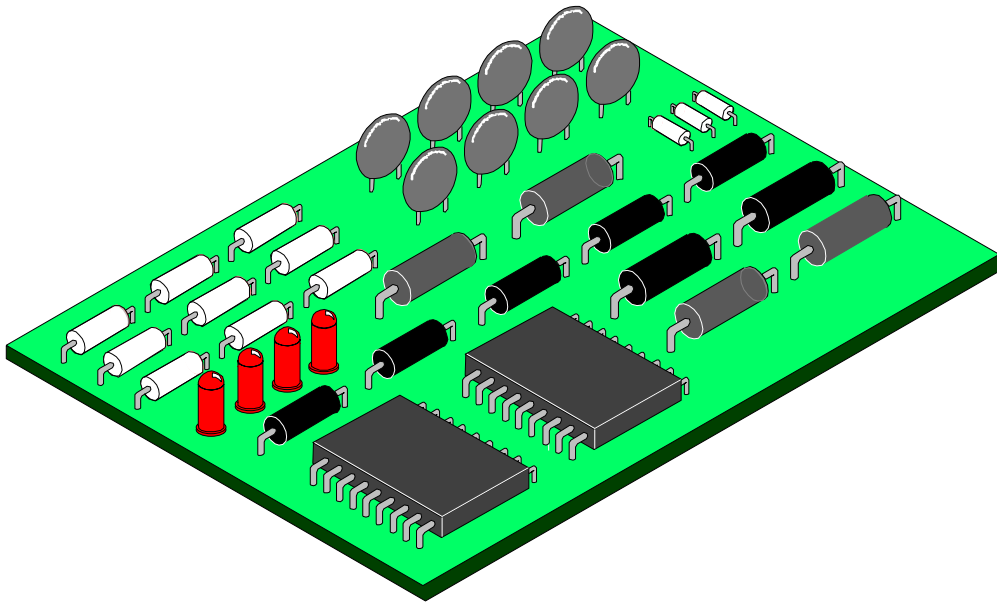


Through Hole Design Guidelines



*Insertion
Machine Division*

Through Hole Design Guidelines



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- Board Design Considerations for Automatic Insertion
- Workboard Holder Considerations
- Axial Component Insertion
- Radial Component Insertion
- Dual In-Line Package Insertion

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C o n t e n t s

All specifications are subject to periodic review and may be changed without notice.

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Automation Benefits

The purpose of this document is to improve printed circuit board design and layout by detailing the basic considerations associated with the electronic assembly process. Universal's experience has shown that applying these design principles produces efficient, reliable board designs.

Automatic component insertion provides the consistency required to ensure the highest levels of circuit board quality, throughput, and process control. When properly planned and implemented, automatic component insertion provides significant cost savings in the printed circuit board assembly process.

The benefits realized from automating circuit board assembly processes span all areas of manufacturing. Ultimately, all of these benefits result in improved products and reduced production costs.

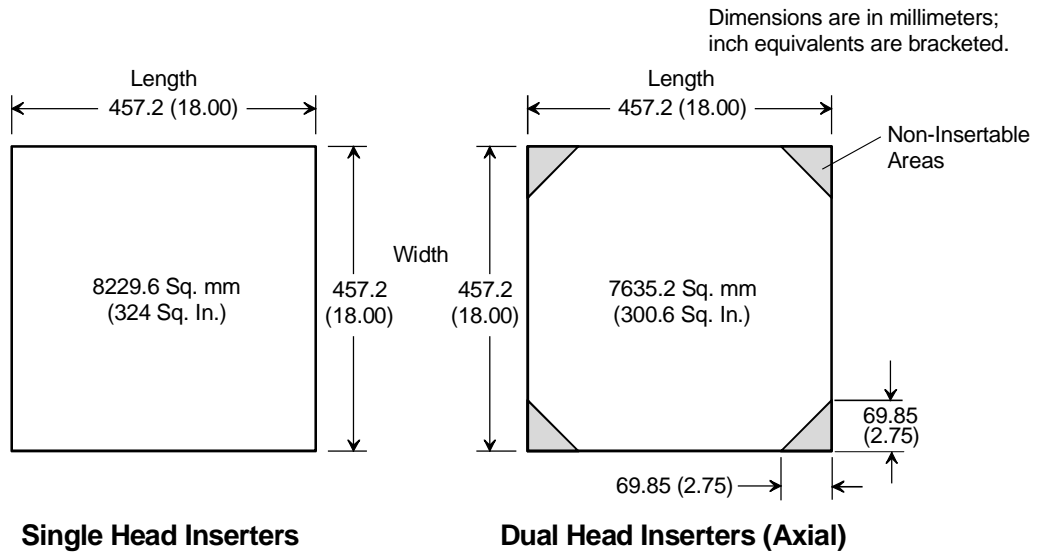
Three key inputs affect the economics and logistics of PC board assembly: (1) the circuit boards, (2) the equipment used to assemble the boards, and (3) the components to be inserted. By precisely understanding and standardizing these three primary elements, manufacturers can improve the quality of the finished boards, increase the throughput of the assembly equipment and the system, and more precisely define the process control standards to provide a basis for future applications. Standardizing these elements reduces process variability, which leads to increased insertion reliability, improved product quality, enhanced system price/performance and, ultimately, reduced production costs.

Board Considerations

Universal’s automated assembly equipment provides reliable automatic component insertion utilizing standard printed circuit board materials. These materials include, but are not limited to, glass epoxy, paper epoxy, and paper phenolic. As long as the select materials meet the size, shape, form, and positional accuracy described in this document, reliable component insertion will be achieved.

Size

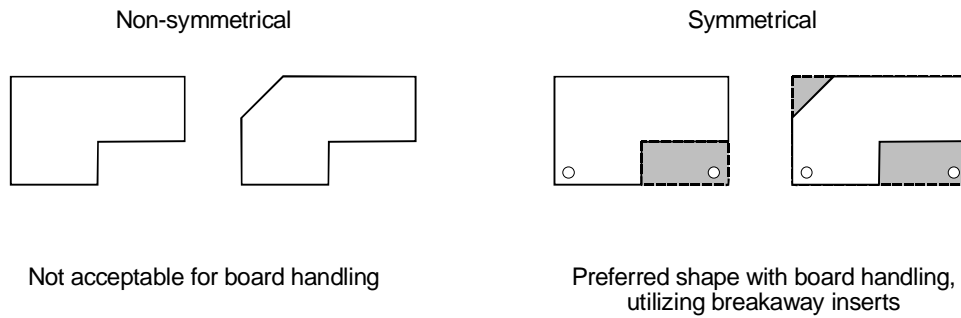
Maximum board size is generally related to the insertable area of the insertion machine.



| INSERTABLE AREA | | |
|--|--|---|
| | Board Size Without Board Handling | |
| Single Head Inserters (Radial, DIP and Axial) | 457.2mm L x 457.2mm W (18" x 18") | |
| Dual Head Inserters (Axial) | 457.2mm L x 457.2mm W (18" x 18"), less corners | |
| | Board Size With Board Handling | |
| Single Head | Min. 100mm L x 80mm W (4.0" x 3.1") | Max. 483mm L x 406mm W (19.0" x 16.0") |
| Dual Head | Min. 100mm L x 80mm W (4.0" x 3.1") | Max. 457mm L x 330mm W (18.0" x 13.0") |

