BLANKING & PIERCING • FORMING • DRAWS

STAMPINGS

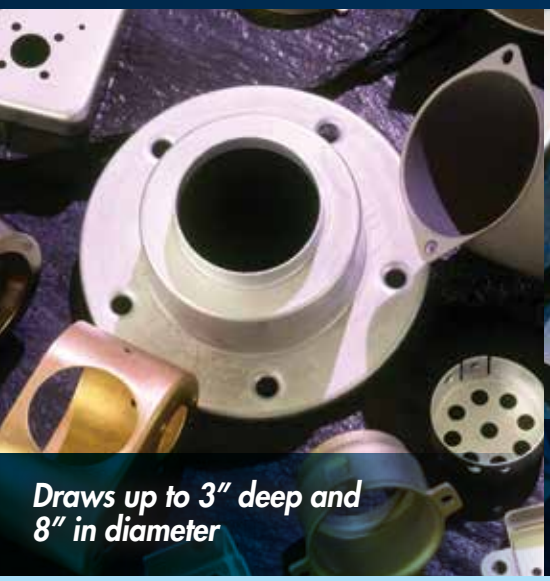
SPECIALISTS SINCE 1919

AS9100C
ISO9001:2008
CERTIFIED

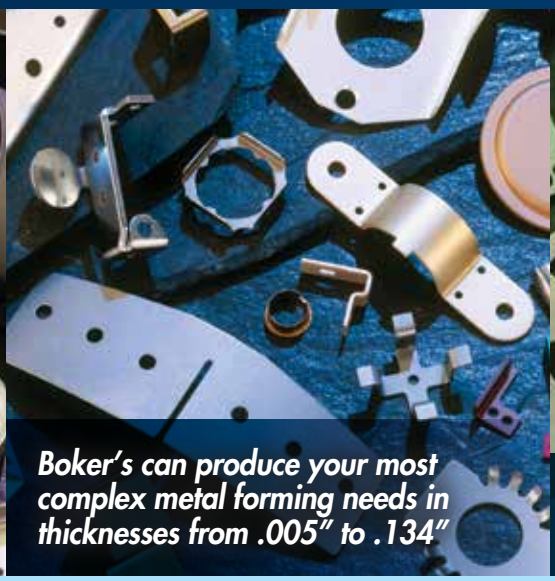
BOKER'S, INC.®

YOUR SOURCE FOR QUALITY STAMPINGS

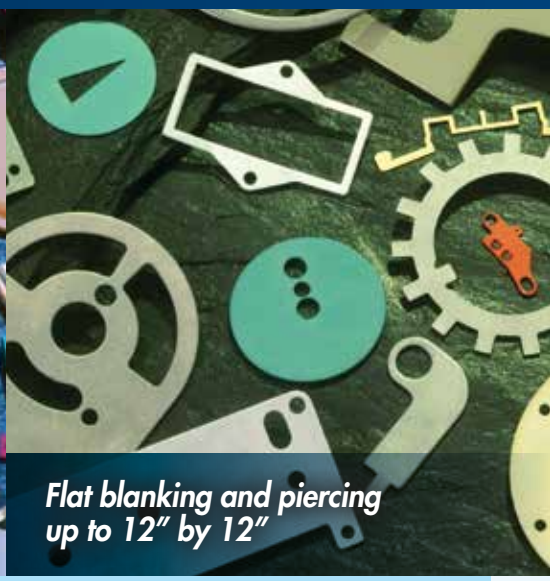
Quality Stampings Made to Order



Draws up to 3″ deep and 8″ in diameter



Boker's can produce your most complex metal forming needs in thicknesses from .005″ to .134″



Flat blanking and piercing up to 12″ by 12″

Boker's has specialized in producing high quality metal stampings for over nine decades. Our precision manufacturing covers a complete range of sizes up to 12″ x 12″ (flat) with thicknesses from .005″ to .134″ and draws of up to 3″ deep and 8″ in diameter.

