MATE®
PRECISION TECHNOLOGIES
RESPECT • SUPPORT • INSPIRE

HIGH PERFORMANCE TOOLING SYSTEMS
FOR EUROMAC PRESSES

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CONTENTS

Mate offers the most comprehensive range of thick turret tooling systems designed to accommodate any punching application. Use this simple chart to determine which system is right for your typical thick turret applications.

LESS • MORE •• ••• ••••	ULTRA TEC®	ULTRA XT™	Original Thick Turret
Overall Value – The combination of features, purchase price, and operating costs.	••••	•••	••
Cost Savings – The ongoing cost savings of operating the tooling system over time.	••••	•••	•
Ease of Use – Design features included in the tooling system that make it faster to install, simpler for the operator to set up, and more convenient to maintain.	••••	••	•
Interchangeability – The ability of a tooling system to be compatible with other popular systems from other major suppliers.	••••	•••	••
Quick Set-up – Integral features which enable tools to be changed quickly and accurately, thus maximizing machine up time.	••••	•••	••
Grind Life – The sum of the number of holes punched between regrinds AND the total grindable length of the punch tip before it needs to be replaced.	••••	•••	••
SLUG FREE® Die – Advanced die geometry that prevents the slug from being pulled back to the top of the sheet.	••••	••••	••••
Features – Elements of a tool system that affects its ease of use, performance and longevity.	••••	•••	••
Purchase Price – The initial purchase price of the system.	•••	••	•

ULTRA TEC® Precision Tooling System

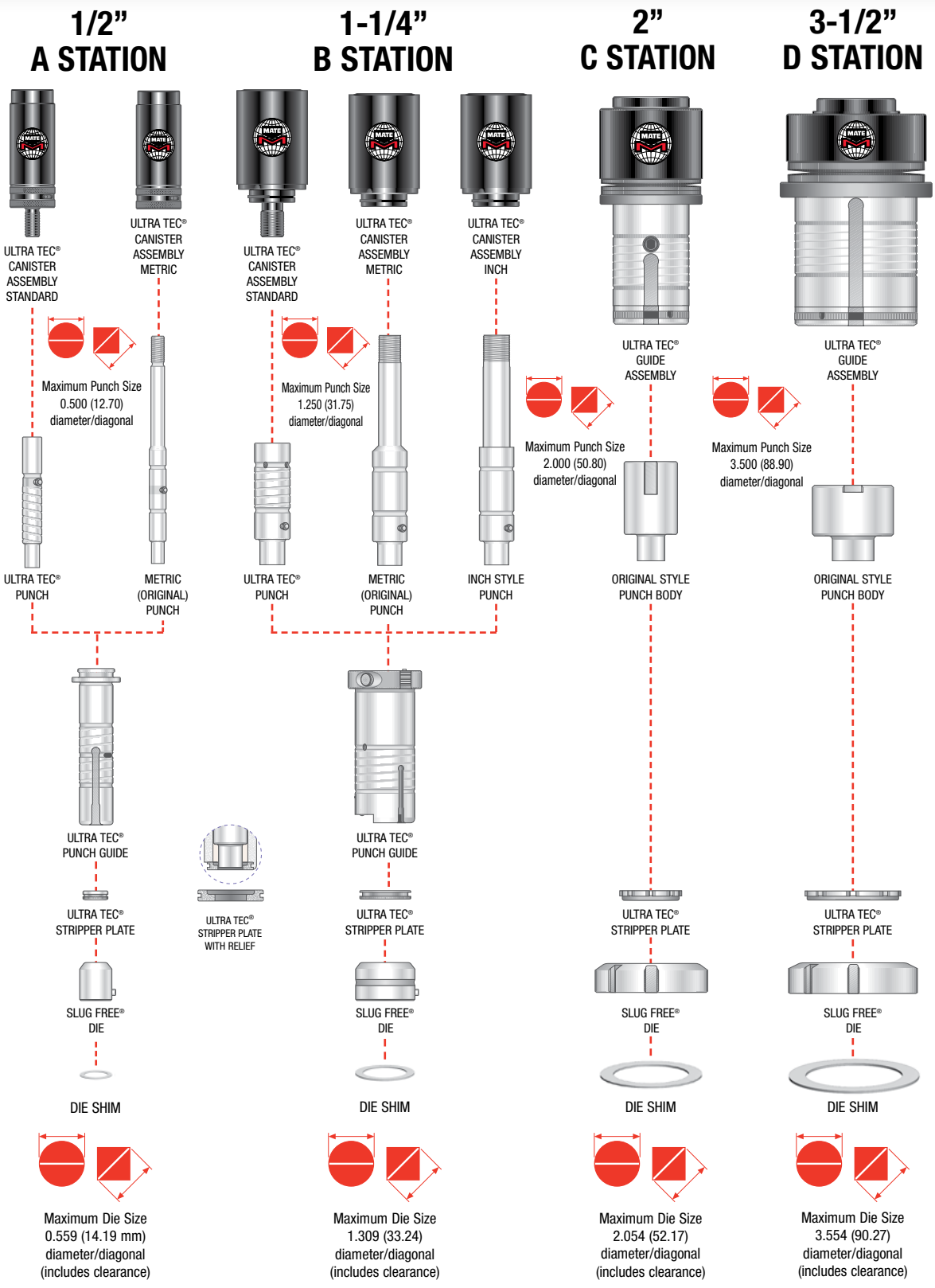
PERFORMANCE

Mate's ULTRA TEC® precision tooling system is a thick turret punching system which increases tool performance and flexibility, offers extended tool life and allows interchangability with existing systems.

Some features of the ULTRA® system include:

- Premium high speed tool steel punches
- Quick tool change strippers – no tools required
- Relieved strippers for extended grind life
  - 0.118(3.00) for 1/2" A and 1-1/4" B station
  - 0.078(2.00) for 2" C, 3-1/2" D and 4-1/2" E stations
- Easy click length adjustment - no shims or tooling required
- Internal and external tool lubrication
- Hardened guides
- SLUG FREE® die design

ULTRA TEC® TOOLING SYSTEM



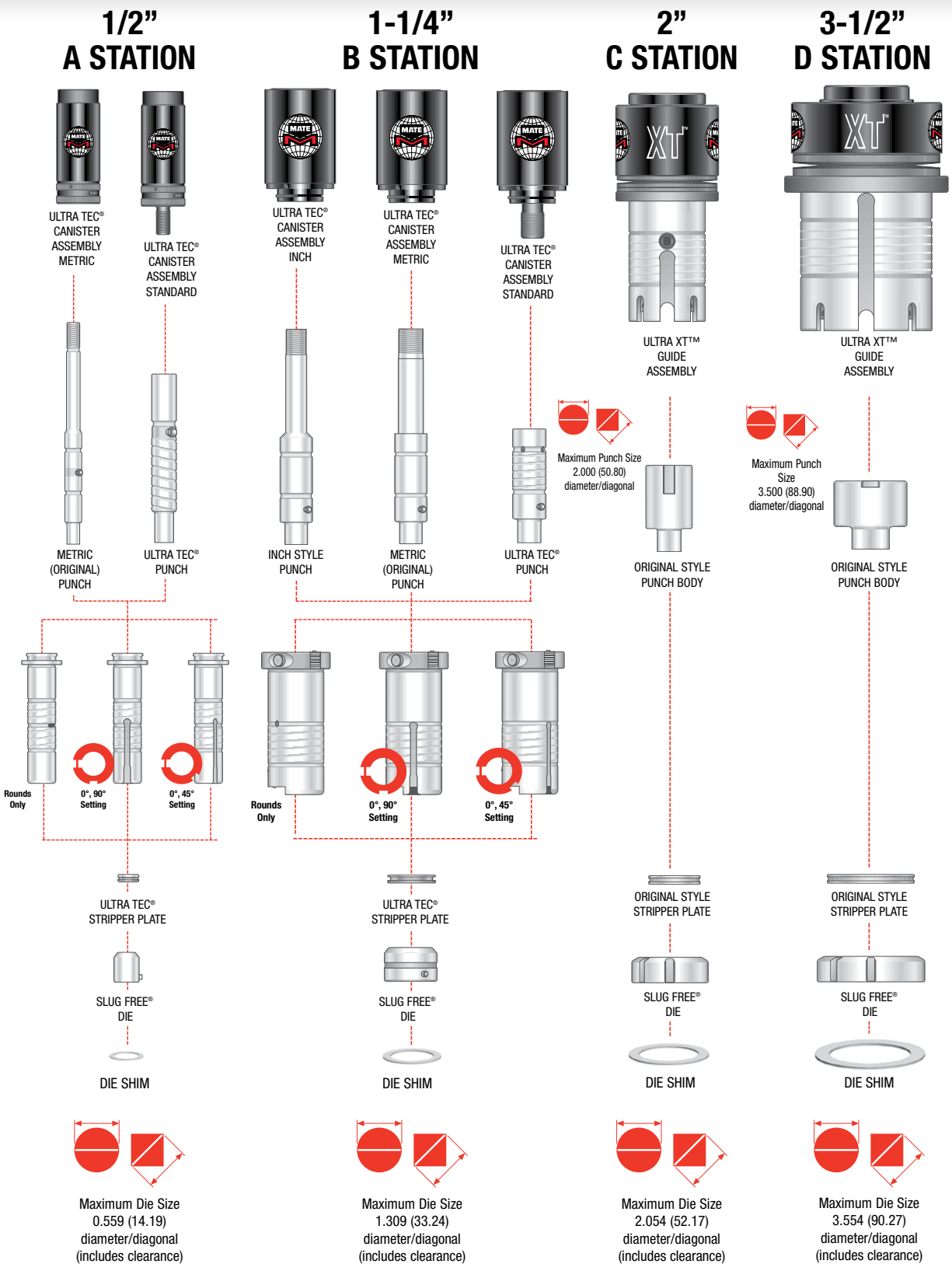
Recommended Stripper Lead:

STATION	STRIPPER LEAD
A	0.048 (1.22)
B	0.048 (1.22)
C	0.033 (0.84)
D	0.073 (1.85)

LIFTER "T" HANDLE

[Dimensions in Inches (mm)]

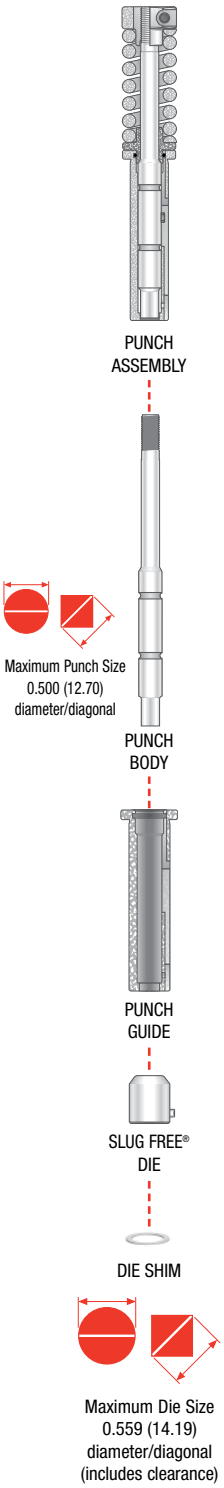
ULTRA XT™ TOOLING SYSTEM



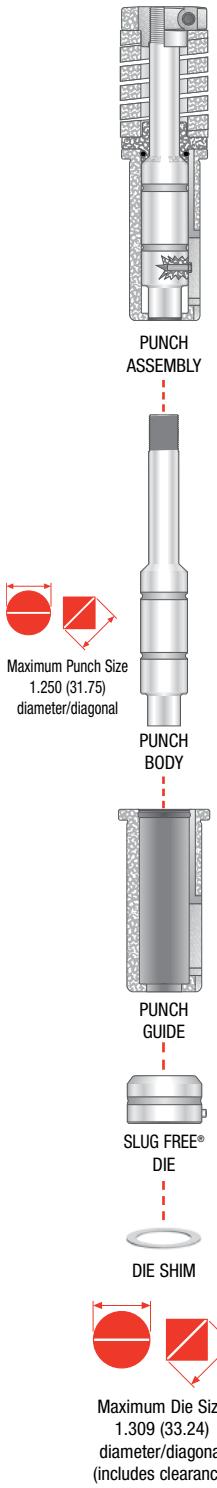
[Dimensions in inches (mm)]

THICK TURRET STYLE TOOLING SYSTEM

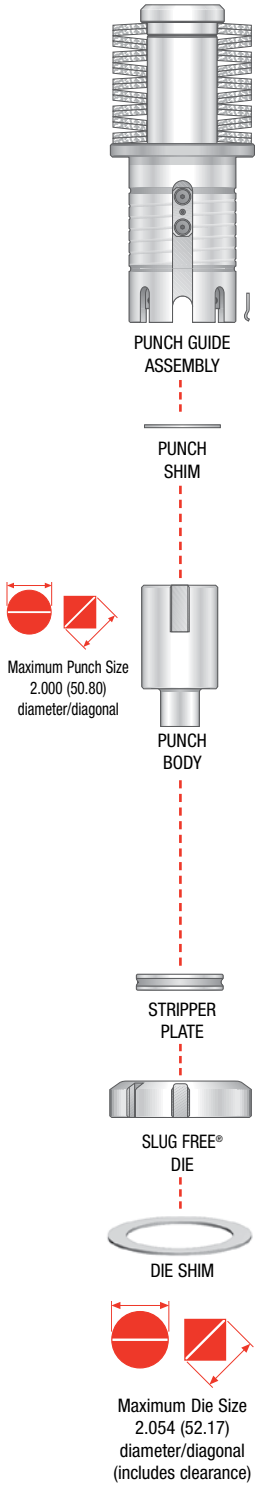
1/2” A STATION



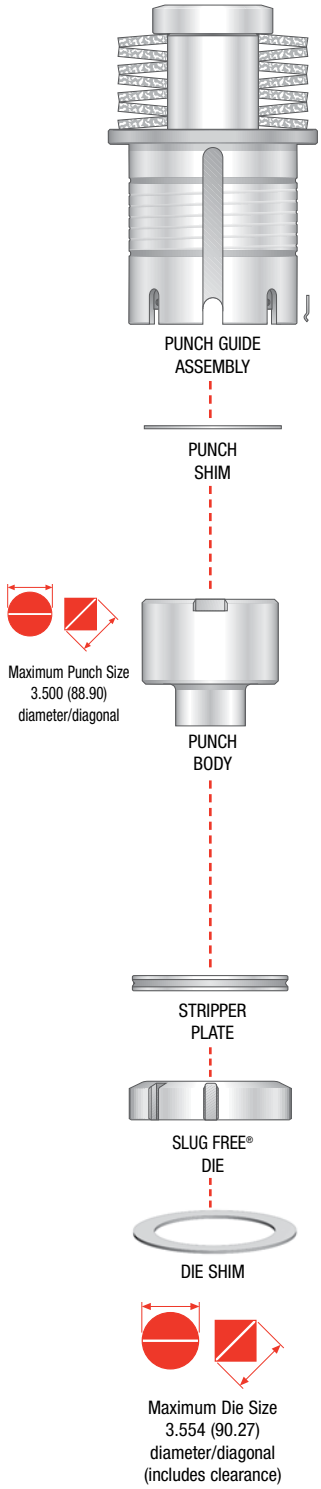
1-1/4” B STATION



2” C STATION



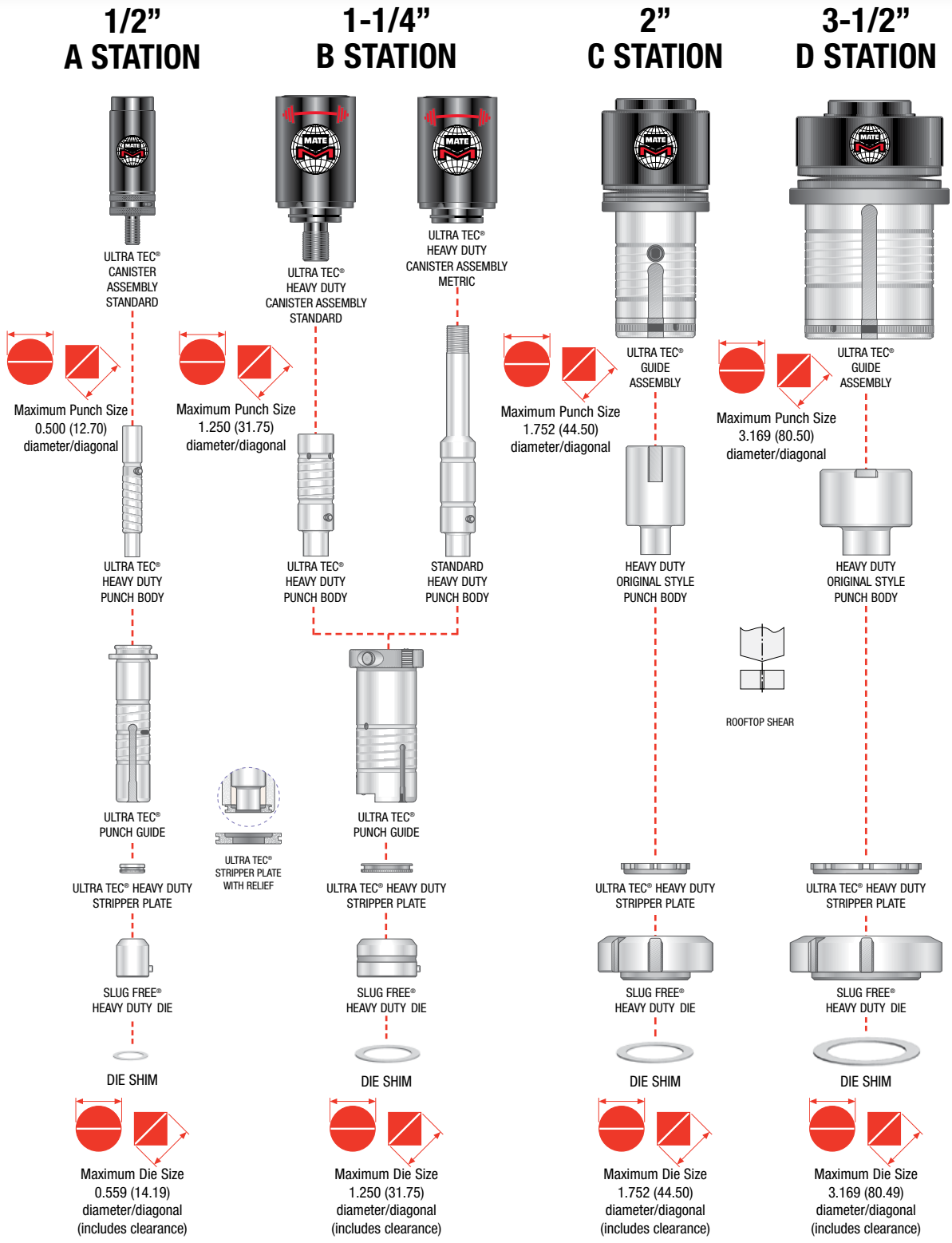
3-1/2” D STATION



EUROMAC

[Dimensions in Inches (mm)]