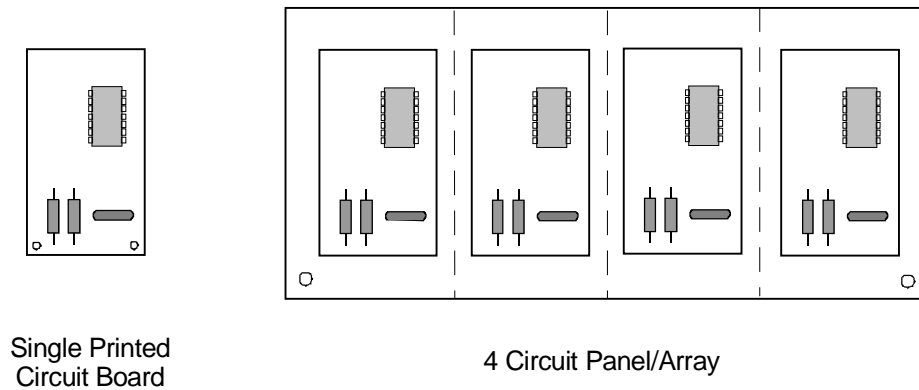
Shape

For machines operating in a stand-alone configuration, board shape (rectangle and square, for example) is not a major concern as these boards are typically placed on a dedicated workboard holder. Machines using automatic board handling require special consideration to size, shape, warpage, and cutouts.



Panelization

Throughput may be increased by positioning small boards into multiple breakaway panels/arrays. Standardization of panel size will reduce setup time during job changeover.



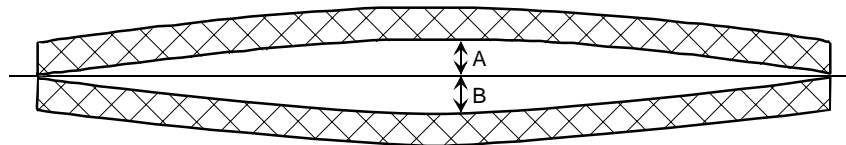
Thickness

Universal's insertion machines and board handling equipment can process boards with thicknesses of:

| Board Thickness | |
|--------------------|--------------------------------------|
| Radial, Axial, DIP | 0.8mm - 2.36mm (0.032" - 0.093") |
| BHS Board Handling | 0.8mm - 2.36mm (0.032" - 0.093") |
| SBT Board Handling | 1.52mm - 2.36mm (0.060" - 0.093") |

Warpage

Warpage should be minimized. Board warpage may cause board transfer errors and reduce insertion performance.



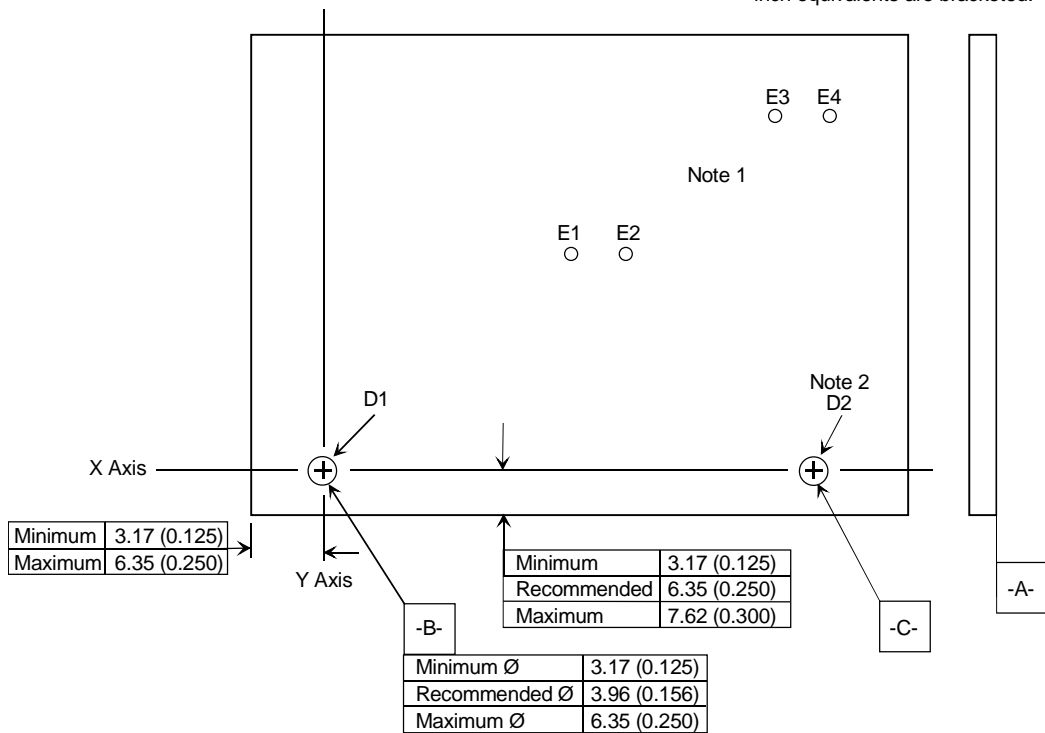
| Max. | A | B |
|------------|-----------------|-----------------|
| Axial, DIP | 3.17mm (0.125") | 3.17mm (0.125") |
| Radial | 1.60mm (0.063") | 3.17mm (0.125") |

Location References

Of prime importance in board design and construction is the establishment of accurate datum points. Datum holes provide the locating references to which all holes are drilled or punched. These references are also used to accurately position the board on the workboard holder and reduce printed circuit board tolerance accumulation.

Printed Circuit Board Design Considerations

Dimensions are in millimeters; inch equivalents are bracketed.



Note 3, 5

| | HOLE DIAMETER TOLERANCE | HOLE POSITION TOLERANCE |
|---------------------------|-------------------------|-------------------------|
| E1 - E4 (Insertion Holes) | ±0.07mm (0.003") | |
| D1 (Primary Datum Hole) | ±0.05mm (0.002") | |
| D2 (Secondary Datum Hole) | | |

Note 4

Notes:

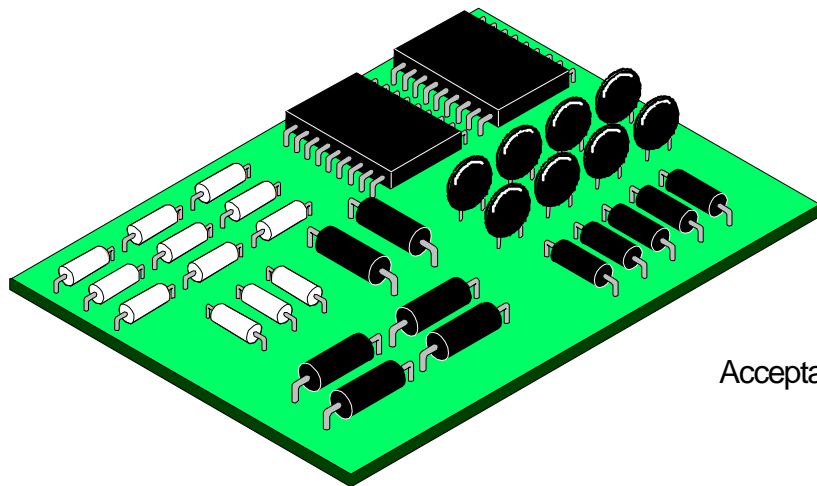
- For recommended insertion hole diameters, see appropriate sections later in this document: Axial (page 14), Radial (page 36), DIP (page 78).
- Datum holes should be positioned with the longest lateral span between them.
- Standardization of datum hole diameters and spacing reduces downtime associated with changeover.
- These symbols represent geometric tolerancing in accordance with ANSI Y14.5M.
- When designing boards for PASS-THRU II Board Handling configuration, the maximum locating hole diameter is 4.74mm (0.187").

