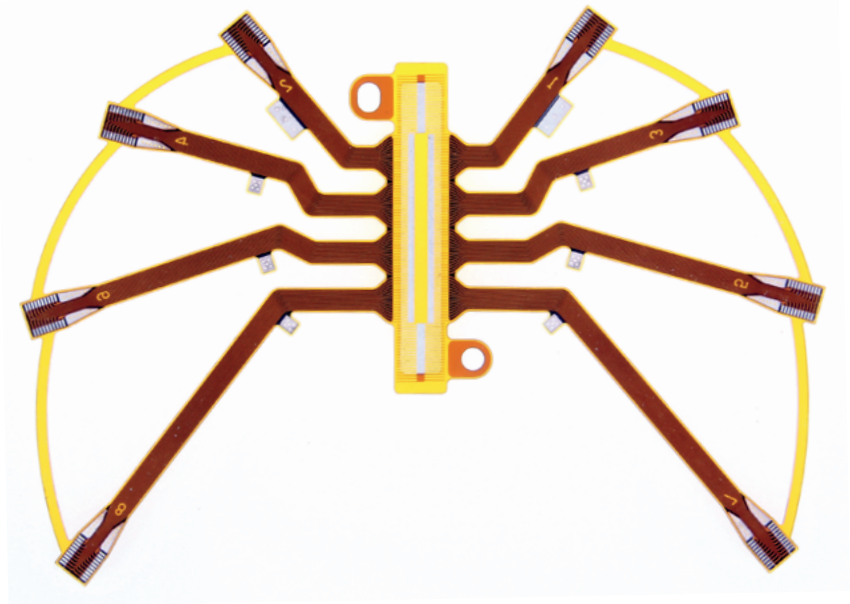
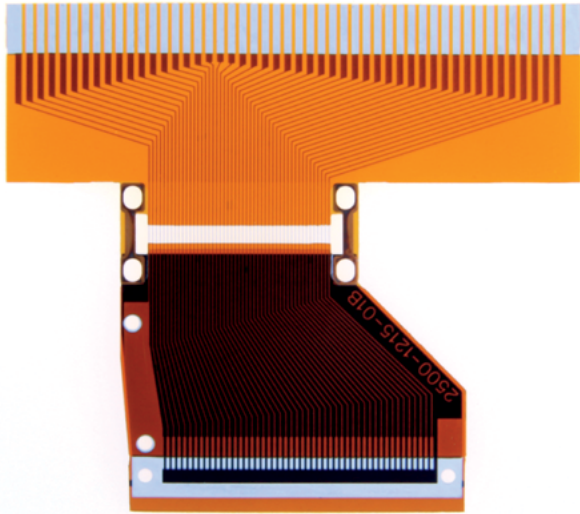


Design Brief _____

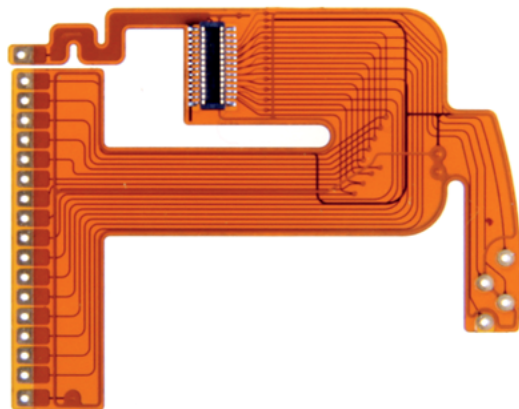
High Reliability Flexible Circuits for the Medical Marketplace



