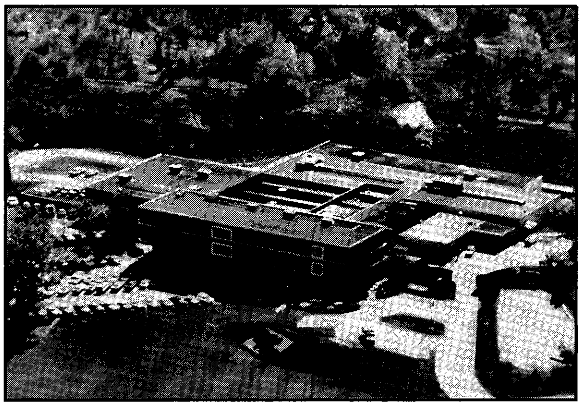
1 Progress ... It's More Than a Part of Our Name.
It's a way of life here.
"Here" is Dayton Progress Corporation. Founded in Dayton in 1946. Because we felt we had something new and different to contribute to the stamping industry. Progress is change ... for the better.



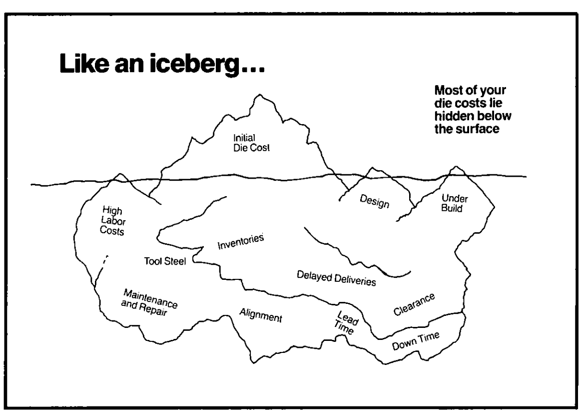
2 Since 1946, DAYTON PROGRESS has been involved in the stamping industry ... producing perforating components, and studying the stamping process in a continuing effort to develop even better tools and systems.

3-9 Plant photographs.

Die
Clinic Seminar

The Tooling

10 This Die Clinic Seminar titled "The Tooling" has been designed with the die designer, builder, and maintainer all in mind. Hopefully, after completion of this clinic you will be able to implement new ideas and cost savings.



11 Like an iceberg most of your die costs lie hidden below the surface. How many times has someone substituted price for quality or service? Does this action come to the surface in the long run?

Technical Programs Available:

Birth of a Hole
Versatile System of Die Design (VSD)
Stamping Basics:
- Presses
- Die Assemblies
- Die Operations

Die Component Engineering
Ball Lock and the True Position˙ Retainer
Die Clinic

12 Dayton Progress has been the leader and innovator of "Technical Programs" to assist the metal Stamping Industry for over 40 years. DAYTON has available six (6) Technical Programs.

Objectives

Primary

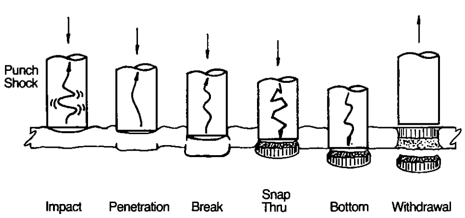
Reduce Costs

Secondary (How?)

Increase Production Runs
Reduce Downtime
Reduce Breakage
Reduce Burrs
Increase Tool Life

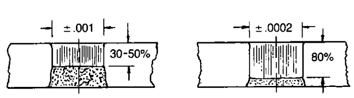
13 The objective of this seminar is primarily to assist in reducing the true costs of producing metal stampings.

Birth of a Hole
The Perforating Process



14 Although perforation is considered to be a two-step operation, it actually consists of six separate phases — IMPACT, PENETRATION, BREAK, SNAP-THRU, BOTTOM, AND WITHDRAWAL. What we're going to do is examine these steps thru the program to better understand die problems.

Punched Holes
What Are They Used For?



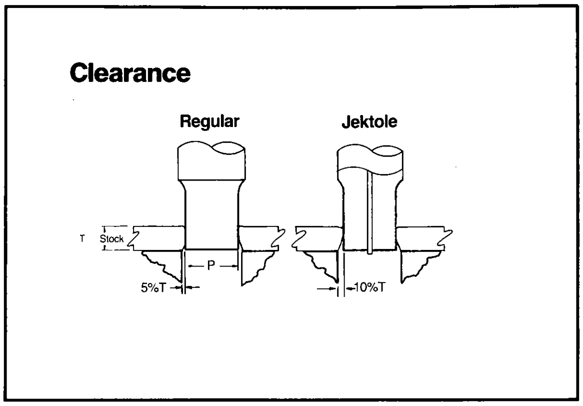
Clearance Holes

95% are non-functional ...merely for clearance.

Functional Holes

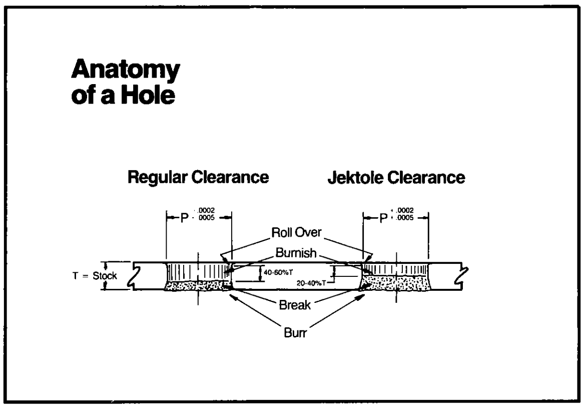
5% are for secondary operations or functional requirements

15 Punched Holes: "What are they used for? Many times in resolving design and build problems we need to determine whether the hole is functional or non functional. From this determination decisions on clearance and other considerations can be made.



16 Clearance has a major effect on the perforating process and is defined as the lateral distance between the punch and matrix. Clearances are universally expressed as a percentage of stock thickness, and for clarity, should apply to one side only (½ the difference between the punch and matrix). The symbol Δ (delta) designates clearance per side. Two types of clearance will be analyzed.

Regular — The clearance developed by prior art, the historical Δ 5 to 7% of stock thickness, and Jektole, the engineered clearance, relating material, hole character and productivity for optimum results. In mild steels, Jektole clearance is approximately double Regular, Δ 10 to 12% of stock thickness.

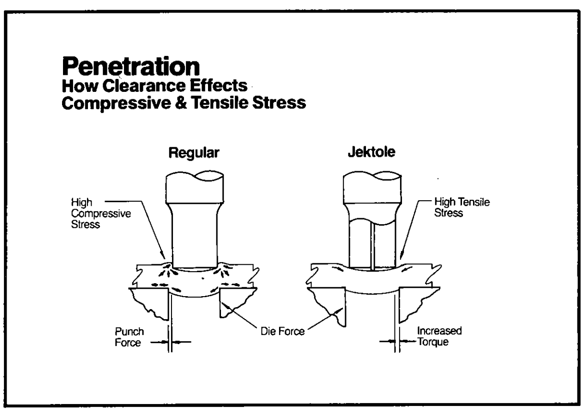


17 Let's look at the difference between the Regular Clearance and Jektole Clearance holes.

Regular Clearance perforates holes undersize by −.0002″ to −.0005″ compared to punch point size.

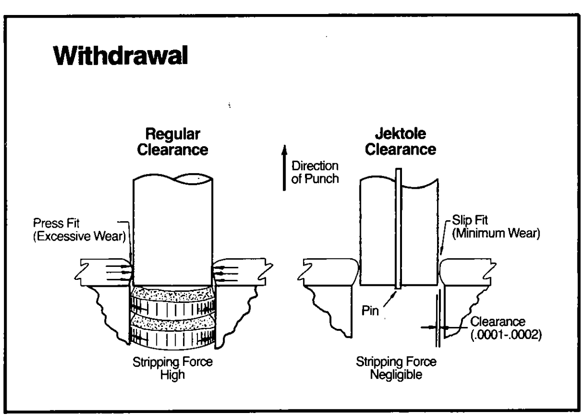
The hole perforated with Jektole Clearance has an increased roll-over and a reduced burnish length. And the diameter of the burnished land is +.0002″ to +.0005″, compared to punch point size.

Result? Punches using JEKTOLE CLEARANCE normally produce three times more holes than those using Regular Clearance.

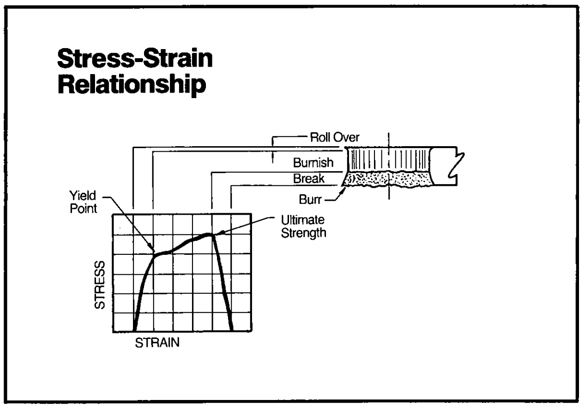


18 The type of stress induced in the stock is a function of the clearance. REGULAR CLEARANCE produces a high compressive stress because of the limited lateral distance between the two opposing forces. The flow of the stock is restricted which builds the compressive stress. JEKTOLE CLEARANCE in effect doubles the lateral distance between the forces causing:

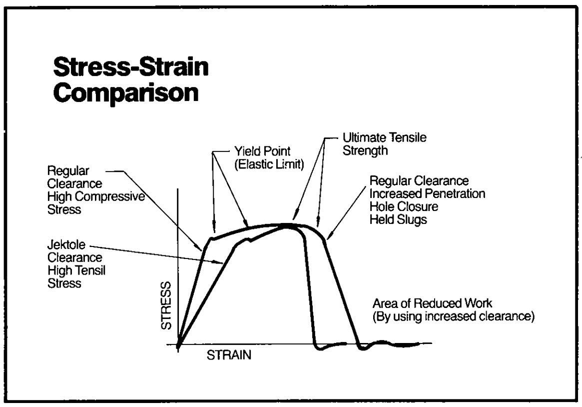
1. A reduction in compressive stress.
2. An increase in torque which produces a high tensile stress. Because perforating requires a tensile failure, the advantage of Jektole clearance is easily seen.



19 During withdrawal, probably the most important benefits of Jektole clearance are seen. The piston effect which tends to suck the slug from the matrix with Regular clearance is of course greatly reduced... but most important, the high stripping force and wear caused by Regular clearance's press fit is eliminated and reduces ⅔ of the punch wear.