Component Location Objectives

Axis Considerations

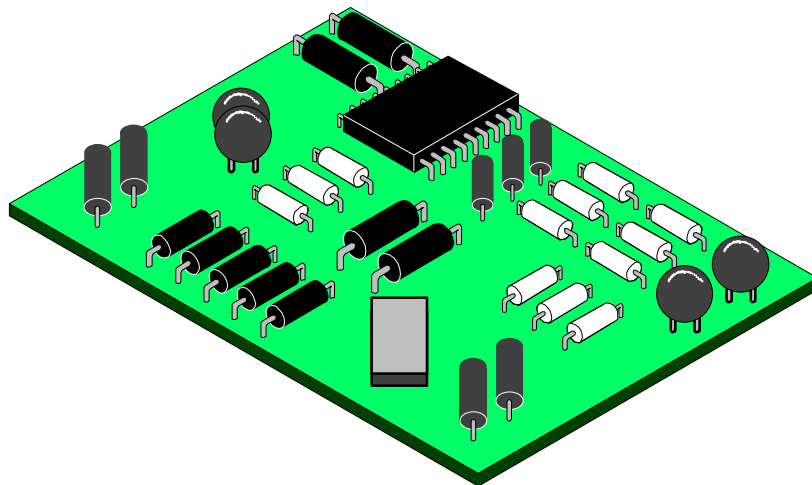
Universal insertion machines are capable of inserting components at 0° and 90° . For maximum throughput on DIP and axial inserters, components should be inserted in one axis only. Radial machines can insert components at 0° or 90° without affecting throughput.

Two axes insertion, as shown below, is an acceptable and efficient way of inserting components.



Acceptable

Insertion at other than 0° or 90° is not possible.



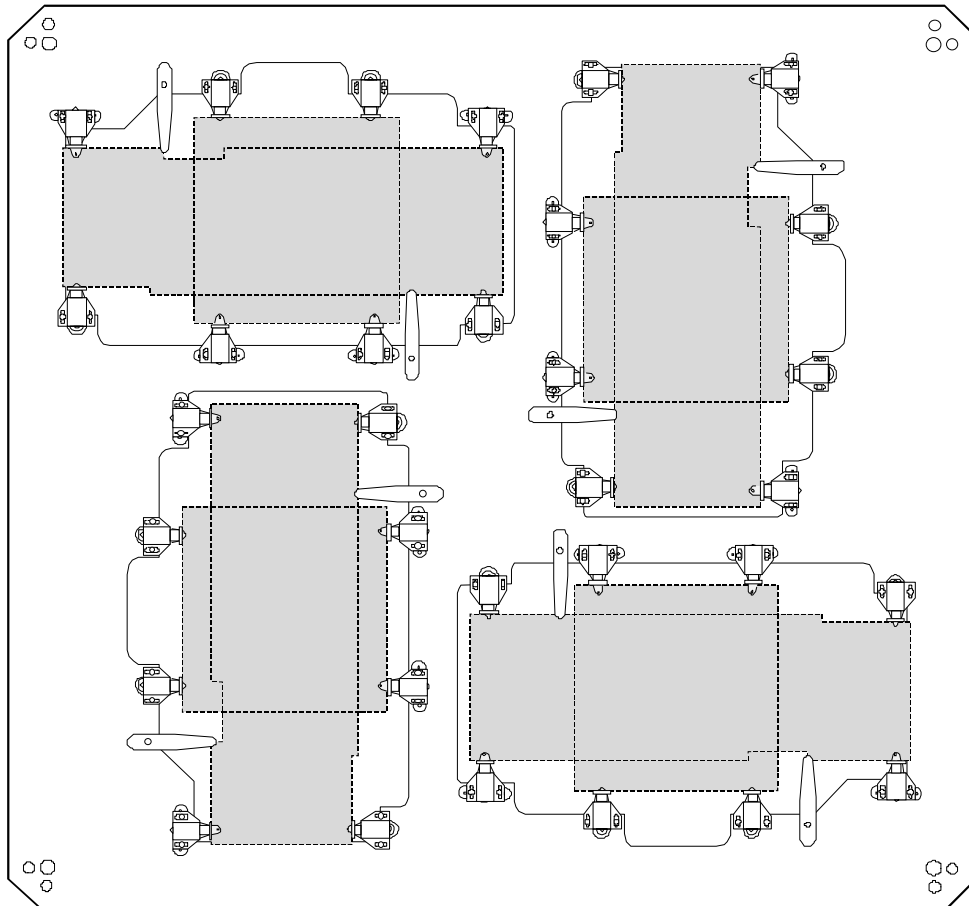
Not
Acceptable

Workboard Holder Considerations

The workboard holder allows one or more printed circuit boards to be secured to the positioning system for component insertion. Workboard holders that do not provide accurate and reliable board location will reduce insertion performance.

Custom Workboard Holders

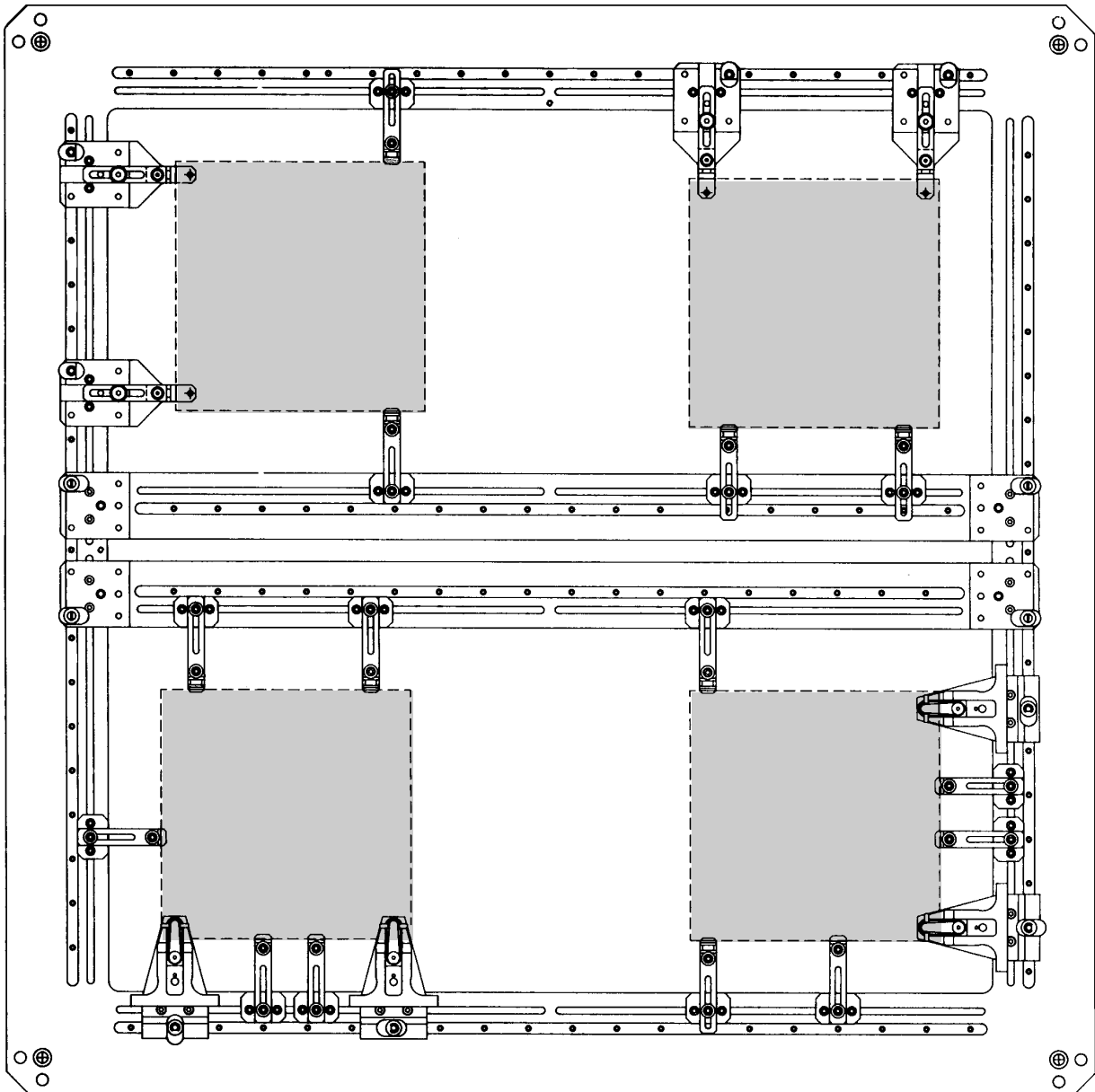
Custom workboard holders are designed to accommodate specific printed circuit board sizes. Multiple printed circuit boards may use the same custom workboard holder if board sizes and locating holes are standardized. A production environment where large lot sizes, medium-to-high product changeovers, and maximum throughputs are required is ideal for custom workboard holders.



