



[www.E-FAB.com](http://www.E-FAB.com) Photo Chemical Machining

## Terminology PCM Engineering Terms

### Online CNC Glossary of Machining & Photo Chemical Engineering

Technical glossary micro CNC machining terms master of on-line photo [chemical machining process](#) terms chemical milling process, definition of photo etching, glossary for milling, and manufacturing and technical engineering terms for photographic etching definitions info defined.

On-line English technical terminology. Click the following link to download the [PDF Engineering Terminology Dictionary Version](#)

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

## Engineering Terminology Dictionary

Chemical machining engineering vocabulary definitions note: all information subject to interpretation. A mile may have 5280 ft. or then again it may not.

[nota bene N.B. coordinatograph in E.C.](#)

A

### Alignment:

The proper relative position accuracy of a graphic image, on an emulsion photo resist film mask with respect to an existing graphic image on a substrate.

### Alignment marks:

Images selectively placed within or without an array for either testing, aligning or both.

### Angstrom(Å):

Unit definition used to define light wavelength, ultra-violet energy and x-rays; one angstrom is equivalent to  $10^{-10}$  nanometers ( $1.0 \times 10^{-10}$  meters).

### Artwork:

An accurately scaled pattern which is used with producing the technical engineering drawing artwork photo master or photo mask(s); a product consisting of an image on the stable base surface. The proper description to define artwork and must include the required specification for tone and orientation; these specifications impact subsequent photo processing operations and/or usability.

**Artwork master:**

An accurate one to one pattern, usually a single image, which is what is used in producing the photomask(s). The proper description defining the artwork master must include the required specification for tone & orientation; these specifications are what impact subsequent photo processing or CAD/CAM operations.

B

**Background:**

The surface area against which the pattern is relieved. The surface area of the background is usually much greater than the area relieved.

**Backlighting:**

Viewing or photographing an object by placing it between a light-source & the eye or recording medium.

**Bake:**

A thermal process used to dry or cure.

**Base Material Layer:**

The material layer onto which coating or plating is applied, and/or from which stock is selectively removed by ([photochemical milling procedure](#)) photo chemical machining; onto which a strippable photosense is applied for use with producing phototools.

**Border Area:**

Region areas outside the functional pattern area(s).

**Border Data:**

The data patterns which appear within the borders areas of phototooling; the patterns may include tooling hole bullseyes, identification, test, and registration marks.

**Bullseye:**

Stylized control pattern located within the borders areas of a (phototool or photomask or photo master) to assist in phototooling alignment and/or control registration.

**Burn In:**

To heat a printed image until the film resist coating becomes photo-sensitive etchant-resistant material or the burn in process utilized to complete fine line image developing of photoresist.

C

**CAD:****Computer Aided Designing**

The integration of computers and programs to design products. The output can be graphics or a file

list of coordinates and commands used in cnc machines for manufacturing the products.

## **CAM:**

### **Computer Aided Manufacturing.**

The combined integration of cad to a cnc device is typical referred to as cam or cad/cam.

## **Camera Reduction:**

The process involved in photographically reducing the scaled artwork size; the product produced by such a process.

## **Characteristic Curve:**

A curve, which D is plotted against Log E resulting from photographic plates exposed to a constant light I (power intensity) for a series of time(time-scale exposures).

## **Chatter:**

The sawtooth pattern along a cut line on artwork patterns caused by an uneven blade application while scribing the line cut.

## **Chemical Etching:**

Selective stock removal from the base by chem etch, etching, chemmaching, electro chemical machining, or conversion of material by an electrochemical reaction procedure.

## **Chemical Milling:**

Selective stock removal from the base by chem etch, chemical milling etchant, chemmaching, or conversion of material by an electrochemical reaction procedure.

## **Clean Room:**

A room, with the environmental controls (temperature and humidity) are maintained plus the environment is maintained pure "clean" free of contamination by HEPA filters or some other type of (HEPA) high efficiency small particle removal filters.

## **CNC Machining:**

Acronym CNC: computer numerical control. Prior to using a computer in controlling machine tools it was simply, NC or numerical or numeric control.