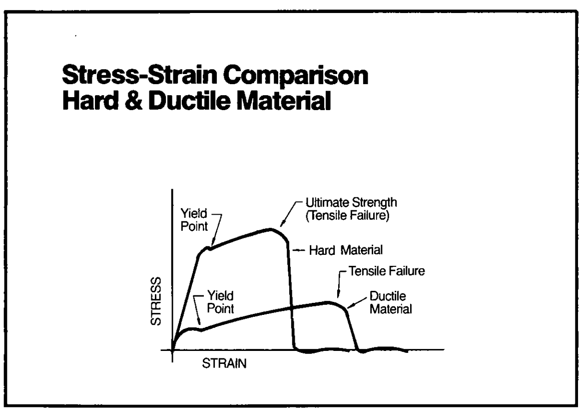


20 Note this graph. Relating the characteristics of a hole to the Stress (load) — Strain (change in form) Curve, the MAXIMUM STRESS IS APPLIED DURING THE BURNISH PHASE (between the yield point and ultimate strength). You can see that when the break occurs, there is a dramatic release of Stress (load).

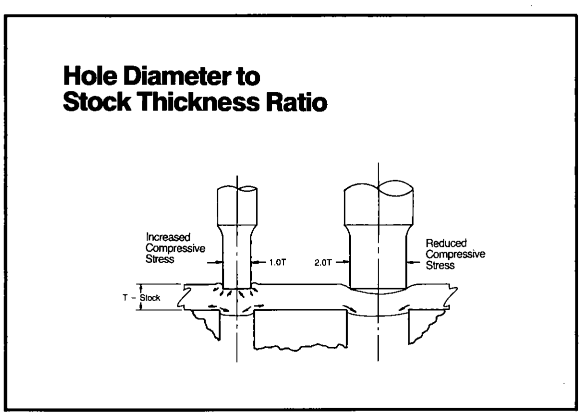


21 Although the peak stress required for tensile failure is the same with either clearance, Jektole clearance requires less total energy, as shown by the shaded areas on the graph. The increase in area before ultimate tensile strength is caused by high compressive stresses. The remaining area is caused by increased penetration, hole closure and the load required to force slugs into matrix.

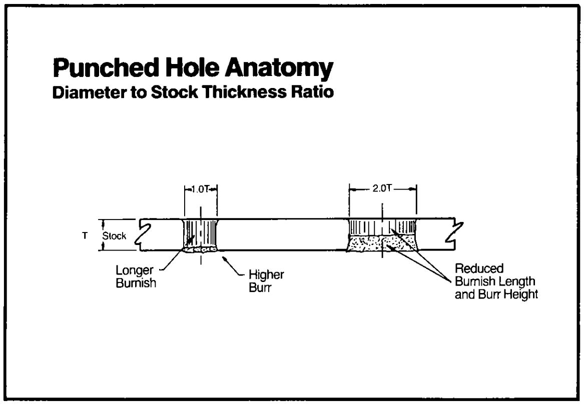
With Jektole clearance less energy is removed from the press therefore less energy must be restored. Potential overloading is reduced and the press runs smoother.



22 There is a significant difference in the stress-strain characteristics of ductile and hard materials. As this graph shows, harder materials cause a more rapid stress build-up, and a resultant early fracture … which subjects the punch to more extreme shock conditions than with ductile materials. Ductile materials require less stress over a longer period of time to reach tensile failure.



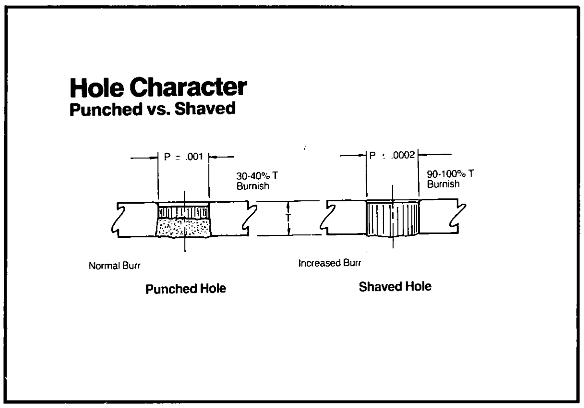
23 Hole size has an effect on the punching process. On the left, we see that holes which are less than 1.5 times the stock thickness create significant change in the process. The slug is very rigid and resists deformation. This increases the compressive stress. Additional load is needed and the punches are subject to extreme wear.



24 The resulting hole has a minimum roll-over, longer burnish and higher burr. For holes under 1.5 times the stock thickness, clearance should be increased beyond that of Jektole. This improves hole characteristics and increases productivity.

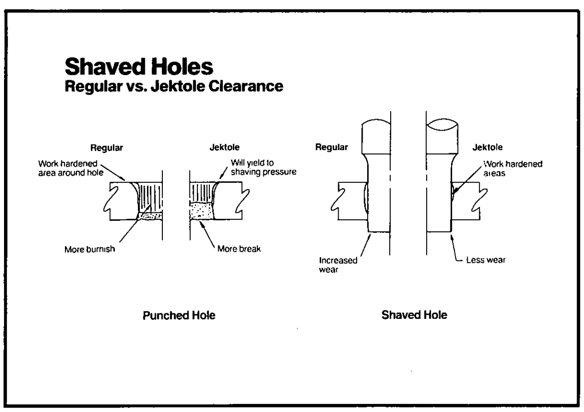
Both holes shown were punched using the same clearance.

Clearance should be calculated by the die designer for each hole prior to build.



25 In normal perforating operations the hole produced should have approximately 30% of burnished area. The hole produced should be the size of the punch or slightly larger if using Jektole clearance.

The shaved hole produces a burnish area of 90% to 100%. The hole produced is always smaller than the punch diameter causing excessive wear. These holes for the most part are functional and used as bearing surfaces. Shaved holes use approximately .0005 to .002 clearance per side dependent on material thickness.



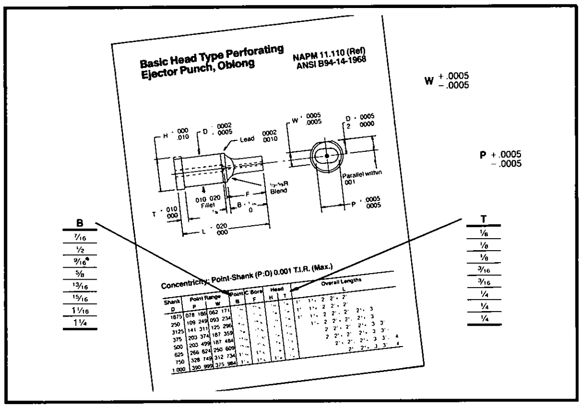
26 It is beneficial to use Jektole clearance for the perforated hole. This clearance seems to cause much less work hardening since the material fails more readily in tensile and residual stresses are reduced. The perfed hole does have more breakout and less burnish length. However, these characteristics seem to benefit a shaving operation.

Predicting the results of a perfed hole allows the shaving punch to cut a material that is not as work hardened as with conventional clearance. There is some work hardening at the top of the hole but the material below the roll-over can be cut away more easily. This reduction of resistance on the cutting edge of the shave punch enhances longer tool life.

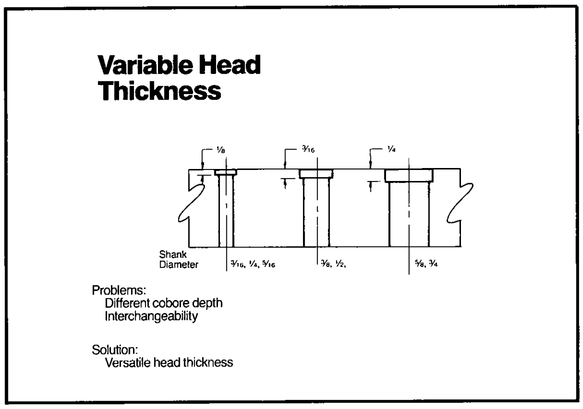
Problems

The Punch...
- Head Breakage
- Point Breakage
- Chipping & Flaking
- Wear

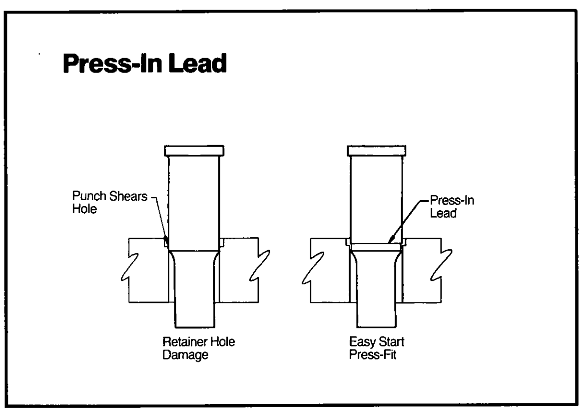
27 As the majority of die problems involve the punch we will cover this area first. The most common problems are head breakage, point breakage, chipping, flaking, and wear. We will cover each of these areas in the upcoming slides.



28 The first considerations when we design the die are do we select the basic series or Versatile series known for quality and versatility for the builder as well as the designer.

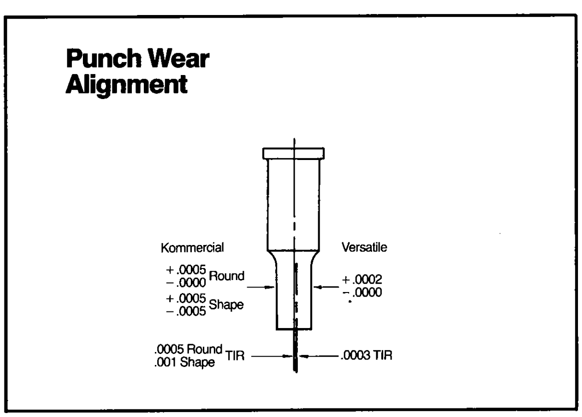


29 The ANSI standard punch comes with three different head thicknesses. At time of build we must be careful to counterbore the retainer plate to the proper depth for that given body diameter. With Versatiles interchangeability this problem is eliminated.



30 When a conventional punch is forced down into the retainer hole, it shears or distorts the inner surface. It is almost like shaving the hole out and when the punch is removed, the shank will appear galled and the hole will probably be bell-mouthed and slightly oversized.