ULTRA TEC® HEAVY DUTY TOOLING SYSTEM



MINIMUM SIZE FOR HD TOOLS IS 6,35MM

Features include:

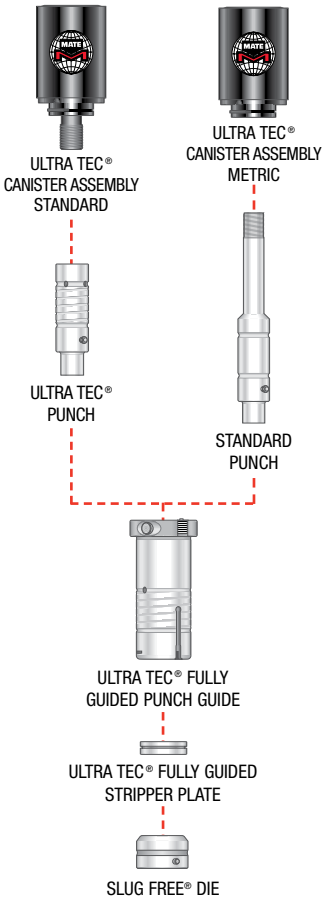
• 1° BACK TAPER ON PUNCHES (PER SIDE) • HEAVY DUTY SLUG FREE® DIE DESIGN • HEAVY DUTY SPRINGS (B STATION) • QUICK TOOL CHANGE • QUICK LENGTH ADJUST • ROOFTOP SHEAR (B STATION, C STATION, D STATION) • PREMIUM HIGH SPEED TOOL STEEL

EUROMAC

[Dimensions in inches (mm)]

ULTRA TEC® FULLY GUIDED

1-1/4" B STATION



2" C STATION

3-1/2" D STATION

ULTRA TEC® FULLY GUIDED TOOL

What does fully guided mean? Fully guided means that the punch is held securely in at least two extreme points – the punch point and the back of the punch. The objective of punch point guiding is to prevent lateral movement of the punch to assure accurate hole punching and long tool life. The punch tip is supported by the stripper, which is manufactured **with 0.03mm** clearance between the punch and the stripper (**standard is 0.06mm**).

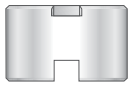
STANDARD FEATURES AND BENEFITS:

- **Fully guided assembly**
  Accurate and close tolerances between guide and stripper hold punches rigid, control against hole distortion and saw toothing.
- **Stripper opening 0.0015(0.04) TC to point**
  Guiding at punch point supports punches, increases hole accuracy, improves stripping, and prevents scrap from rising into the assembly.
- **Quick length adjustment**
  With the push of the quick length adjustment button, rotation of the punch head will adjust the punch length.
- **Hardened and ground guide**
  Reduces abrasive action of punching, diffuses heat effectively, resists galling, extends tool life, increases turret life, and improves up time.
- **Interior and exterior spiral grease grooves**
  Even and consistent tool lubrication increases tool life.
- **Tool Lubrication**
  Interior vertical fluid grooves and fluid through holes provide even and efficient transfer of lubrication fluid to internal surfaces and to external guide surface area, increases lubrication and tool life.
- **Premium high speed tool steel punches at 61-62 Rockwell C**
  Specially formulated high speed steel and specially developed heat treatment processes result in unusually high tool performance, superior dimensional accuracy and maximum tool life.
- **SLUG FREE® die design**
  Clearing the slug every cycle eliminates slug pulling, extends tool life, improves piece part quality, and reduces scrap.

[Dimensions in Inches (mm)]

3-1/2” D STATION

ULTRA TEC®
FULLY GUIDED
CLAMP CLEARING
GUIDE ASSEMBLY



PUNCH
RETAINER

SLITTING
INSERT

DOUBLE “D”
STRIPPER
PLATE

SINGLE “D”
STRIPPER
PLATE

DOUBLE “D”
CLAMP CLEARING
SLUG FREE® DIE

SINGLE “D”
CLAMP CLEARING
SLUG FREE® DIE

STANDARD FEATURES AND BENEFITS:

- **Fully guided assembly**
  Accurate and close tolerances between guide and stripper hold punches rigid, control against hole distortion, and saw toothing.

- **Stripper opening 0.0015(0.04) TC to point**
  Guiding at punch point supports punches, increases hole accuracy, improves stripping, and prevents scrap from rising into the assembly.

- **Punching close to form**
  Specially relieved strippers allow punching as close as 15mm from the edge of an upward form to the center of your slitting punch. Die relief allows punching as close as 20mm from the edge of a downward form to the center of the die opening. Maximum efficiency is retained when full length slitting tools can punch closer to forms. Even tools in a B station cannot punch this close to forms.

- **Quick length adjustment**
  With the push of the quick length adjustment button, rotation of the guide will adjust the punch length. Guide will adjust punch point length by 0.008(0.20) per click.

- **Hardened and ground guide**
  Reduces abrasive action of punching, diffuses heat effectively, resists galling, extends tool life, increases turret life and improves up time.

- **Interior and exterior spiral grease grooves**
  Even and consistent tool lubrication increases tool life.

- **Tool Lubrication**
  Interior vertical fluid grooves and fluid through holes provide even and efficient transfer of lubrication fluid to internal surfaces and to external guide surface area, increases lubrication and tool life.

- **Additional 0.079(2.00) punch grind life**
  Use insert style punches from Mate in combination with this specially designed stripper to gain additional grind life.

- **Premium high speed tool steel punches at 61-62 Rockwell C**
  Specially formulated high speed steel and specially developed heat treatment processes result in unusually high tool performance, superior dimensional accuracy, and maximum tool life.

- **SLUG FREE® die design**
  Clearing the slug every cycle eliminates slug pulling, extends tool life, improves piece part quality, and reduces scrap.

ULTRA LIGHT™ TOOLING SYSTEM

1/2" A STATION

ULTRA LIGHT SPRING CANISTER ULTRA® STYLE

ULTRA LIGHT SPRING CANISTER METRIC STYLE

Ultra Light 1/2" A station canisters apply 70% of the stripping force of the standard Ultra Tec® 1/2" A station canisters

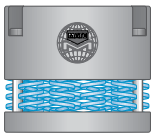
1-1/4" B STATION

ULTRA LIGHT SPRING CANISTER ULTRA® STYLE

ULTRA LIGHT SPRING CANISTER METRIC STYLE

Ultra Light 1 1/4 B station canisters apply 60% of the stripping force of the standard Ultra Tec® 1 1/4" B station canisters

2" C STATION

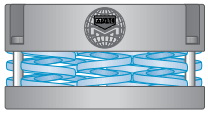


ULTRA LIGHT SPRING ASSEMBLY

MATE00038 is assembled with 9 medium pressure blue springs

(package of 9) HEAVY PRESSURE GOLD SPRINGS

3-1/2" D STATION



ULTRA LIGHT SPRING ASSEMBLY

MATE00033 is assembled with 9 medium pressure blue springs

(package of 9) MEDIUM HEAVY PRESSURE RED SPRINGS

Ultra Light Stripping Force spring combinations compared to disc spring stack (%) in a 2" C station

3 Blue	4%
6 Blue	7%
9 Blue	10%
3 Gold	12%
3 Blue + 3 Gold	15%
6 Blue + 3 Gold	19%
6 Gold	24%
3 Blue + 6 Gold	27%
9 Gold	36%

Ultra Light Stripping Force spring combinations compared to disc spring stack (%) in a 3-1/2" D station

3 Blue	5%
6 Blue	10%
3 Red	11%
9 Blue	15%
3 Blue + 3 Red	16%
6 Blue + 3 Red	21%
6 Red	22%
3 Blue + 6 Red	27%
9 Red	33%

Precision Control of Stripping Force for High Quality Precision Punching…

- ***Reduce spring pressure to eliminate unwanted sheet marking.***
- ***Designed for thin or decorative materials.***
- ***Perfect for high polish, textured, pre-painted or reflective metals where finish appearance is critical.***
- ***Quieter punching in all applications. Reduce noise levels by as much as 10 decibels.***
- ***Maximum control over total spring pressure. Combine two spring sets for nine pressure variations.***

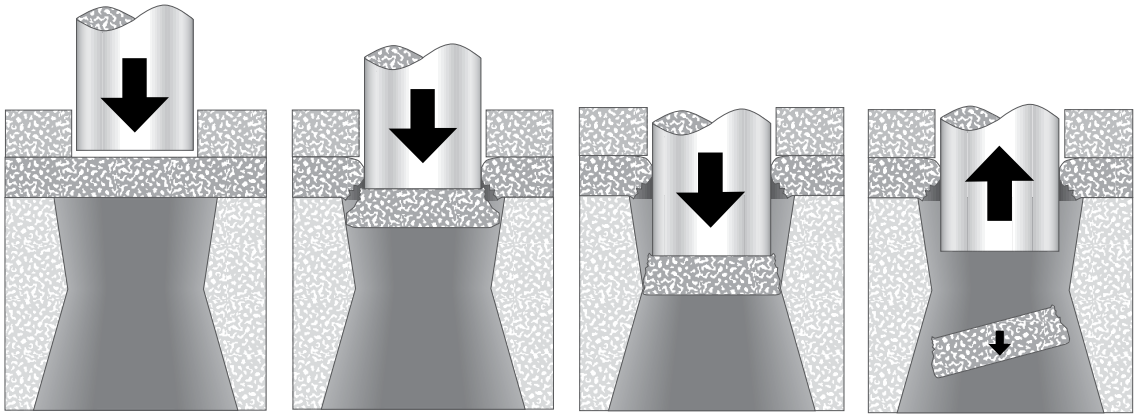
[Dimensions in Inches (mm)]

Mate SLUG FREE® dies eliminate slug pulling. Slug pulling is a condition where the slug returns to the top of the sheet during the stripping portion of the punching cycle. The slug comes between the punch and the top of the sheet on the next cycle. This causes damage to the piece part and the tooling. SLUG FREE dies eliminate this problem.

- **Eliminate slug pulling**
- **Reduce tool breakage**
- **Improve tool life**
- **Increase quality**

The SLUG FREE die has been designed with an opening that has a constriction point below the surface so the slug cannot return once it passes this point. Once the slug is separated from the punch, it is free to fall away from the punching area. Slug pulling is eliminated.

*Maximum penetration of the punch if the die=3mm for thickness up to 3mm; for thickness over 3mm the penetration can be decreased.



Material held securely by stripper before punch makes contact

Punch penetrates the material. Slug fractures away from sheet.

Pressure point constricts slug. Punch stroke bottoms out as slug squeezes past pressure point.

Punch retracts and slug is free to fall down and away through exit taper of the SLUG FREE® die.

MATE SLUG FREE LIGHT™ DIES FOR THIN SHEET METAL.

Mate Slug Free Light™ thick turret dies are designed to eliminate slug pulling when punching thin sheet metal material, where the recommended die clearance is less than 0.008(0.20).

*Penetration of the punch in the die should equal 3mm for thickness up to 3mm; for thickness over 3mm the penetration can be decreased.

The Mate Slug Free Light die works by introducing a series of small protrusions around the edge of the slug. Each protrusion is created by a small angled notch cut into the die opening (See Photo 1). As the slug passes through the die, the position of the protrusion relative to the notch changes slightly. This change creates slight pressure between the slug and the die land, which traps the slug into the die and eliminates the possibility of the slug being pulled back through the die. By eliminating slug pulling with every punch cycle, the piece part quality is improved and tool life is increased.

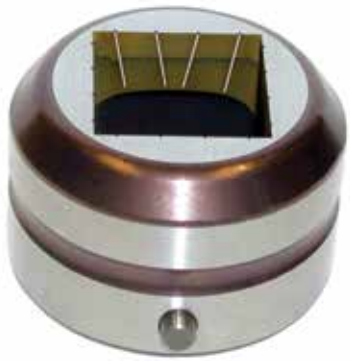


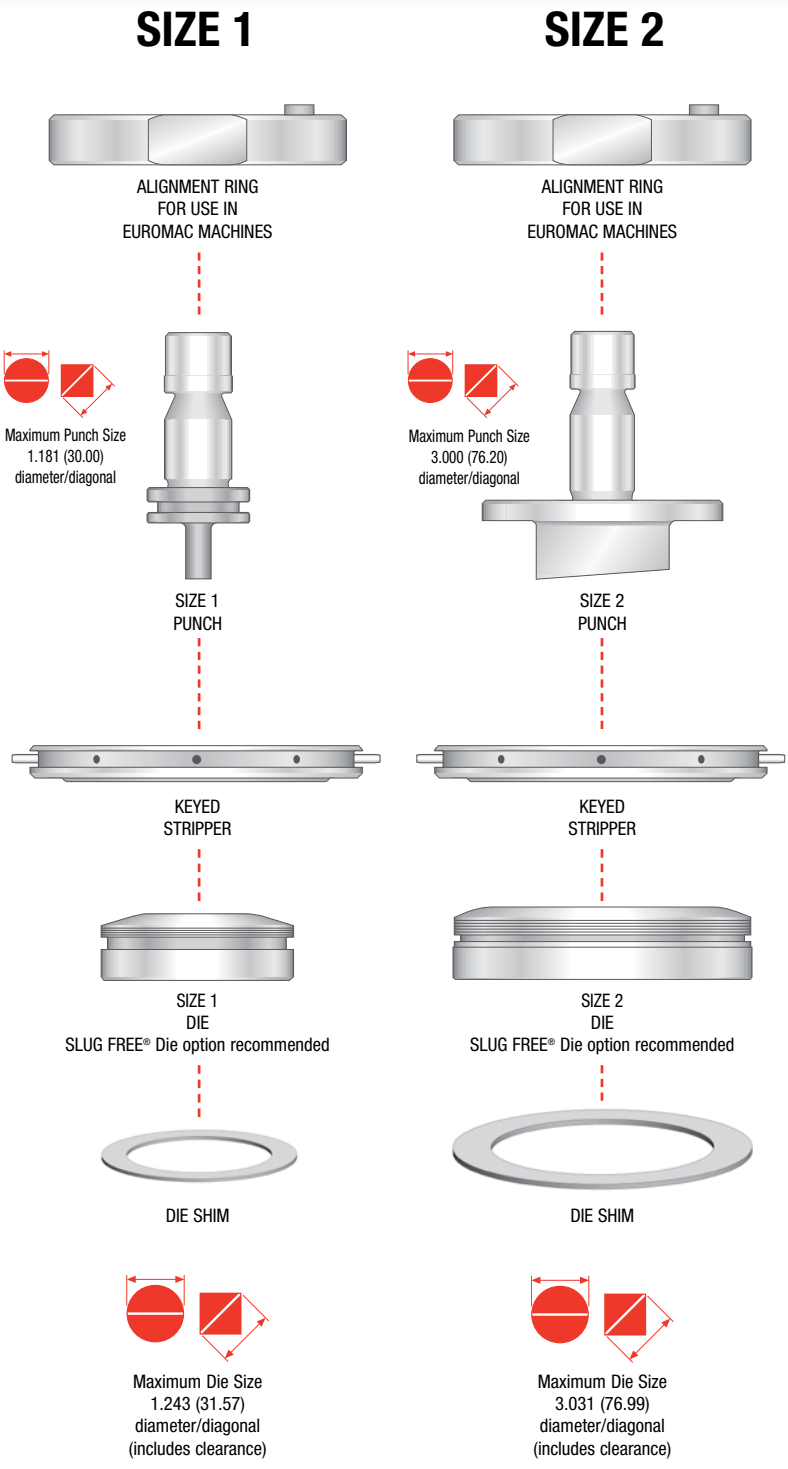
Photo 1: Mate Slug Free Light notches are cut at an angle to create a series of protrusions on the slug. As the slug moves through the die, the protrusions become trapped against the die land to prevent the slug pulling back on to the sheet. (Image enhanced for additional clarity)