## **Coat:**

To cover or apply onto a substrate a photo resist film material coating as by dipping, rolling, spraying, laminating, spinning, or flow.

## **Compensation:**

The compensation changes made in the dimensions on the master drawing from those specified on

the engineering drawing allowing for chemmachining process variables, e.g., etch factor, etching undercut, etc.

### **Composition:**

A photographic procedure, which have patterns on two separate substrates and are aligned or registered then transferred to a third substrate. This may be accomplished in conjunction with contact printing or cameras operations. The composition usually involves intermediate photo tools.

### **Contact Printing:**

A photographic process, with images being transferred from one surface by light exposure to the photosense side of a second. The printed image orientation is dependent on the relative positioning of the surfaces; the tone is dependent on the photosensitive chemical matter used.

### **Coordinatograph:**

An x and y coordinate photo plotting machine consisting of a fixed or rotating table & movable head, on fixed ways that is capable of precisely locating a point on a line or surface. A coordinatograph is commonly used with cut-and-strip scribe coat materials to generate artwork patterns.

### **Copy Camera:**

Cameras adapted for enlarging, reducing, color separating, & photographic materials screening. Also referred to as a process camera.

### **Cosine Law:**

An illumination law which indicates that the flux radiated or received in a given direction varies with the projected area of the receiver or emitter in a plane perpendicular to the flux direction.

### **Crease:**

A line, groove, or ridge that is made by or as if by folding a pliable substance.

### **Cut-and-Strip:**

A method for producing artwork by cutting the pattern then stripping away the unwanted areas of two layers of material, the engineering terminology "cut-and-strip" & "Cut-and-Peel" are synonymous. The preferable term is "Cut-and-Strip."

D

### **Datum:**

A position or element in relation to which others are determined.

#### **Datum Line:**

A line from which distances or dimensions are reckoned.

#### **Datum Plane:**

A plane from which distances or dimensions are reckoned.

#### **Datum point:**

A point used as the basis for reckoning.

**Defect:**

An undesirable blemish within the functional pattern or background, commonly called flecks, voids, pin holes, spurs, notches, etc.

**Definition:**

The fidelity of reproduction with the pattern edge relative to the original engineering master.

**Density (D):**

The log (1/T) where T is transparency. The value for D depends on the photo emulsion component, the magnitude power and nature of the exposure, the dev processing conditions, and the densitometer optical arrangement.

**Design of Experiments: What is DOE?**

DOE, Design of Experiments is a statistical method used to determine the interrelationships between two or more process variables.

**Develop:**

To subject photosensitive film material to a chemical treatment designed in producing a usable image from matter previously modified by radiation.

**Diaz**

A nonsilver, room lighting, UV sensitive coating usually on a stable transparent film substrate. diazo coatings yield mirror image with duplicate tone through contact printing and are developed in ammonia vapor. The image has high actinic density & visual transparency.

**Digitizing:**

Any method for reducing feature locations on a flat plane represented by digital x-y coordinates.

**Dropout:**

Parts electro chemical etching without tabs.

**Dry:**

A thermal process reducing or eliminating water or solvent.  
E

**Electro Chemical Machining (ECM)**

ECM, Electro Chemical Machining “is based on a controlled anodic electrochemical dissolution process of the workpiece (anode) with the tool (cathode) in an electrolytic cell, during an electrolysis process”

[University of Nebraska-Lincoln: General Description of Electrochemical Machining \(ECM\)](#)

**Embedded Particle:**

A solid substance, foreign particle impressed into the material surface. (See glossary technical term: inclusion.)

**Emulsion Component:**

See technical glossary: photographic layers.

**Emulsion Hardening:**

The process inherent in the developing of layers which renders the desired image abrasion-resistant from handling.

**Emulsion Side:**

The film's side or plate which has the photographic layers.

**Engineering:**

The practical application of scientific methods, technical principles, & mathematical processes in solving problems or engineer improvements, development, designing, manufacturing: technology systems, machines, devices, computers, engineer software, etc.