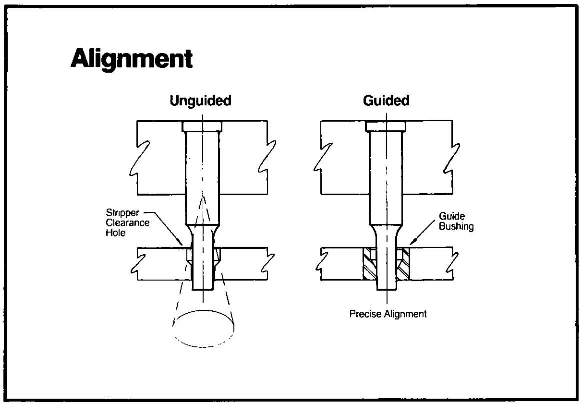
The lead-in is a standard feature on all DAYTON head type punches and pilots. The lead is slightly smaller in diameter than the shank and acts as a pilot to get the punch started into the hole. Any replacement punch of the same size and tolerance will always assemble correctly.



31 Tool alignment is dependent on the skill of the die builder, but the maintenance of true alignment during actual operation is quite a different circumstance.

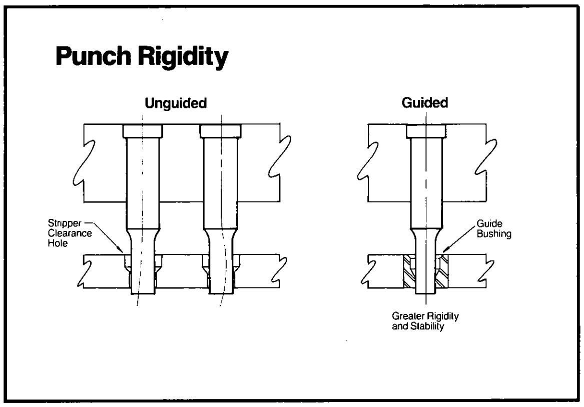
The tolerance of replacement tooling is of the upmost importance. Whenever the cutting clearance between the punch and matrix becomes unequal around the profile of the shape, the load is unbalanced and causes deflection on the unsupported length of the punch.

Of all die principles involved in die building, the effect of tool alignment contributes the most to optimum die performance. Keep in mind that Versatile products are manufactured to a tolerance three times closer than the ANSI Standard.



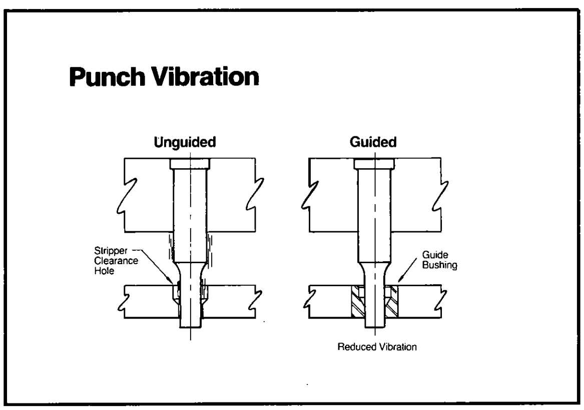
32 Maintaining alignment between a punch point and the matrix cavity is difficult under certain conditions of operation. The die assembly can be in perfect alignment on the bench but once installed in the press and running, many deflective forces tend to promote drift and misalignment.

DAYTONS' Versatile guide bushing limits the magnitude of this potential misalignment by providing an effective guidance system. Although called a guide bushing, its primary function can also be expressed as a support bushing.



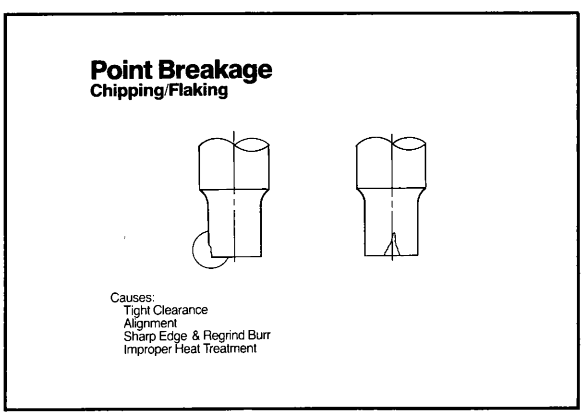
33 During die operation, small diameter punch points may tend to waver under impact loading. An oversize stripper clearance hole allows a slender punch point to deflect or even buckle. Bending and buckling can give the punch point a permanent misalignment and also cause breakage.

By using DAYTONS' guide bushing the punch point is supported. This support against deflection is concentrated in the area and at the point of impact where the actual work is being performed. The shock wave generated by impact is directed vertically into the greater mass of the punch body and retainer rather than laterally within the more fragile point.



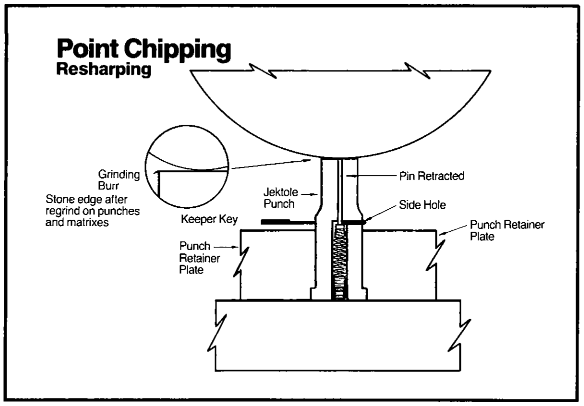
34 This condition of vibrating can reach a destructive frequency and eventually result in punch breakage. When only a clearance hole is used in the stripper plate, the vibration is allowed to develop without any hindrance.

By using a DAYTON guide bushing as shown on the right, any tendency for vibration to set up is immediately dampened. Destructive forces are reduced significantly and punches last much longer in production.



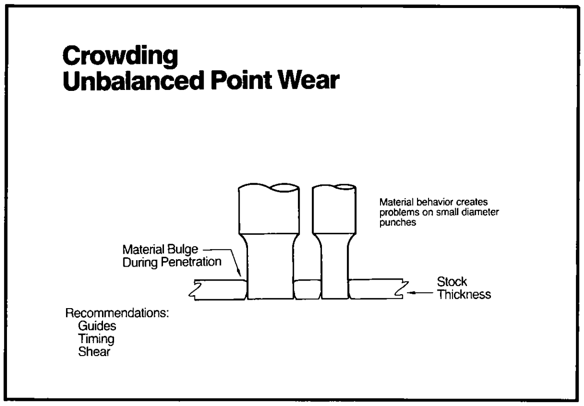
35 Point Breakage — Unexpected point breakage, especially at high speeds, can wreck the entire die. Much of this can be avoided by taking proper precautions in both die design and die building.

Chipping and Flaking — Edge break-down normally occurs early in a production run, but still represents down-time and can be avoided. Corrective action can often eliminate any further problem. The most common corrective actions are checking alignment and clearance so that a balanced load on the punch point is possible.

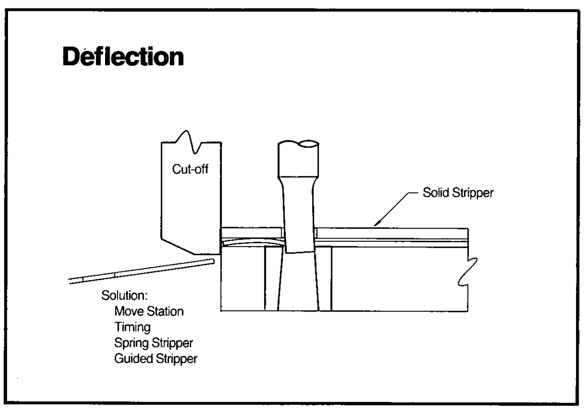


36 After grinding of the punch surface a small razor edge burr is produced on the punch face. This burr must be removed before returning the die to production. If this burr is not removed it will chip off during production causing excessive wear. This burr can be removed with an indian stone or a piece of brass. A maximum of .002 radius should be stoned on the cutting edge.

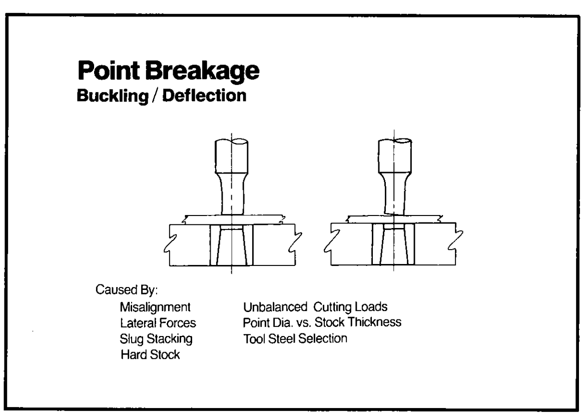
There is one additional major advantage which the Jektole punch offers. Only DAYTONS' Jektole incorporates the "keeper key" feature which eliminates the need for disassembly before grinding. Just push the ejector pin in place, lock it by inserting the keeper key into Jektole's patented side vent hole, grind, remove the key, and you're back in business, and with proper pin extension.



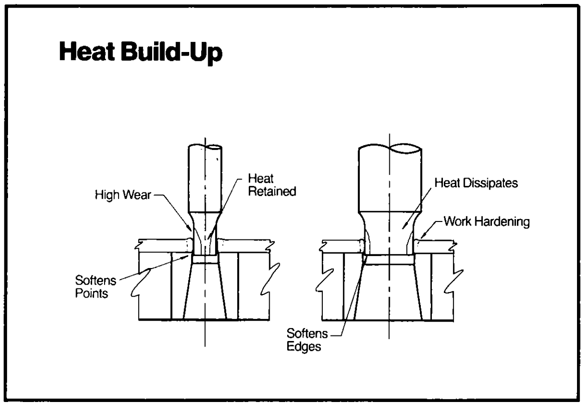
37 Perhaps the most significant factor that determines die life is the rate of wear on the punch point. Wear promotes the generation of burr and may result in frequent sharpenings and low production. When delicate cut operations are performed near severe or larger operations the smaller punch will deflect. Recommendations such as guide bushings, die timing, and shear angles should help to promote better tool life.



38 As a deflected punch cannot be expected to wear as well as punches that are properly aligned we need to take the necessary precautions to eliminate the problem. It's very important to consider deflection when designing the die. Practical die design principals necessitate that we do not have small cut operations near major cut or form stations, we may want to enter the small punches after the large cut operations are completed and the material is stabilized. Spring loaded strippers and guides aid in keeping the punch properly aligned with the die.