See machine manual for more information

EUROMAC

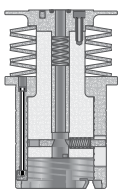
[Dimensions in Inches (mm)]

TRUMPF STYLE TOOLING SYSTEM*



*** Not for forming tools.**

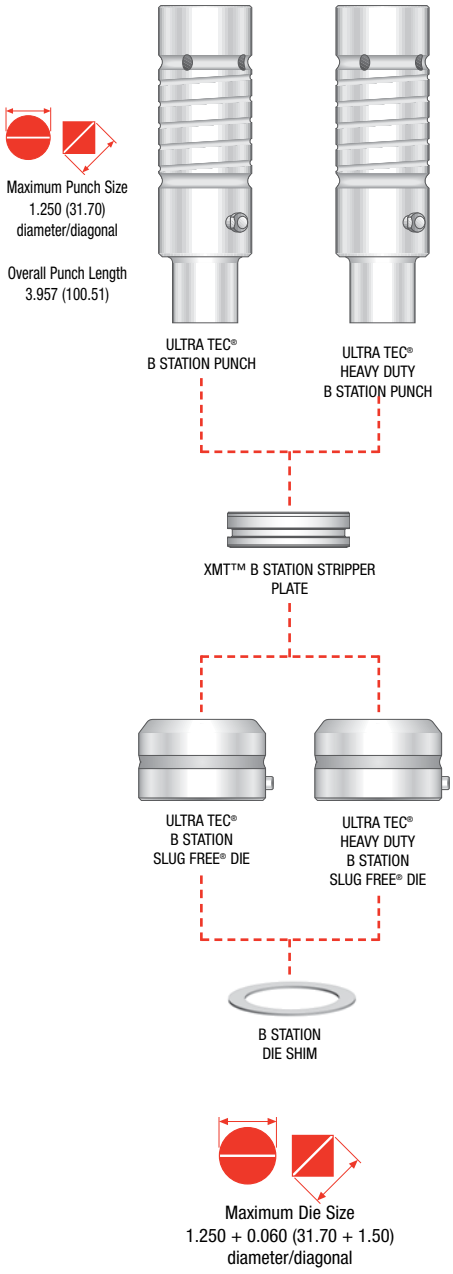
Euromac Trumpf Adapter Required
Available from Euromac.



EUROMAC

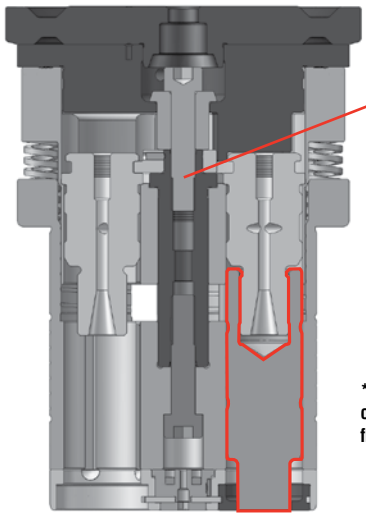
[Dimensions in Inches (mm)]

B STATION



For replacement strippers on MTE4 use standard Ultra B-Station stripper. See Page 3.

FMTE4 Upper Assembly



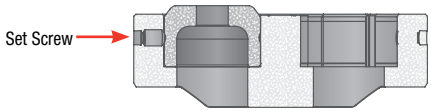
Tighten drawbolt to a torque of 26 ft.lbs (35 Nm) Use 8mm hex wrench

Up to 12mm Maximum Material Thickness for Copper and Aluminum with Flat Punch*

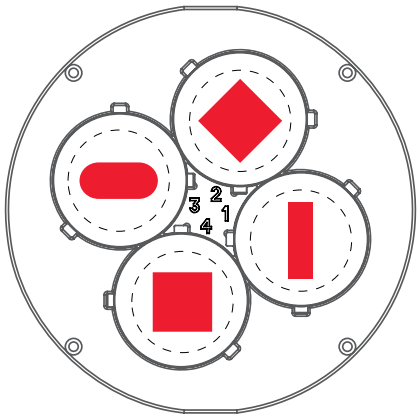
***8 to 12mm thickness processable only with a copper or aluminum and flat non-ground punch**

Patent EP1138411 Europe, Patent US6675688 USA and Patent CN1319665 CINA
Patent EP1153676 Europe, Patent US7032812 USA and Patent CN1182929 CINA
Patent EP2392620 Europe, Patent US2011296969 USA and Patent CN102286593 CINA
Maximum recommended tonnage: 22 metric tons.

FMTE4 Die Holder (side view)



FMTE4 Die Holder (die view)



0° angle setting is always at 3 o'clock. By properly selecting the station, all shaped tools can be set at 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 315°.

Total Die Clearance (TDC) and Slug-Free Die Land punch point - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.003(.010)	0.007(0.20)	0.016(0.41)	0.024(0.61)	0.039(1.00)	0.049(1.25)	0.059(1.50)
Die Land	0.109(2.79)	0.109(2.79)	0.129(3.30)	0.157(4.01)	0.227(5.79)	0.242(6.15)	0.270(6.86)
Punch - MAX Grind Life - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.354(9.00)	0.354(9.00)	0.314(8.00)	0.275(7.00)	0.236(6.00)	0.196(5.00)	0.157(4.00)

Notes:
Data is based on Full Punch SBR length; please note that small punch points may have reduced SBR and reduced grind life.
Total Die Clearance (TDC) and Slug-Free Die Land thickness is based on recommended TDC for mild steel.
Data is based on 3mm die penetration; reducing die penetration for thicker materials can allow more grind life.

See machine manual for more information

EUROMAC

[Dimensions in brackets (mm)]

TOOLING FOR EUROMAC MULTI TOOLS FMTE6 (LONG)

XMT™ Punch

24 mm

Maximum 0.945 (24.00)
diameter/diagonal

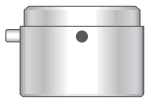
Overall Punch Length
3.937 (100.00)

XMT™ Stripper

24 mm

XMT™ SLUG FREE® Die

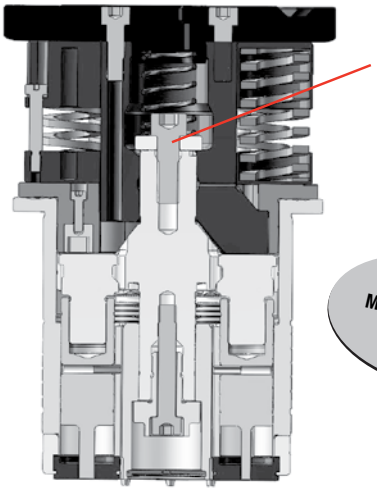
24 mm



Maximum 0.945 + 0.016 (24.00 + 0.40)
diameter/diagonal

Die Shim

FMTE6 Upper Assembly

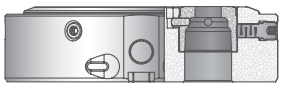


Tighten drawbolt to a torque of 26 ft.lbs (35 Nm) Use 8mm hex wrench

Up to 6mm Maximum Material Thickness

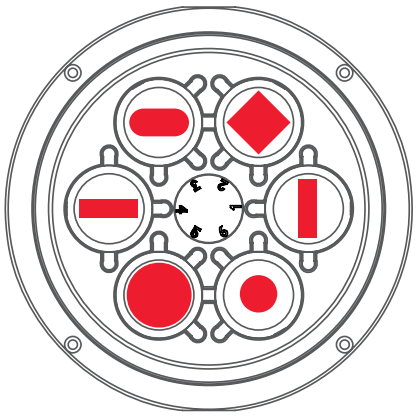
Patent EP1138411 Europe, Patent US6675688 USA and Patent CN1319665 CINA
Patent EP1153676 Europe, Patent US7032812 USA and Patent CN1182929 CINA
Patent EP2392620 Europe, Patent US2011296969 USA and Patent CN102286593 CINA

FMTE6 Die Holder (side view)



Set Screw

FMTE6 Die Holder (die view)



0° angle setting is always at 3 o'clock. By properly selecting the station, all shaped tools can be set at 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 315°.

As material thickness increases over 0.157 (4.00), then maximum punch diameter decreases.

Mild Steel Example:

Thickness	Max Diameter
0.157 (4.00)	0.898 (22.80)
0.197 (5.00)	0.878 (22.30)
0.236 (6.00)	0.862 (21.90)
0.250 (6.35)	0.858 (21.80)
0.276 (7.00)	0.846 (21.50)
0.315 (8.00)	0.827 (21.00)
0.354 (9.00)	0.807 (20.50)
0.394 (10.00)	0.783 (19.90)
0.433 (11.00)	0.701 (17.80)
0.472 (12.00)	0.677 (17.20)
0.500 (12.70)	0.638 (16.20)

Total Die Clearance (TDC) and Slug-Free Die Land punch point - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.003(.010)	0.007(0.20)	0.016(0.41)	0.024(0.61)	0.039(1.00)	0.049(1.25)	0.059(1.50)
Die Land	0.109(2.79)	0.109(2.79)	0.129(3.30)	0.157(4.01)	0.227(5.79)	0.242(6.15)	0.270(6.86)
Punch - MAX Grind Life - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.354(9.00)	0.354(9.00)	0.314(8.00)	0.275(7.00)	0.236(6.00)	0.196(5.00)	0.157(4.00)

Notes:
Data is based on Full Punch SBR length; please note that small punch points may have reduced SBR and reduced grind life.
Total Die Clearance (TDC) and Slug-Free Die Land thickness is based on recommended TDC for mild steel.
Data is based on 3mm die penetration; reducing die penetration for thicker materials can allow more grind life.

XMT punch grind life is 0.106(2.69) for materials up to 0.334(8.48) thick at recommended die penetration.

Grind life is reduced at a ratio of 1:1 as material thickness increases above 0.334(8.48).

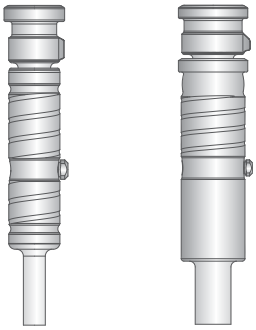
Reducing die penetration enables additional holes to be punched, but increases the possibility of slug pulling.

[Dimensions in Inches (mm)]

TOOLING FOR EUROMAC MULTI TOOLS FMTE10

XMT™Adjustable Punch

12.7 mm 24 mm



Maximum 0.945 (24.00) diameter/diagonal

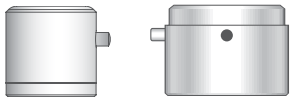
Overall Punch Length 3.937 (100.00)

XMT™ Stripper

12.7 mm 24 mm

XMT™ SLUG FREE® Die

12.7 mm 24 mm

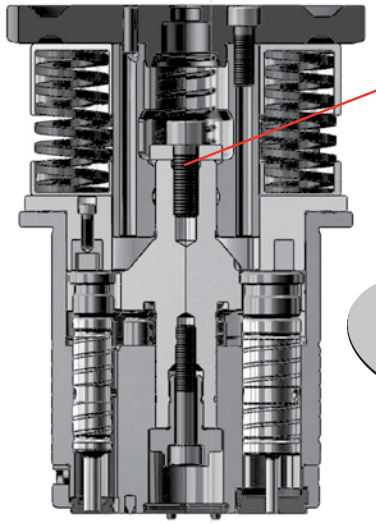


Maximum 0.500 + 0.021 (12.70 + 0.54) diameter/diagonal

Maximum 0.945 + 0.016 (24.00 + 0.41) diameter/diagonal

Die Shims

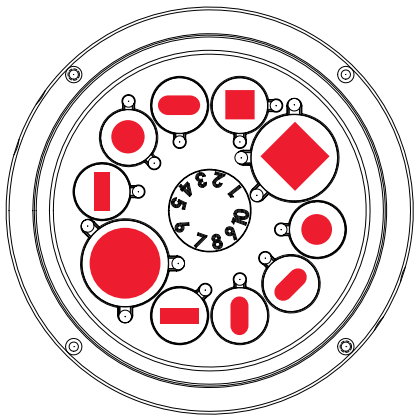
FMTE10 Upper Assembly



Patent EP1138411 Europe, Patent US6675688 USA and Patent CN1319665 CINA
Patent EP1153676 Europe, Patent US7032812 USA and Patent CN1182929 CINA
Patent EP2392620 Europe, Patent US2011296969 USA and Patent CN102286593 CINA

FMTE10 Die Holder (side view)

FMTE10 Die Holder (die view)



0° angle setting is always at 3 o'clock. By properly selecting the station, all shaped tools can be set at 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 315°.

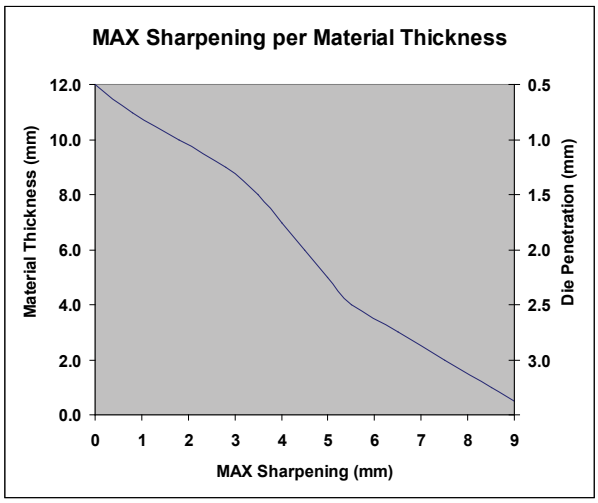
Total Die Clearance (TDC) and Slug-Free Die Land punch point - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.003(.010)	0.007(0.20)	0.016(0.41)	0.024(0.61)	0.039(1.00)	0.049(1.25)	0.059(1.50)
Die Land	0.109(2.79)	0.109(2.79)	0.129(3.30)	0.157(4.01)	0.227(5.79)	0.242(6.15)	0.270(6.86)
Punch - MAX Grind Life - inch(mm)							
Material	0.0196(0.50)	0.039(1.00)	0.078(2.00)	0.118(3.00)	0.157(4.00)	0.196(5.00)	0.236(6.00)
TDC	0.354(9.00)	0.354(9.00)	0.314(8.00)	0.275(7.00)	0.236(6.00)	0.196(5.00)	0.157(4.00)

Notes:
Data is based on Full Punch SBR length; please note that small punch points may have reduced SBR and reduced grind life.
Total Die Clearance (TDC) and Slug-Free Die Land thickness is based on recommended TDC for mild steel.
Data is based on 3mm die penetration; reducing die penetration for thicker materials can allow more grind life.

EUROMAC

[Dimensions in Inches (mm)]

SHARPENING FMTE4, FMTE6, AND FMTE10 PUNCHES



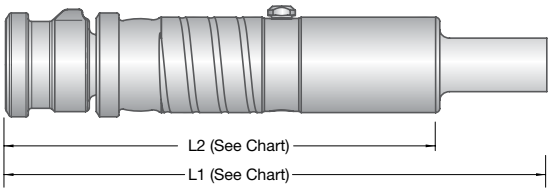
When sharpening punches, pay ATTENTION to the **MAX material thickness** to punch and to the depth reached by the punch and die, to prevent tool or workpiece damage. The shorter the punch, the thinner the sheet that can be punched.