**Engineering Drawing:**

Engineering technical drawing representing the part.

**Etch Allowance:**

The total dimensional adjustment, expressed as: inches (mils) per side, incorporated into the artwork design for a photochemical machined part, compensating for the chem etching process.

**Etch Allowance Band Design:**

Designing artwork using this [photochemical machining](#) method for the chemical machined part whereby all shapes are outlined with a controlled line width to be etched vs. non-outlining with the results being non-controlled etched areas.

**Etch Factor Definition:**

Etched depth to the lateral etch ratio, or etching undercut. The proper etch factor must include the required specification for sidewall condition.

**Etch Factor Rate:**

Material removal rate caused by the photo etching process.

**Etchant:**

The chemical milling etchant involved with photo etching a component.

**Etched Blank:**

The pcm machined part in the flat or preformed configuration.

**Etching:**

Chem. dissolution of material.

**Exposure (E):**

The light quantity received per unit area, exposure expressed in intensity, spectral composition and duration terminology.

F

**Film Sandwich:**

A sandwich composed of photomasks made with flexible film materials.

fleck:

A defect in the clear background for a phototool with a black pattern or within the clear pattern for a phototool with a black background.

**Fog:**

See glossary engineering: photographic fog.

**Foot Candle Power:**

Illumination power unit equal to luminous flux density of 1 lumen per sq. ft. striking surface.

**Functional Pattern:**

The phototooling configuration required in obtaining the designed part.

G

**Glass Sandwich:**

A sandwich composed of photomasks made with rigid glass materials.

H

**Halogen:**

Non-metallic elements fluorine, chlorine, bromine & iodine.

**Hardening:**

See engineering glossary: photo resist hardening, emulsion hardening, and metal hardening.

**HEPA Filters:**

This acronym stands for high efficiency particulate air filter.

I

## **Illuminance (or Illumination):**

The result of luminous flux striking a surface. In English units, 1 lumen of flux falling on one square foot area is defined as one foot-candle illumination. In metric units, 1 lumen illuminating one square meter is the definition for 1 lux. This gives a direct conversion factor  $10.76 \text{ lux} = 1 \text{ foot-candle}$ .

## **Image:**

The functional pattern representation on a substrate:

- a) drafting – as part of a master drawing or layout;
- b) optical – as projected on a screen;
- c) photographic – a photomask or the emulsion chemical on a film or plate;
- d) photo resist film – exposed and developed coating on a substrate.

## **Inclusions:**

Undesired materials in a solid matrix.

## **Infrared:**

Electromagnetic energy usually defined as heat in the invisible light spectrum beyond the 7600Å range. Inverse Square Law: illumination law which states that the surface illumination, via a point source is proportional to the source intensity and inversely proportional to the square distance from the source and the surface.

J

THERE ARE NO (- J -) technical machining terms, terminology.

K

## **Keys:**

See engineering tech glossary: alignment mark.

L

## **Lamination:**

A parts series or etched blanks which are stacked and bonded with proper registration, forming a complete unit. lateral reversal: mirror image of the pattern's geometric orientation.

## **Layout:**

The composite patterns description, required to produce the functional pattern involving the phototooling, photo fabrication, or photo chemical machining.

## **Legend:**

A lettering format or symbols on the part. e.g., part number, components locations, and patterns.

## **Light:**

Electromagnetic energy defined as visible energy between 3800-7800 Angstrom range.

**Lumen:**

Luminous flux unit defined as total flux in a space angle of one steradian, emitted by a one candela source (one candela emits 4 or 12.57 lumens.)

**Luminance (or Brightness):**

Flux reflected or emitted from a surface. The measurement has english units (foot lamberts) and metric units (candelas/square meter).

**Luminous Energy:**

Measurement for flux flow rate. The units are in lumen seconds.

**Luminous Flux:**

Visible light energy flow measurement past any given point in space and is defined as the flux amount generated by a source (one candela into a solid angle of one steradian).