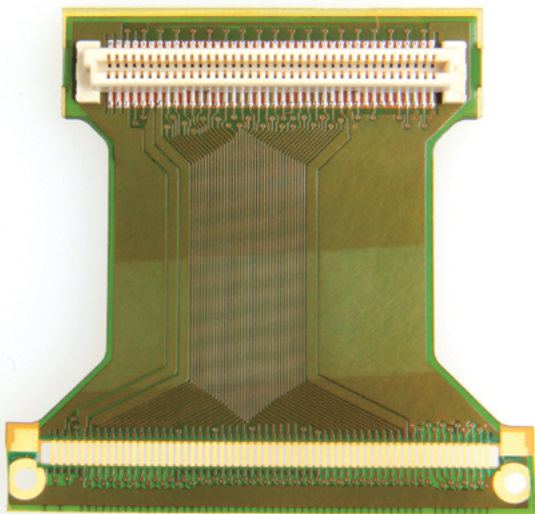
Tech-Etch
www.tech-etch.com



Windowed Leads



Connector Assembly



High Reliability Flexible Circuits for the Medical Marketplace

Tech-Etch manufactures high reliability flex circuits used in the diagnostic imaging, patient monitoring, cardiac management and life science industries. Flexible circuits provide the thinnest and lightest interconnect method available. Their extreme thinness makes them very well suited for dynamic applications where the flex will be in constant or periodic motion. They contribute to reducing overall system complexity by facilitating assembly and eliminating wiring errors. Flexible circuits will conform to the available geometry for connections of electronics located on different planes within the finished electronic device. This capability is sometimes referred to as 3D packaging.

Medical Applications Supported

The demand for wireless, portable, and more complex electronic assemblies has led to the use of flexible circuits in many high reliability medical applications. Tech-Etch has developed manufacturing processes to produce the sophisticated circuits required by these electronic devices:

Medical Imaging including ultrasound transducers, CT scanners and X-ray scanners. These circuits are typically multilayer microvia circuits requiring fine pitch trace / space and precise circuit layer registration.

Implanted Devices including cardio defibrillators pacemakers and neurostimulators. These circuits often require telemetry coils, piezo ceramic assembly and nickel or niobium terminations.

Medical Instruments including ultrasonic and phaco surgical handpieces. These circuits often require conductor materials other than copper, such as beryllium copper or stainless steel.

Drug Delivery Flex circuits supporting external drug delivery pumps often require component assembly which might include a sensor.

Increasing Complexity of Medical Flexible Circuits

The advent of more complex electronic assemblies has driven the need for high density interconnect circuits. These difficult designs must be sourced from very capable flexible circuit manufacturers who are able to produce multi-layer, fine-line circuits. Tech-Etch will typically use laser drilling technology to fabricate very small micro vias in addition to laser direct imaging to generate equally dense circuit patterns. In some cases these features are so small they cannot be electrically tested using the conventional test fixture process and quality must be confirmed using more sophisticated flying probe electrical test process.



Laser Drilling



Laser Direct Imaging



Screening and Pick & Place



Flying Probe Electrical Test

Process Capabilities

A broad array of process capabilities and vertical integration makes it possible to manufacture flexible circuits to the stringent quality standards of the medical industry, as well as other high reliability applications:

UV Yag Laser

6 UV Yag lasers allow for drilled holes down to .001" diameter as well as prototype and production outlining within .002" of existing copper features.

Automated Plated Through Hole Process

Process reliability and consistency controlled by automated PTH process. Hoist system built by industry leader Integrated Process Systems.

Laser Direct Imaging (LDI)

Laser direct imaging provides excellent circuit layer registration, with via to pad registration to +/- .001" and lines and spaces capabilities down to .001".

Additive Copper Processing

Inert anode copper plating supports nodule free copper traces down to .002" trace and space. in 1 oz. thick copper with straight sidewalls.

Subtractive Copper Processing

Fine line .001" trace and space on thin copper down to .0005" thick

Automated Optical Inspection

State of the art AOI equipment is used to confirm accuracy of copper geometry on all work in process.

Finishing Options

Soft Gold, Hard Gold, Nickel, Tin, Tin/Lead, Immersion Silver, ENIG, ENEPIG all available to support assembly process from soldering to wire bonding.