Draws, Forming, Blanking and Piercing

At Boker's, we utilize the latest stamping technologies and manufacturing concepts to continually provide you with stampings of the highest quality. This diligent effort to achieve and retain the highest quality possible in our metal stamping processes goes back to 1919.

Our process begins with our in-house tool department, where wire EDM-produced tooling provides the dimensional tolerances you require. Complete Statistical Process Control (S.P.C.) is available upon request to further assure accuracy throughout the manufacturing process. Our "Dock-to-Stock" capability saves you inspection time and is another example of our commitment to customer service. Boker's can also meet your delivery requirements with flexible Just-In-Time (J.I.T.) programs.

NEW! Boker's 3D Printing Prototyping Services

Boker's now offers additive manufacturing (3D printing) to provide customers with 3D prototypes. With our Stratasys 3D Printer, you'll be able to see how your product will turn out in advance. No more guess work or uncertainty. Only precision. This service allows customers to test parts for form, fit and function prior to production of the actual stamped part. Make sure to take advantage of our capabilities next time you work with us.

Over 2,000 Materials

To expedite your order and shorten delivery time, Boker's has immediate access to over 2,000 commonly specified and hard-to-find materials including low carbon, cold rolled strip and sheet steel; SAE 1050, 1075, and 1095 spring steel, blue and black temper spring steel, low alloy steel sheets, brass, copper, nickel silver, beryllium copper, phosphor bronze, stainless steel, aluminum; and several non-metallic materials such as acetal, PTFE, polyester, nylon, fiber, polyethylene, and various phenolics. Plus varieties of wrought cobalt, iron and nickel-base superalloys for demanding, high-performance applications. Certificates of Compliance or chemical/physical analysis are available upon request. Whatever your requirements, if it can be stamped, Boker's can turn it into the part you need.

Secondary Operations

Boker's provides the secondary operations you require including deburring, tapping, reaming, counterboring, and spotfacing to name a few. Boker's also has approved vendors for heat treating, grinding and plating. See page 4 for a full list of equipment and capabilities.

AS9100C/ISO 9001:2008 Certified

Boker's takes their manufacturing practices very seriously and maintains AS9100C/ISO 9001:2008 certified status. This means when you purchase your products from Boker's you will have the confidence our processes are efficient and effective.

AS9100C ISO9001:2008 CERTIFIED

Quality Assurance and Certification

- ✔ C of C
- ✔ PPAP
- ✔ DFARS
- ✔ RoHS
- ✔ S.P.C.
- ✔ F.A.I.
- ✔ AS9102
- ✔ Dock-To-Stock
- ✔ REACH
- ✔ ITAR

Boker's Environmental Compliance Statement

Boker's, Inc. is committed to responsible business practices that portray our dedication to our employees, customers and country. Boker's sources conflict-free material and services, in addition to materials that do not contain regulated or hazardous substances, from validated suppliers. These include, but are not limited to, tin, tantalum, tungsten and gold. It is important that our suppliers adhere to the laws put in place to ensure our values and commitments are reflected in our customer offering.

Edge Conditions for Stampings and Washers

Burrs are a normal by-product of the metal stamping blank and piercing process. They can have ragged, sharp and uneven edges.

For more information please contact one of our estimators for assistance at **800-927-4377**.

MATERIAL THICKNESS	WHEN DEBURRING IS NOT SPECIFIED	WHEN DEBURRING IS SPECIFIED SUCH AS "MUST BE BURR FREE"
.010" or less	.001"	**.0005"**
.011" – .039"	.002"	**.001"**
.040" – .079"	.003"	**.002"**
.080" – .125"	.004"	**.003"**
.126" or more	.006"	**.004"**

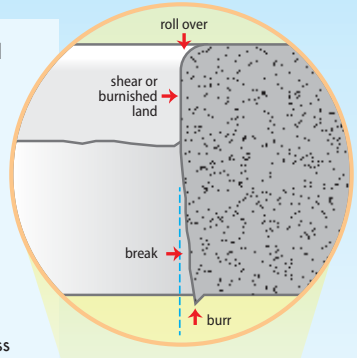
Boker's maximum burr on metallic washers and stampings

Feature Size: This is to be measured only in cut portion of the hole and cut portion of the outside diameter.

