



## Product information

# Rigid-flex printed circuits

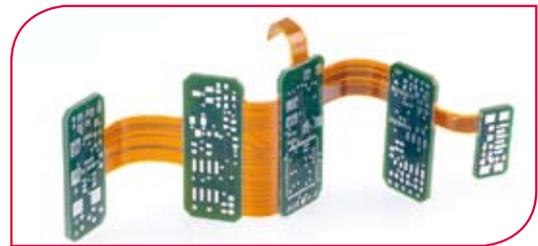
## 1. Introduction

Rigid-flex printed circuits means hybrid systems, which combine the characteristics of rigid and flexible circuit substrates in one product. Whether in medical technology, sensors, mechatronics or in instrumentation, electronics squeezes ever more intelligence into ever smaller spaces, and the packing density increases to record levels again & again. Using flexible and rigid-flex printed circuits, whole new horizons open up for electronic engineers and designers.

Some of the advantages of this application are:

- Reduction of weight and volume
- Defined characteristics of the circuit systems on the printed circuit (impedances and resistances)
- Reliability of the electrical connections due to reliable orientation and reliable contacts as well as savings on connectors and wiring
- Dynamically and mechanically robust
- Freedom to design in 3 dimensions

=> cost savings for the product as a whole



## 2. Materials

### Flexible base material:

Flexible base material consists of a foil made of flexible polyester or polyimide with tracks on one or both sides. **contag** uses polyimide materials exclusively. Depending on the application, we may use Pyralux® and Teclam® made by DuPont®, the glueless flexible laminates in the Espanex™ series made by Nippon Steel Chemical Co. Ltd. or the EPOFLEX® materials made by Krempel.

Apart from the thickness of the polyimide, the materials mainly differ in their adhesive systems (on glueless, epoxy or acrylic basis) as well as in the copper quality. For comparatively static bending applications with a low number of bend cycles (for assembly or maintenance) ED (electro-deposited) material is adequate. For more dynamic, flexible applications RA (rolled annealed) materials must be used.

Materials are selected on the basis of the product and production specific requirements, and the datasheets of the materials used can be requested as required.

### Adhesive systems:

As a bonding agent between the flexible and the rigid materials, systems using adhesive on an epoxy or acrylic basis (which is still capable of reacting) are used. The options are as follows:

- Composite film (polyimide film coated on both sides with adhesive)
- Adhesive films (adhesive systems poured onto a paper base and covered with a protective film)
- No-flow prepregs (glass mat/epoxy resin prepreg with very low resin flow)

**contag** mostly uses no-flow prepregs as bonding agents.

## 3. The characteristics of flexible materials

Flexible materials differ from rigid materials in their essential characteristics, which have to be taken into account:

- Significant reduction of copper adhesion at higher temperatures (e.g. when soldering)
- Increased water absorption
- Changes of dimensions which are larger, by a factor of up to 10 in the individual production stages, especially for wet processes

## 4. Layout guidelines

From the differences mentioned above, for the layout and use of rigid-flex printed circuits, the following can be deduced:

- For single-sided flexible circuits, the bending radius is approximately 6 x the thickness of the flexible material, and for double-sided circuits it is approx. 12 x the thickness.
- Choose track widths and spacing in the flexible region to be as large as possible (> 150 µm)
- The flexible region should have parallel tracks which are the same width, with the same leakage resistance, and which run at 90° to the bend line
- Tracks should extend at least 1 mm into the rigid region
- On flexible layers, include hatched copper areas which are as large as possible
- The tracks on double-sided, flexible parts should be symmetrically offset
- Holes should be at least 2 mm away from a flexible part



- Choose solder surfaces to be as large as possible, the diameter of solder eye pads should be at least twice the diameter of the hole.
- Solder must not come closer than 1 mm to the flexible area
- Add about 1 mm all round to the dimensions of openings in non photostructured covering films
- To be able to assemble the components on a board, to solder & check them, a stiff frame with defined breaking points should be used. Blanks can contain single or multiple boards.
- Always use smooth (round) milling transitions to the connected parts of the circuit

## 5. Assembly variations

contag manufactures rigid-flex printed circuit boards with flexible external or internal layers.