4-Window Custom Workboard Holder

Adjustable Workboard Holders

Adjustable workboard holders are designed to accommodate production environments that consist of multiple printed circuit board sizes (prototypes and contract manufacturers) with low-to-medium job changeover.



4-Axis Adjustable Workboard Holder

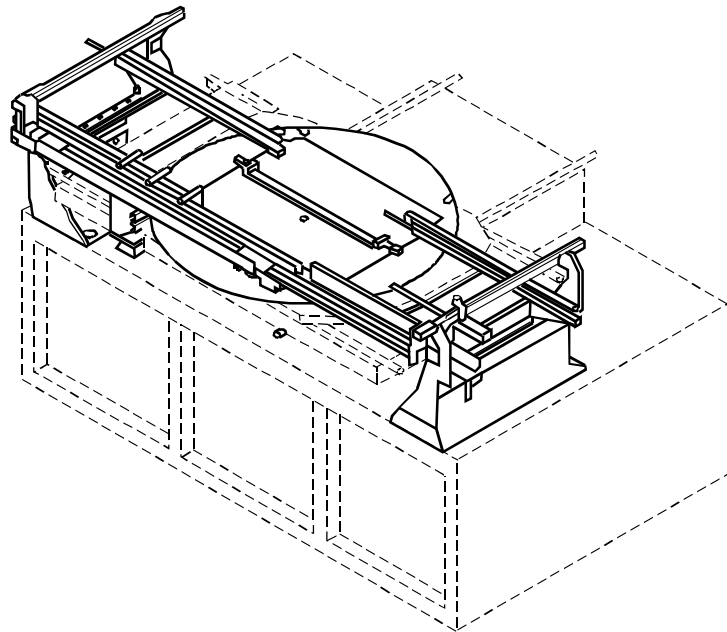
Board Handling System (BHS) Workboard Holders

Automatic board handling allows continuous machine operation by loading and unloading PC boards without operator intervention. The best applications are high volume, with low-to-medium job changeover.

Two types of automatic board handling are currently available:

- BHS (Board Handling System) for L-to-R or R-to-L board transfer, which is available on single or dual head machines.
- SBT (Single Board Transfer) is available for same side in/out applications, for single head machines only.

Board Handling System (BHS)

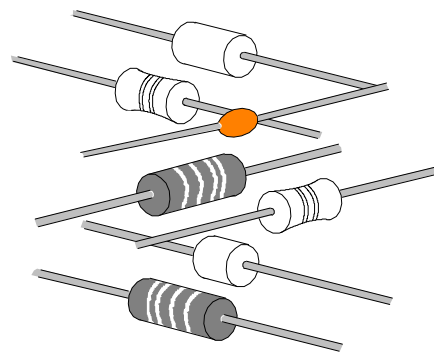


Axial Lead Component Insertion

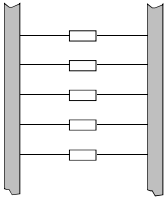
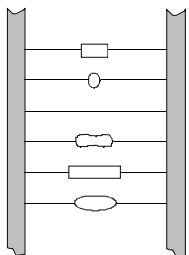
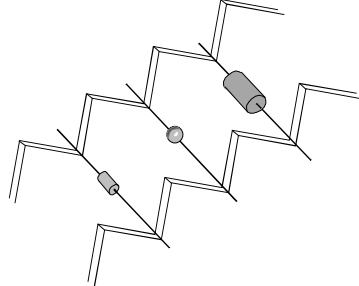
This section has been prepared to assist in the design of boards for use with the Universal axial lead component insertion machines. Included in this group of machines are Universal's line of axial sequencers and axial and jumper wire inserters.

In addition to the inserters, information pertaining to the Stand Alone Sequencer product line (2596 series) is included.

These design guidelines are intended to provide optimum component insertion reliability when processing axial components on Universal equipment. It is important to understand that there is optional tooling available for Universal axial insertion equipment that should be considered when designing clearances around components.