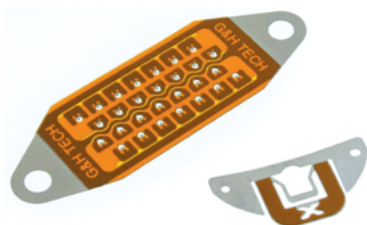
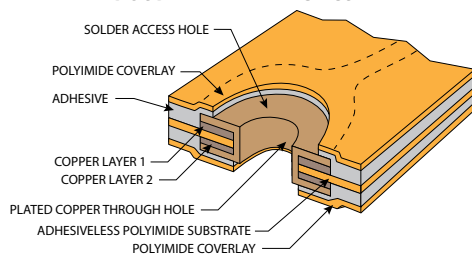
Assembly

Automated SMT assembly using Samsung CP45NEO pick & place delivers package sizes down to 0201 and 4mm pitch components. Tech-Etch also offers precision single point, bar bonding and hand assembly.

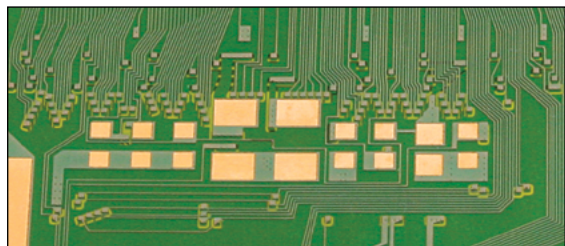
Circuit Test

- Standard Opens and Shorts testing per IPC-9252 9252 using dedicated fixtures.
- High density bare board testing achieved using flying probe (fixtureless) electrical test.
- Hipot and Insulation Resistance testing up to 16 channels.
- Impedance, Inductance and Capacitance bare board testing, as well as functional in-circuit testing of discrete components (capacitors, resistors, diodes).

DOUBLE LAYER FLEX CIRCUIT



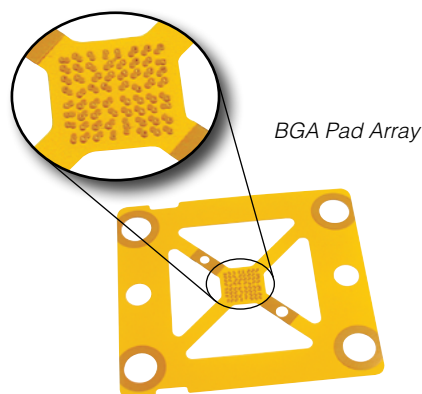
Stainless Steel Circuits



Flex Illustrates Fine Line and Laser Drilling Capability



Actual Size .75"



BGA Pad Array

Flex Circuit Substrates

Tech-Etch typically uses polyimide film as the base layer on single metal layer flex circuits and for inner layers of multilayer circuits. Polyimide offers dimensional stability, has low moisture absorption, excellent thermal and electrical resistance, and is UL rated.

Copper is the most common material used for circuit traces and offers the most cost effective solution. Thickness typically ranges from .0007" to .0028". Other materials can be used for specific applications such as high resistance metals (kovar / stainless steel) for heater applications, thicker copper for high power requirements, or beryllium copper for applications which require spring properties. Selective tungsten segments are used when radiopacity is required.