M

**Machining:**

Process involved with removing, forming, shaping, turning, reducing, finishing, milling material (any type) by various processes (chemically mill, milling machine tool, or others).

**Marking:**

See technical glossary: legend

**Mask:**

A selective barrier to the passage of radiation. Masks, metal on glass: An optical mask comprising a glass substrate selectively covered by thin, opaque metal layers, a photomask type.

**Master Drawing:**

The technical drawing for the etched blank whose documented dimensions include all compensations for the chemmaching process.

**Metal Hardening:**

A thermal, mechanical, or chemical engineering treatment used to increase the hardness of a metal.

**Milling:**

Process involved typically with larger area removal of material (any type) by various processes (mill chemically, mill machine tool, or others).

**Misalignment:**

Improper relative image positioning. Molecular dye imaging materials: A particular diazo material sensitometrically designed for phototool applications by the manufacturer.

N

### **Negative Acting Resist:**

A resist film which is polymerized (hardened) by light, and which, after exposure and development, remains on the substrate surface involving those areas which were under the transparent photomask's parts.

### **Notch:**

A void; an undesirable indent within the photographic patterns edge, i.e., a clear indentation in a black pattern; a black indentation in a clear pattern.

O

### **Opacity:**

By definition,  $1/T$  where T is transparency.

### **Orientation:**

Definition: The manner in which the functional pattern is to be viewed. Proper orientation requires "right reading" definition. The orientation for the various phototooling elements is described as either "right reading up" or "right reading down."

### **Orthochromatic:**

The emulsion silver component spectrally photo sensitive to blue, green, and yellow frequencies.

### **Overlay:**

A film containing graphics material which is used for inspection by superimposing the film on the graphics material.

P

### **Panchromatic:**

The emulsion silver component spectrally photo sensitive to the entire visual frequency spectrum portion (red, green, and blue).

### **Pattern Information:**

See glossary information functional pattern.

### **Patter Area:**

The designed configuration area which includes the pattern and background. The pattern area bounds can be defined by a physical outline or by an imaginary outline formed by enclosing the pattern inside a box.

## **Perpendicularity:**

Perpendicularity is measured by the degree to which the angle between the x-x AND y-y axis approaches a right angle.

## **Photo**

### **Chemical Etching Fabrication (Photofabrication):**

The production of precise metal shapes and other substances by reproducing a precise photographic image on the surface of the substance & etching away (or depositing upon) the unprotected areas by chemmaching or electrical means.

**Alternative Usage Terms:** Photochemical Milling

Definition

photo chemical machining, electrochemical machining milling, chemical blanking  
process definitions:

### **Photo Chemical Machining**

The precision removal from a thin metal sheet by etching or the conversion of material by electrochemical reaction. The chemmaching or milling process results in a very high tolerance with the parts being fabricated.

**More Usage Terms Include:** Photochem, photoetch, photographic photo etching, photomill, photomilling, photomachining, process definitions:

The precision removal from a thin metal sheet by etching. The photochem, photoetch, photoetching, photomill, photo etching / milling, or photomachining process results in a very high tolerance with the parts being fabricated.

### **Photographic Fog:**

Any plus density on negative working photographic products or a density loss on positive working products that appear on a exposed processed glass, film, or paper, but is not the result of image exposure. Fog can be produced by numerous causes including safelight, chem, diachronic, & fogs caused by aerial oxidation.

### **Photographic Layers:**

A photo-sensitive etchant-resistant material containing silver halide, which has been exposed & treated to yield a visible image of dispersed metallic silver obtained by photographic processes.

### **Photographic Operations:**

A term generically applied to the entire spectrum for procedures & techniques utilized in the phototools's preparation . This includes photoplotting, contact printing, step & repeating, composition, camera reduction or magnification, registration, & touchup.

### **Photographic Plate:**

Layers on "soda-lime-silica" sheet glass.

## **Photographic Reduction Dimension:**

Dimensions (e.g., define the distance between lines or between two specified points) on the artwork indicating to the photographer the extent which the artwork is to be photographically reduced. The value: dimensions refers: 1:1 scale which must be specified.