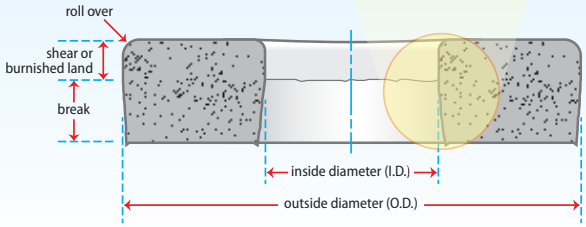
Shear or Burnished Land: This is a burnished area which is approximately one third of the material thickness.

Break: This is an area which is tapered about three degrees. This area has a rougher surface than the shear area.

Roll Over: This area is a natural consequence of the punching process and the mechanical properties of the material being punched and the die application techniques employed.



DETAIL CLOSE-UP



WASHER CROSS-SECTION

Equipment and Capabilities List

Housed in over 100,000 square feet of buildings, the equipment listed below, as well as all tooling, are protected by a central station security and fire system.

Tool & Die Department

- CAD CAM Drawing System
- Kitamura Vertical Machine Center
- Mori Seiki Vertical Machine Center (20″ x 40″)
- Mori Seiki High Precision C.N.C. Lathes
- Digital Optical Comparator
- (2) Clausing Surface Grinders
- Matsui Precision Grinder
- (3) Charmilles Wire E.D.M.s (14″ x 21″ x 8″)
- Charmilles E.D.M. Drill
- Okamoto Precision Grinder
- Stratasys Dimension SST 1200ES 3D Printer

Washer Department

- 18 Punch Presses (10 to 75 tons)
- Digital Servo Feeders
- Electric Coil Reels (1,200 lb. capacity)
- Coil Straighteners
- Tonnage Monitors

Stamping Department

- 46 Punch Presses (10 to 180 tons)
- 2 High Speed Minster Progressive Die Presses (60 to 150 tons)
- Digital Servo Feeders
- Electric Coil Reels (6,000 lb. capacity)
- 48″ Press Brake
- Optical Part Detection Systems
- Press Control Automation
- Tonnage Monitors

Heat Treating Department

- Electric High Temperature Hardening Furnaces
- Electric Tempering Furnaces (all furnaces calibrated)

Raw Stock & Shear Department

- 2-10′ Shears (.25″ thick maximum)
- Stanat Model Rolling Mill
- Cooper Weymouth Roller Levelers
- Coil Set Straightener
- Wilder Coil Slitter
- Computer Inventory & Control System

Secondary Operations Department

- Trimming Lathes
- Production Milling Machines
- Pneumatic Presses
- Tapping Machines
- 6 Spindle Machine Centers (multiple head drilling, tapping, and reaming)
- 4 Straight-liners up to 18″
- Parts Washing System

Cleaning & Deburring Department

- Agitated Chemical Washing System
- Rotary Deburring Machines
- Vibratory Deburring Machines
- Centrifugal Tumblers
- Heated Centrifugal Dryers
- Lewis Ultrasonic Cleaner
- High Energy Deburring Machines
- Mass Finishing Machines
- Custom Parts Dryer

Material Capabilities

- Material Thickness: .005″ to .134″
- Blank Size: 12″ x 12″ maximum (flat)
- Draws: 8″ diameter, 3″ deep maximum

Shipping Department

- Toledo Electronic Scales & Printer
- Precision Electronic Scales & Printers
- Automated Protective Packaging Bagger
- Polychem Automatic Plastic Strapping System
- Hercules Ergo Container Handling System
- Wulftec Pallet Wrapper

Inspection Department

- Numerex Coordinate Measuring Machine
- Digital Optical Comparator
- Digital Buehler Hardness Tester
- Digital Profilometer
- Ceramic Gauge Block Sets
- Plug Gauge Sets
- Height Gauges
- Thread Gauges
- Statistical Process & Capability Studies Available
- Climate Controlled

