the contact (molded) and the PCB are fixed and the position tolerance at the base is greater than 0.1 mm, the contact must be designed to be flexible at its base, otherwise unacceptable bending or deformation of the contact may occur due to angular pressing. Needle eye contacts in particular can be destroyed. If in doubt, please contact us.

12. Quality assurance.

Release tests are carried out for each new punching tool.
The license manufacturer must perform and document the following tests for each new tool for a BIZON contact:

- Dimensional test
- Press-in and press-out diagrams according to standard with a test PCB and customer PCB
- Cross-sections
- Photos of the new and the pressed-out contact
- Photos of the traces in the hole

These simple and quick tests, when interpreted by experts, provide comprehensive information about the quality and suitability of a BIZON contact.
Together with many years of experience, these tests can replace the complete tests according to the relevant standards. If qualification tests still have to be carried out, it can be assumed that the tests will be passed.
BIZON contacts are very flexible and adaptable in the design and layout of their properties. For the optimum adaptation of an individual BIZON contact to the customer's requirements, the following information and the earliest possible and comprehensive cooperation between user and manufacturer are very helpful:

13. User specifications

- Design of the individual press-fit component
- Current (A)
- Dimension midline PCB to press-fit shoulder or contact tip
- operating temperature
- Minimum holding forces, maximum insertion forces
- External forces on the contact (temperature expansions, bending, push, pull)
- Shape and position tolerances on the component

- Contact tip trap circle
- Same tip height for different contact sizes
- Printed circuit board material and thickness
- Grid
- Hole diameter, only if external specified
- Sheet thickness, only if external specified, the contact size results from this
- Material, only if mandatory
- Surfaces, only if mandatory

and individually more

14. Coordination between user and manufacturer of the press-fit contacts

- Materials, strength
- surfaces
- Retaining forces
- Position and location tolerances on the component
- Contact tip catch circle
- Same tip height for different contact sizes
- Contact size, sheet thickness, max. length
- hole diameter
- Grid
- Press-in depth, tolerances
- Dimension of contact shoulder to center of printed circuit board
  (theoretical coordination dimension between user, contact manufacturer, injection molder)
- Width of contact shoulder
- PCB material and thickness

Furthermore see also **www.bizon-kontakt.de/en** **info@veigelnorm.de**