## **Photo Mask Definition:**

An accurately made phototool whose images may be transferred by light exposure into a photoresist film coating.

## **Photo Mask Registration Process:**

Accomplishing the phototooling registration requirements; method for incorporating physical features (holes, pins, bushings, targets, etc.) into the individual phototooling components to effect the desired registration.

## **Photometry:**

Visible light intensity, energy measurement as it affects the human eye.

## **Photo Plotting:**

Photographic procedures whereby an image is generated by a controlled light's beam motion and/or positioning by numerical control directly onto a light sensitive material (usually emulsion).

## **Photoresist:**

A material which when properly applied to a substrate becomes sensitive to portions of the electromagnetic spectrum. When properly exposed and developed, substrate portions are masked with a high degree of integrity.

## **Photoresist Hardening:**

The process whereby photoresist is rendered more resistant to the plating effects AND/OR etching operations.

## **Photo-Resist Integrity:**

The photoresist soundness measured using such terms as chemical resistance, uniformity & adhesion.

## **Photoresist, Negative:**

See glossary: negative-acting tone resist

## **Photoresist, Positive:**

See: positive-acting tone resist.

**Photo Sensitive Materials:**

Materials which when exposed to light chemically changes their properties.

**Photo Tool:**

A general term applicable to any specifically defined photographic products. The artwork, artwork master, working master, and photomasks are each individually phototools. (See glossary: phototooling.)

**Phototooling:**

A term generically applied to the entire products group, used in producing photochemical parts.

**Phototooling Aids:**

Products used to assist in inspection, i.e., as overlays, and not normally used for transferring imagery onto photoresist.

**Photo Tooling Process:**

See Photographic Operations.

**Pinhole:**

A clear defect completely within a black pattern or in the black background of a clear pattern.

**Positive Acting Resist:**

A resist which is decomposed (softened) by light, which after exposure and development, is removed from those areas which were under the transparent parts for a production master.

**Power of Source:**

The luminous flux quantity emitted from a source into a solid angle. The basic measurement unit is candle power, renamed a candela when defined by melting platinum.

Q

There are no glossary q terms.

R

**Radiance:**

Output measurement for a point source; measured in: power per unit area per solid area defined by the unit watt/square meter-steradian.

**Radiant Energy:**

Measured in watts, reaching a given point accumulated over a given time interval, referred to as joules (watt-sec).

**Radiant Flux:**

The amount of power incident on a given surface expressed in watts.

**Radiant Intensity:**

The power from a point source generated in a solid angle: measured units = watts/steradian.

**Radiometry:**

The radiation measurement involving the optical spectrum which includes ultraviolet, visible, & infrared light.

**Reciprocity Failure:**

Deviation from the reciprocity law. Typically, this deviation occurs at either low intensity or at short interval exposures & high intensity and/or long interval exposure.

**Reciprocity Law:**

A general law for photochemical reactions which states that the photoproduct's mass from such reactions are determined simply by the total exposure involved, i.e., by the product, intensity + time, which is independent of the two factors separately.

**Reduction:**

See Camera Reduction.

**Reduction Marks:**

A stylized patterns set, located in the border area of an artwork between which the "photographic reduction dimension" is defined.

**Register Marks:**

Alignment marks or fiducials for registering the artwork.

**Registration:**

Alignment of artwork, materials, and layers.

**Resist:**

See photoresist.

**Resolution, Usable:**

The smallest image which can be produced & subsequently processed in a given photo resist.

**Resolving Power:**

The photographic system ability to maintain, in the developed images, the separate identity of parallel

bars when their relative displacement is small.

### **Reversal Development:**

A process used with certain emulsions for reversing the image's tone from that which is accomplished with conventional developing. This process is carried out by developing the exposed silver halide, subsequently bleaching out the developed silver, then developing the remaining silver halide after an overall second exposure.

### **Right Reading:**

A photo tool definition orientation which is the geometric image view as shown on the master.

Right Reading Up:

A photo tool orientation which is the functional pattern as shown on the drawing with the emulsion film surface or glass plate toward the viewer.

