Consulting for contact technology
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DIN/VDE · EN · IEC

BIZON® pat. Einpresstechnik

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

Content (interactiv**)**

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 1.45 mm).

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. Incoming inspection

The contacts must be checked for the following dimensions and properties:

- General dimensional inspection
- Fixed expansion measurement (belly)
- Symmetrical edge radii
- Parallelism of the contact legs
- Flatness of the contact
- Perfect tip

3. 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. 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 with the BIZON contact is already low because it does not press the tin layers, but pushes them aside. The less tin there is on the contact and in the hole, the lower the risk of whisking. BIZON contacts may be blank. The tin layer thicknesses should generally be in the range of 0.5 to 1.2 µm, i.e. only as corrosion protection. Since nickel plating is not common on printed circuit boards, whiskers are mainly produced from the tin of the printed circuit board. Since the formation of whiskers is not yet completely known, there are always surprises. A low-whisker tin layer or no tin is the best prevention.

4. 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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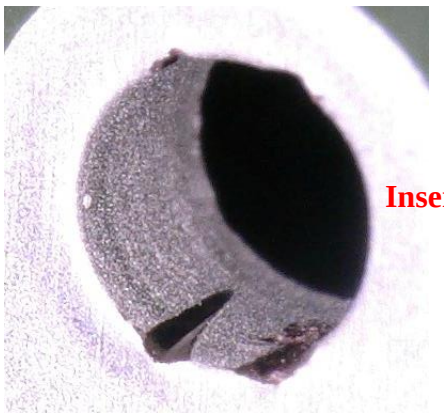
For the press-fit process itself, it is irrelevant whether the PCB is positioned at the bottom or pressed into a housing from above. In any case, the press-fit device must be designed in such a way that the housing and the printed circuit board are supported in such a way that the force path is as straight as possible. Deflections in the housing and especially in the printed circuit board are not permissible. Such deflections regularly lead to faulty connections and can cause fractures, detachments and pre-damage of components on the printed circuit board.

5. 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.

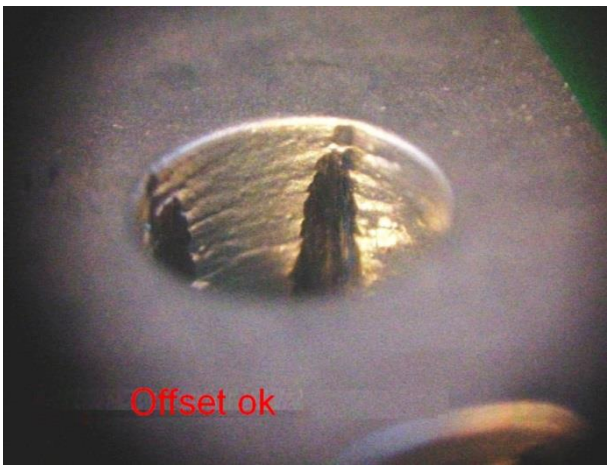


Insertion depth too low

The easiest way to determine the correct insertion depth is to use the contact track 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).

6. 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.

7. 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 should not decrease significantly from the initial value during the service life after permissible loads and also after all tests.

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 after 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.

8. 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 speed of 50 mm/s (3000 mm/min), the press-in force drops to the level of sliding friction. The contact surfaces between the contact and the bore become very smooth. As a result, the holding force may be slightly reduced after 24 hours. At slower speeds, the press-in forces are high and contact surfaces rough, and the contact immediately has more holding force due to this undesirable roughness with increased coefficient of friction. Whether this also improves the electrical quality is at least questionable. The gas tightness and thus corrosion resistance of the joints as well as the subsequent cold welding should be better with smooth surfaces.

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 at least 1500 mm/min. This significantly shortens the manufacturing process, especially for large contacts.

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 required for other reasons.

9. Release tests 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 curves according to standard with a test plate or customer PCB
- cross-section
- 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 supersede the complete tests according to the relevant standards.

For the optimal design and material determination of an individual BIZON contact, the following points should be clarified.

An early and comprehensive cooperation between user and manufacturer is very helpful.

10. 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
- 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 external specified
- Surfaces, only if external specified

and individually more

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

- Materials, Strength
- Surfaces
- Holding forces
- Shape and position tolerances on the component
- Contact tip trap circle
- Contact size with dimensions, sheet thickness
- Hole diameter
- Grid
- Offset, dimension from contact tip to centre of printed circuit board
- Printed circuit board material and thickness

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