Certified WBENC Women's Business Enterprise

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(612) 729-9365 • Fax (800) 321-3462
Call 800-WASHERS
bokers.com • sales@bokers.com

Gauge Decimal Equivalents

For accuracy, specify by decimal—not by gauge

GAUGE NUMBER	Non-Ferrous Brown & Sharp			Steel Sheets (Uncoated) Based on .2833 lb./cu. in density		Strip & Tubing Birmingham or Stubs	
	Lbs./Sq. ft. 1100,6061 Aluminum	Gauge Decimal	Lbs./Sq. ft. Alloy 260 Brass	Gauge Decimal	Lbs./Sq. ft. Steel Strip	Gauge Decimal	Lbs./Sq. ft. Steel Strip
000000		.5800					
00000		.5165				.500	20.40
0000		.4600				.454	18.52
000		.4096				.425	17.34
00		.3648				.380	15.50
0		.3249				.340	13.87
1		.2893				.300	12.24
2		.2576				.284	11.59
3		.2294		.2391	9.754	.259	10.57
4		.2043		.2242	9.146	.238	9.710
5		.1819		.2092	8.534	.220	8.975
6	2.286	.1620	7.185	.1943	7.926	.203	8.281
7	2.036	.1443	6.400	.1793	7.315	.180	7.343
8	1.813	.1285	5.699	.1644	6.707	.165	6.731
9	1.614	.1144	5.074	.1495	6.099	.148	6.038
10	1.438	.1019	4.520	.1345	5.487	.134	5.467
11	1.280	.0907	4.023	.1196	4.879	.120	4.895
12	1.140	.0808	3.584	.1046	4.267	.109	4.447
13	1.016	.0720	3.193	.0897	3.659	.095	3.876
14	.905	.0641	2.843	.0747	3.047	.083	3.386
15	.806	.0571	2.532	.0673	2.746	.072	2.937
16	.717	.0508	2.253	.0598	2.440	.065	2.652
17	.639	.0453	2.009	.0538	2.195	.058	2.366
18	.569	.0403	1.787	.0478	1.950	.049	1.999
19	.507	.0359	1.592	.0418	1.705	.042	1.713
20	.452	.0320	1.419	.0359	1.465	.035	1.428
21	.402	.0285	1.264	.0329	1.342	.032	1.305
22	.357	.0253	1.122	.0299	1.220	.028	1.142
23	.319	.0226	1.002	.0269	1.097	.025	1.020
24	.284	.0201	.892	.0239	.975	.022	.898
25	.253	.0179	.794	.0209	.853	.020	.816
26	.224	.0159	.705	.0179	.730	.018	.734
27	.200	.0142	.630	.0164	.669	.016	.653
28	.178	.0126	.559	.0149	.608	.014	.571
29	.160	.0113	.501	.0135	.551	.013	.530
30	.141	.0100	.444	.0120	.490	.012	.490
31	.126	.0089	.395	.0105	.428	.010	.408
32	.113	.0080	.355	.0097	.396	.009	.367
33	.100	.0071	.315	.0090	.367	.008	.326
34	.089	.0063	.279	.0082	.335	.007	.286
35		.0056	.248	.0075	.306	.005	.204
36		.0050	.222	.0067	.273	.004	.163
37		.0045	.200	.0064	.261		
38		.0040	.177	.0060	.245		

Glossary of Terms

Bar Coding - Machine readable alphabetic and/or numeric information used for identification of packaged parts.

Barrel Tumbling - Process in which parts to be deburred are put together with abrasive material into a barrel and rotated for prolonged periods for the purpose of burr removal.

Bend Radius - Inside radius.

Bend Relief - Clearance notch at an end of flange to allow bending without distorting or tearing adjacent material.

Bending - Generally applied to forming. Creation of a formed feature by angular displacement of a sheet metal workpiece. See also "Drawing" and "Forming."