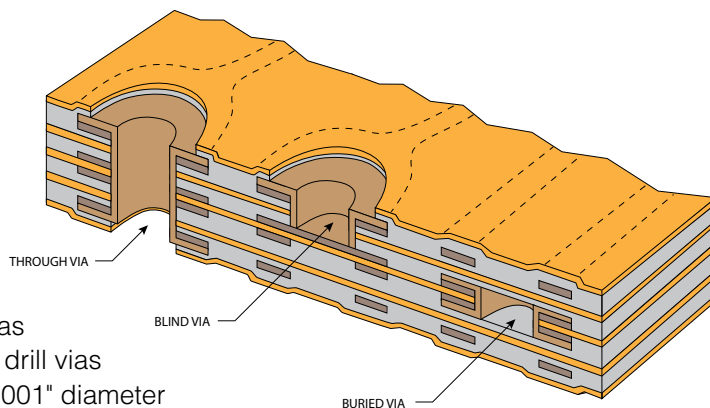
Adhesiveless Substrates

For applications where thinness is a concern, adhesiveless base materials can be used to further reduce the overall thickness of the flexible circuit. These materials do not have the layer of adhesive typically found between the polyimide film and copper circuitry layer. The use of these materials can reduce the thickness of the flexible circuit by approx. .001" per copper layer.

Flex Circuit Construction

Plated Through Vias

A via is a metalized through hole that connects the conductive layers of a flexible circuit. The drawing below illustrates the three varieties: through, blind and buried vias.



Tech-Etch has the ability to drill vias as small as .001" diameter using UV Yag laser technology.

Circuit Layer Geometry

Tech-Etch has the ability to fabricate fine line circuit layer geometry and high density via arrays through the use of Laser Direct Imaging combined with Additive or Subtractive copper processing. The processing method for the copper layer is dictated in part by the design requirements, process capabilities, material requirements, and is usually determined by Tech-Etch. Tech-Etch can produce fine line circuits with trace and space patterns as small as .001" in production volumes.

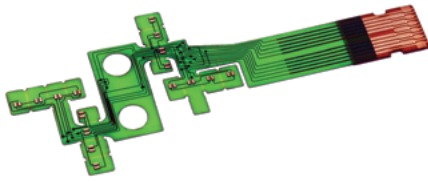
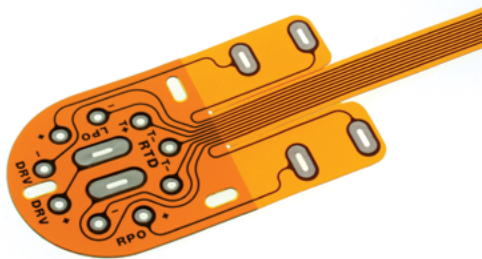


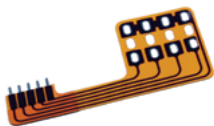
Photo Imageable Coverlayers



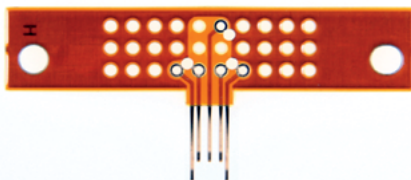
Polyimide Stiffener



Molded Plastic Stiffener



Cantilevered Fingers



Formed Beryllium Copper Contact Fingers

Coverlayer

The insulating layer, or cover layer, is typically constructed of a pre-cut piece of polyimide film laminated over the conductors using either acrylic or epoxy adhesive. Polyimide offers dimensional stability, has low moisture absorption, excellent thermal and electrical resistance, and is UL rated.

For high density applications surface mount technology will be used for assembly, Tech-Etch also has the ability to work with **Photo Imageable Coverlayer**. This material is coated over the conductors and does not require adhesive or lamination. Though not as resilient as polyimide film, it does support very small and dense access openings required by many of today's electronic components.

Tech-Etch can register extremely small openings in Photo Imageable Coverlayer to corresponding circuit layer geometry by using Laser Direct Imaging.

Stiffener Options

Polyimide film may be used when the additional thickness required is between .002" - .009". Polyimide stiffeners can have coincidental edges to the circuit outline. Other materials such as metal or molded plastic components can also be used as stiffeners for specific flex circuit design requirements.