Length Adjustment / Sharpening Data									
Style	DIM -->	L1*	L2 (MAX)	OAL	PH-Len**	PH-Gap**	SBR	S-Land	Grind (MAX)
XMT12.7A	-	100	85.85	80.39	17.96	1.65	20.57	4.04	9.0
XMT24A	-	100	85.85	80.39	18.59	1.02	20.57	6.96	9.0
Ultra B	-	150	134.7	100.55	47.24	2.21	18.80	3.99	9.0
*L1 is nominal or goal for ideal punch length adjustment									
**Older FMTE4 assemblies may use EPMD04PH, with slightly smaller PH-Gap									

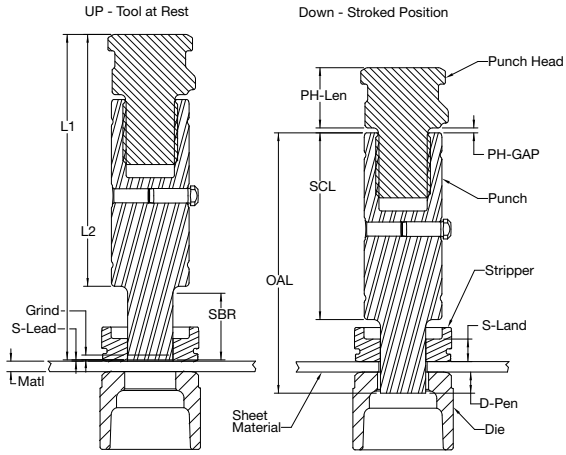
Length Adjustment / Sharpening Features			
Label	Feature	Size / TOL	NOTES
L1	Punch Assembly Length	Nominal	OAL + PH-LEN + PH-GAP
L2	Punch Assembly To SCL	MAX	SCL + PH-LEN + PH-GAP
OAL	Punch OAL*	New	New, Subtract Sharpening
PH-Len	Punch Head Body Length	REF	Never Changes
PH-Gap	Punch Head Gap*	Variable	Do Not Seat On Punch (MIN > 0)
SBR	Punch Point SBR**	New	New, Subtract Sharpening
S-Land	Stripper Land**	REF	Never Changes
S-Lead	Stripper Lead	REF	MIN = 0, Nom. = 0,3, MAX = S-Land - 1mm
MATL***	Sheet Material Thickness	Variable	See Note For Thick Matl***
Grind***	Sharpening	Variable	MAX Sharpening of Punch Point, See Note For Thick Matl***
D-Pen	(Punch In) Die Penetration	Variable	Punch Penetration in Die, See Note For Thick Matl***
*Dimension given for new Punch			
**SBR = "Straight Before Radius" = usable length of Punch Point			
**Smaller point sizes may have reduced SBR and Stripper Land			
***Thick MATL will require reduced Die Penetration and Limits Sharpening			
***Tonnage Limit may be reached first for Thick Material			

Use DTE24 or similar ISO 32 VG hydraulic oil

FITTING THE PUNCH & STRIPPER



- Screw the punch onto the punch head until you obtain a total height, punch + head, of L1.
- Fit the punch into the seat on the punch holder body by turning the key to the needed position.
- Before securing the punch in place, fit the stripper, adjust its position to match the punch and complete punch insertion.
- For FMTE4, rotate skid plate for punch insertion and to index position for assembly.
- Fit the striker body and tighten the central retaining screw.



- IMPORTANT! When sharpening the punches, make sure the total length (OAL) plus that of the punch head (PH-Len + Ph-Gap) is L1 (SEE CHART).
- IMPORTANT! L2 must never be greater than MAX (corresponding to - MAX sharpening). Use a Mate stripper, punch and die per tooling style (SEE CHART).

Part Numbers by Tooling Style			
NAME	XMT12.7A	XMT24A	XMTB / ULTRA B
Punch Head Assembly*	MATE02081	MATE01901	MATE02182**
Shape Punch	PLXA	PLXZ	PAUB
Round Punch	PLXA0	PLXZ0	PAUB0
Shape Stripper	S6XA	S6XZ	S6XB
Round Stripper	S6XA0	S6XZ0	S6XB0
Shape Die	D0XA	D0XZ	D0AB
Round Die	D0XA0	D0XZ0	D0AB0
*Punch and Punch Head Sold Separately			
**Older FMTE4 assemblies may use EPMD04PH			

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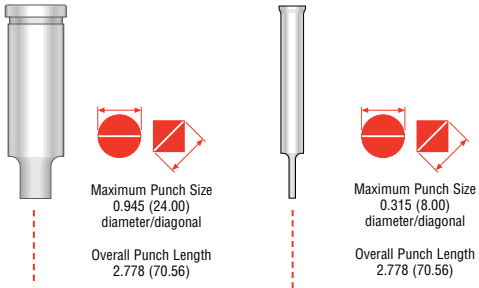
[Dimensions in Inches (mm)]

TOOLING FOR OBSOLETE EUROMAC
MULTI TOOLS MTE4*, MTE6, MTE10, AND FMTE6

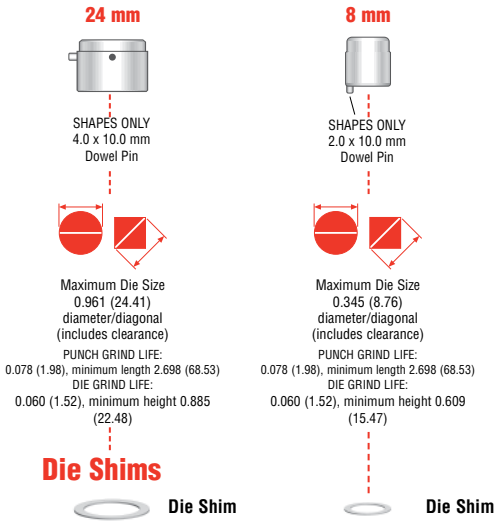
PUNCHES, DIES AND STRIPPERS FULLY SUPPORTED

MT™ Punch



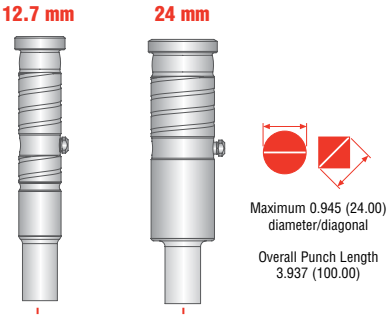
MT™ Stripper

MT™ SLUG FREE® Die

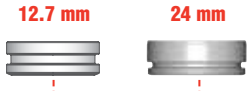


Die Shims

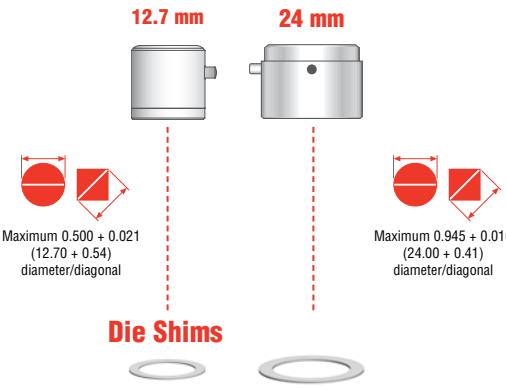
XMT™ Punch



XMT™ Stripper



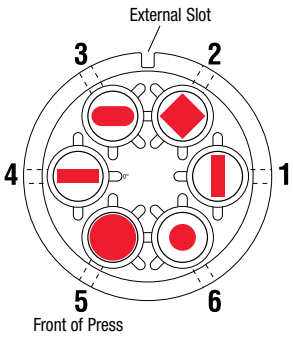
XMT™ SLUG FREE® Die



Die Shims

MTE6 Die Holder (die view)

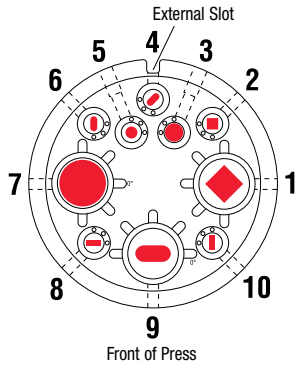
Holds 24mm tooling



0° angle setting is always at 3 o'clock. By properly selecting the station, all shaped tools can be set at 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 315°.

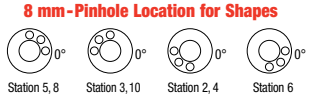
MTE10 Die Holder (die view)

Holds 24mm and 8 mm tooling



0° angle setting is always at 3 o'clock. By properly selecting the station, all shaped tools can be set at 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 315°.

8 mm - Pinhole Location for Shapes



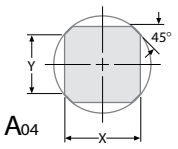
*MTE4

Obsolete Euromac Multi Tools MTE4
Note: These products use standard Mate ULTRA® punches, dies and strippers. Please see Page 3 for product information.

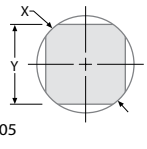
EUROMAC

[Dimensions in Inches (mm)]

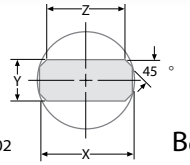
SPECIAL SHAPES



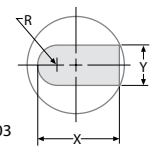
A04
SQUARE WITH CHAMFERED CORNERS



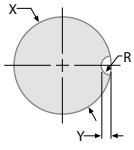
A05
QUAD D



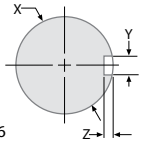
B02
RECTANGLE WITH CHAMFERED CORNER



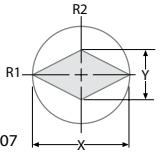
B03
RECT/OVAL



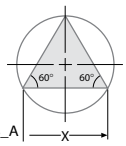
C05
KEYWAY



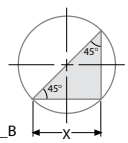
C06
KEYWAY



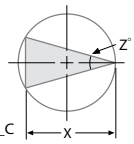
C07
DIAMOND



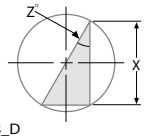
C08_A
EQUILATERAL TRIANGLE



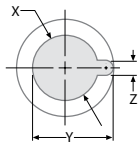
C08_B
45° RIGHT TRIANGLE



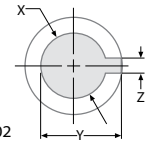
C08_C
ISOSCELES TRIANGLE



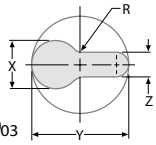
C08_D
RIGHT TRIANGLE



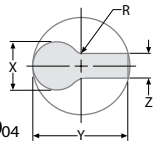
D01
KEYHOLE



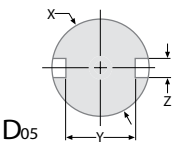
D02
KEYHOLE



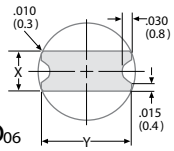
D03
KEYHOLE



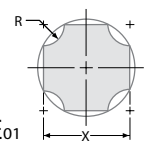
D04
KEYHOLE



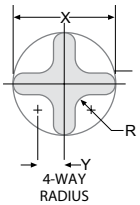
D05
DOUBLE KEYWAY



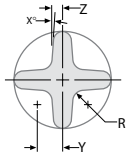
D06
SHAKE AND BREAK



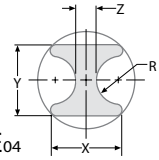
E01
4-WAY RADIUS



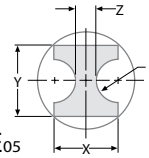
E02
4-WAY RADIUS



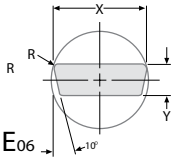
E03
4-WAY RADIUS



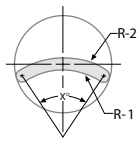
E04
2-WAY RADIUS



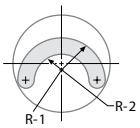
E05
2-WAY RADIUS



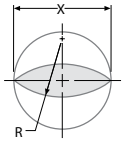
E06
CABLE CONNECTOR



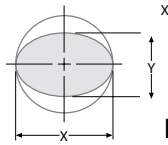
E07
ARC OVAL



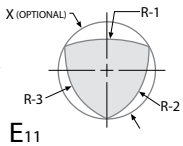
E08
ARC OVAL



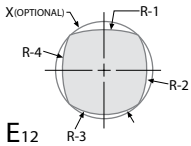
E09
FOOTBALL



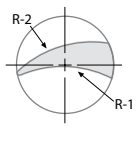
E10
ELLIPSE



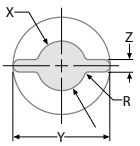
E11
TRI-RADIUS



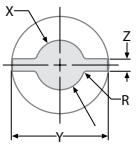
E12
QUAD-RADIUS



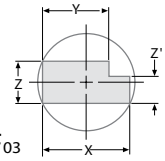
E13
INSIDE/OUTSIDE RADIUS



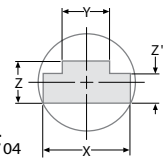
F01
DOUBLE KEYHOLE



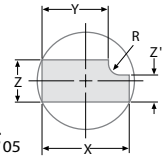
F02
DOUBLE KEYHOLE



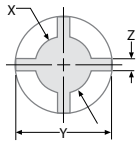
F03
RECT ONE NOTCH



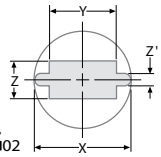
F04
RECTANGLE WITH TWO NOTCHES



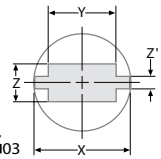
F05
RECTANGLE WITH RADIUS NOTCH



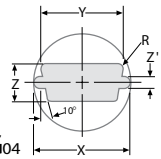
G01
4-WAY SQUARE KEYHOLE



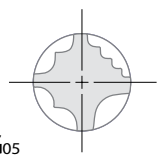
G02
RECTANGLE WITH TABS



G03
DOUBLE RECTANGLE

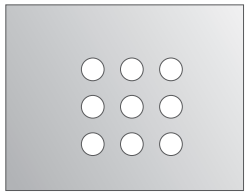


G04
CABLE CONNECTOR WITH TABS

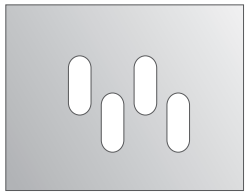


G05
9-WAY CORNER ROUNDING

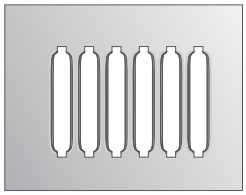
[Dimensions in Inches (mm)]



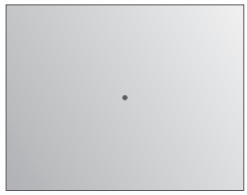
Cluster – Round ▲



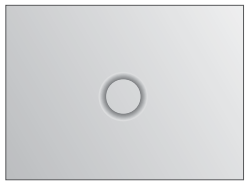
Cluster – Shape ▲



Card Guide

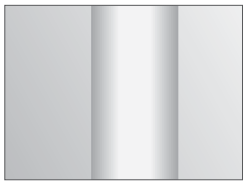


Centerpoint ▲



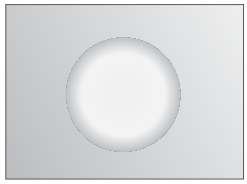
Countersink – Round ▲

Countersink – Shape ▲



Emboss – Beading

Emboss – Edgeform

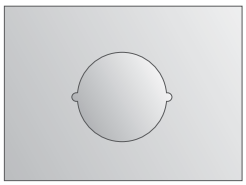


Emboss – Formed (Round and Shaped) ▲

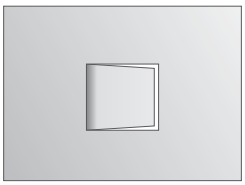
Emboss – Cold Forged ▲

Extrusion – Tapping ▲

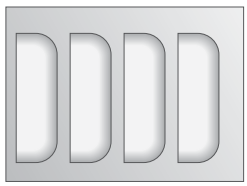
Extrusion – Flanged Hole ▲



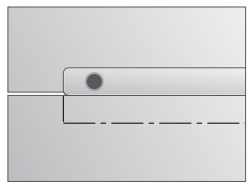
Knockout ▲



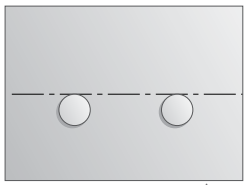
Lance And Form ▲



Louver



Scissortool™

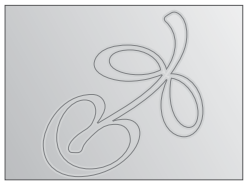


Shearbutton ▲ (Round and Shaped)

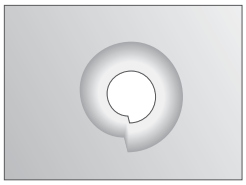
Rollerball™

Sheetmarker™

Stamping – Alpha Numeric ▲



Stamping – V-line ▲



Threadform ▲

▲ Select special assemblies available for some multi tool applications. These are **forming down applications only!** Contact customer service regarding your application.