Blank - (1) Sheet metal stock from which a product is to be made. (2) Workpiece resulting from blanking operation.

Blanking - Die cutting of the outside shape of a part.

Bow Distortion - Out of flatness condition in sheet material commonly known as "Oil Canning" in which, with the edges of the sheet restrained, the center of the sheet can be popped back and forth but cannot be flattened without specialized equipment.

Breakout - Fractured portion of the cross section of a cut edge of stock. A condition naturally occurring during shearing, blanking, punching and other cutting operations.

Burn Mark - Heat discoloration created in the contact area of a welding electrode.

Burr - Raised, sharp edge inherent in cutting operations such as shearing, blanking, punching and drilling.

Burr Direction - Side of the stock on which burrs appear.

Burr-Free - Edge without sharp protrusions.

Burr Height - Height to which burr is raised beyond the surface of the material.

Burr Rollover - Condition of burr displacement resulting from mechanical deburring operation.

Chain Dimensioning - Drafting practice which dimensions repetitive features from each other rather than a common datum.

Clamp Marks - Slight indentations at the edge of one side of stock caused by pressure from turret press holding devices.

Coining - Compressive metal flowing action.

Compound Die - Tool used to pierce, form and blank a part at the same time, with one stroke of the press.

Concentricity - Dimensional relationship of 2 or more items sharing a common center line.

Corner - Three surfaces meeting at one point.

Corner Radius - Outside radius.

Counterboring - Machining or coining operation to generate a cylindrical flat-bottomed hole.

Countersinking - Machining or coining operation to generate a conical angle on a hole.

Cumulative Tolerance - Progressive accumulation of tolerances resulting from multiple operations or assembly of multiple parts.

Datums - Theoretically exact planes, lines or points from which other features are located on design drawings.

Deburr - To remove the sharp, knife-like edge from parts.

Dedicated Tooling - Commonly referred to as "hard tooling"—tooling made to produce a specific part.

Die - Tool with a void or cavity which is precisely fitted to a "Punch" used to shear or form sheet metal parts.

Die Clearance - Amount of space between the punch and die opening.

Die Marks - Scratches, scrub marks, indentations, galling or burnishing of sheet metal workpieces by tooling.

Drawing - (1) Engineering document depicting a part or assembly. (2) In metalforming, the stretching or compressing of a sheet metal part into a die by a punch to create a 3-dimensional part. See also "Bending".

Ductility - Ability of a material to be bent or otherwise formed without fracture.

Edge Bulge - Condition resulting from any forming, piercing, hardware insertion or spot welding operation too close to an edge.

Edge-to-Feature - A dimension between the edge of the part and a feature.

Feature-to-Feature - Dimension between two features on a part.

Fixture - Tooling designed to locate and hold components in position.

Flange - Formed projection or rim of a part generally used for stiffness or assembly.

Flat or Matte - Coating surface which displays no gloss when observed at any angle; a perfectly diffused reflecting surface.

Formed Tab - Small flange bent at an angle from the body of a metal workpiece.

Forming - Operation converting a flat sheet metal workpiece into a three dimensional part. See also "Bending" and "Drawing".

Gauge - (1) Instrument for measuring, testing, or registering. (2) Numeric scale for metal thickness.

Go/No-Go Gauge - Measuring device with two registration elements which determine if a feature to be measured is between two established limits.

Gouge - Surface imperfection, deeper than a scratch, often with raised edges.

Grain Direction - (1) Crystalline orientation of material in the direction of mill rolling. (2) Orientation of a surface finish generated by abrasive method.

Grinding - Process of removing material by abrasion.

Half Shearing - Partial penetration piercing, creating a locating button with a height of about 1/2 material thickness.

Hard Tooling - Tooling made for a specific part. Also called "dedicated tooling".

Hem (Dutch Bend) - Edge of material doubled over onto itself for the purpose of safe handling or to increase edge stiffness.