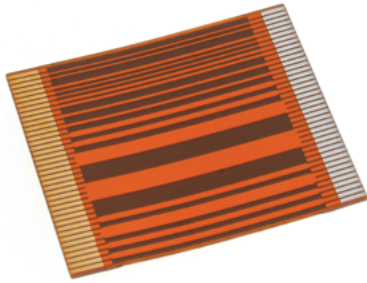
FR-4 is used when the additional thickness required is greater than .010". The stiffener features are typically smaller than the corresponding circuit features by .015". Applications with surface mount components typically require the use of a rigid stiffener. FR-4 can be added to the opposite side of the flex circuit to strain relieve the solder joints.

Finish Options

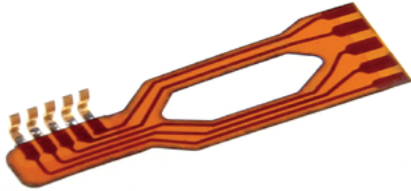
Exposed pads will typically need a finish for corrosion resistance or compatibility with the assembly process or application. Electroplating is the most common finishing process. Tech-Etch offers in-house electroplating of Tin, Tin Lead, Copper, Nickel, Soft Gold, and Hard Gold. Electroplating can only be used when all the traces are connected to a common external plating bus during fabrication.

For designs where the traces cannot be bussed into the panel, electroless finishing options such as hot air solder leveling, ENIG (immersion gold / electroless nickel), ENEPIG (immersion gold / electroless palladium / electroless nickel), immersion silver, and immersion tin are available as alternatives.

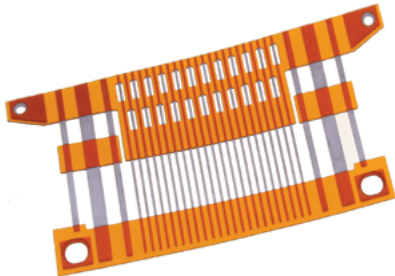
The final finish applied to a flex circuit can be tailored to support end customer assembly process. For example, exposed pads on the flex circuits can be plated with tin to support soldering process or soft gold to support more sophisticated assembly processes like wire bonding. Because flexible circuits are sometimes used to interconnect different



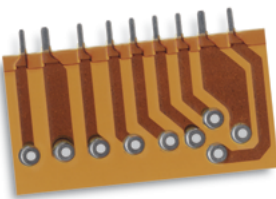
Flex with Selective Plating



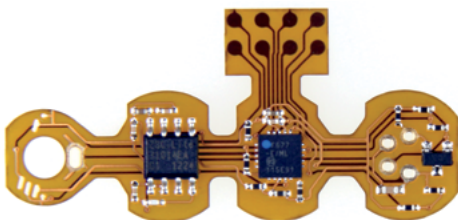
Beryllium Copper Spring Contacts



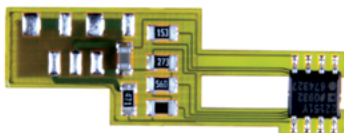
Conductors Suspended in Open Window



Contoured Circuit



Component Assembly



electronic modules, **Selective Plating** can be applied to the different areas of the circuit to support multiple assembly processes. This is particularly useful when multiple assembly processes will be used on the same circuit design.

Tech-Etch flex circuits can be made RoHS compliant by selecting the proper finish. Our product engineers will help ensure the finish selected supports the intended application.

Quality and Qualification

Accurate dimensional inspection is supported by the use of OGP smart scopes and Keyence automatic inspection equipment, both of which use edge detection technology.

In process inspection of plating thickness is done with XRF and CMI equipment on an AQL basis.

Dedicated engineering resources and thorough understanding of PFMEA, MSA (GR&R), and statistical analysis support customer requirements for data collection and qualification reporting.