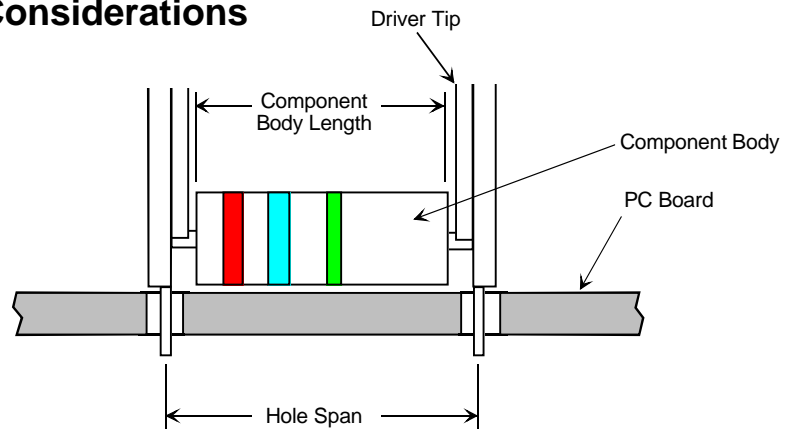
Component Input Taping Considerations

| SEQUENCER INPUT 2596 Series or 6241 Series | | STAND-ALONE SEQUENCER OUTPUT 2596 Series | | | | VCD SEQUENCER SEQUENCED OUTPUT 6241 Series | | | |
|---|--|---|------------------------|-------------------|---|--|----------------------|--------------------|-------------------------------------|
|  | |  | | | |  | | | |
| INPUT CLASS | DISTANCE BETWEEN TAPES | OUTPUT CLASS | DISTANCE BETWEEN TAPES | MAX. BODY LENGTH | MAX. INSERTION HOLE CENTER DISTANCE (FOR STAND-ALONE VCD) | OUTPUT CLASS | COMPONENT CUT LENGTH | MAX. BODY LENGTH | MAX. INSERTION HOLE CENTER DISTANCE |
| 26mm | 26mm (1.024") ±1.5mm (0.059") | N/A | – | – | – | AAA | 26mm (1.024") | 7.6mm (0.300") | 12.7mm (0.500") |
| S1 | 49mm (1.930") ±1.5mm (0.059") | AA | 36.1mm (1.42") | 12.7mm (0.50") | 14.8mm (0.58") | AA | 45.5mm (1.792") | 12.7mm (0.500") | 16.5mm (0.650") |
| I | 52.4mm (2.063") ± 1.5mm (0.059") | A | 41.1mm (1.62") | 15.7mm (0.62") | 19.8mm (0.78") | A | 50.2mm (1.980") | 15.7mm (0.620") | 21.6mm (0.850") |
| I | 52.4mm (2.063") | Std | 43.7mm (1.72") | 15.7mm (0.62") | 22.35mm (0.88") | N/A | – | – | – |
| II | 63.5mm (2.500") ±1.5mm (0.059") | B | 52.3mm (2.06") | 19.1mm (0.75") | 30.99mm (1.22") | N/A | – | – | – |
| III | 73mm (2.874") ±1.5mm (0.059") | C | 60.5mm (2.38") | 25.4mm (1.00") | 32.26mm (1.27") | N/A | – | – | – |

Notes:

1. It is acceptable to use up to two sizes larger (wider) "input class" to the sequencer than recommended.
2. For stand-alone sequencers, Std output is the standard output class. Others must be requested through Universal's "Request For Quote" process. Sequencer inserters are available with class A output (model 6241D) or with class AAA output (6242E). Others must be requested through RFQ process.

Component Body Length Considerations



The formulas below are used to calculate the minimum hole span (distance between hole centers) for a given component body length. A PC board design using proper hole spans for each size component will ensure the component body is not damaged by the driver tips during the insertion process.

Because component body lengths may vary, PC boards should be designed with hole spans greater than the calculated minimum.

Minimum Insertion Hole Span Formulas for Various Body Lengths

Standard Tooling

Metric Formula: Minimum Hole Span = [(Component Body Length¹ x 1.112) + 2.36mm] - Lead Diameter

Inch Formula: Minimum Hole Span = [(Component Body Length¹ x 1.112) + 0.093"] - Lead Diameter

Large Lead Tooling

Metric Formula: Minimum Hole Span = [(Component Body Length¹ x 1.085) + 4.11mm] - Lead Diameter

Inch Formula: Minimum Hole Span = [(Component Body Length¹ x 1.085) + 0.162"] - Lead Diameter

5mm Tooling

Metric Formula: Minimum Hole Span = [(Component Body Length¹ x 1.109) + 1.40mm] - Lead Diameter

Inch Formula: Minimum Hole Span = [(Component Body Length¹ x 1.109) + 0.055"] - Lead Diameter

5.5mm Tooling

Metric Formula: Minimum Hole Span = [(Component Body Length¹ x 1.067) + 2.30mm] - Lead Diameter

Inch Formula: Minimum Hole Span = [(Component Body Length¹ x 1.067) + 0.090"] - Lead Diameter

¹ Subtract an additional 0.41mm (0.016") from the maximum body length for non-symmetrically shaped components.

Body Diameter Considerations

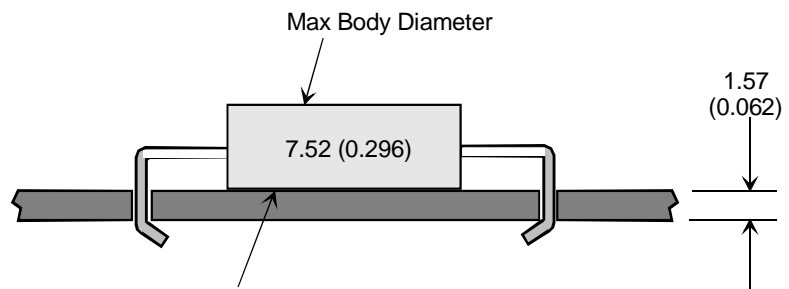
In axial insertion, the board thickness versus maximum body diameter is important since the overall form length is fixed. Taking board thickness into consideration, the maximum body diameters that are insertable with sufficient lead remaining for the cut and clinch process are shown below.

Dimensions are in millimeters; inch equivalents are bracketed.

| Maximum Component Body Diameter | | | | |
|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--------------|
| Standard | High Density | Large Lead | 5mm/5.5mm | 5mm 'AAA' |
| 10.69 (0.420) -2 x board thickness | 10.69 (0.420) -2 x board thickness | 10.69 (0.420) -2 x board thickness | 11.68 (0.460) -2 x board thickness | 7.62 (0.300) |

Example Using Standard Tooling

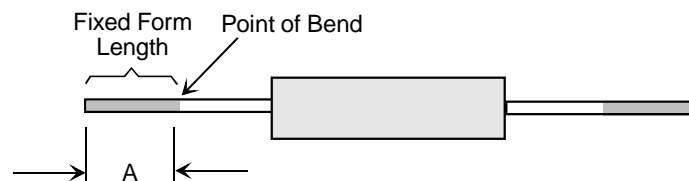
| | A |
|---|------------------|
| Standard | 7.62mm (0.300") |
| High Density | 7.62mm (0.300") |
| Large Lead | 7.62mm (0.300") |
| 5mm/5.5mm | 8.128mm (0.320") |
| Note: The maximum body diameter formulas are derived using the fixed form lengths "A" called out in this table | |



Board Thickness = 1.57 (0.062)

Max Body Diameter Using Standard Tooling (Metric) = $10.69 - (2) 1.57 = 7.5$

(Inch) = $0.420 - (2) 0.062 = 0.296$



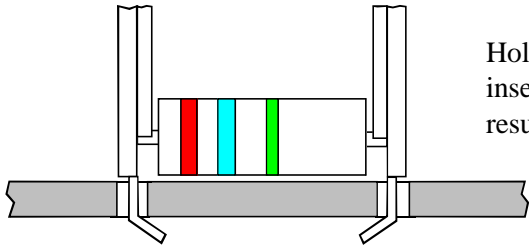
Note:

At 5mm insertion span, maximum component body diameter is 2.29mm (0.090").

Component Lead Hole Considerations

Printed circuit boards should be punched or drilled for component lead insertion to the following recommended hole diameters.

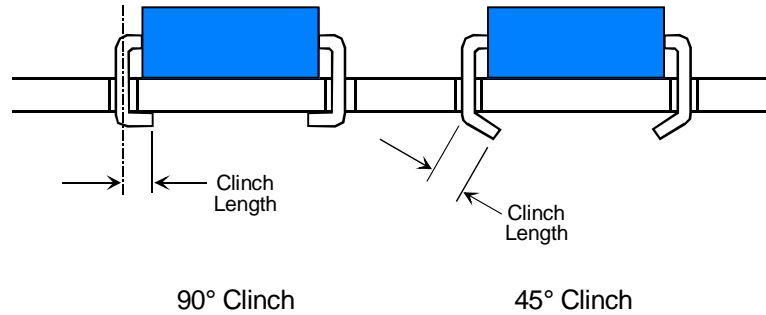
$$\text{Hole Diameter} = \text{Lead Diameter} + 0.48\text{mm} \pm 0.08\text{mm} \\ (0.019") \quad (0.003")$$



Hole sizes less than recommended may result in a degradation of insertion reliability, while hole sizes greater than recommended may result in loose components in the PC board.