Hold-Down Marks - Slight indentations or scuff marks on one side of the stock which can result from the pressure of hold-down devices during shearing operations.

Hole Rollover - Rounding of the top edge of a pierced feature caused by the ductility of the metal, which flows in the direction of the applied force.

Hole-to-Form - Distance from the edge of a hole to the inside edge of a formed feature.

Hole-to-Hole - Dimension between the centers of holes.

Hydraulic Press - Machine which exerts working pressure by hydraulic means.

Inspection Criteria - Characteristics by which the part will be evaluated both dimensionally and cosmetically.

Lead Time - Time required to manufacture a product from order placement until availability.

Master Die - Universal tool receptacle for holding changeable tool systems.

Metal Thinning - Thickness reduction during any forming operation.

Model - Pre-production sample made with limited emphasis on tolerance to test a design concept. See also "Prototype".

Nesting - (1) Grouping of identical or different parts in multiples within a workpiece to conserve material. (2) In packaging, stacking of parts whose shape permits one to fit inside another.

Nibble Marks - Slight irregularities at the edge of the stock surface after progressive punching ("nibbling") operations in a turret press.

Notching - Operation in which the punch removes material from the edge or corner of a strip or blank.

Penetration - (1) Depth of a cutting operation before breakout occurs. (2) In welding, the depth of material through which fusion occurs.

Perpendicularity - Dimensional relationship of a part or datum located at right angles (90°) to a given feature.

Piercing - Punching of openings such as holes and slots in material.

Pinch Trim - Trimming excess material from a drawn part at the bottom of the stroke. Leaves drawn shell without an inside burr, but with an outside burr and a thinned edge.

Progressive Tool - Die using multiple stations or operations to produce a variety of options. Can incorporate piercing, forming, extruding and drawing, and is usually applied to high quantity production runs.

Prototype - First part of a design which is made to test tolerance capability, tooling concepts and manufacturability.

Pull Down - Area of material next to the penetrating edge of a piercing punch, or die edge of the blanking station, where the material yields i.e., flows in the direction of the applied force creating a rounded edge. Also known as "roll-over".

Punch Press - Machine supplying compression force for reshaping materials.

Punch Side - Opposite side from burr side for pierced features; side on which the punch enters the material.

Quick Change Inserts - Tool sections or parts which may be changed without removing the entire tool from the press.

Rerolling - Final cold rolling operation, usually done to achieve specific thickness control and improved finish.

Roundness - Extent to which a feature is circular.

Run Out Flange - Feature on a formed part which is designated by the designer to absorb the tolerance accumulations created by multiple forming operations.

Scrap - Leftover, unused material relegated to recycling.

Shear-to-Feature - Shearing of an edge of stock to an exact dimension from an already existing feature.

Shearing - Cutting force applied perpendicular to material causing the material to yield and break.

Shut Height - Clearance in a press between ram and bed with ram down and adjustment up.

Slide Forming - A high-volume stamping process in which a machine with multiple slides sequentially performs various operations (i.e. - blanking, piercing, forming, etc.).

Slug - Scrap from a piercing operation.

Slug Marks - Surface defects caused by scrap being indented into the metal surface.

Spot Face - Circular flat surface as a bearing area for hardware.

Squareness - Measure of perpendicularity of adjacent edges or surfaces.

Spring Back - Partial rebounding of formed material caused by its elasticity.

Staking - Method of fastening using displaced material for retention.

Stiffening Rib - Embossed feature in a sheet metal workpiece which is added to make the part more rigid.

Stretcher Leveled - A flattening process in which a material is stretched to achieve a desired flatness tolerance.

Stripper - Mechanical hold-down device applied to the workpiece during the punching process.

Stripper Marks - Imprints on one side of the stock around pierced holes, caused by punch strippers.

Stripping - Process of disengaging tooling from the workpiece.

Strips - Sheet material, sheared into narrow long pieces.

Stroke - RAM travel from top dead center (TDC) to bottom dead center (BDC).

Tapping - Operation to create internal threads by either cutting or forming.