### **Rotational Error:**

.

### **Runout:**

The sum, cumulative-pitch error when measured across a number of functional geometric patterns on a photomask.

S

### **Sandwich:**

Phototooling for double sided photo fabrication usually composed of two registered photo masks with same tone identical images, but opposite orientation such that the photoresist coated material can be physically positioned between the two photomasks & the images simultaneously transferred to the opposite surfaces. Sandwiches composed of photo mask sets with different images or with opposite tone images may be required to support special applications.

### **Scribe Coat:**

An opaque coating composed of a stable base such as glass or film.

### **Scribing:**

To produce artwork by scraping the opaque coating from the scribe coat with a blade-like cutting tool with the blade edge parallel to and resting on the base material's plane.

### **Selective Etch:**

Etching at unequal rates involving limited areas frequently from inhomogeneities in the work piece, hot spots from unequal heat transfer or, on a micro scale, selected grain faces or constituents.

### **Serif:**

Drafting compensation involving the photo emulsion component, silver

## **Solarization:**

The decrease of developed density with increased exposure or reversal.

## **Spindle Runout**

“The definition of spindle radial runout is how much wobble a spindle produces at the nose. Axial runout is the measurement of how much play there is perpendicular to the axis of rotation. The reading is represented by Total Indicated Runout, [TIR](#).” cite: [Probe Industries, Inc.](#)

## **Spur:**

An undesirable projection from a photographic pattern, i.e., a clear projection from a clear pattern; a black projection from a black pattern.

## **Step-And-Repeat:**

Dimensionally positioning same or intermixed functional multiple patterns accurately within a given area on a photo plate or a film by repetitious contact or projection printing.

## **Straight Walling:**

The continued part etching after breakthrough to reduce the exaggerated chevron-shaped profile. Substrate:

.  
T

## **Tabs:**

Un-etched substrate portions which tie the parts together.

## **T.I.R. (Total Indicated Runout):**

Total Indicated Runout, TIR, which means the distance of measurement between the largest plus direction and the largest minus direction of [radial runout](#) for a total indicated amount. Total Indicated Runout, TIR.” cite: [Probe Industries, Inc.](#)

## **Test Pattern:**

A pattern used for inspection or testing purposes.

## **Tone:**

The description, identifying the artwork features as being opaque or clear, expressed as positive or negative.

## **Tooling:**

See engineering: Photo Tooling.

## **Tooling Pins (Holes):**

Pins placed on a glass plate artwork. Enabling the plate positioned accurately for the manufacturing process. Similarly, holes punched in film artwork, enable the film positioned accurately for manufacturing.

## **Touch Up:**

Process of inspecting and correcting defects in the film image or photoresist.

## **Transparency (T):**

The transmitted radiation ratio to the incident on an uniformly exposed and processed area that is large compared with the area of a grain in the emulsion.

U

## **Undercutting:**

The lateral etching into a substrate under a film resist coating.

## **Ultraviolet:**

Invisible electromagnetic radiation defined between 1,000-3,800 Angstrom.

V

## **Void:**

A defect; an undesirable blemish within the photographic pattern, i.e., a clear pattern's black defect (flecks and notches); a black pattern's clear defect (pinhole and spurs).

W

## **Working Master:**

One to one phototool used in producing the photomask(s). The proper artwork's description must include the required specification for tone & orientation; these specifications impact subsequent photo processing operations and/or usability.

## **Wrong Reading:**

Obsolete technical terminology for defining phototooling's geometric orientations.

X

## **X Axis:**

A two-dimensional coordinates system's horizontal, or left-to-right direction. The x-x signifies one direction followed, with a step-and-repeat method.

## **Xenon:**

A rare gases used to fill gas discharge lamp, having high luminous efficiency.

Y

## Y Axis:

A two-dimensional coordinates system's vertical direction, perpendicular to the x axis. The y-y signifies one direction followed with a step and repeat method.

Z

## Z Last Information:

The last technical glossary terminology about: machining, cnc, engineering, chemical, and photo chemical machining.

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