

Aluminum Stamping Solutions



Reducing Downtime,
Increasing Profit



www.daytonlamina.com

a MISUMI Group Company

Dayton Progress Understands the Issues Associated with Stamping Aluminum

- Aluminum Oxide buildup
- Perforating problems
- Accelerated die component wear
- Galling (adhesive wear)

Ultimately you have more downtime and increased maintenance costs; robbing your company of profit.

You can rely on solutions from Dayton Progress to increase profits.



The Dayton Progress Solution

We have developed punches specially designed for stamping aluminum. The combination of the right punch material, design, coating, and finish will improve your day-to-day operations.

Punch Design: Features that perforate cleanly and eject slugs efficiently.

Punch Material: Durable tool steel, heat treated in-house in our modern vacuum ovens.

Coatings: Dayton Progress uses long lasting coatings that reduce friction and increase wear life.

Finishes: Precision micro finishes that enhance the performance of our coatings.



Grind vs. Polish

This publication is part of a series of free technical self-study and classroom courses designed to improve your knowledge of the metal stamping process. Other types of Dayton technical assistance include person-to-person consulting, online and printed catalogs, CAD-compatible design software, and other materials and programs.

Options That Fit Your Situation and Budget

Production	Good	Better	Best	Callout
Punch Material	M2	PS4	PS	M2, PS4, PS
Chamfer	—	Yes	Yes	XS20 (round) or XS25 (shape)
Jektole	—	Yes	Yes	BJ_, DJ_, VJ_
Back Taper	—	—	Yes	XAR (round)
Diamond Coating	Yes	—	—	XCD
Polished Diamond Coating	—	Yes	Yes	XCDP



Order Examples

Good VPX 37 1020 P.250 M2 XCD XS20 A7°
Better VJX 37 1020 P.250 PS4 XCDP XS20 A5°
Best VJX 37 1020 P.250 PS XCDP XS20 A5° XAR

DPO 08 1371 P4.20 W3.5 M2 XCD XS25 A15° Y0.5
 DJX 08 1371 P4.20 M2 XCDP XS20 A5°
 DJX 08 1371 P4.20 PS XCDP XS20 A7° XAR

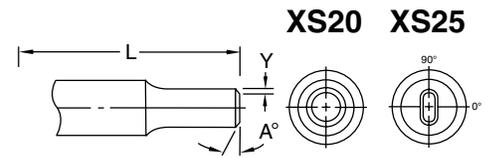
Optimizing Punch Performance



Chamfer Shear Angles

XS20, XS25—Shear Angles are used primarily to reduce slug pulling. This feature has been proven effective to generate longer cycle life.

Studies show that the XS20 (round) and XS25 (shape) shear angle can improve life cycles by 200-300%.



	XS20	XS25
A	any angle	7.5°, 15°, 30°, 45°
Y	0.04" (1.0mm)	0.020" (0.5mm), 0.040" (1.0mm), 0.060" (1.5mm)

Tolerance on all angles is +/-15 minutes.



Jektole® Punch

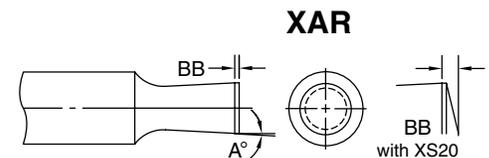
Many aluminum material applications use lubrication throughout the die and some materials contain a wax coating. This combination acts a bonding agent between the punch and slug. This magnifies surface tension and increases the possibility of slug bonding.

The benefits of using a Jektole punch are twofold. The spring loaded Jektole pin (extending from the face of the punch) is a method to retain the slug in the die button after perforating. The Jektole punch also has a side vent hole which allows air to get in, breaking the vacuum and lubrication seal between the punch and slug.



Back Taper

XAR—Round punches can be ground with a back taper to reduce stripping pressure, heat, and material build up on point. This precise change in the size facilitates stripping material and is much less likely to adhere to the punch. Grind life is not affected. The reduction in diameter is so small that the punch remains within normal tolerances for both hole size and die clearance throughout its life.