Tolerance - Permissible variation from a specification for any characteristic of the product.

Transfer Die - Variation of a progressive die where the part is transferred from station to station by a mechanical system. Mainly used where the part has to be free from the strip to allow operations to be performed in a free state.

Turret Press - Automatic punch press indexing the material and selecting the intended tool out of the rotary tool holding device (turret) totally by computer control for piercing, blanking and forming workpieces as programmed.

V Die - Tool used in conjunction with a V punch.

V Punch - Vee shaped tool used for angle forming.

Vibratory Finishing - Burr removal process in which an appropriate number of parts, depending on part size and abrasive material, is accelerated and decelerated by mechanical means inside of a drum-like enclosure.

Webs - Material between two openings or edges.

Wipe Die - Forming tool using two opposing edges, separated by one material thickness, moving past each other to form material.

Terms provided courtesy of the Precision Metalforming Association.

BOKER'S, INC.®

888-STAMPINGS (888-782-6746)

Base Elements Index

ELEMENT	SYMBOL
Actinium	Ac
Aluminum	Al
Antimony (Stibium)	Sb
Argentum (Silver)	Ag
Arsenic	As
Aurum (Gold)	Au
Barium	Ba
Beryllium (Glucinum)	Be
Bismuth	Bi
Boron	B
Cadmium	Cd
Calcium	Ca
Cassiopeium (Lutetium)	Lu
Cerium	Ce
Cesium	Cs
Chromium	Cr
Cobalt	Co
Columbium (Niobium)	Nb
Copper (Cuprum)	Cu
Cuprum (Copper)	Cu
Dysprosium	Dy
Erbium	Er
Europium	Eu
Ferrum, Cast (Iron, Cast)	Fe
Gadolinium	Gd
Gallium	Ga
Germanium	Ge
Glucinum (Beryllium)	Be

ELEMENT	SYMBOL
Gold (Aurum)	Au
Hafnium	Hf
Holmium	Ho
Hydrargyrum (Mercury)	Hg
Indium	In
Iridium	Ir
Iron, Cast (Ferrum, Cast)	Fe
Kalium (Potassium)	K
Lanthanum	La
Lead (Plumbum)	Pb
Lithium	Li
Lutetium (Cassiopeium)	Lu
Magnesium	Mg
Manganese	Mn
Mercury (Hydrargyrum)	Hg
Molybdenum	Mo
Neodymium	Nd
Nickel	Ni
Niobium (Columbium)	Nb
Osmium	Os
Palladium	Pd
Platinum	Pt
Plumbum (Lead)	Pb
Plutonium	Pu
Potassium (Kalium)	K
Praesodymium	Pr
Promethium	Pm
Rhenium	Re

ELEMENT	SYMBOL
Rhodium	Rh
Rubidium	Rb
Ruthenium	Ru
Samarium	Sm
Scandium	Sc
Selenium	Se
Silicon	Si
Silver (Argentum)	Ag
Sodium (Natrium)	Na
Stannum (Tin)	Sn
Stibium (Antimony)	Sb
Strontium	Sr
Tantalum	Ta
Tellurium	Te
Terbium	Tb
Thallium	Tl
Thorium	Th
Thulium	Tm
Tin (Stannum)	Sn
Titanium	Ti
Tungsten (Wolfram)	W
Uranium	U
Vanadium	V
Wolfram (Tungsten)	W
Ytterbium	Yb
Yttrium	Y
Zinc	Zn
Zirconium	Zr

Boker's Precision Washers and Spacers

Boker's also offers thousands of flat non-standard washer sizes with no tool charges. Available outside diameters are 0.080" to 5.140", with a wide variety of inside diameters and thicknesses. Combined with over 2,000 material variations, this creates millions of possibilities. Metric sizes are also available. A complete listing of washer sizes is available in two formats: a hard copy catalog, or on the Internet at **bokers.com**. Boker's electronic media allows you to quickly sort and access the exact sizes you need. Request your catalog, or visit our website today!