See **MATE** Forming Tool Order Guide for forming tool ordering specifications...
Ask for part number **LIT00002**

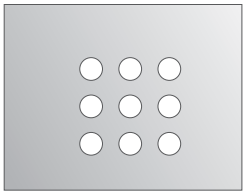
Cluster ▲

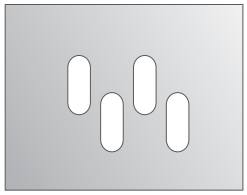
Use:
To produce multiple holes with minimal hits.

Typical Application:
- Material thickness from 0.020(0.50) to 0.157(4.00).
- Other restraints dependent upon station size, punch size and shape and press tonnage.

Comments:
- For greater hole uniformity and flatter sheets, spread the punches to avoid punching adjacent holes in the same hit.
- Do not re-punch through previously punched holes to complete a pattern. A single hit tool may be necessary

See pages 31, 32, and 36 for more information.



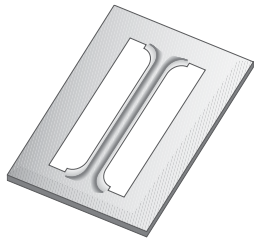


Card Guide

Use:
As a retainer for printed circuit boards.

Typical Application:
- Material thickness from 0.040(1.00) to 0.078(2.00).
- Maximum recommended top to top height 0.125 (3.20).

Comments:
- Length of the card guide is dependent upon station size and machine tonnage.
- Also available as a continuous form to increase productivity and flexibility.



Countersink – Dedicated ▲

Use:
Allows screw and rivet head to sit flush or below the surface of the material.

Typical Application:
- Material thickness from 0.048(1.22) to 0.250(6.35), dependent upon press tonnage capacity.

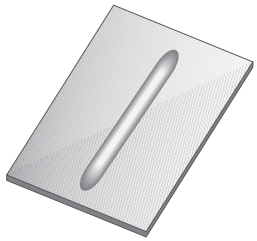
Comments:
- The *shoulder* (dedicated) style is generally ordered for one material thickness and screw size.
- The shoulder style coins the surrounding area, producing a clean flat countersink with minimal burring.

Emboss – Continuous

Use:
As a stiffener to add rigidity to sheet metal panels.

Typical Application:
- Material thickness from 0.027(0.70) to 0.250(6.35), dependent upon press tonnage capacity.

Comments:
- The increment between hits is determined by the cosmetic requirements for the finished part. Smaller increments result in improved appearance.
- The form height should be as low as possible to minimize sheet distortion.



▲ Select special assemblies available for some multi tool applications. These are **forming down applications only!** Contact customer service regarding your application.

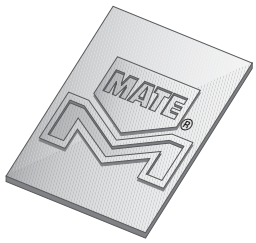
[Dimensions in Inches (mm)]

Emboss – Cold Forged ▲

Use:
To produce a logo or design on a part.

Typical Application:
- Material thickness from 0.018(0.46) to 0.118(3.00).
- Best results in material thickness from 0.040(1.00) to 0.078(2.00).
- Maximum size dependent on the tooling style, station size and press tonnage capacity.

Comments:
- An exact drawing, CAD file or artwork of logo is required to produce this type of assembly.

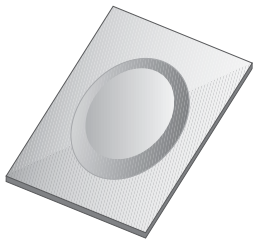


Emboss – Formed ▲

Use:
Provides a recess or a protrusion.

Typical Application:
- Material thickness from 0.027(0.70) to 0.250(6.35), dependent upon press tonnage capacity.

Comments:
- Best results are attained when the side wall angle is 45° or less.
- Optimum form height is 3 x the material thickness or less.

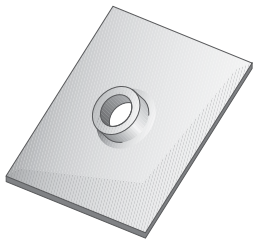


Extrusion – Tapping ▲

Use:
Threading for screws and increased bearing area for tubes, etc.

Typical Application:
- Material thickness from 0.031(0.80) to 0.106(2.70).
- Overall Height—2x to 2.5x material thickness.
- Diameter—0.374(9.50) (M-10).

Comments:
- Additional inverted dies are required to accommodate alternate material thickness.

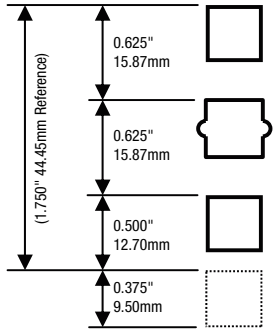


Mate 19" Racking Cluster

Use:
For high speed punching of the mounting hole pattern commonly found in electronic and telecommunications cabinets. The hole spacing conforms to DIN41494, IEC 297 and BS 5954.

Typical Application:
- Material thickness from 0.020(0.50) up to 0.157(4.00).

Comments:
- Special shape "U" pitch marker on the central punch point allows the end user to count pitches, not holes!
- Solid (non-insert) style cluster tools and insert style cluster assembly options available.



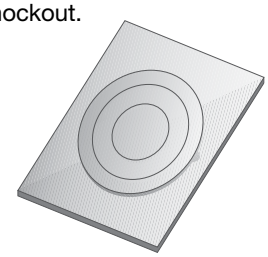
▲ Select special assemblies available for some multi tool applications. These are **forming down applications only!** Contact customer service regarding your application.

Knockout ▲

Use:
Allows optional pathway for electrical cable.

Typical Application:
- Material thickness from 0.024(0.60) to 0.118(3.00).
- Maximum size dependent upon material type, thickness and press tonnage capacity.

Comments:
- The tool can normally be used with other material thickness within a range of + or - 0.016(0.41) from design thickness.
- Maintain 0.236(6.00) difference between diameters used for knockout.

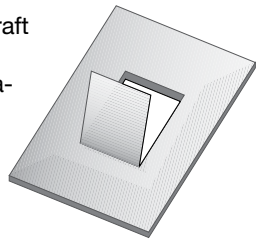


Lance And Form ▲

Use:
For air flow, decoration, as card guides, location markers, shear tabs, wire harness, or clip attachments.

Typical Application:
- Material thickness from 0.020(0.50) to 0.118 (3.00).
- Maximum recommended top-to-top height is 0.250(6.40).
- Other limitations include material type, station size and press tonnage capacity.

Comments:
- The inclusion of a 5° draft angle is recommended to assure reliable operation of open ground forms.

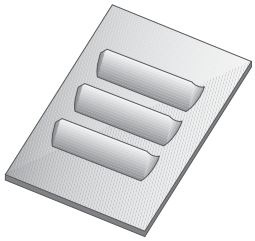


Louver

Use:
To provide air flow or ventilation.

Typical Application:
- Material thickness from 0.028(0.70) to 0.106(2.70)
- Maximum recommended top-to-top height is 0.255(6.50)

Comments:
- One tool cuts the sheet and produces the form in the same operation.
- The tool is designed for a specific material thickness.



Stamp—Alpha Numeric ▲

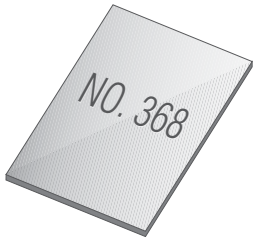
Use:
To provide indelible marking of alpha-numeric characters on the top or bottom of the sheet.

Typical Application:
- Material thickness 0.032(0.80) up to machine capacity.
- Characters available in 4 popular sizes. See table.

Comments:
- Individual characters can be easily changed.

Insert Sizes Available

Fractional	Decimal	Metric
3/32	0.094	2.40
1/8	0.125	3.12
3/16	0.188	4.50
1/4	0.250	6.34



▲ Select special assemblies available for some multi tool applications. These are **forming down applications only!** Contact customer service regarding your application.

See **MATE** Forming Tool Order Guide for forming tool ordering specifications...
Ask for part number **LIT00002**

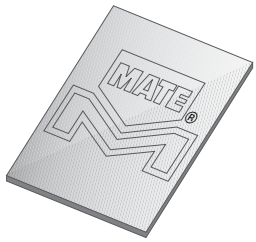
[Dimensions in Inches (mm)]

V-Line Inscription ▲

Use:
To produce logos, messages or symbols.

Typical Application:
- Material thickness from 0.032(0.80) up to machine capacity.
- Maximum size is dependent on station size and size of symbols and characters and press tonnage capacity.

Comments:
- V-Line Stamping -- renders the image with a sharp line stamped into the surface.
- An exact drawing, CAD file or artwork of logo is required in order to produce this type of assembly.



Threadform ▲

Use:
To provide a form to accept a sheet metal screw.

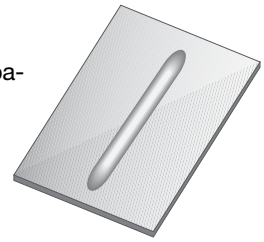
Typical Application:
- Material thickness 0.020(0.50) to 0.048(1.20).
- Size is dependent upon screw size selected.
- Thicker material requires a countersink operation or thinning prior to threadforming.

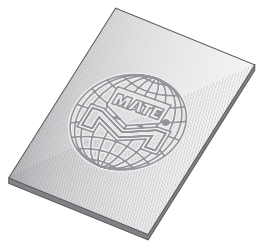
Rollerball™

Use:
The Rollerball™ is an exciting new concept designed
by Mate Precision Technologies to take advantage of the extended programming capabilities of hydraulic and other punch presses capable of operating in the
x and y axis with the ram down. The Rollerball® gives
you the benefit of making forms not possible with single hit forming tools.

Typical Application:
- Maximum workable material thickness is 0.105(2.70) mild steel.

Comments:
- The press must be capable of holding the ram down while the sheet is moved in the X and/or Y axis.





▲ Select special assemblies available for some multi tool applications. These are **forming down applications only!** Contact customer service regarding your application.

Mate SnapLock™

Use:
For joining materials, thus eliminating secondary operations such as spot welding, riveting or fastening with threaded hardware.

Typical Application:
- Material thickness from 0.020(0.50) up to 0.118(3.00).
- Other limitations include material type, station size, and press tonnage capacity.

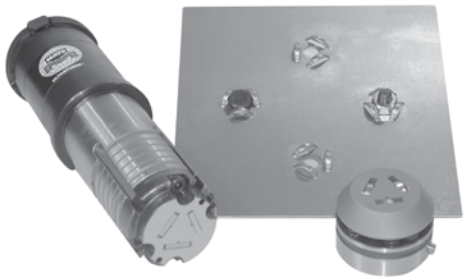
Comments:
- Suitable for joining materials of dissimilar type and/or thickness.
- Positive locking and locating feature for fast and accurate assembly.

Mate HexLock™

Use:
To provide a reliable and secure method of retaining common threaded fasteners in sheet metal.

Typical Application:
- Material thickness from 0.020(0.50) up to 0.118(3.00)
- Other limitations include material type, station size, and press tonnage capacity.

Comments:
- Suitable for hexagon nuts and hexagon headed bolts that conform to DIN933 or DIN934

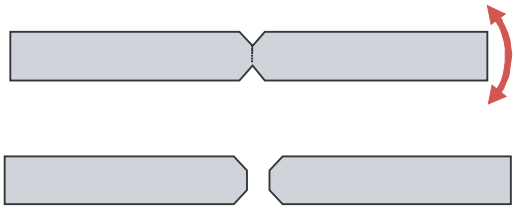


Mate EasySnap™

Use:
Scrapless retention system to allow fabricator to snap punched parts out of sheet metal.

Typical Application:
- Material thickness from 0.020(0.50) up to 0.078(2.00) for mild steel and aluminium, and 0.020(0.50) up to 0.059(1.50) for stainless steel.

Comments:
- Reduces the need for slitting and micro joints for part retention.
- Material type and thickness must be specified at time of order.



Mate EasyTap™

Use:
For producing threaded holes in previously punched and/or extruded holes on your punch press. Requires 1-1/4" B Station Auto-index.

Typical Application:
- **Material thickness from 0.020(0.50) up to 0.157(4.00)**
- **Thread sizes from M2.5 to M8, or #3 to 5/16"-18.**
- Tap shank standards including DIN 371, ANSI/ASME, ISO 529, and JSI.

Comments:
- Uses standard taps and Bilz Quick-Change collets for maximum convenience.
- Requires suitably equipped punch press.

See machine manual for more information

[Dimensions in Inches (mm)]

Concept: One adjustable length holder can be used with a variety of special forming inserts. The benefits include reduced tooling cost, increased flexibility, and the length of the assembly can be accurately pre-set.

Quick Length Adjustment:
The push-button length adjustment mechanism allows the overall length of the assembly to be set in 0.002(0.05) increments, without disassembly or removal from the machine.

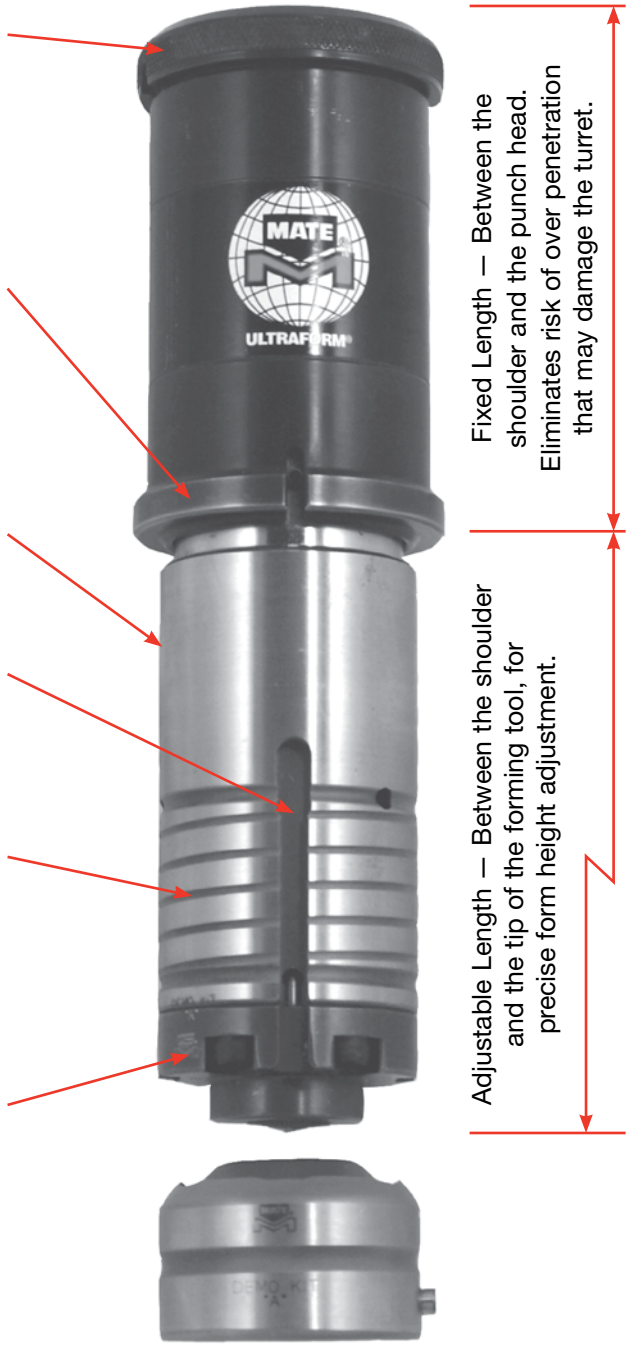
Adjustment Below the Shoulder:
The length adjustment is made below the shoulder of the assembly, thus maintaining the gap between the ram and the tool at top of stroke to prevent the ram from hitting the tool.

Hardened Guides:
The hardened guides, combined with the lubrication grooves, reduce friction and extend turret bore life.

Multiple Angle Settings:
All ULTRAFORM® holders can be set at 0, 90, 180 and 270 degrees as a standard, for maximum flexibility.

Tool Lubrication:
ULTRAFORM® holders provide internal channels and external grease grooves to allow lubrication of forming tools. ULTRAFORM® is compatible with all popular punch press machine tool lubrication systems.

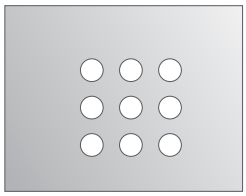
One Holder – Multiple Applications:
The ULTRAFORM® holder system is designed to allow an unlimited number of forming tools to be used with the same holder, which reduces tooling inventory costs.