A	$\leq 10^\circ$
BB	tolerance $\pm 0.015'' / \pm 0.38\text{mm}$



Diamond-like Carbon Coating

XCD—This diamond-like carbon coating combines high hardness with an extremely low coefficient of friction. Offering good protection against abrasive and adhesive wear, it is ideal for aluminum. (Approximate hardness: Vickers 5000)

XCDP—This super-smooth, polished finish is combined with a DLC coating for a very low coefficient of friction with high wear resistance. It is excellent for stamping aluminum. (Approximate hardness: Vickers 2800)

Galling Solutions for Aluminum

One of the most frequent problems encountered with perforating aluminum is punch galling. Aluminum, in general, possesses a gummy characteristic which causes it to adhere to a surface of the punch when it's drawn, pulled, trimmed, perforated, or pierced. This accumulation of material on the punch is known as galling (adhesive wear). The galling occurs both on the initial penetration into the material and extraction from the material. The elastic nature of the aluminum collapses

back into the hole as the punch is extracted, creating drag and pull on the punch. The tensile nature of the material must be considered in determining the correct die button. Dayton's Engineered Clearance will aid in developing the proper clearance.

The galling of aluminum on the punch tip over time will cause the hole size to expand. This creates an out of tolerance hole quality issue on the part. Several remedies are available for this situation. These solutions may be incorporated separately or used in conjunction with one another to alleviate the galling and prolong punch life.

The initial solution considers how to offset the adhesive influence of the aluminum. To counteract the galling, we must reduce the co-efficient of friction between the punch and aluminum. This can be accomplished through several venues. One is to use a low co-efficient of friction coating on the punch. But coatings containing aluminum in their chemistry must be avoided. The trace aluminum will create an intense adhesive issue. OEM manufacturers have had great success with Dayton's XCDP coating.

Perforating Considerations

The various grades of aluminum behave differently when perforating holes. A selection of M2 or PS4 or PS tool steel for the punch material generally achieves very good results. When punching the 5000 and 6000 aluminum series, the perforated hole size movement is minimal. By using the proper die clearance, the hole will be slightly larger than the punch.

However, when perforating the softer 3000 and 4000 aluminum grades, dramatic hole shrinkage may be experienced. Again utilizing the proper die clearance, the amount of hole shrinkage can be managed. Edge radius punch points for the softer aluminum grades should be avoided. A flat, sharp edged punch point without any shear angle performs best. The shear has a tendency to only deform the aluminum and cause more rollover in the hole in the softer aluminum grades.

Punch to die clearance is a key factor when perforating aluminum. The recommended die clearance is directly related to the type of aluminum, its tensile strength, and the aluminum sheet thickness. The die clearances can run within a range of 3% to as high as 20% per side.

How to Select the Proper Clearance

Identify the tensile strength from the last rows in the chart.

Determine the recommended clearance from the shaded area for alloys.

Multiply the recommended clearance with the thickness scaling factor table.

Engineered (Jektole®) Die Clearance and Tensile Strength

Clearance per Side (Δ), % Material Thickness →	3-7 %	7-13%	13-20%	
Al-Copper Alloys (2xxx, etc)				
Al-Manganese Alloys (3xxx, etc)				
Al-Silicon Alloys (4xxx, etc)				
Al-Magnesium Alloys (5xxx, etc)				
Al-Magnesium-Silicon Alloys (6xxx, etc)				
Al-Zinc Alloys (7xxx, etc)				
Al-Other Alloys (8xxx, etc)				
Tensile Strength				
MPa	110	175	285	430 610
KSI	16	25	41	62 88

*Many variables, such as hardness, thickness & chemical composition, can affect results.