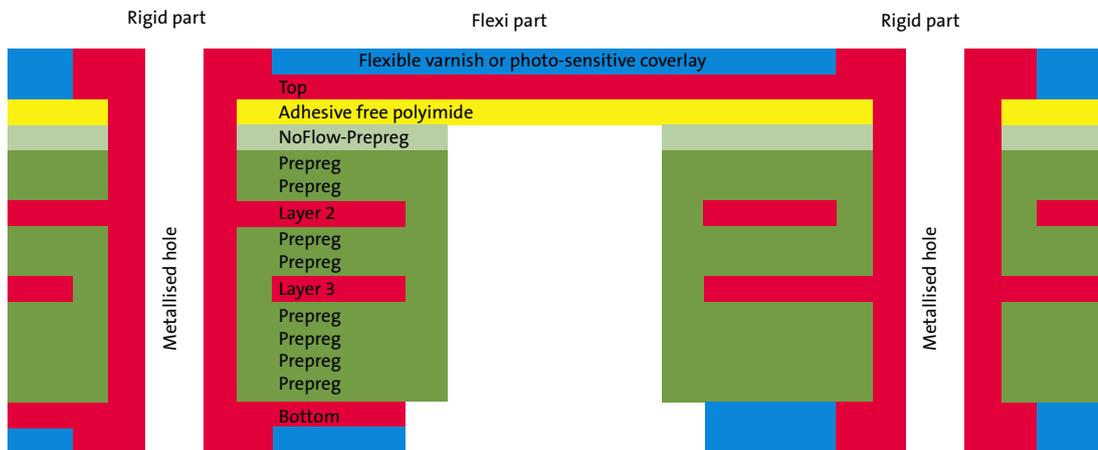


Abb. 1: Example structure of a 4 layer board with a flexible top layer

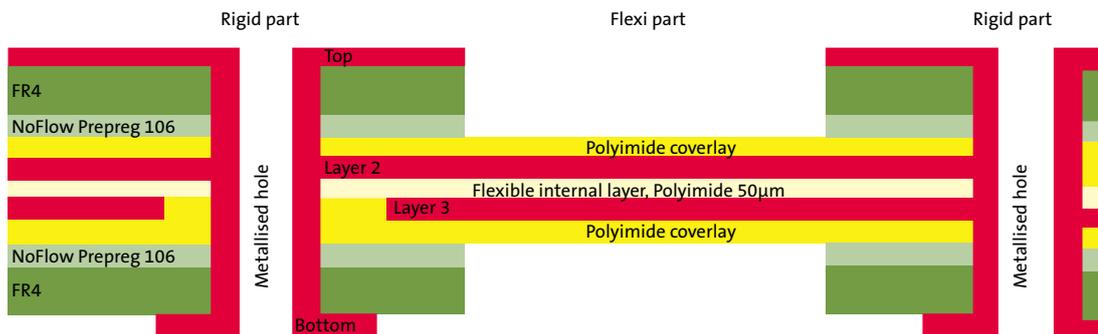


Abb. 2: Example structure of a 4 layer multilayer board with a flexible internal layer

## 6. Processing notes

In principle rigid-flex printed circuits can be soldered without restrictions using the parameters for rigid printed circuits.

As polyimide film is however very hygroscopic, it is vital to dry it before soldering. If this is not done, delamination may occur, bubbles may form or sleeves may rip out during the soldering process.

We recommend drying for > 2 h at 120°C and then processing immediately (< 6 h) afterwards.

When designing rigid-flex printed circuits, there are many possible options for the construction and for the materials used. Please get in touch. Together, we can produce the ideal solution!

For further technological questions concerning circuit boards, please contact our team of technologists (Tel. 030/351 788 – 155).