Clinch Lengths and Angles

Clinch Pattern Options

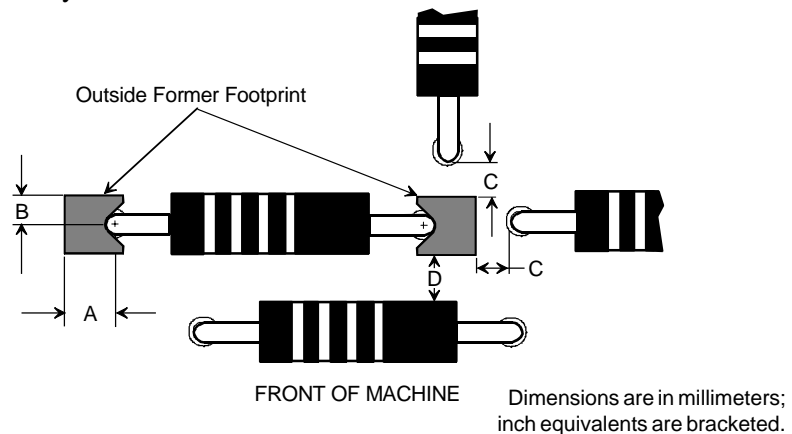


Clinch lead angle is adjustable over a range (0° - 45°). Clinch lead length is adjustable from 1.28mm (0.050") to 1.80mm (0.071") and is measured from the center of the insertion hole to the end of the lead.

Component Density and Lead Diameter Considerations

Topside

Universal's axial lead insertion tooling is equipped with outside formers which guide the leads to the point of insertion on the printed circuit board. Clearance around a given hole must be taken into consideration to allow the equipment to function properly. The top view of the outside former is shown, illustrating the clearances required between the lead being inserted and any adjacent component body or lead.



| | VCD AXIAL TOOLING FOOTPRINT | | | | | | JUMPER WIRE TOOLING FOOTPRINT |
|---------------|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------------------|
| | STANDARD | | LARGE LEAD | | 5mm/5.5mm | | CUT TOOLING |
| Lead Diameter | 0.38 (0.015) | 0.81 (0.032) | 0.64 (0.025) | 1.07 (0.042) | 0.38 (0.015) | 0.81 (0.032) | 0.61 (0.024) |
| A | 1.78 (0.070) | 2.01 (0.079) | 1.80 (0.071) | 2.08 (0.082) | 0.97 (0.038) | 1.22 (0.048) | 1.98 (0.078) |
| B | 1.14 (0.045) | | 1.57 (0.062) | | 1.14 (0.045) | | 1.14 (0.045) |
| C | 0.25 (0.010) | | | | | | |
| D | 0.76 (0.030) | | | | | | |

Notes:

1. C and D are recommended clearances for all tooling styles.
2. 6295, 6292, & 6287 series machines: It is recommended that the insertion span within five consecutive insertions not vary more than 10mm (0.400") from the lesser to the greater span or lead scrap problems could occur. Throughput may be affected.
3. When inserting components at 5mm (0.197") insertion spans, maximum lead diameter is 0.61mm (0.024").
4. 6241: To prevent lead scrap problems, the hole span within two consecutive insertions cannot vary more than 5mm (0.200") from the lesser to the greater span.

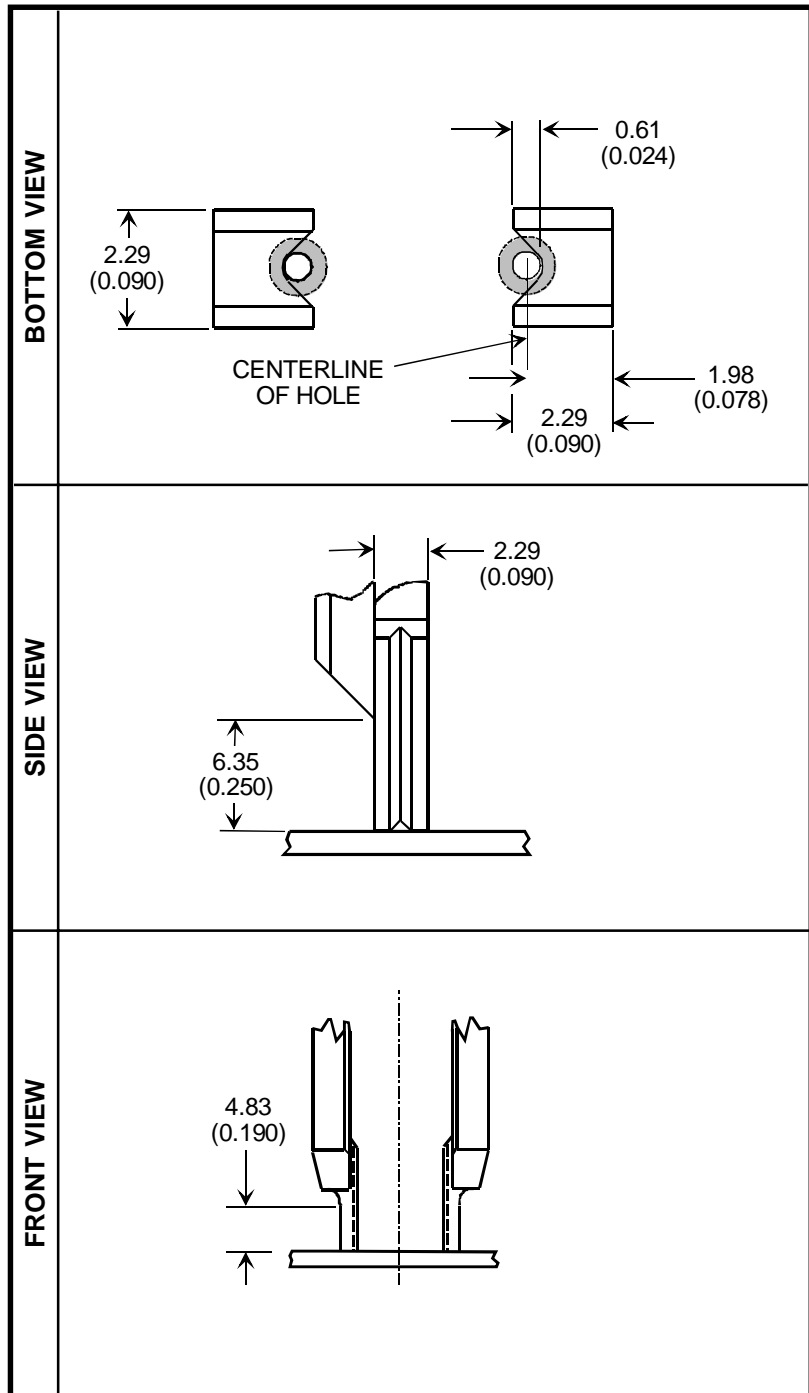
Axial Insert Tooling Footprint

Dimensions are in millimeters;
inch equivalents are bracketed.