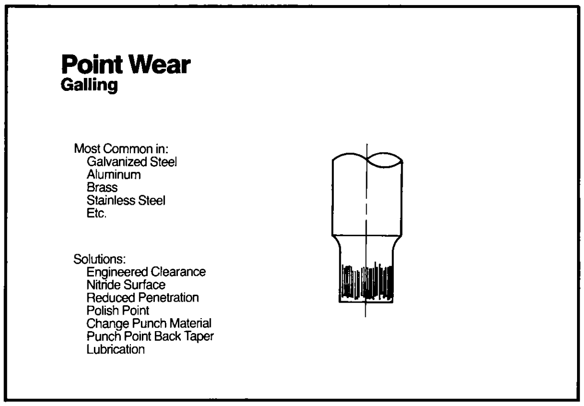


39 Buckling and deflection can be caused by many circumstance. In design it is important to use the minimum point length available as long slender points can cause problems. In die set-up we must be sure as to not bottom the stripper out on the punches causing them to bend or break. Recommendations to help eliminate other buckling and deflection problems are increased clearance, guiding the punch, reducing land length to eliminate excess slugs in the matrix, and tool steel selection. A-2 steel will be more forgiving when deflection and misalignment are concerned, but it does not withstand the compressive load as does M-2 steel.

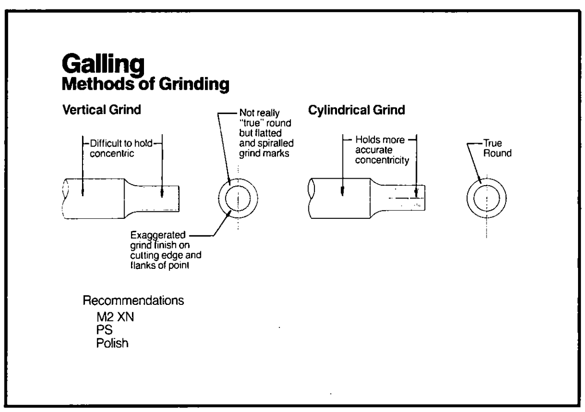


40 Punches enter and retract with each press stroke so that the total time of contact is twice that of the slug passing through the die land. Small diameter punches are easily affected because they retain more heat than larger sizes that can absorb some of the temperature away from the surface.

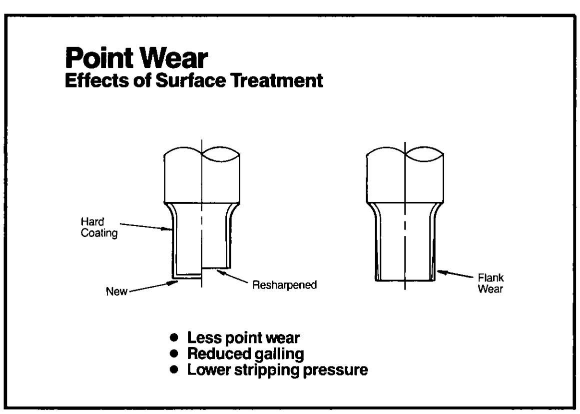
Steels that have low tempering ranges may actually start drawing down in hardness at the point end. Besides frictional heat, there is also the heat generated from within the material being worked. It may be that low tempering steels will not be suited for high speed operations if enough heat is generated to result in reduced wear resistance.



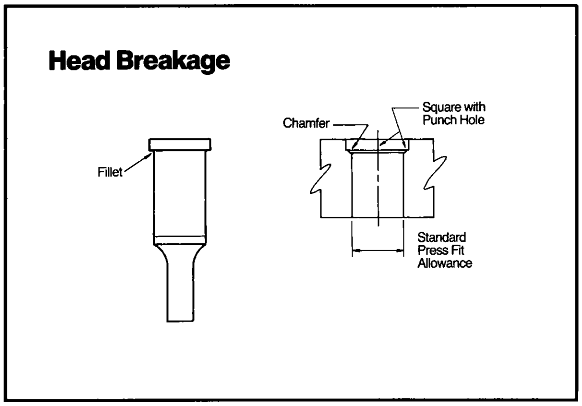
41 Other than heat build-up, galling can be caused by galvanized and other ductile materials. Clearance between punch and die, Daytriding of the punch, and die lubrication are important steps to eliminate or slow down galling.



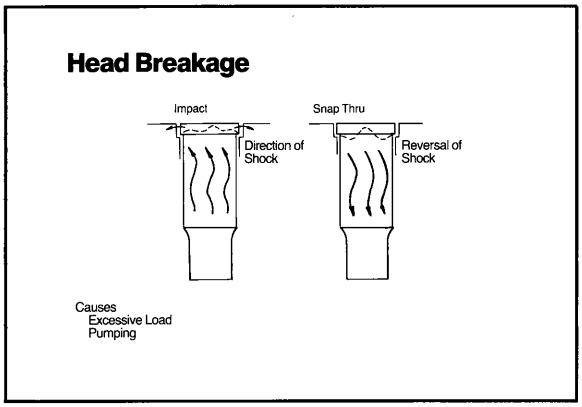
42 The direction of grind does not determine the pick-up or galling of a punch point. Research done by an independent lab concluded no significant difference in tool life verses methods of grinds. When pickup or galling is the primary concern simply keep in mind M-2 XN (DAYTRIDE).



43 Tool life can be enhanced by applying either surface treatments or coatings. The most common types are Nitriding and Titanium Nitriding. By increasing the surface hardness these treatments reduce wear, galling and stripping force requirements.

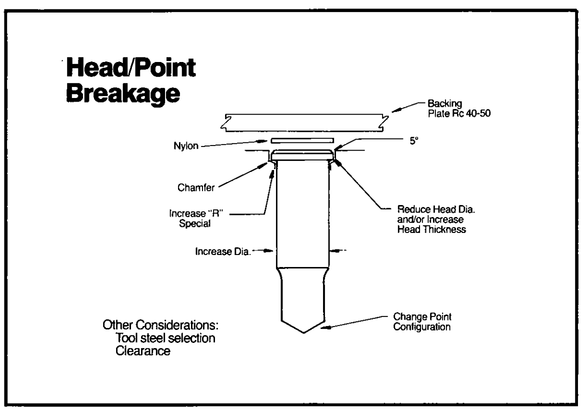


44 Care must be taken to prepare the retainer hole properly to prevent any interference with the fillet when the punch is assembled into the retainer. If the edge between the punch hole and the cobore is left sharp, it can dig into the fillet and result in a very severe stress condition on the head.



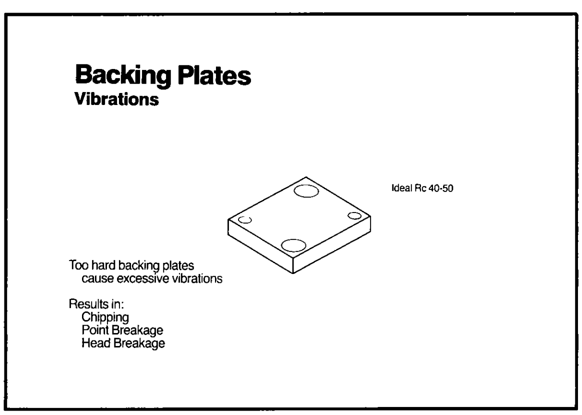
45 Compressive loading on a punch can generate shock of such magnitude that some heads simply cannot take the stress. The greater majority of head breakage will occur during this impact.

During the Snap-Thru phase of punching, the shock waves reverse their direction and the sudden release of stress can cause the head to separate.

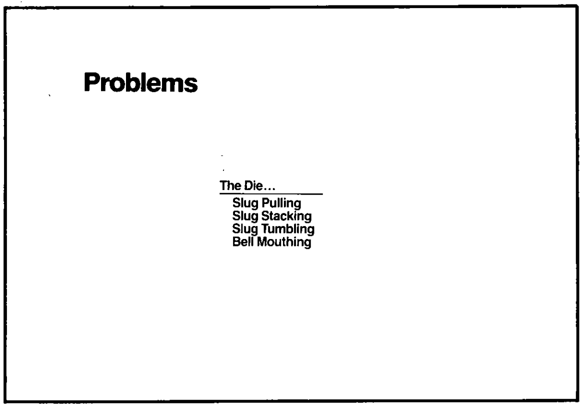


46 When head breakage seems to be a constant problem in a particular die operation, it may be necessary to make some corrective adjustment. It is better to evaluate the reason for breakage rather than changing the type of steel as a solution.

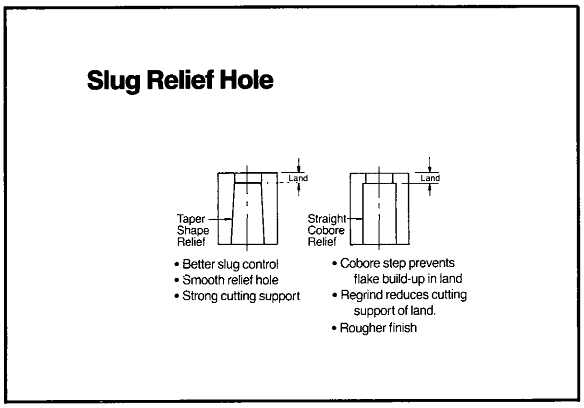
In most cases head breakage can be eliminated by one of several simple recommendations. The common corrections are to reduce the head diameter, change point configuration, increase body diameter, etc. There are rare occasions such as perforating certain grades of stainless that several changes in the die will have to be made to keep the head from breaking.



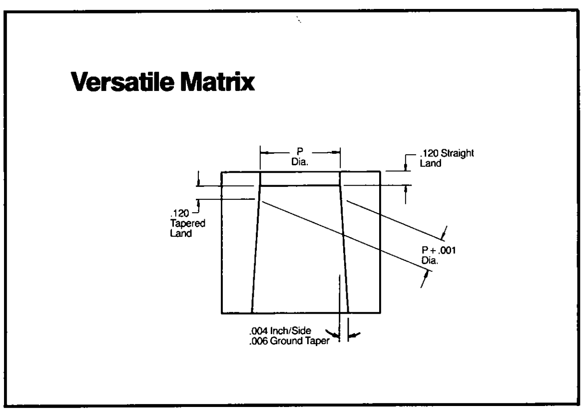
47 When using backing plates to support the back of the punch it is important to remember that too hard of a plate will cause excessive vibrations and harmonics in the punch causing the punch to fail prematurely. Common practice was to use oil hardened tool steel at 58 R/C. There are problems in heat treating of 0-1 tool steel such as warpage and inconsistencies not found in A-2 steel. The plate works very much like a tuning fork. In most cases backing plates at approximately 45 R/C are sufficient to back up the punch.



