



Rigid Flex | Whitepaper

Why Rigid Flex is More Costly Than Traditional PCBs

Rigid flex circuits are approximately seven times the cost of traditional printed circuit boards (PCBs).

In this whitepaper, we'll explore the reasons why.

First, some quick facts about rigid flex:

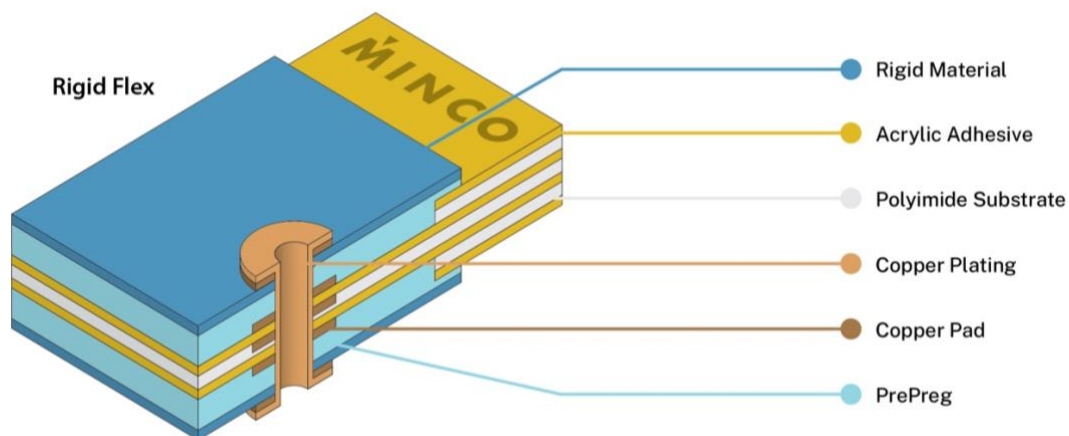
- Rigid flex uses a combination of flexible and rigid board technology to create a circuit with flexible inner layers and rigid exterior layers.
- Rigid flex assemblies offer the advantages of both flexible cables and conventional PCBs.
- The primary reasons to spec a rigid flex PCB versus PCB and ribbon cables are weight savings and reliability. This is where rigid flex circuits really shine.

The demand for rigid flex PCBs is growing due to the increasing need for highly reliable, smaller, lower weight solutions that reduce the potential for fail points. Military and aerospace applications have largely driven the use of rigid flex PCBs to date, but industry analysts expect this technology will soon find its way into more mainstream applications due to growing demand in the high-end consumer electronics and healthcare device markets.

Rigid flex PCBs can be designed with conventional through-hole connectors and additional integrated components, such as heaters and sensors, to create a single solution that reduces assembly errors and improves capabilities. However, rigid flex is more costly due to a variety of factors – from requiring more layers and material to additional processing steps.

Now, let's explore the major cost-drivers for rigid flex construction vs traditional PCBs.

Reason #1: Additional Layers Mean Additional Cost and More Complex Construction



Rigid flex PCBs can have as many as 20+ layers – and with more layers, comes higher costs. With a rigid flex PCB, flexible insulation layers are inserted between each flexible conductive layer, with through-holes to connect the circuit between each layer. Additional layers mean a more complicated assembly for rigid flex versus PCB and ribbon cables.

Rigid flex also requires a more advanced and diverse assembler skillset and there are many different connecting materials that require electrical, thermal and mechanical expertise to ensure the proper connection. These requirements and complex construction methods ultimately increase the cost of a rigid flex PCB.

But with more layers also comes more functionality. Circuits designed primarily as flex circuits have greater opportunities to increase design capabilities when integrated rigid areas are included. The rigid areas provide excellent hard mount points for components, connectors and chassis while flex areas offer dynamic flexing, flex to fit, and component mounting to take advantage of low mass and vibration resistant zones.