Scaling Factor— Engineered Die Clearance

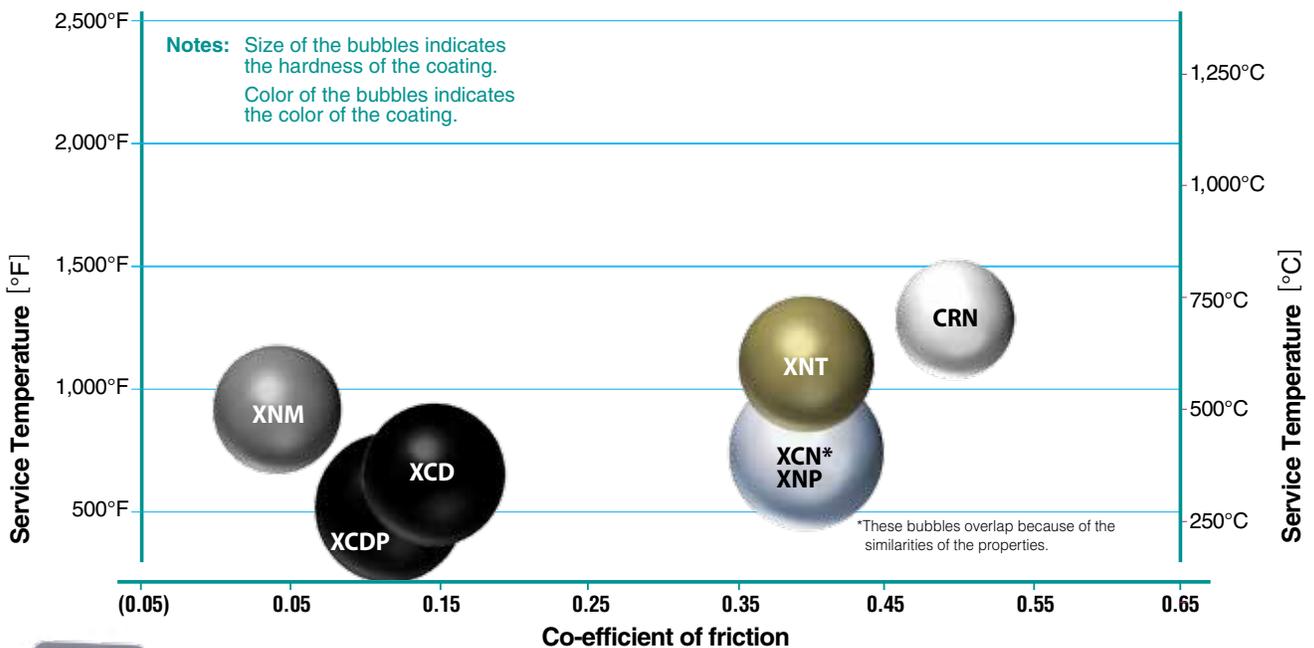
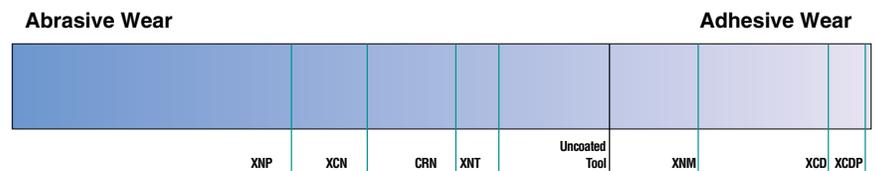
Thickness Scaling Factor	< 0.060" (1.5mm)	> 0.060" (1.5mm)	> 0.120" (3.0mm)
Aluminum	1.00	1.03	1.05

Select the Coating that Matches Your Specific Needs

Regardless of the end product(s) your company manufactures, you can improve the length of run time, reduce changeover time, improve uptime, and get more for your stamping dollar by selecting the type of coating that matches your individual operational capabilities.

The chart on the right describes the causes, effects, and solutions for abrasive wear and adhesive wear. The slider graph following shows the relative suitability for each type of treatment/coating in both of those categories. The bubble chart shows the relationship between service temperature, coefficient of friction, and hardness of the coating.

	Abrasive Wear	Adhesive Wear
Common Names	Abrasion, pitting, cavitation, striation, etc.	Galling, pick-up, sticking, welding, etc.
Processes	Hard sheet material—jagged edges Piercing, shearing, etc.	Soft sheet material Drawing, extruding, etc.
	Perpendicular to direction of forming	Sliding wear—along direction of forming
	Process temperature may be too high or low	Process temperature may be too high
	Clearances may be too tight	Clearances may be tight
Solutions	Increase surface hardness	Increase lubrication
	Increase clearances	Choose lower coefficient coating
	Choose high thermal resistance coating	Choose high thermal resistance coating
		Increase clearances





Dayton coated punches are heat treated, precision ground, and made with high performance steel, including, but not limited to, the following:

- **M2**—triple tempered HSS for longer runs. Performs well at higher temperatures; ideal for high-speed applications.
- **PS**—triple tempered with high vanadium and carbon particles. Higher wear and impact performance.
- **PS4**—with 4% vanadium it provides higher wear resistance and improved toughness.

Special tool steels are available on request.

Commitment to Quality & Customer Satisfaction

Dayton Lamina is a leading manufacturer of tool, die and mold components for the metal-working and plastics industries. As a customer-focused, world-class supplier of choice, we provide the brands, product breadth, distribution network and technical support for all your metal forming needs.

Our goal is to give our customers the most innovative and value-added products and services.



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*Dayton Lamina's line of Danly products is available only to North America.

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