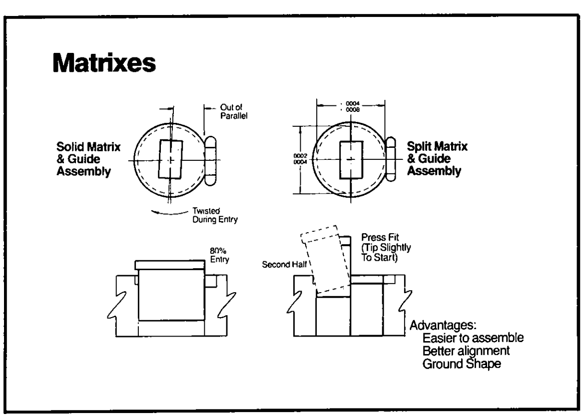
48 Many times punch problems can be traced to the matrix as being responsible for the failure or unsatisfactory die performance. If the punch breaks, the natural tendency is to find fault or blame that component. We will discuss the common die problems in the upcoming slides.



49 The two common types of slug relief holes are tapered and counterbore. They both have certain advantages. The taper relief die buttons controls the slug where as the counterbore die button is more prone to slug tumbling and jamming. With the cutting edge being supported taper relief buttons out last counterbored buttons by two to three times.



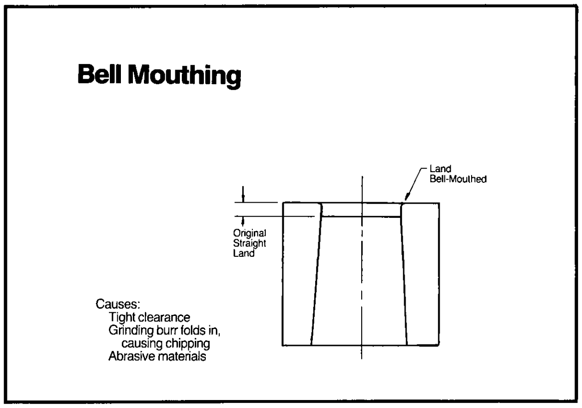
50 DAYTONS' Versatile standard matrix has an important die life advantage. Both the straight land and the tapered shape relief are precision ground. The back hole is tapered (.004/.006/ inch/side) or about a quarter of a degree (¼°) per side. This type of relief hole gives you the best slug control and helps prevent slug jamming inside the matrix.



51 The difficulty with solid matrixes in assembly is that they have a tendency to turn while being inserted. Before final lock with the key is possible, the matrix may have twisted enough to be out of proper orientation and assembly cannot be completed.

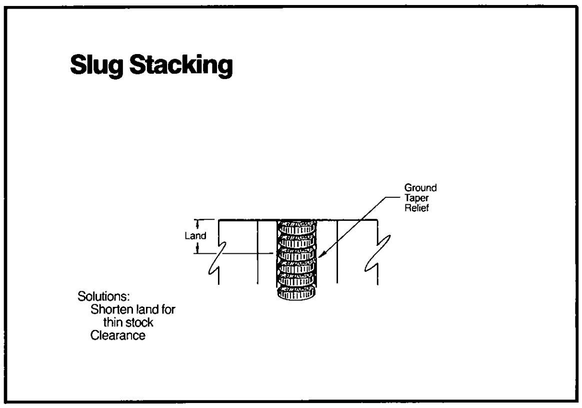
Split matrixes and guides are not difficult to assemble. As shown on the left, the matrix half that is keyed is entered first into the retainer hole.

To simplify assembly, the second half of the split matrix is tipped slightly away from the vertical as shown. As it is straightened under minimal pressure, it is pressed into and against the already positioned keyed half.



52 Under certain conditions the cutting edge diameter at the top of the matrix can become worn over-size. Such a condition can result in slug jamming and the generation of heavy burrs.

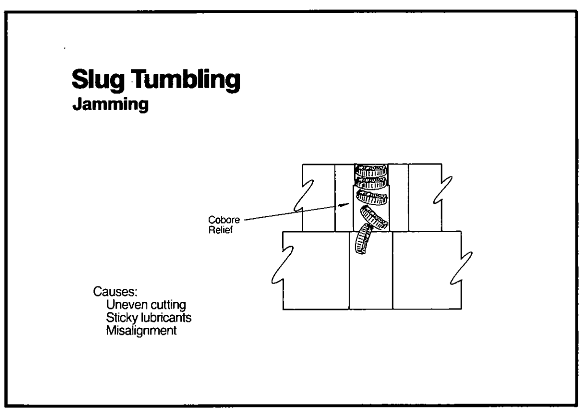
This condition can be caused by purchase of a poor quality die button, failure to remove the grinding burr after re-sharpening, or abrasive materials being stamped. If the material being stamped is causing bell mouthing then the clearance should be examined and the button steel changed to PS.



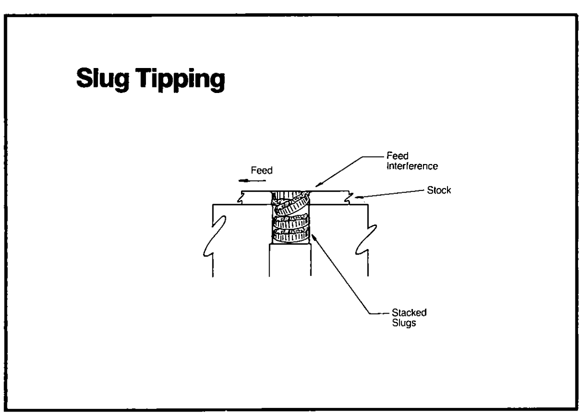
53 When slugs stack up in the matrix cavity and are tightly packed, the punch may not be able to penetrate the material. Such conditions cause punch breakage and even splitting of the matrix.

Suggestions for elimination of slug stacking are: shorten the land length which will enable slugs to fall freely through the die and evaluate the clearance between punch and die.

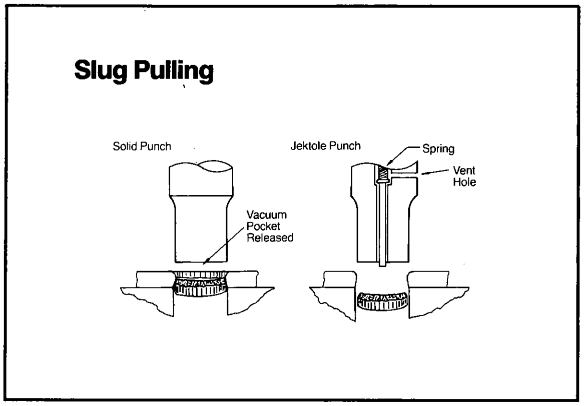
Jektole clearance will create a slug slightly smaller than the die opening, causing the slug to fall freely thru the die.



54 Improper relief holes within the matrix cavity can allow loose slugs to tip and bridge against each other. Eventually, a mass of slugs can become trapped and result in slug jamming, similar to the slug stacking effect.



55 It is possible for a slug to tumble or spin and end up sticking above the die surface. As the stock is advanced during its feed cycle, the edge of the part or blank can catch on this slug and cause the strip to buckle. If the stock cannot flatten out in time or if the slug works up under the material, subsequent stroking will result in punch failure or other die damage.



56 Slug Pulling — Due to the vacuum pocket and oil seal between the slug and the face of the punch, slugs may be pulled from the matrix and left on the die surface. This can result in feed restrictions or double hits.

Slug Pulling Solutions

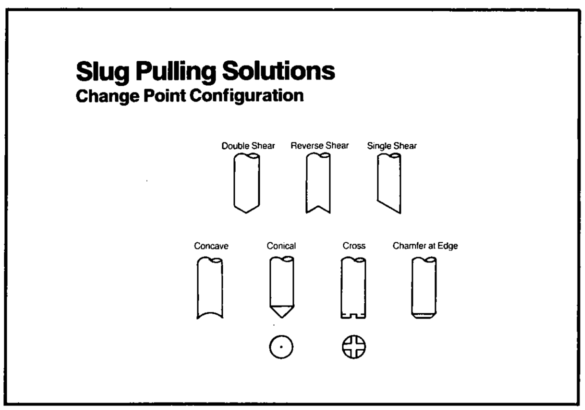
Jektole Punches	Jekt/air™
Penetrate slug below die land	Roughen or nick die land
Tighten clearance	Demagnetize punches
Vacuum-slug sucker	Check lubrication

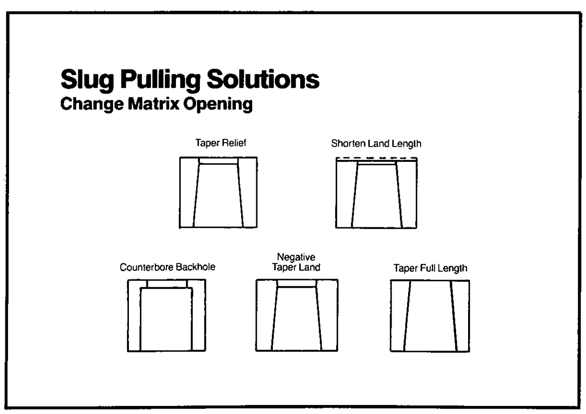
57, 58

In the two sides on the left we have listed several recommendations to eliminate the problem of slug pulling.

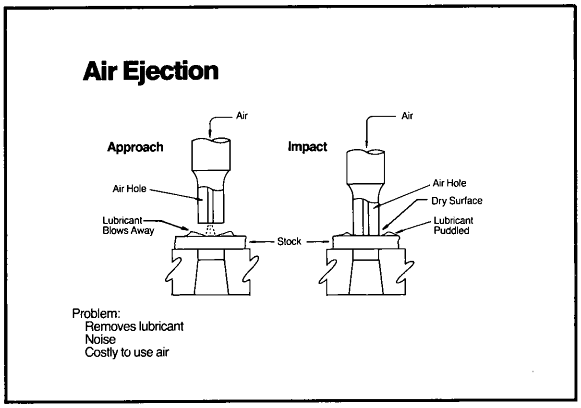
The first and most simplistic is to use Jektole punches. While the ejector pin helps to push the slug into the matrix — it allows air to vent through the punch points to eliminate any vacuum that has been created. Many designers and builders find it cost effective to use Jektole punches at time of original build.

Other considerations can range from air ejection to changing lubrication. The slides on the left list the common recommendations to eliminate slug pulling.