Integrated Interconnection Options

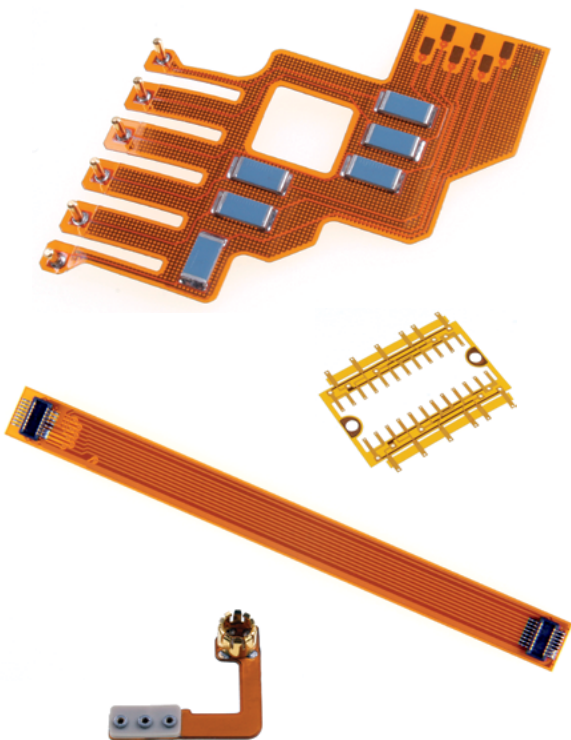
By using our unique polyimide etching technology, Tech-Etch can supply circuits with conductors suspended across an open window in the polyimide film or cantilevered from the edge of the circuit, referred to as **Windowed Leads**. These traces can be directly attached to mating components using solder or wire bond process. For circuits made with beryllium copper, cantilevered leads can be formed and used as integral spring contacts.

Capitalizing on its experience with thick metal photo etching, Tech-Etch can supply **Contoured Circuits** with integral contact fingers up to .010" thick. The metal in other areas of the circuit is etched down to approximately .003" thick. Particularly useful for applications where current carrying capacity is a requirement, this process also supports raised solder pads above the cover layer or circuits manufactured on material as thick as .020".

Component Assembly

Surface mount component package sizes down to 0201 and leaded components down to .4mm pitch are attached using automated solder printing, pick & place, and reflow equipment (**SMT Process**). In addition to surface mount components, high density surface mount connectors can also be added as a way to connect the flexible circuit to the corresponding electronics.

Tech-Etch also offers through hole component assembly as well as Single Point or Bar bonding for applications requiring significant process control such as ACF bonding, or for specialty components such as axial lead thermistors, piezo elements, wound coil antennas, and circuit pins.



Flex Circuit Dimensions and Tolerances

Optimum Sizes

Tech-Etch provides circuits up to 16" long. Multi-layer circuits up to 8 conductive layers are available. Consult factory for larger sizes.

Shielding

For designs requiring shielding, additional layers of copper can be added in solid or grid patterns. Conductive ink shield layers are also available.

Flexibility

Dynamic regions on a Flex Circuit should be identified on the print to allow for manufacturing features that will enhance dynamic performance. The following are general guidelines that apply to non-dynamic applications where bends are for installation only.

Minimum Bend Radius

Single Layer Circuit 10x thickness

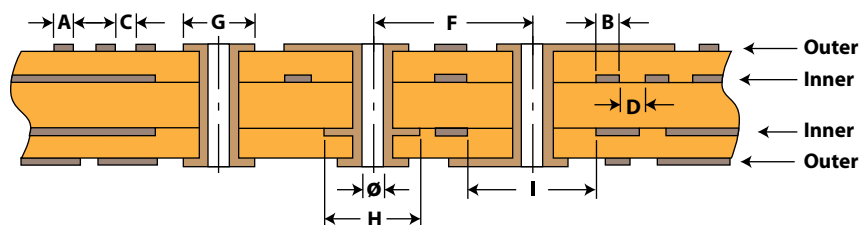
Multi-Layer Circuit 20x thickness

Temperature

Most often the adhesive used is the limiting factor for high temperature rating continuous service. Typical values are 105C (221F) for epoxy adhesive and 120C (248F) for acrylic adhesive. Both systems will withstand normal soldering practices after a moisture driving bake.