| Tooling Footprint | | | |
|--------------------------|-----------------|-------------------|------------------|
| | Standard | Large Lead | 5mm/5.5mm |
| Bottom View | | | |
| Side View | | | |
| Front View | | | |

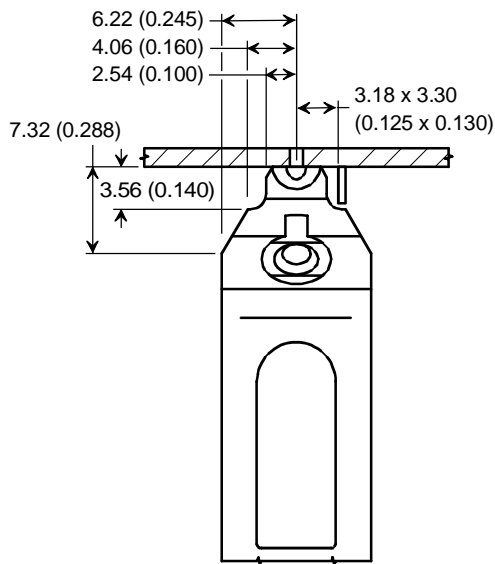
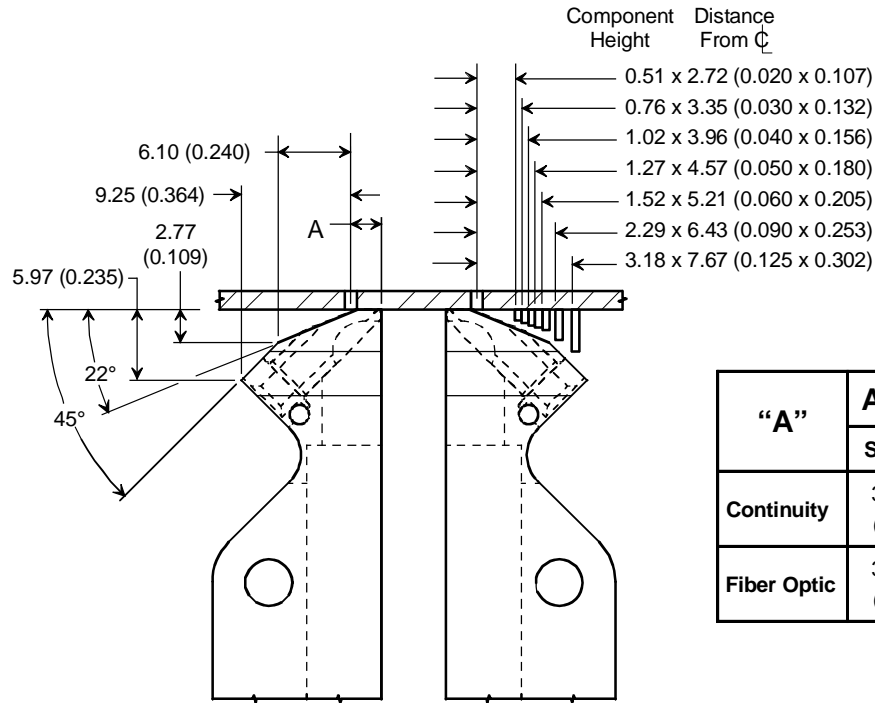
Jumper Wire Insertion Tooling Footprint

Dimensions are in millimeters;
inch equivalents are bracketed.

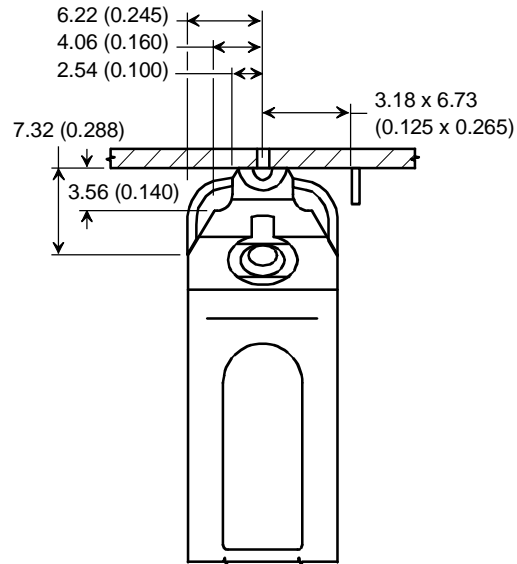


Bottomside

Dimensions are in millimeters;
inch equivalents are bracketed.



Continuity



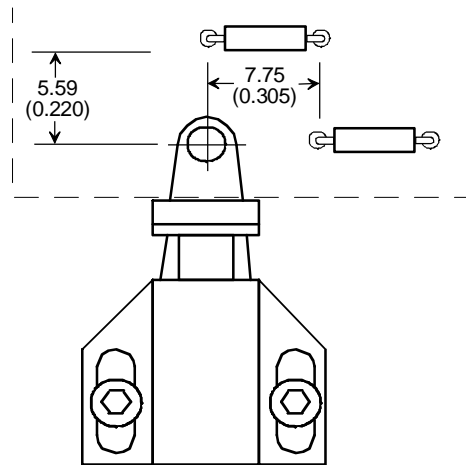
Fiber Optic

Note:

Clinch anvils are symmetrical about the centerline. All dimensions are typical for both sides of the anvils.

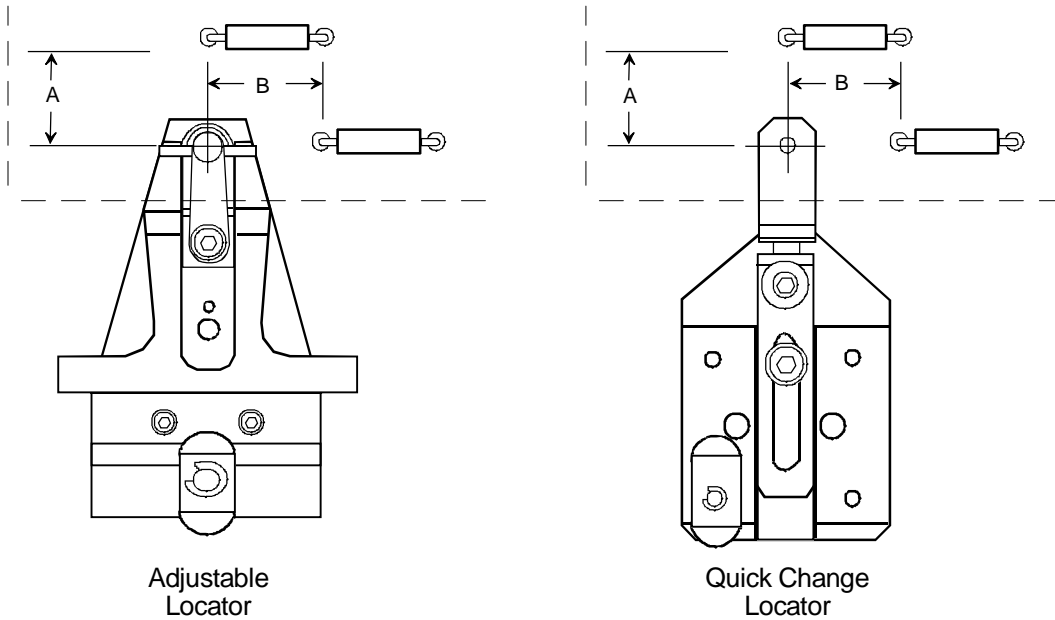
Stand Alone Board Holder

Custom Workboard Holder



Dimensions are in millimeters;
inch equivalents are bracketed.