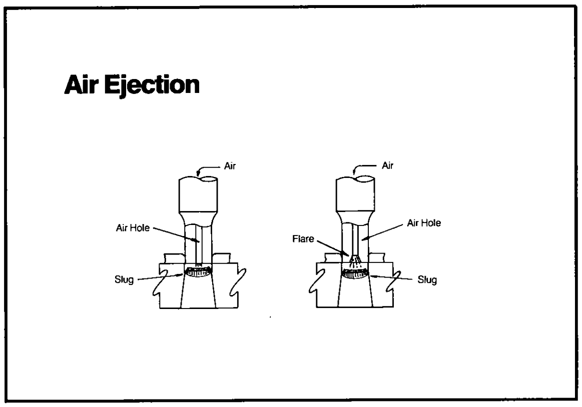


59 When altering the matrix to keep the slugs in the die cavity keep in mind that taper relief, counterbore backhole, and shortened land length are all available as standard products.



60 One of the arguments against air ejection is that the force of the air will blow the lubricant away from the surface of the stock. By the time the punch makes contact with the material, the surface is blown dry of lubricant resulting in punch wear.

There seems to be no real way to avoid this condition. Considering this as a disadvantage may be simply a trade-off. Punch wear can at least be programmed for maintenance whereas a broken punch or a die wreck caused by slug pulling is unpredictable and much more expensive.



61 Replacing mechanized spring pins with air is effective for slug ejection at high speeds. Punches with air holes or vacuum systems below the die cavity are acceptable for positive slug control. Air will usually force a loose slug down into the die relief hole or a vacuumed bushing will suck the slug out of the die cavity.

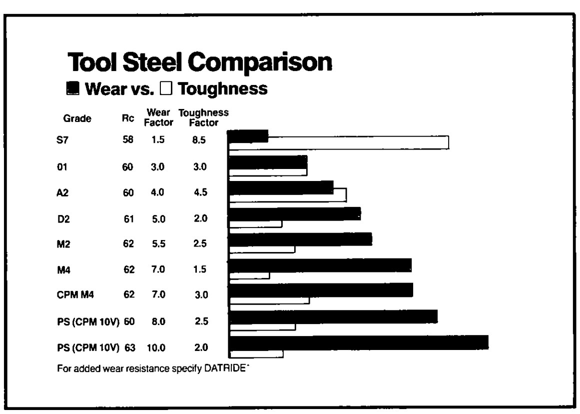
The force of air would be most effective if it hits the slug just as fracture occurs and shuts off as stripping begins. Unfortunately, such exact timing of air impulses becomes almost impossible at high speeds.

When air ejection is used the air hole should be flared to disperse air evenly.

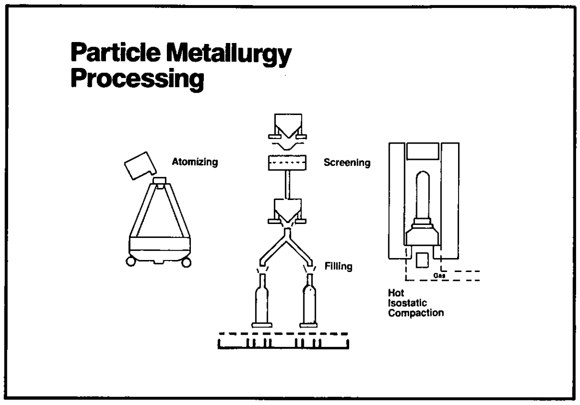
Metallurgy

Tool Steel Selection
Heat Treatment

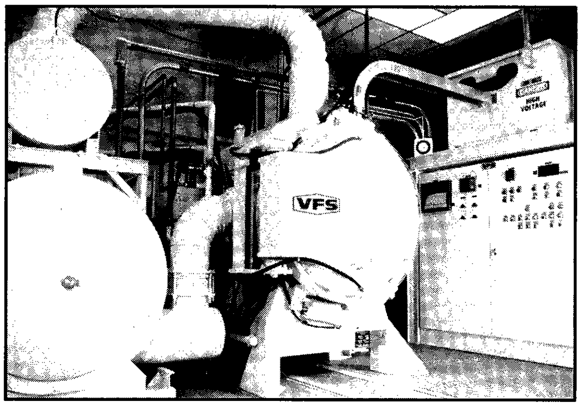
62 In this part of the program we will discuss the basic metallurgical factors related to tool performance. Given proper design and build practices, the performance of the tooling can then depend largely on the inherent characteristics of the material from which it was made. Consequently, selecting the right tool steel for the job along with effective heat treatment on the tool steel becomes an essential part of reducing stamping costs.



63 Many variables can be considered in selecting a tool steel for a particular application. In simple terms this requires finding the correct balance of wear resistance and toughness. While wear resistance is self explanatory, toughness should be recognized as the ability of a tool to absorb impact without deforming or breaking. The graph shows how the DAYTON standard A2 represents a good balance of wear and toughness. For improved wear M2 can be selected, but only with a resulting compromise in toughness. For the ultimate in wear performance the choice is clearly PS (CPM 10V). Due to the CPM process this gain in wear is possible without further loss in toughness relative to M2 steel.

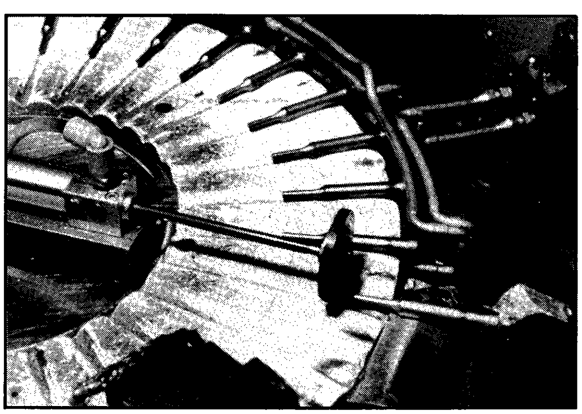


64 The Crucible Particle Metallurgy process represents a breakthrough in steel making technology. This slide shows how molten metal is converted to a fine powder, screened, packed in cans, heated and compacted under high gas pressure to 100% density. The CPM compacts are then finished by conventional mill processing. For the end user, the benefits are an optimum metallurgical structure that provides superior performance characteristics.



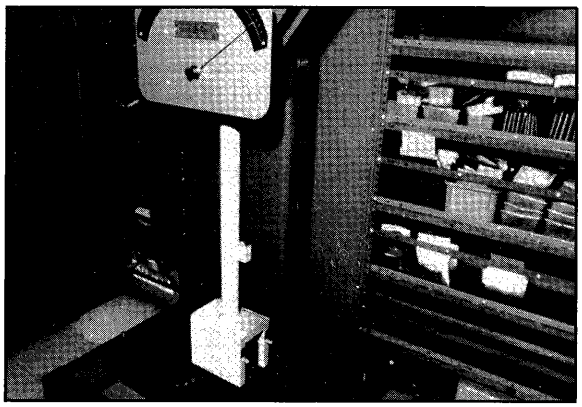
65 High performance tool steels demand a high performance heat treatment. At DAYTON this is accomplished in-house using microprocessor controlled Ipsen vacuum furnaces. The three preprogramed furnaces maintain full control of all heat treat variables, and the use of vacuum eliminates the possibility of any detrimental surface conditions in the finished parts. The end result is a product that performs as expected on a consistent basis.

66 Cryogenic treatment is an added benefit of the DAYTON heat treating process. Soaking at sub zero temperatures subsequent to hardening insures completion of the desired structural transformations in the steel. This helps maintain hardness while actually improving toughness and fatigue strength.



67 Punches are retempered on the head end to help cushion shock and reduce head breakage. The use of automated induction heating provides close control of head hardness. Results are generally held to a spread of RC 45-50 compared to the ANSI standard of RC 40-55.

68 The properties and behavior of steel are directly related to its microstructural characteristics. For this reason DAYTON has a fully equipped lab enabling sample preparation and metallographic analysis. It provides an effective means for control of heat treat quality as well as failure analysis and product development.

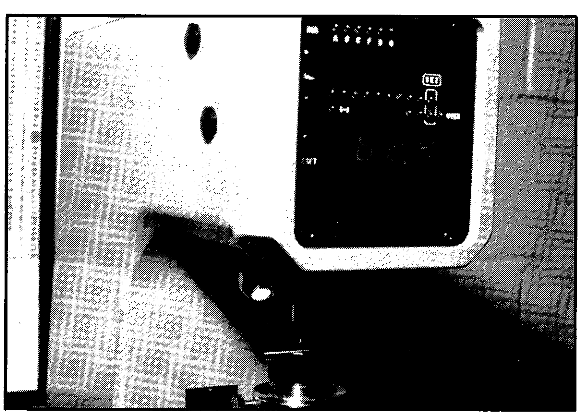


69 As toughness is such a critical aspect of punch performance, a Charpy Impact Tester is used at DAYTON to make routine product evaluations. The test measures the amount of energy absorbed when a ground specimen is fractured by the falling hammer. The data is particularly useful for comparative purposes.

70, 71

A discussion of metallurgical factors would not be complete without mention of the Rockwell hardness test. This has become the universally accepted method for checking hardened parts. However, it should be remembered that the test values are only relative and bad test results are often found to be the result of the test methods used.

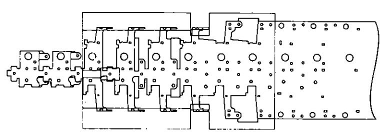
These last two slides serve to illustrate a common problem. A PS punch tested on the point end indicates a hardness of RC 64.4. The same punch checked on its outside diameter shows a lower value of 62.4 due to the curvature of the surface. A correction factor must be used when checking curved surfaces.



Other Design & Build Considerations

72 Before the die is designed or built we need to consider several die principals. In the following slides we will discuss a few of the details.

Die Construction
Solid Die Block Design



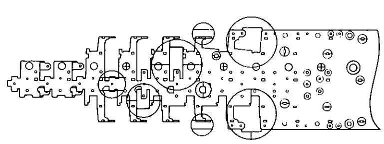
Problem:
- Maintenance is difficult & expensive
- No interchangeability

73 The solid die block design uses a single plate that has been machined for the various die hole openings and slug relief holes.

The big problem doesn't show up until you try to make an engineering change or, worse yet, when the maintenance man needs to repair a broken cutting edge.

Each plate is a special and must be remade with the same skill and precision as the initial plate. Re-work costs are extremely high and dramatically increase the part cost.