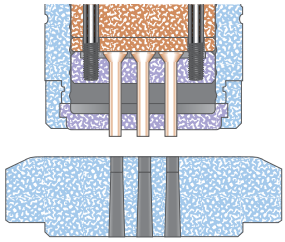
Available for:
- 1-1/4” B Station
- 2” C Station
- 3-1/2” D Station
- 4-1/2” E Station

[Dimensions in inches (mm)]

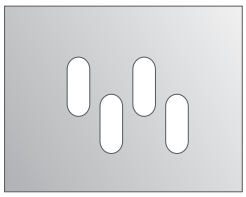
ULTRA® CLUSTER PUNCH (WITH REPLACEABLE INSERTS)



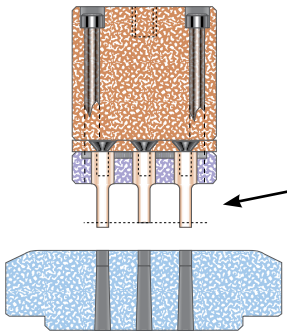
ROUND CLUSTER



ROUND CLUSTER



SHAPE CLUSTER



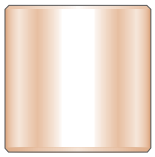
SHAPE CLUSTER

MATE cluster punches can increase the number of holes per hit by several times. Many different punch designs and cluster areas are available to provide a wide variety of punching choices. More holes per hit saves time and cuts cost. One-piece clusters with full station range capacity are also available.

Punching force should not exceed 75% press capacity.

Use staggered punches in a cluster. To help reduce tonnage, vibration, and noise, length adjustment of the punches should be uniformly staggered at approximately 75% of material thickness allowing the first set of punches to break through the material before the second set contacts the material.

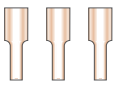
SHAPE CLUSTER ASSEMBLY



UPPER INSERT

PUNCH SCREWS

BACKING DISC



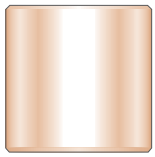
SHAPE INSERT PUNCHES

PUNCH RETAINER

ULTRA CLUSTER STRIPPER

CLUSTER DIE

ROUND CLUSTER ASSEMBLY



UPPER INSERT

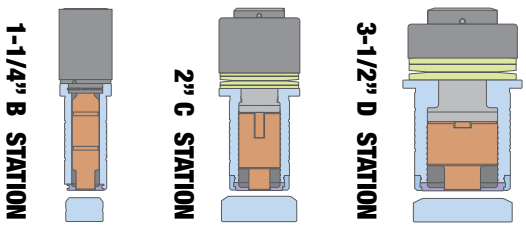
BACKING DISC

ROUND INSERT PUNCHES

PUNCH RETAINER

ULTRA CLUSTER STRIPPER

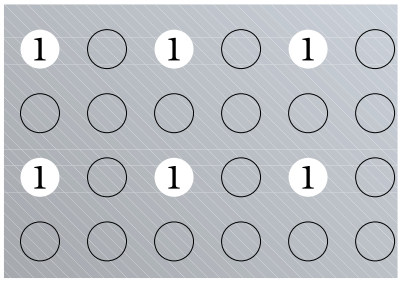
CLUSTER DIE



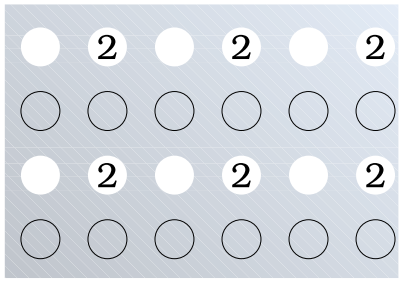
This ULTRA® assembly can be designed for these stations…

[Dimensions in Inches (mm)]

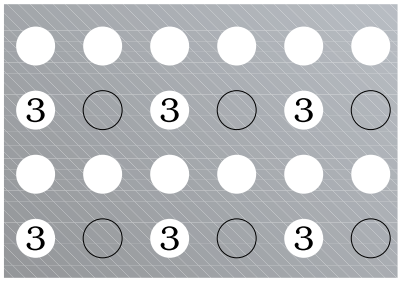
FIRST HIT ...



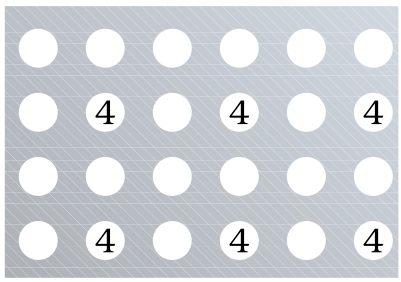
SECOND HIT ...



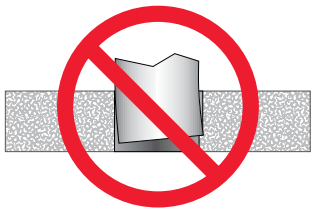
THIRD HIT ...



FOURTH HIT ...



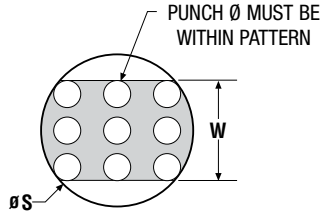
For greater hole uniformity and flatter sheets, spread the punches to avoid punching adjacent holes in the same hit. Repeat for the number of times necessary to finish the pattern.

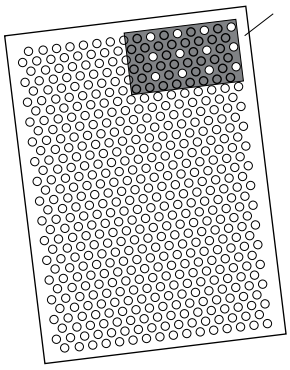


PUNCH CLUSTER PATTERNS

STATION	W DIMENSION	ø S
B	0.591(15.01)	1.181(30.00)
C	1.102(27.99)	1.969(50.01)
D	2.047(51.99)	3.425(87.00)

DO NOT DOUBLE-HIT HOLES. Because of tolerances built into the punch press, using the cluster punch to finish missed holes in patterns will cause punches to shave sides of previously punched holes. The great lateral thrust from this shaving shortens punch life. Use a single-hole punch to complete the pattern.





PUNCHING FORCE FORMULA = linear length of cut x material thickness x shear strength = punching force in kilonewtons(kN).

PUNCHING FORCE SHOULD NOT EXCEED 75% PRESS CAPACITY.

EXAMPLE: Grid of 0.250(6.35) diameter holes spaced on 0.157(3.99) centers. Area of punch covers 48 holes; punch every 4th hole (12 holes 4 times). Mild steel 0.060(1.52) thick. (Linear length of cut = 3.14 x diameter x number of punches)

hole perimeter inches(mm)		number punches in cluster		material thickness inches(mm)		shear strength tons/in²(kN/mm²)		punching force tons(kN)
0.785(19.94)	X	12	X	0.060(1.52)	X	25(0.345)	=	14.1(125.5)

Spring pressure of the spring-loaded cluster assembly runs under a ton (9 kN) and can be ignored in calculations for machine capacity

See machine manual for more information

EUROMAC

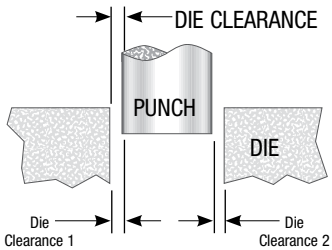
[Dimensions in inches (mm)]

DIE CLEARANCE AND HOLE QUALITY
MATERIAL THICKNESS AND TOTAL DIE CLEARANCE

Blanking Tools are used to punch out a small part down the slug chute.		**Piercing**	**Blanking**
Material Type (Typical Shear Strength)	Material Thickness (T)	Total Die Clearance (% of T)	Total Die Clearance (% of T)
Aluminum 25,000 psi (0.172 kN/mm²)	Less than 0.098(2.50)	15%	15%
	0.098(2.50) to 0.197(5.00)	20%	15%
	Greater than 0.197(5.00)	25%	20%
Mild Steel 50,000 psi (0.344 kN/mm²)	Less than 0.118(3.00)	20%	15%
	0.118(3.00) to 0.237(6.00)	25%	20%
	Greater than 0.237(6.00)	30%	20%
Stainless Steel 75,000 psi (0.517 kN/mm²)	Less than 0.059(1.50)	20%	15%
	0.059(1.50) to 0.110(2.80)	25%	20%
	0.110(2.80)to 0.157(4.00)	30%	20%
	Greater than 0.157(4.00)	35%	25%

WHAT IS DIE CLEARANCE?

Die clearance is equal to the space between punch and die when the punch enters the die opening.

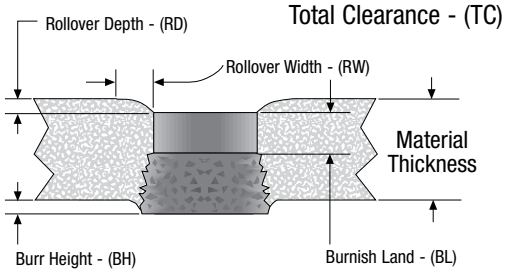


Total Die Clearance = Die Clearance on both sides of punch

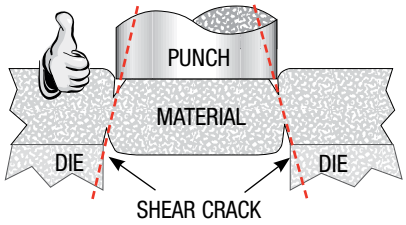
Total Die Clearance = Die Clearance 1 + Die Clearance 2

Regardless of sheet thickness, the recommended penetration of the punch into a SLUG FREE® die is 0.118(3.00).

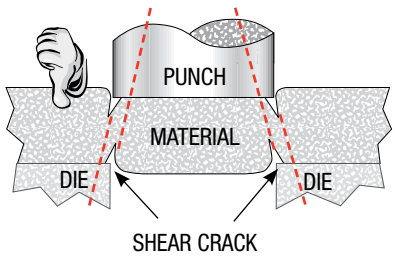
ANATOMY OF A PUNCHED HOLE



WHY USE PROPER DIE CLEARANCE?



PROPER CLEARANCE —
shear cracks join, balancing punching force, piece part quality, and tool life.



CLEARANCE TOO SMALL —
secondary shear cracks are created, raising punching force, and shortening tool life.

***MATE** always refers to **TOTAL DIE CLEARANCE** — **NOT** clearance per side.*

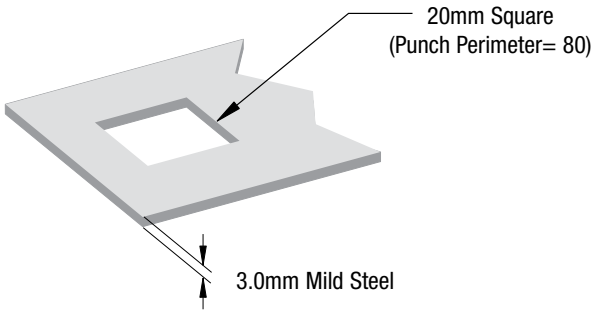
See machine manual for more information

[Dimensions in Inches (mm)]

Tonnage Formula:

Tonnage = Punch Perimeter x Material Thickness x Material Tonnage Value x Material Multipler

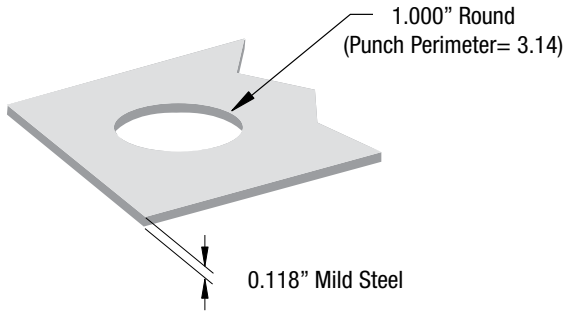
EXAMPLE OF TONNAGE CALCULATION



Metric Example:

Metric Tonnage for a 20mm square in 3.0mm Mild Steel

Tonnage = 80 x 3.0 x 0.0352 x 1.0 = 8.45 Metric Tons

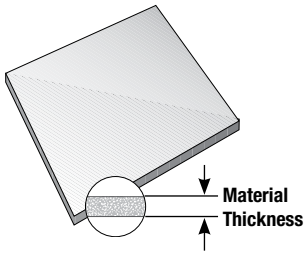


Inch Example:

Imperial Tonnage for a 1.000" round in 0.118" Mild Steel

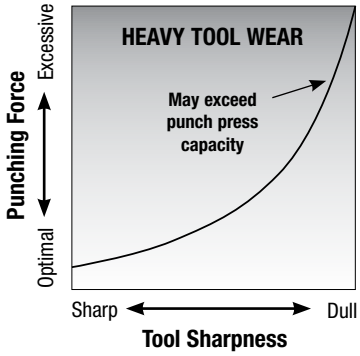
Tonnage = 3.14 x 0.118 x 25 x 1.0 = 9.27 Imperial Tons

MATERIAL THICKNESS



Material thickness is the width of the workpiece or sheet that the punch must penetrate in making a hole. Generally the thicker the material the more difficult it is to punch.

PUNCHING FORCE CHANGES AS TOOLS DULL



MATERIAL TONNAGE VALUE

Metric (Metric Tons/mm²)	Inch (Imperial Tons/in²)
0.0352	25

MATERIAL MULTIPLIER

MATERIAL TYPE	MATERIAL MULTIPLIER
Aluminum (soft sheet)	0.3
Aluminum (1/2 hard)	0.4
Aluminum (full hard)	0.5
Copper (rolled)	0.6
Brass (soft sheet)	0.6
Brass (1/2 hard)	0.7
Mild Steel	1.0
Stainless Steel	1.6

MATERIAL SHEAR STRENGTH —

Material shear strength is a measure of maximum internal stress before a given material begins to shear. This property is determined by metallurgical science and expressed as a numerical factor. Popular materials like aluminum, brass, mild steel and stainless steel have approximate shear strengths of:

MATERIAL :	SHEAR STRENGTH psi/in²(kN/mm²):
Aluminum	25000(0.1724)
Brass	35000(0.2413)
Mild Steel	50000(0.3447)
Stainless	80000(0.5516)

EUROMAC

[Dimensions in inches (mm)]

PUNCH AND DIE MAINTENANCE

You can greatly extend overall punch life by sharpening whenever the edge dulls to a 0.005(0.13) radius. At this point, just a small amount of sharpening will "touch up" the cutting edge. Frequent touch up works better than waiting for the punch to become very dull. The tool lasts longer and cuts cleaner with less punching force.

Maximum amount of sharpening depends on thickness of material being punched, size of punch (length and width), and punch press station.

1. To sharpen, clamp the punch squarely in a Vee Block on the magnetic chuck of a surface grinder. Only 0.001 to 0.002 (0.03 to 0.05) should be removed in one "pass". Repeat until tool is sharp, normally 0.005-0.010(0.13-0.25) total.
2. Use a standard vitrified bond, aluminum oxide wheel: hardness range "D" to "J"; grain size 46 to 60. A "ROSE" wheel made especially for grinding high speed steel is a good choice but not mandatory.
3. Dress the wheel using a rigid single or multi-point diamond: downfeed 0.0002-0.0008 (0.005-0.020); crossfeed quickly 20-30 in/min (508-762 mm/min).
4. Apply coolant with as much force and as close to the tool and wheel as is practical. Use a good general purpose grinding coolant used to the manufacturer's specifications.
5. Feeds and feed rates: A, Downfeed (wheelhead), 0.001 - 0.003 (0.03-0.08); B, Crossfeed (infeed), 0.005-0.010 (0.13-0.25); for nitrided punches, 0.002-0.007(0.05-0.18); C, Traverse (sideways), 100-150 in/min (2,540-3,810 mm/min).
6. After the sharpening, lightly stone the sharp cutting edges to remove any grinding burrs and to leave a 0.001-0.002 (0.03-0.05) radius. This reduces risk of chipping.
7. Demagnetize the punch and spray on a light oil to prevent corrosion.

DIE MAINTENANCE

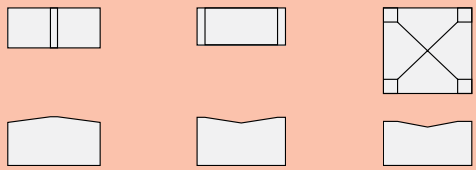
As with punches, keep dies clean and watch for wear.

Use the same sharpening procedures — hold die on surface grinder's magnetic chuck; use same wheel and feed rates. Check die thickness after each sharpening and add shims as necessary.