Reason #2: Rigid Flex Requires More Accurate Dimensioning, Additional Surface Finishes

Another factor that can drive up rigid flex project costs is the need for more accurate dimensioning. In some cases, customers have tried using tolerances from a prior rigid PCB project, but this approach is not feasible as rigid flex projects require tighter tolerances. The best approach involves an initial design phase at the start of the project where engineering experts can identify the correct tolerances needed and make any necessary changes to ensure success.

Additionally, while the metal plating process isn't necessarily a significant cost driver, knowing which surface finishes provide predictable performance for rigid flex PCBs can help save time. PCBs designed decades ago typically included soldering and tin lead, but today electroless nickel immersion gold (ENIG) is the most common surface finish.

Reason #3: Mistakes Can Be Costly When the Project Isn't Specifically Designed for Rigid Flex

Most engineering challenges for rigid flex projects are due to not designing specifically for rigid flex. Engineering experts should be brought into the project early during the design phase to identify and correct any errors — and save money in the long run.

These errors are often evident when the engineering files come in. Much of today's software used for design is geared toward higher volume PCBs or rigid boards. Certain aspects to rigid flex are unique, such as understanding where the bend radius will be and how the layers will stack up. Involving engineers with the right experience and expertise can play a significant role in identifying the best approach to solving these challenges while minimizing costs.

How Can Engineers Keep Costs Under Control?

There are ways to drive down costs in a PCB development project. Let's explore how to lower costs while maintaining product integrity.

Use Flex with Stiffeners

Rigid flex is more costly to produce than flex with stiffeners from a materials and processing standpoint. Sometimes a PCB project can use flex with stiffeners, but if the design calls for surface mount on each side of the circuit, a stiffener can't be used. However, if there is a way to rigidize flex for a project, Minco engineers will suggest doing so as a way to reduce costs.

Pay Attention to Fit

Part dimensions and shape play a significant role in rigid flex projects. When the design calls for fitting multiple components onto one standard panel pane, factors such as part shape, length and width become important. Since components need to nest together properly and efficiently, finding the best way to get more on a panel while maintaining overall integrity is one of the biggest cost drivers in a rigid flex project.

Understanding this from a design standpoint can help the process go more smoothly. For example, if there's a straight circuit and you put a bend and form it into an L shaped circuit, the L shape won't nest as well and fewer components can be included on the panel.

Design for Manufacturing

Assembly errors can add unexpected cost to rigid flex projects and delay production. Design for manufacturing (DFM) as a front-end engineering design process helps eliminate errors during assembly. In-house Minco assembly experts provide input early in the design process, while continuing to review projects throughout development, to provide seamless circuit assembly. Assembly errors are far more frequent when product designers subcontract the assembly process with an outsourced assembly provider.

Focus on Quality

No product designer wants to experience a failure in the field. A failed device is the worst kind of cost, as it often creates more than financial issues. That makes a focus on quality critical to the performance of a rigid flex PCB. From raw materials coming to final products being shipped, every step needs to be meticulously designed and cross-checked to ensure quality. From the very beginning of a project, design

engineers should be picking materials and spec'ing the design to meet the project's specific performance requirements.

Sometimes Rigid Flex is the Inevitable Option

In complex electronic component projects where a critical failure would cause catastrophic consequences, high performance rigid flex PCBs are the safest option. They also provide the high reliability and lower weight that developers need as the miniaturization of electronics continues to drive innovation. But rigid flex does come with a higher cost due to consuming more material and creating more steps in assembly. Working with a solution engineering firm with end-to-end experience in rigid flex is your best bet for minimizing costs and maximizing product performance.

Ready to Innovate with Minco?

When it comes to truly game-changing design, engineering teams need technology that allows them to build smaller, build lighter and build better.

Visit [Minco.com](https://www.minco.com) to learn more about our rigid flex capabilities.

Call Minco at 763.571.3121 or send us an email at CustServ@minco.com to get started.



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