Die Construction
Round Insert Design

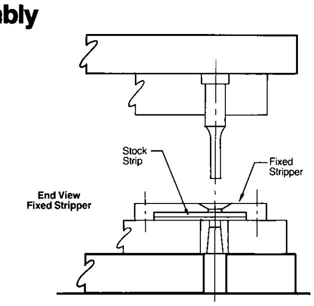


Advantages:
- Ease of maintenance
- Interchangeability
- Engineering changes
- Inexpensive

74 The Versatile System of Die Design uses the single die plate, either hard or soft, but takes advantage of an almost exclusive preference for round insert matrix components. Any shape up to 3 inches across can be included within the round matrix.

The biggest advantage that you should be able to detect in the Versatile Design System is the ease of replacement of components for engineering or maintenance purposes. Should a particular cutting edge chip or break down from excessive wear, it is unnecessary to repair or replace the entire plate such as required in Section or Solid Block dies. All that has to be done is push out the broken insert and push in a new insert. It is that simple.

Die Assembly
Fixed Stripper

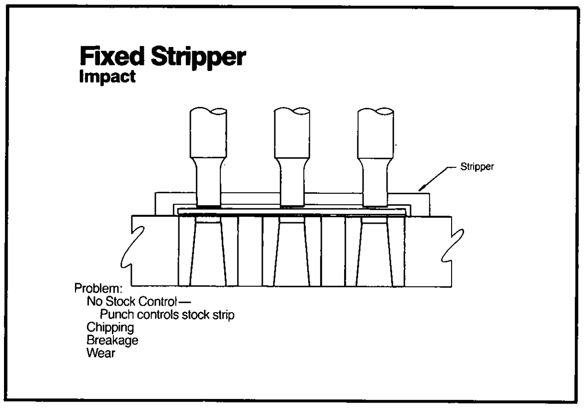


Basic Terms:
- Channel
- Tunnel
- Positive
- Solid
- Bridge

75 The fixed stripper uses a plate that has a channel cleared out and thru which stock can be fed or progressed.

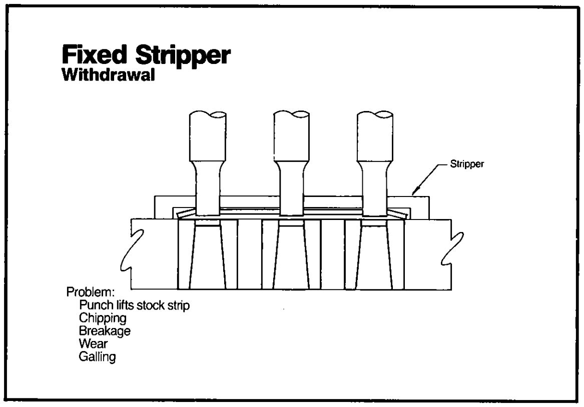
The stripper plate is screwed and doweled in position on the top of the die plate and remains fixed during the operation of the die.

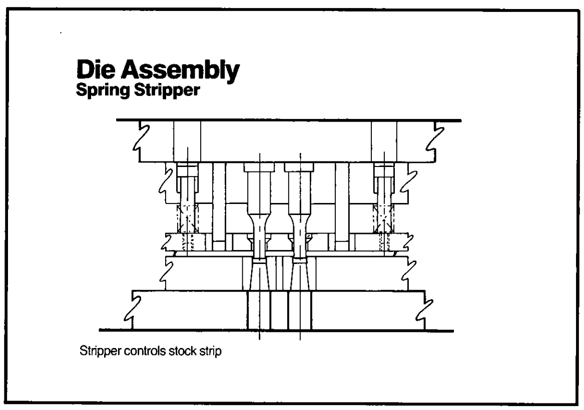
It is apparent that this style of stripper is more economical to make. However, it does have disadvantages when compared with a spring stripper. Insecure part control during punching and stripping, lack of visibility during die operation and burr hang-up during feed are a few of these disadvantages.



76, 77

As the material is not held in place at impact or withdrawal the punch controls the material strip. This lack of material control by the stripper in the die can cause the punch to deflect or the material to shift during the perforating process. In many cases the depth of the channel of the fixed stripper is too deep. The ideal channel depth is stock thickness plus .015 except on very thin materials where the channel depth should be less. This becomes a common factor in punch chipping, breakage, and wear.

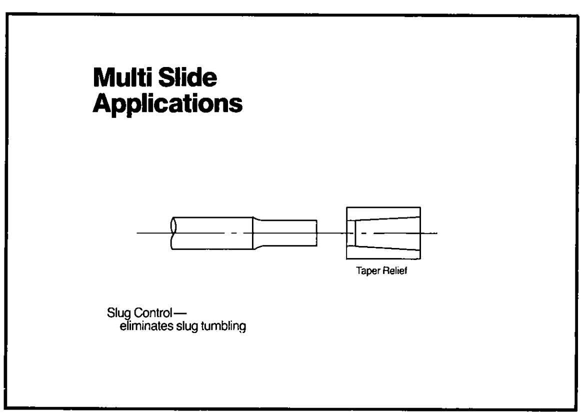




78 The spring stripper, will perform best in production because of the positive stock control during punching and stripping.

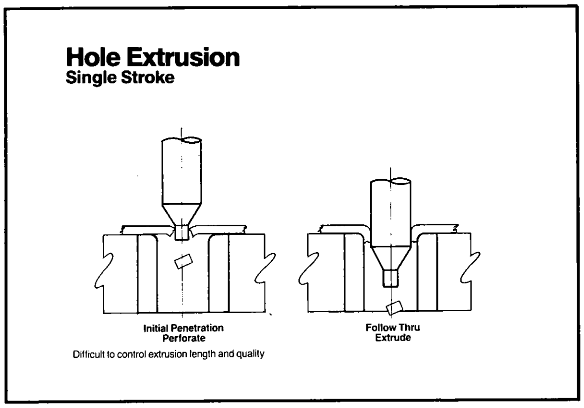
The main advantage of the spring stripper is that as the die closes the stripper controls the material strip. As the die opens the stripper is still controlling the strip enabling the punches to withdraw from the material evenly.

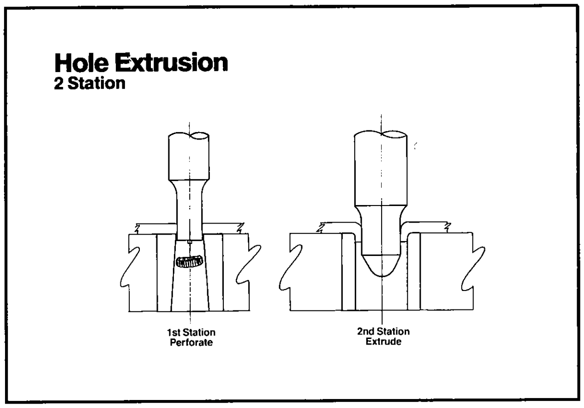
Another advantage of having spring strippers is that the stock strip and work going on is always visible when the die is open after each stroke.



79 When perforating is done in a multi slide machine it is common practice to use taper relief die buttons. If counterbored buttons were used the slug would tip causing other slugs to jam in the counterbore leading to punch and die breakage.

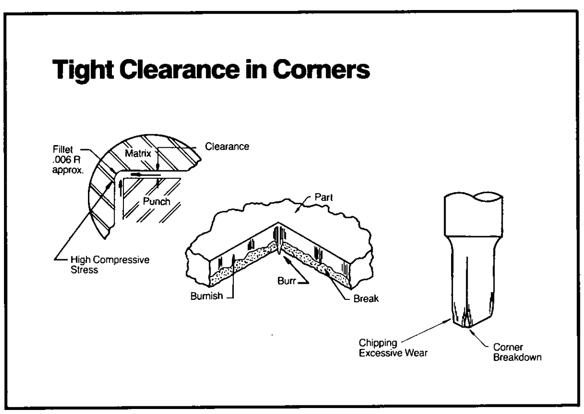
80, 81

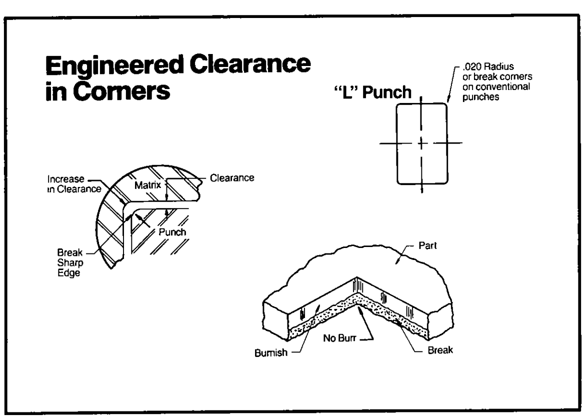




The advantage of using a combination punch and extrude is simply that in one stroke of the press we have developed an extrusion. When additional stations in the progressive die are available it is advisable to create the extrusion with a perforating punch followed by an extrusion punch. This two station extrusion enables us to develop and control extrusion length and quality by changing the perforated hole.

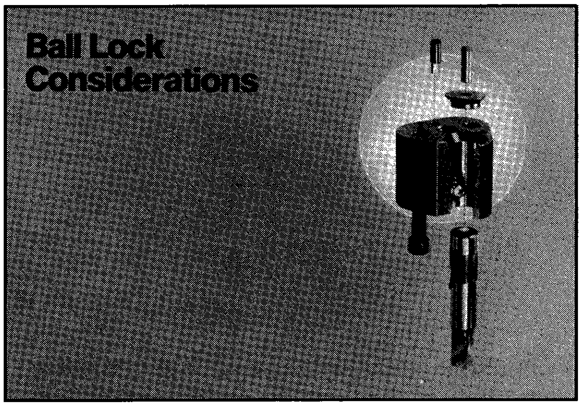
82, 83



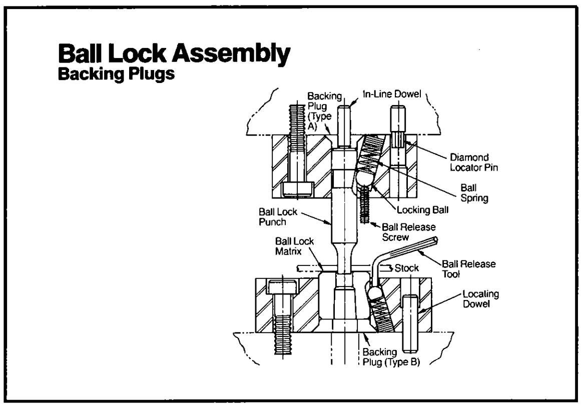


In the selection of clearances it is of major importance to consider material restrictions on shaped punches. As the material is confined as in small holes; shaped holes need additional clearance in the corners.