PUNCH SHEAR RECOMMENDATIONS

STATION	DESCRIPTION	STANDARD	ALTERNATIVE
1/2" A	Rounds and Shapes	None	None
1-1/4" B	Rounds and Shapes	None	None
2" C	Rounds	None	2-Way Concave
	Rectangles Width ≤ 0.188(4.78)	None	Rooftop
	Rectangles Width ≤ 0.188(4.78)	None	2-Way Concave
	Squares	None	4-Way
3-1/2" D	Rounds	None	2-Way Concave
	Rectangles Width ≤ 0.188(4.78)	None	Rooftop
	Rectangles Width ≤ 0.188(4.78)	None	2-Way Concave
	Squares	None	4-Way
4-1/2" E	Rounds	Rooftop	2-Way Concave
	Rectangles Width ≤ 0.188(4.78)	Rooftop	Rooftop
	Rectangles Width ≤ 0.188(4.78)	Rooftop	2-Way Concave
	Squares	Rooftop	4-Way

ALTERNATIVE SHEARS

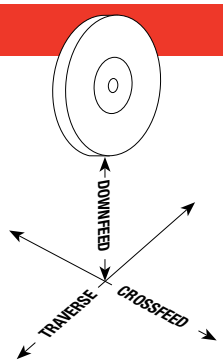


FEED RATES PER PASS

Downfeed:
0.001-0.003(0.03-0.08)

Crossfeed:
0.010(0.25)

Traverse:
100-150 in/min.
(2.50-3.80 m/min.)



WHEELHEAD

FIXING SHARPENING PROBLEMS

PROBLEM:	CAUSE:	CURE:
Discoloration** and/or surface cracks	Insufficient coolant	Increase or redirect flow.
	Improper wheel	Use coarser grain, softer grade grinding wheel.
	Improper dress	Drop wheelhead 0.0002-0.0004 (0.005-0.010) and redress. Move crossfeed approx. 50 in/min. (1.25 m/min.)
Harsh cutting sound and/or poor surface finish	Excessive stock removal	Less downfeed; lower crossfeed rate
	Improper wheel	Use coarser grain, softer grade grinding wheel.
	Improper dress or glazed wheel	Redress wheel, break glaze on wheel surface

**Dark discoloration indicates damage not necessarily limited to the tool surface. Removal of burned surface will not rectify damage. Recommend replacement of the tool.

A-2 and S-7 STEEL

Grinding Wheel Hardness: **G-J**
Grit: **46-60**

M-2 and M4PM™ STEEL

Grinding Wheel Hardness: **D-G**
Grit: **46-60**

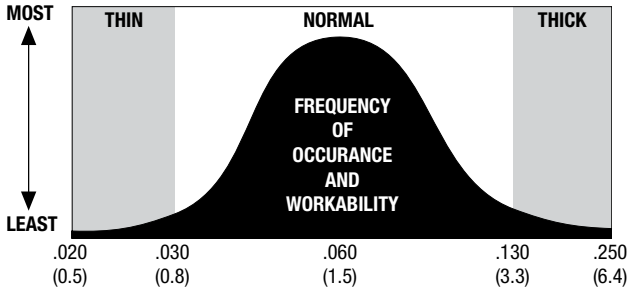
[Dimensions in Inches (mm)]

Punching Thick Materials -Greater Than 0.157(4.00):

- Use sharp punches and dies.
- Use die clearance between 25% and 30% of the material thickness.
- Add extra back taper to punches.
- Use a punch width to material thickness ratio of 1:1 minimum.
- Add 0.020(0.50) radius on all punch corners.
- Inspect tools frequently for wear.
- Lubricate the sheet, punch, and guide.
- Run the machine on slow cycle.
- Use Heavy Duty tool configuration.
- Use Maxima® coated, or Nitride treated punches.
- Use a special shear punch. (Shear punches are best for minimizing tonnage when blanking parts.)
  Benefits of using a shear punch:
  - Reduced tonnage
  - Noise reduction
  - Slug control
  - Reduce shock loads
  - Improved stripping

What Constitutes "Normal" Sheet Metal?

Thickness: 0.030-0.130(0.80-3.30)
Shear strength: 25,000-75,000 psi (0.172-0.157 kN/mm^2)
Normal sheet metal will provide the most trouble-free operation and longest tool life.
Material that is not in the normal range but still within the capacity of the punch press may require special tools, high lubrication, multiple hits and/or other procedures to produce a satisfactory job. Call Mate customer service for suggestions.



Punching Thin Materials - Less Than 0.020(0.50):

- Use sharp punches and dies.
- Use appropriate die clearance. See page 27.
- Use Slug Free Light™ dies. See page 10.
- Ensure proper tool alignment.
- Use special point tolerance for punch and stripper.
- Use proper die penetration.
- Use guides in good condition.
- Use fully guided punches.
- Demagnetize tooling after sharpening to help prevent slug pulling.
- Use Maxima® coated or Nitride treated punches.
- Avoid use of die adaptors.
- Use SLUG FREE® dies to reduce slug pulling.
- Use slug ejectors for thin materials.
- Not using station adapters if possible.
- Use shorter slitting tools (more details to the right).

Use Shorter Slitting Tools In A 3-1/2" D-Station:

The use of a smaller length slitting tool (Example: 5 x 50mm instead of a 5 x 80mm) in a D-Station helps prevent loss of die clearance. A longer slitting tool can exaggerate the following effects:

- Tooling that is not 100% aligned.
  Example: A 5 x 80mm punch produces a 37% larger saw tooth step than a 5 x 50mm punch when tools are not 100% aligned.
- Turret bore wear.
- Old or worn guides fitting loosely in the turret, which can lead to accuracy and tolerance issues.

MATERIAL THICKNESS RECOMMENDATION

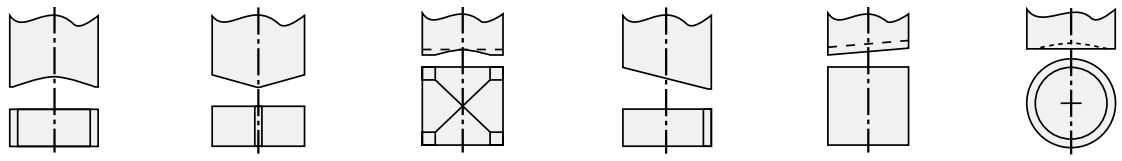
Material Thickness Recommendation

Station	Style	Recommended Maximum			Extreme Maximum			Shear
		Aluminum	Mild Steel	Stainless Steel	Aluminum	Mild Steel	Stainless Steel	
A	ULTRA TEC®	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.157 (3.99)	0.157 (3.99)	0.157 (3.99)	Flat
	Ultra Heavy Duty	0.250 (6.35)	0.180 (4.57)	0.157 (3.99)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	Flat
	Thick Turret Style	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.157 (3.99)	0.157 (3.99)	0.157 (3.99)	Flat
B	ULTRA TEC®	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	Flat
	Ultra Heavy Duty	0.250 (6.35)	0.250 (6.35)	0.180 (4.57)	0.315 (8.00)	0.315 (8.00)	0.250 (6.35)	Rooftop
	Thick Turret Style	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	Flat
C	ULTRA TEC®	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.374 (9.50)	0.374 (9.50)	0.250 (6.35)	Flat
	Ultra Heavy Duty	0.315 (8.00)	0.250 (6.35)	0.180 (4.57)	0.413 (10.49)	0.413 (10.49)	0.250 (6.35)	Rooftop
	Thick Turret Style	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.374 (9.50)	0.374 (9.50)	0.250 (6.35)	Flat
D	ULTRA TEC®	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.374 (9.50)	0.374 (9.50)	0.250 (6.35)	Flat
	Ultra Heavy Duty	0.315 (8.00)	0.250 (6.35)	0.180 (4.57)	0.413 (10.49)	0.413 (10.49)	0.250 (6.35)	Rooftop
	Thick Turret Style	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.374 (9.50)	0.374 (9.50)	0.250 (6.35)	Flat
1	Trumpf Style	0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	Cup or Flat
2		0.157 (3.99)	0.157 (3.99)	0.114 (2.90)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	Whisper
8mm	MT™	0.157 (3.99)	0.118 (3.00)	0.078 (1.98)	0.250 (6.35)	0.189 (4.80)	0.090 (2.29)	Flat
24mm		0.197 (5.00)	0.197 (5.00)	0.098 (2.49)	0.250 (6.35)	0.250 (6.35)	0.118 (3.00)	Flat
12.7mm	XMT™	0.197 (5.00)	0.197 (5.00)	0.098 (2.49)	0.250 (6.35)	0.250 (6.35)	0.118 (3.00)	Flat or Rooftop
24mm		0.197 (5.00)	0.197 (5.00)	0.098 (2.49)	0.250 (6.35)	0.250 (6.35)	0.118 (3.00)	Flat or Rooftop

Notes:

- All recommendations assume tooling is properly sharpened and maintained.
- Consideration must be given to the application, the machine tonnage capability and the tooling before exceeding the recommended maximum material thickness.
- The maximum material recommendations should be adjusted downward when the punch diameter or width dimension (width or diameter) is equal to or less than the material thickness.
- Use Heavy Duty tooling when punching 0.118 (3.00) material or thicker.
- Use Heavy Duty tooling or tooling with shear to reduce noise.
- The recommended penetration of the punch into a SLUG FREE® die is 0.118 (3.00).
- For materials thicker than 0.315 (8.00), die penetration and stripper lead may be reduced.

SHEAR OPTIONS



Note: Not all shears are available in all styles of tooling.

[Dimensions in Inches (mm)]

Maxima™ Coating

Maxima is a premium tool steel coating that has been specially formulated for turret punch press tooling applications. Maxima is a multilayer Zirconium Titanium Nitride (ZrTiN) coating that is hard, wear resistant, and lubricious. It acts as a barrier between the punch and the sheet metal being punched and, because of its exceptional lubricity, greatly improves stripping.

Maxima is applied to the precision ground surface of Mate's premium tool steel punches. Since Maxima is an extremely hard, wear resistant, slippery material which reduces the friction that occurs during the stripping portion of the punching cycle, it is particularly good for abrasive tooling applications. Less friction means less heat build up, less galling and longer tool life.

Maxima coating is recommended for applications such as 3000 and 5000 series aluminum, galvanized and stainless steel, or any application where lubrication cannot be used such as vinyl coated or pre-painted materials. Maxima's added lubricity is also beneficial when punching sharp cornered shapes with a 90 degree or smaller angle.

Results! In real life tests around the world, Maxima has increased tool life by a factor of 2 to 10 times, and the tools are still in production.

Nitride Treatment

Nitride is an optional heat treatment feature for high speed steel (HSS) punches. It is a surface treatment, which becomes an integral component of the structure of the material itself, therefore extending tool life!

Punches with Nitride Treatment are recommended for punching abrasive materials such as fiberglass or materials that cause galling such as stainless steel, galvanized steel, and aluminum. It is also recommended for high speed punching (see below for nibbling limitations). It is not recommended for punches smaller than 0.158(4.01) in diameter or width, for material thicker than 0.250(6.35), or where significant punch deflection may occur.

Application Recommendations

Shape	Minimum tool widths suitable for Maxima™ coating	Minimum tool widths suitable for Nitride treatment	Minimum tool widths suitable for Nitride when nibbling
Round	Minimum diameter is 0.098(2.50)	Minimum diameter = 0.158(4.01)	0.500 (12.70)
Rectangle	If length is >0.250(6.35) the minimum width is 0.060(1.50) If length is <0.250(6.35) the minimum width is 0.098(2.50)	Minimum width = 0.158(4.01)	0.500 (12.70)
Oval	If length is >0.250(6.35) the minimum width is 0.060(1.50) If length is <0.250(6.35) the minimum width is 0.098(2.50)	Minimum width = 0.158(4.01)	0.500 (12.70)
Square	Minimum width is 0.098(2.50)	Minimum width = 0.158(4.01)	0.500 (12.70)
Others	Consult a Mate application specialist		

Forming Tool Recommendations:

- Always form as far from the clamps as possible.
- Forming should be made as the last operation.
- Form tools with stripping springs require time to strip. Use the Post Dwell feature.
- Forming should be done at slower machine speeds to allow time for material flow.
- Lubricate the sheet and use the machine's tool lubrication system.
- Ball roller dies should be used on either side of the forming stations.
- Machine stroke lengths vary between machine. The length may need to be adjusted when switching between machines.
- Set up using the tool's minimum length and adjust in 0.006(0.15) increments to achieve a sharp form where the tool is properly bottomed.

Punching Non-Metallic Material:

- Use sharp punches and dies.
- Reduce die clearance to between 5% and 8% of the material thickness.
- Run the machine on a slow cycle.
- Lubricate hard plastic if possible.
- Use Maxima™ or Nitride treated punches.
- Use urethane pads if marking occurs.
- Support thin materials where possible.

Overcoming Stripping Problems:

- Use additional back taper on punches.
- Increase die clearance.
- Check stripping springs for fatigue.
- Use heavy duty configurations.
- Remove galling.
- Lubricate sheets.
- Use sharp punches and dies.
- Use larger station for extreme stripping applications.

Reduce Galling (Adhesive Wear And Cold Welding):

- Use sharp punches and dies.
- Lubricate work piece.
- Use Maxima™ coated, or Nitride treated punch. See page 32.
- Increase die clearance.
- Adjust machine hit rate (slower).
- Use tool lubrication system if available.

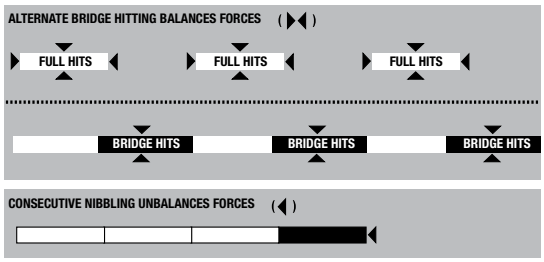
Maximizing Tool Life:

- Sharpen frequently.
- Use proper die clearance.
- Use proper sheet configuration.
- Lubricate punch, guide, and sheet.
- Check turret alignment regularly.
- Inspect tool holders for wear.
- Use Maxima™ coated, or Nitride treated punches for special applications.
- Use radii on all sharp corners.
- Demagnetize all tooling after regrinding.

Small Diameter Or Narrow Holes:

When punching small diameter or narrow holes, maintain the following ratio of punch size (minimum) to material thickness.

Material	Punch to Material Ratio	
	Non-Guided	Fully Guided
Aluminum	0.75 to 1.0	0.50 to 1.0
Mild Steel	1.0 to 1.0	0.75 to 1.0
Stainless Steel	2.0 to 1.0	1.0 to 1.0



Bridge Hitting Reduces Tool Wear:

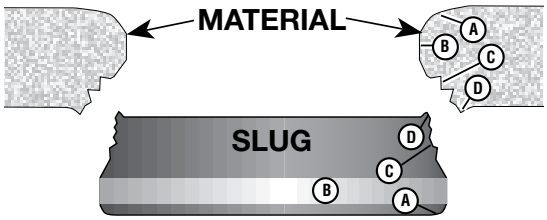
By alternating hits when performing shearing/slitting operations, forces upon the tool remain balanced from side to side and end to end. As a result, the punch operates square to the material and die. Over time you will notice a difference in the reduced frequency of sharpening and generally longer tool service. This practice is called "bridge" hitting because the full hits leave a "bridge" of material between them that is removed by the bridge hits.

[Dimensions in Inches (mm)]

If Punches Overheat:

- Use a lubricant. This will decrease friction. If lubricant is unacceptable or if slug pulling occurs:
- Use more than one punch of the same size in the sequence. By rotating the punches, there will be a longer time for each punch to cool down before it is used again.
- Simply give the tool a rest. Plan the program so that the tool that is overheating alternates with different punches.
- Stop the press for awhile.

What Do Your Slugs Tell You?

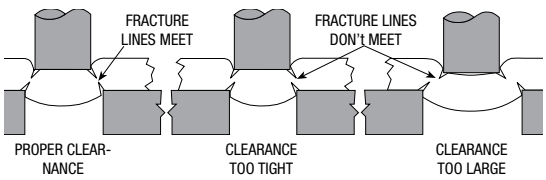


The slug is essentially a mirror image of the hole, with the same parts in reverse order. By examining your slugs you can tell if punch-to-die clearance is correct. If clearance is too large, the slug will show a rough, undulating fracture plane and a small burnish zone.

The larger the clearance, the greater the angle between the fracture plane and the burnish zone. If clearance is too small, the slug will show a fracture plane with little angle, and a large burnish zone.

Excess clearance makes a hole with large rollover and fracture so that the profile is somewhat pointed with a thin edge. Inadequate clearance makes a hole with small roll-over and steep fracture so that the profile is more or less perpendicular to the surface of the material.