Circuit Layer Design Guidelines

Attribute	Detail	Nominal	
		Minimum	Preferred
Line Width – Outer Layers	A	0.0015"	.002"+
Line Width – Inner Layers	B	.001"	.002"+
Line to Line Space – Outer Layers	C	0.0015"	.002"+
Line to Line Space – Inner Layers	D	.001"	.002"+
PTH Diameter – Drilled	Ø	.001" min	
PTH to PTH Pitch – Center to Center	F	Ø+.0065"	Ø+.0075"+
PTH Pad Diameter – Outer Layer	G	Ø+.002"	Ø+.003"+
PTH Internal Land Dia. – Inner Layers	H	Ø+.002"	Ø+.003"+
PTH Clearance Dia. – Inner Layers	I	Ø+.004"	Ø+.005"+



Coverlayer Design Guidelines

	Polyimide Coverlay				Photo Imageable Coverlay			
	Nominal		Tolerance		Nominal		Tolerance	
	Min.	Pref.	Min.	Pref.	Min.	Pref.	Min.	Pref.
Feature Size	0.008"	0.020"	± 0.001"	± 0.010"	0.004"	0.008"	± 0.001"	± 0.002"
Registration	-	-	± 0.001"	± 0.010"	-	-	± 0.001"	± 0.005"

If your design requirements exceed the capabilities stated above, please contact the factory to see if an alternate process or tooling are available.

**Click on photo
to send for brochures below.**

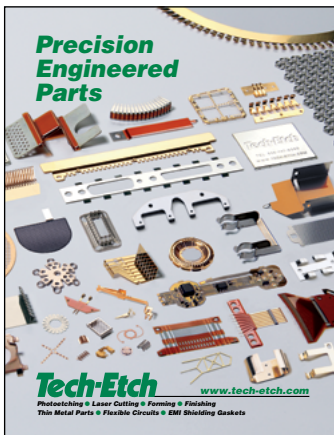
Flexible Printed Circuits

Design Guide highlights advanced manufacturing techniques.



Precision Engineered Parts

Photoetching, forming, laminating and laser machining capabilities are described.



EMI/RFI Shielding Products

Our 52-page catalog describes all standard EMI/RFI shielding products.



TECH-ETCH - A TOTAL CAPABILITY

World Technology Leader

Tech-Etch manufactures precision parts for the medical device, semiconductor, telecommunications, military / aerospace, and analytical instrument industries. The company has a long history of technological innovation, quality products, excellent customer service and growth. From its beginnings as a research firm in 1964, Tech-Etch has expanded its product offerings, acquired new businesses and constructed new facilities. Tech-Etch currently operates three manufacturing facilities and has over 500 employees. Corporate headquarters and most of the custom engineering and manufacturing are located in Plymouth, MA, just over 40 miles south of Boston. Over 160,000 square feet of floor space, conference and training rooms, and state-of-the-art chemical processes and equipment make this Tech-Etch's centerpiece. The other facilities located in Fall River, Massachusetts and Litchfield, Minnesota add a combined 100,000 square feet of floor space.

Wide Range of Processes

Tech-Etch performs a wide range of processes. This vertical integration enables the company to assume total responsibility for the quality and delivery of our precision products. In plant services include flexible circuit design and production, photo etching and chemical milling, artwork generation and phototooling, stamping from coil stock, forming of etched blanks, tool and die making, production heat treating, welding and soldering, metal finishing, plating and laser cutting. Secondary operations such as solder joints to seal seams, spot welding and the application of pressure sensitive tapes and insulation materials are also available.

ISO 9001:2008 Certification

Tech-Etch operates a Quality Management System that is registered to ISO 9001:2008 and AS9100:2009, the internationally recognized standards of quality. These standards set guidelines that a company follows to provide confidence to its customers that it is able to supply products that consistently meet requirements. AS9100:2009 is based on the core requirements of ISO 9000, but includes additional requirements necessary to meet the needs of the aerospace industry.



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