It is also important to note that in die buttons or solid die block construction shaped holes have approximately a .006 fillet in the corners. The mating punch has sharp corners. This represents a conflict and the solution is to break the sharp corners on the punch. DAYTON offers the "L" punch, where a .02 radius is ground on the corners of rectangular punches. Where sharp corner punches produce a part with a burr in the corners the "L" punch produces a part with a balanced and clean break. This creates less wear on the corners of the punch and increases productivity.

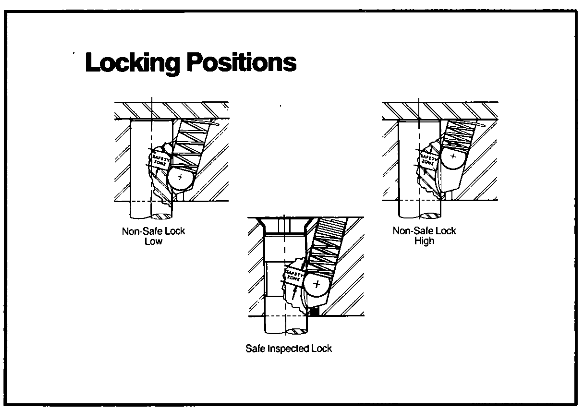


84 The Ball-Lock concept of retention and quick punch replacement has been in use for many years. The ability to change patterns of punches simply by disconnecting them has made this system attractive to designers in recent years.



85 The Ball-Lock retention system is a unique adaptation of the wedge principle. It assures positive locking, both vertically and radially, and permits rapid replacement of punches from the die assembly.

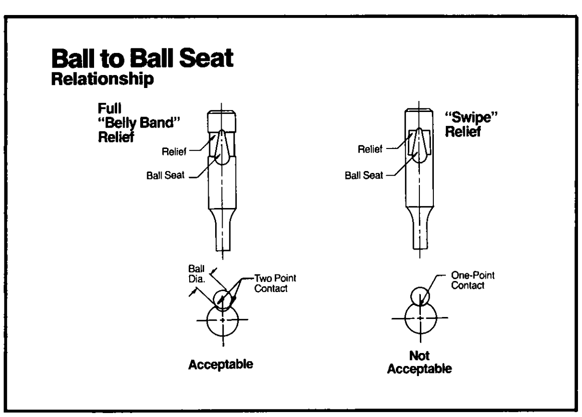
Component installation is quick and simple — insert the punch into the retainer and twist. The ball drops into the ball-seat to provide an immediate and positive lock. To remove a component, it is only necessary to depress the ball by means of a release tool. This action frees the punch so that it can be pulled out of the retainer.



86 As illustrated a punch if not safely locked can either be a low lock or a high lock condition.

If the ball is too low in the locking position it can allow the punch to pump and turn in the retainer. Radial location for shaped punches would be very inaccurate.

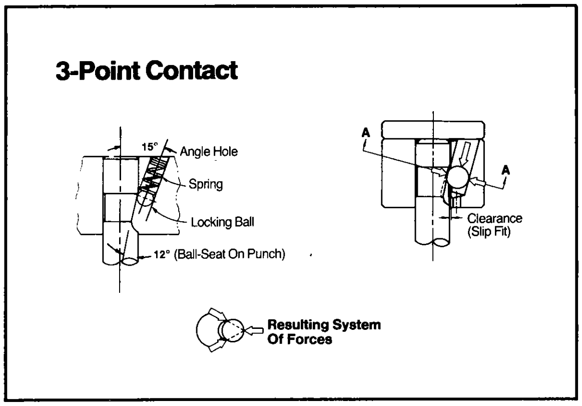
If the ball is too high on the punch and if the stripping force is severe, the punch can pull out. Should this happen, damage to the die can be expected.



87 It is important that the ball-seat have a two-point contact with the hardened ball which is contained within the retainer body.

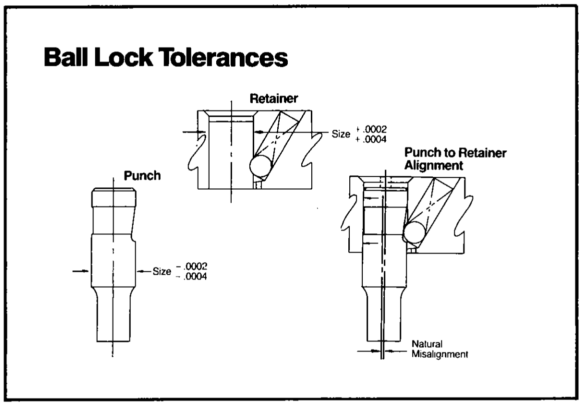
A single point of contact is not acceptable because it does not provide the required radial control of the punch when producing hole shapes other than round.

The locking area of the ball-seat must be relieved by a diametrical reduction of the punch body. The relief provides clearance for minor deformations of the ball seat edges that result during punching. The clearance eliminates the risk of interference during punch removal.

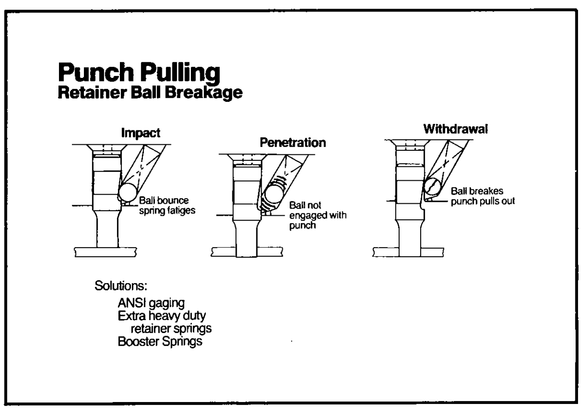


88 The retainer body contains a perpendicular hole which is a slip-fit with the punch body. An angular ball-hole is provided adjacent to and intersecting this punch hole.

It is important to note that the angle of the ball-hole (15°) is greater than the angle of the ball-seat (12°) in the punch. This angular difference helps to develop a dependable wedging action.

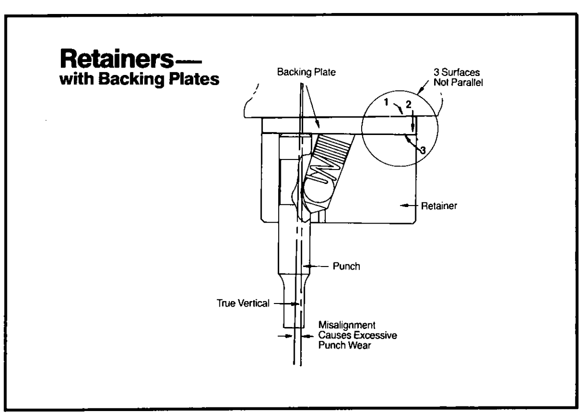


89 The ANSI standard for ball lock is that the punch or matrix body diameter is ground .0002 to .0004 under nominal while the retainer hole is ground .0002 to .0004 over nominal. This condition determines alignment of punch to matrix.



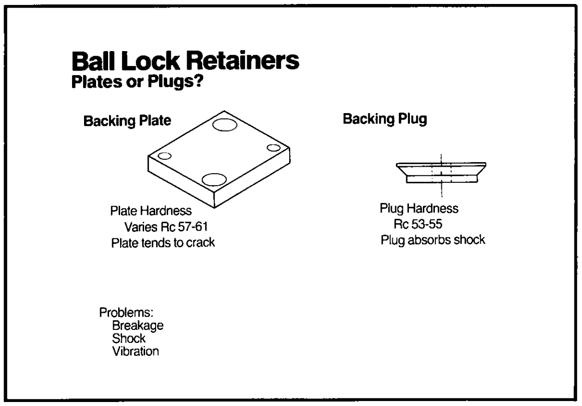
90 A compression spring forces the hardened ball between the punch and the retainer body. In effect, the ball is solidly wedged between the ball-hole and the ball-seat while the punch is forced against the opposite side of the retainer hole.

Any downward force on the punch, such as that imposed by stripping, will increase the wedging action. Any upward force on the punch due to impact will be absorbed through the upper die shoe.

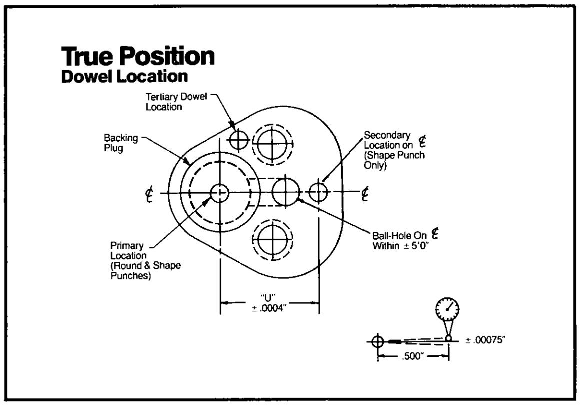


91 The backing plate has always been a problem for die builders. Many times these plates are not parallel to the retainer surface and resulted in the punch being something less than perpendicular to the lower die. Rework is often necessary to correct this condition.

Surfaces 1, 2 and 3 shown out of square would generate misalignment in the punch. Such assemblies would promote deflection and reduces both production and overall die life.



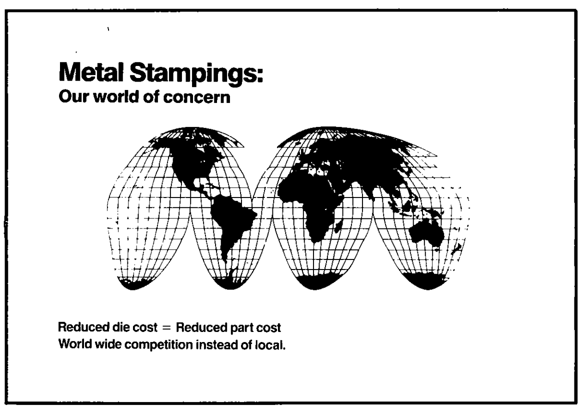
92 As discussed earlier in the program the means of support behind the punch does determine and contribute to chipping and breaking problems. Through market test it has been found that ball lock backing plates (57-61 R/C) do not absorb shock and vibration as well as backing plugs at 53 to 55 Rc.



93 DAYTONS' True Position retainers are manufactured using the in-line dowel concept. The dowel hole relationship to the punch hole is established on the same center-line.

The spread between the punch-hole and the secondary dowel-hole is ±.0004".

The angle or ball-hole is also precision ground on location to assure radial accuracy for the ball engagement to the punch.



94 Simply stated "reduced die cost = reduced part cost", this is a concern for all of us.

For further information on this "Die Clinic" or any of our seminars contact your local DAYTON Distributor or the Regional Manager who services your area.