An ideal slug is created when the fracture planes coming from the top and bottom of the material have the same angle and form in alignment with each other. This keeps punching force to a minimum and forms a clean hole with little burr. At this point, any extension in tool life gained by increasing clearance, comes at the sacrifice of hole quality.



Care And Maintenance Of Punch Guides:

Observe the following general guidelines to ensure long service life of your punch holders and punching machine.

Punch Guide Storage:

- Clean the inside and outside of the punch guides with a clean soft cloth.
- Prevent scratches and dents on the punch guide when in storage
- Apply light coating of lubricating oil to prevent build-up of rust. (Use DTE-26 or SAE30W or similar).

Preparation For Use:

- Clean the punch guide before use.
- Check all visible surfaces for scratches, burrs, and dents. Use fine oil stone to remove any scratches or burrs.
- Apply light coating of lubricating oil to internal and external surfaces. (Use DTE-26 or SAE30W or similar).

Installing The Punch Into The Guide:

- Check all visible surfaces of the punch for scratches, burrs, and dents. Use fine oil stone to remove any scratches or burrs.
- Insert the punch by hand until it reaches the bottom of punch holder. Avoid using any extreme force to install the punch.
- Tighten the punch using a torque wrench and the appropriate hex wrench bit.

Installing The Guide Into The Machine:

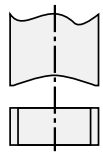
- Inspect the inside surfaces of the machine bore for signs of damage. Resolve as appropriate.
- Clean the inside surfaces of the machine bore with a soft cloth.
- Apply light coating of lubricating oil to internal and external surfaces. (Use DTE-26 or SAE30W or similar).
- Hold the punch guide assembly above the bore, and align the keyway on the punch holder and the key in the bore.
- Lower the guide into the bore, while ensuring that the holder is not tipped in any direction.

NOTE: Mate does not recommend using shear to bring punching force within press capacity because dulling tool edges quickly raises punching force, and press capacity may be exceeded.

Punches With Shear:

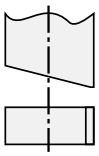
Punch "shear" is the geometry of the punch face. The standard shear for 1/2" A through 3-1/2" D station ULTRA TEC® punches is flat – without shear. Other shear types are available upon request. Shear helps reduce tonnage because the punch is not hitting with the full face on the material. Benefits include:

- Tonnage reduction
- Noise reduction
- Slug control
- Reduced shock loads
- Improved stripping



Concave

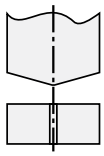
Concave shear is a good alternative shear for nibbling, although Mate recommends without shear for nibbling applications.



One-Way

Rooftop shear is the best shear for minimizing tonnage in thicker materials.

One-way shear is best for minimizing tonnage when blanking.



Rooftop

The amount of tonnage required to punch a hole is reduced when shear is included on the punch. The amount that the tonnage is reduced is dependant on the material thickness.

Step 1.
Calculate the tonnage required to punch the hole assuming the punch has no shear on it.
See page 18.

Step 2:
Multiply the tonnage calculated for a punch without shear, by the value that corresponds with the material thickness shown in the table.

Material Thickness	Shear Factor for punches with shear*
0.050(1.27)	50%
0.060(1.52)	50%
0.075(1.91)	58%
0.105(2.67)	72%
0.120(3.05)	75%
0.134(3.40)	78%
0.165(4.19)	83%
0.190(4.83)	86%
0.250(6.35)	90%

*depth of shear 0.060(1.50)

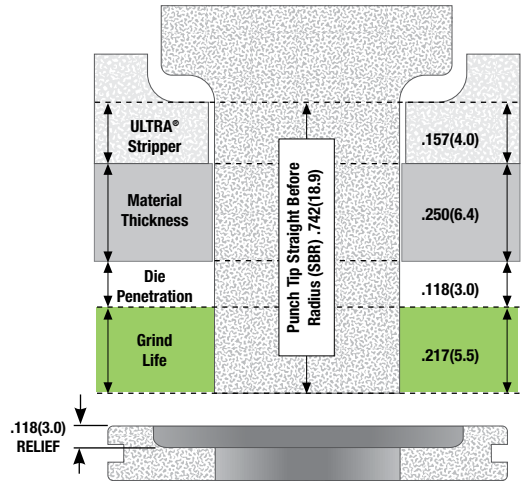
Example: 20mm square hole in 3.00mm mild steel

- Without shear = 8.45 metric tons (see page 18)
- With shear = 8.45 x 75% = 6.36 metric tons.

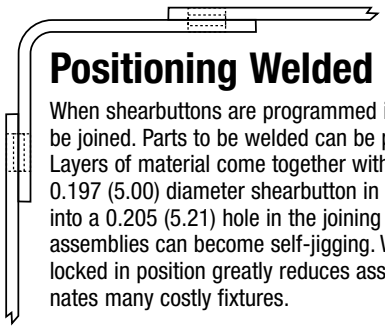
Calculating Grind Life:

The available grind life of a punch increases as the material thickness decreases. The calculation is:

Grind life = Punch Tip Straight Before Radius (SBR) - Stripper Thickness - Material Thickness (t) - Die Penetration.

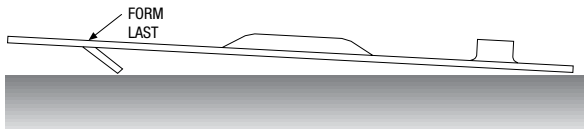


Example: SBR 0.742(18.85) - Ultra stripper thickness 0.157(3.99) - material thickness 0.079(2.00) - die penetration 0.118(3.00) = grind life 0.388(9.86)



Positioning Welded Parts:

When shearbuttons are programmed into surfaces to be joined. Parts to be welded can be positioned precisely. Layers of material come together with NC accuracy. A 0.197 (5.00) diameter shearbutton in one part fits snugly into a 0.205 (5.21) hole in the joining part. Complex assemblies can become self-jigging. Welding with parts locked in position greatly reduces assembly time and eliminates many costly fixtures.

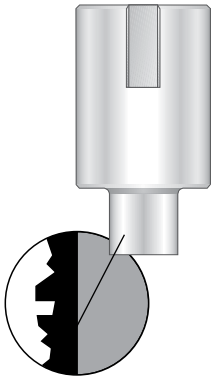


Form-Down Last:

When using forming tools, form-down operations are generally avoided because they take up so much vertical room and any additional operations tend to flatten them out or bend the sheet. Forms can also drop into dies, get caught and pull out of work holders. However, if a form-down operation is the only solution for a particular piece part, make it the last operation on the sheet.

[Dimensions in Inches (mm)]

When Galling Occurs On Punch Tips:

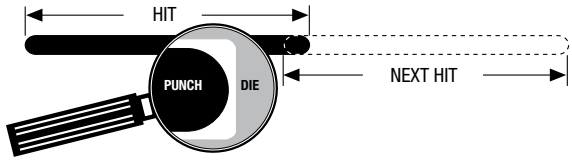


(Galling is an adhesion to the punch tip of metal being punched, caused by pressure and heat) The best technique for removing galling is to rub it off with a fine stone. The rubbing should be done parallel to the direction of the punching motion. This will polish the surface which contacts the material, decreasing the chance of any future galling. Do not sandblast, belt sand or use other harsh abrasive methods. These create a coarse surface finish to which material adheres more easily to the tool.

Noise Reduction:

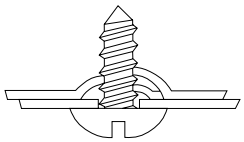
Use heavy duty tooling when punching 0.118 (3.00) material or thicker to help reduce noise. Heavy Duty tooling is manufactured with punch shear (rooftop, whisper, one-way) which creates less noise when punching. For best hole quality, a flat punch, (a punch without shear), is recommended. See page 20 for shear examples.

A Smooth Slitting Tip:



To get rid of the small "teeth" left on edges by rectangular tools, it is a common practice to order oval punches with rectangular dies having radiused corners for slitting and parting. The radii blend into the next cut more smoothly even on older machines with play in the toolholder bores and workholders. Workpieces are less likely to cause cuts and scratches when being handled, and need less finishing work later.

Eliminate Cost For Bolts And Lockwashers:



If thread forms can be programmed into a part, then the cost for bolts and lockwashers can be eliminated. This domed shape with a screw thread acts like a locknut as a screw tightens it down. Mate's special threadform tools make both the screw hole and the raised dome in one hit.

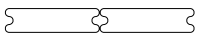
When Punches Get Dull Too Fast:

Clearance may be too tight, when punches get dull too fast. It should be 20-25% of material thickness TOTAL clearance (not per side). In partial hitting (notching, nibbling, shearing), lateral forces may deflect the punch tip and tighten clearance on one side. Sometimes the punch tip may move far enough to shave the side of the die. This results in rapid deterioration of both punch and die.

When To Sharpen Tools:

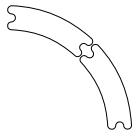
If a piece-part is starting to show too much roll over, if the punch press is making more noise than you think it should, or if it's working harder than it used to – perhaps a tool is dull. It is recommended that tools be resharpened when the edges are worn to 0.005 (0.13) radius. You get improved consistency in quality of work. Machines last longer and so do tools if resharpened in small amounts more frequently rather than waiting until they are "really" dull.

Shake-and-Break:

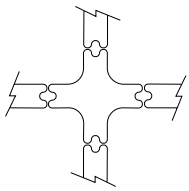


Shake-and-break is a popular name for this easy method of separating multiple parts from a sheet of material. The method is based on small, interconnecting tabs between the parts created by programming spacing of the shearing or slitting punch. These tabs keep the sheet and parts intact while being punched, yet easy to separate off the machine. Any parts that don't fall loose by shaking the sheet are quickly twisted out by hand. The tabs should be 0.008(0.2) wide. A number of punch shapes are available, depending upon the shape of the part. Although straight X and Y axis parting can be performed in any station, curved shapes are only practical in the auto index stations.

CURVED

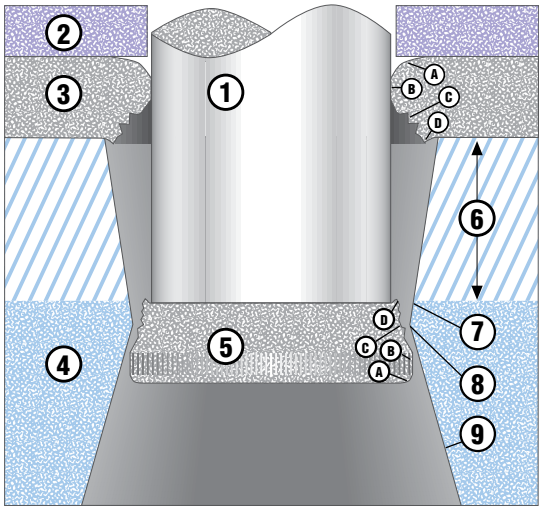


CORNERS



SLUG FREE® Die:

The recommended penetration of the punch into a SLUG FREE die is 0.118 (3.00). For material thicker than 0.315 (8.00) die penetration may be reduced. This SLUG FREE design is standard on ULTRA TEC®, Thick Turret, and MT™ dies manufactured by Mate. SLUG FREE design is an option on Trumpf style dies made by Mate.



SLUG FREE®Die Components

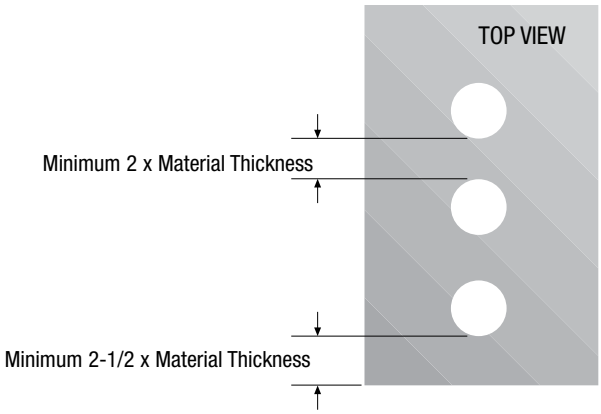
1. Punch
2. Stripper
3. Material
4. SLUG FREE® Die
5. Slug
6. Grind Life
7. Entry – Constricting Taper
8. Pressure Point
9. Exit – Relief Taper

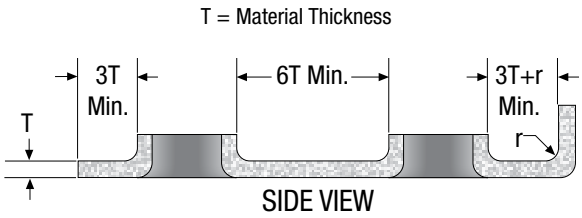
Hole/Slug Geometry

A. Rollover
B. Burnish
C. Fracture
D. Burr

Recommended Minimum Distances Between Holes (Forms And Edges Of Sheets):

Holes and forms placed closer to each other or to the edge of the sheet than shown below will cause distortion to the material and to the neighboring forms.





"Clearance Corners" In Dies Control Corner Burrs:

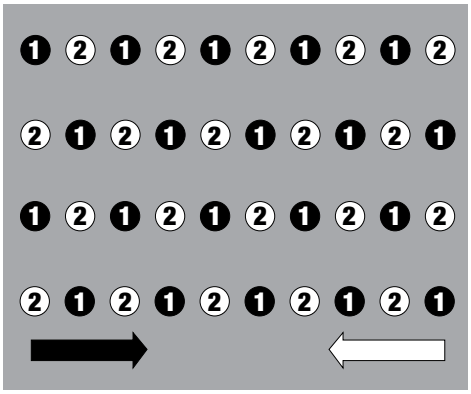
Why put a radius in the corners of rectangular and square dies with clearance greater than 0.020(0.5)? Because it keeps clearance uniform around the corner of the punch. If the die is sharp cornered too, then distance between punch and die corners would be greater than side clearance, resulting in larger burrs. To get clearance corners always order "punch size plus clearance" [Ex. 1.000 + 0.037(25.4+0.9)].

[Dimensions in Inches (mm)]

Combatting Material Warp:

If you're punching a large number of holes in a sheet and the sheet does not stay flat, it could be caused by the cumulative effect of punching. Each time a hole is punched, material surrounding the hole is stretched downward, placing the top of the sheet in tension. The downward movement causes a corresponding compression at the bottom of the sheet. For a few holes, the effect is insignificant, but as the number of holes increases, the tension and compression can multiply to the point where the sheet deforms.

One way to counteract this effect is to punch every other hole first and then come back and punch the remaining holes. This places the same amount of force on the sheet, but it disrupts tension/compression accumulation that occurs when punching operations follow one another in close succession and in the same direction. It also allows the first set of holes to absorb some of the distorting effect of the second set.



The Secret To Finest Quality Custom Stamped Inscriptions:

If you want your company logo or other symbol to look the best it possibly can, there is no substitute for good artwork. That means a well executed drawing rendered with crisp, clean lines. It should be at least two times as large as the final stamped image. Ship it by mail with protection against bending or other damage — artwork sent by fax is not recommended.

Considerations In Grinding:

A grinding wheel's abrasive particles, in effect, are break-away "teeth". These teeth can be made from a variety of very hard, abrasion resistant materials, such as diamond, borozon and, most commonly, aluminum oxide.

The abrasive particles are embedded in a softer matrix material and meant to fracture loose from the matrix as cutting pressure becomes greater. Cutting pressure can increase from raising the feed rate or from dulling of abrasive particles. Pressure causes surface particles to fracture or break free from the wheel matrix and expose new sharp edges, resulting in the wheel's sharpness.

For our purposes, in selecting a vitrified bond aluminum oxide wheel, we need only be concerned with two variables: hardness and coarseness of the wheel. Hardness refers to the bond strength of the matrix. Coarseness refers to the size and concentration of the abrasive particles (grit).

Generally speaking, harder materials require softer wheels — softer materials require harder wheels. Grinding a harder and/or more abrasive resistant material, such as hardened tool steel, dulls abrasive particles quickly. The wheel then needs increased feed forces. A softer wheel allows spent particles to break loose from the matrix more easily. The newly exposed sharp edges will cut rather than rub and tear at the workpiece. Less pressure is required and the wheel runs cooler.

Coarse wheels with large, widely spaced abrasive particles perform less cutting per revolution and allow greater "chip" clearance. The wheel stays cleaner. Friction is reduced.

Balancing hardness and coarseness results in a wheel that stays sharp and clean to optimize cutting action. It meets the grinding objective of removing material from the workpiece while expending a minimal amount of wheel energy. Wheel energy losses largely translate to workpiece heating. Workpiece heating, in turn, will result in softened and/or highly stressed tools which will not perform well. Hardened tool steels are particularly vulnerable.

It is generally desirable to use a softer "G" or "H" hardness wheel with a grit concentration/size of about forty-six.

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