BOKER'S, INC.
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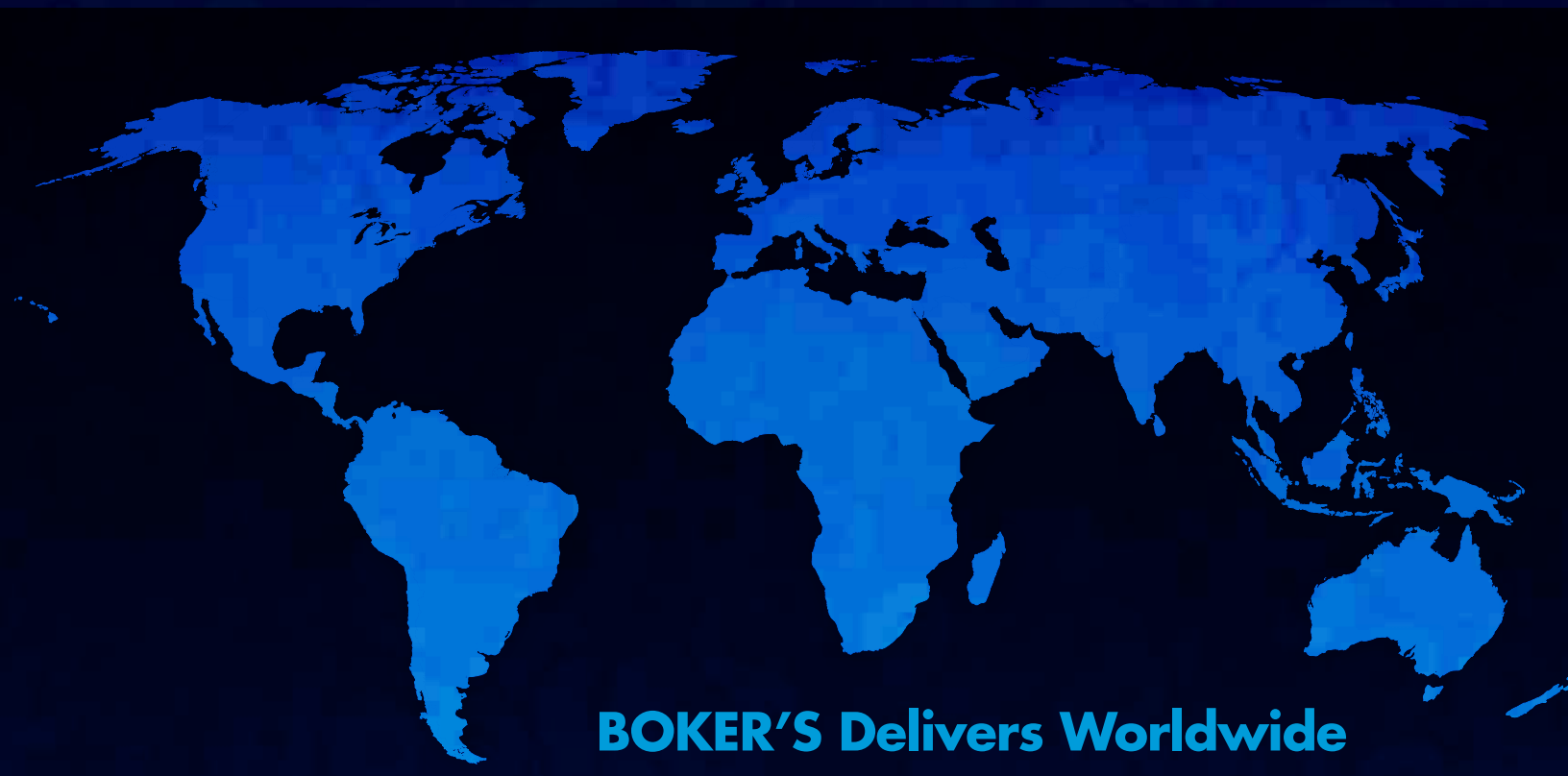

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