Adjustable Workboard Holder



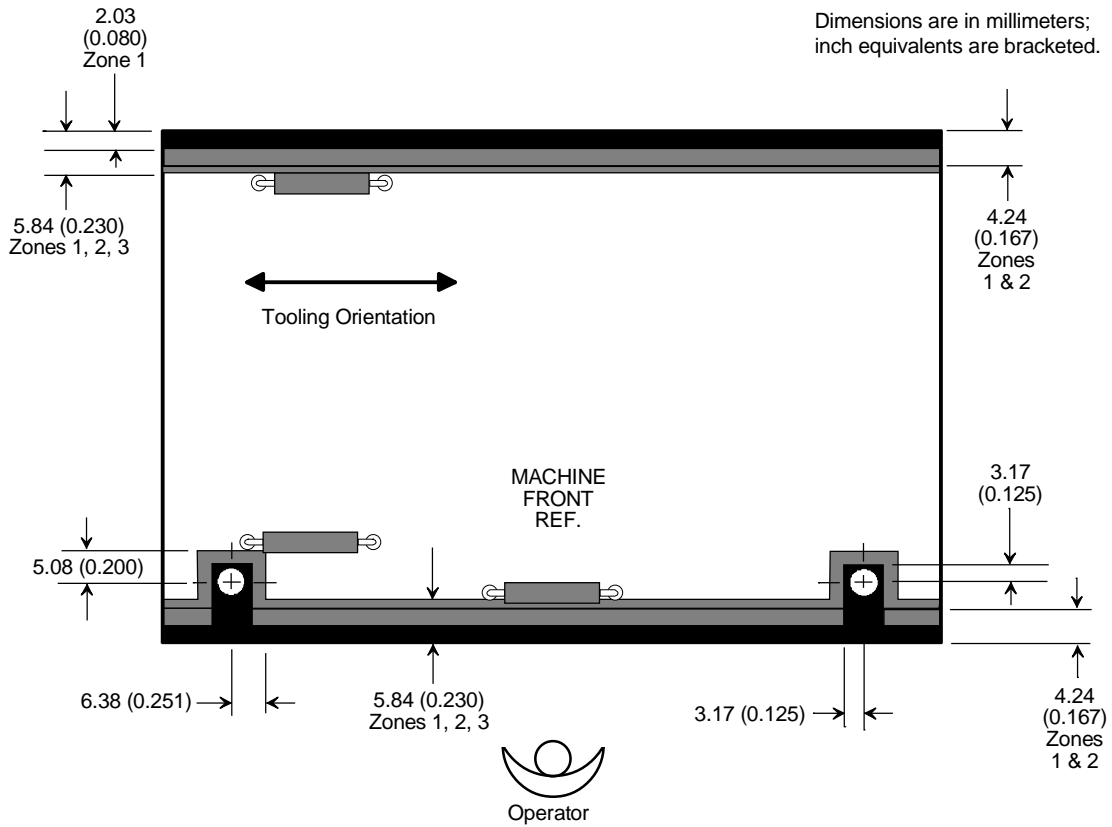
Adjustable
Locator

Quick Change
Locator

| | A | B |
|----------------------------|--------------------|---------------------|
| ADJUSTABLE LOCATOR | 8.38mm (0.330") | 12.75mm (0.502") |
| QUICK CHANGE LOCATOR | 6.35mm (0.250") | 12.50mm (0.492") |

Board Handling

Single Board Transfer Board Holder: Axial Machines (Table Positioned at 0° Rotation)



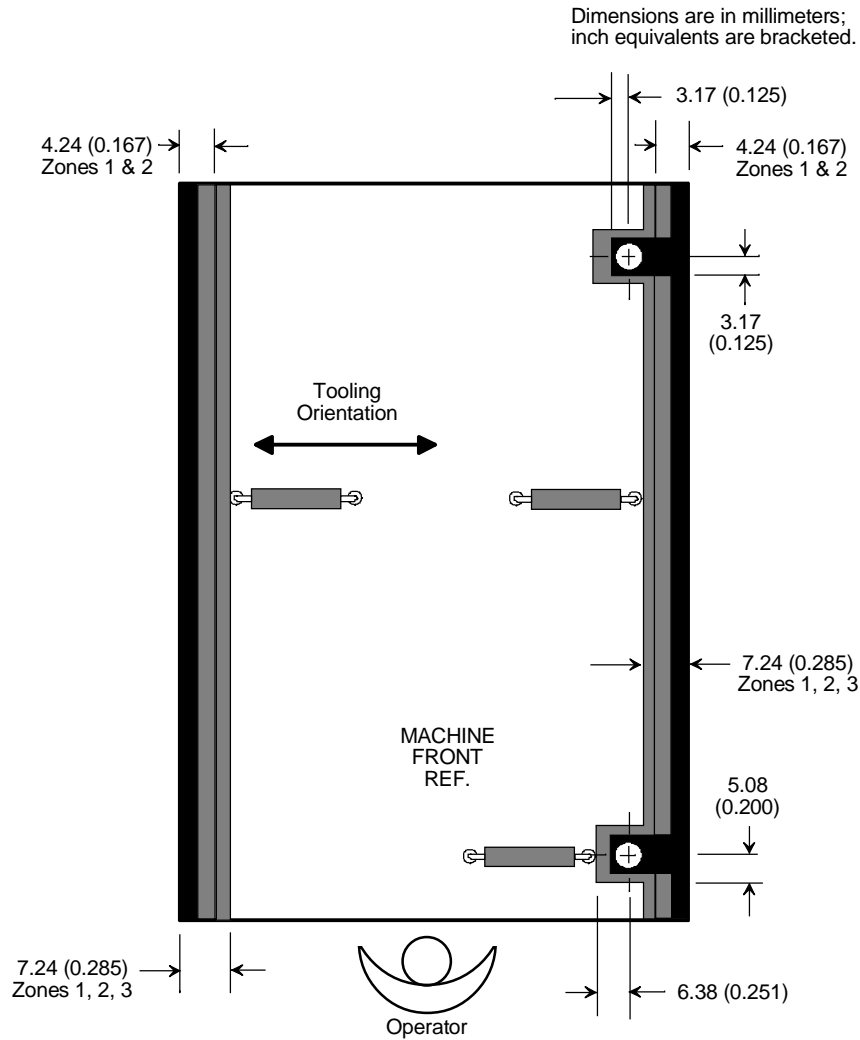
VCD Axial Lead with Single Board Transfer Component Insertion Limitations

NOTES:

- ZONE 1 - Minimum clear area required on top side of board to feed and locate in the SBT system.
- ZONE 2 - Minimum clear area required on bottom side of board to feed and locate in the SBT system.
- ZONE 3 - The insertion limitation imposed by the insertion head and cut and clinch tooling.

Ensure that component body does not interfere with Zone 1.

Single Board Transfer Board Holder: Axial Machines (Table Positioned at 90° Rotation)



VCD Axial Lead with Single Board Transfer Component Insertion Limitations

NOTES:

- ZONE 1 - Minimum clear area required on top side of board to feed and locate in the SBT system.
- ZONE 2 - Minimum clear area required on bottom side of board to feed and locate in the SBT system.
- ZONE 3 - The insertion limitation imposed by the insertion head and cut and clinch tooling.

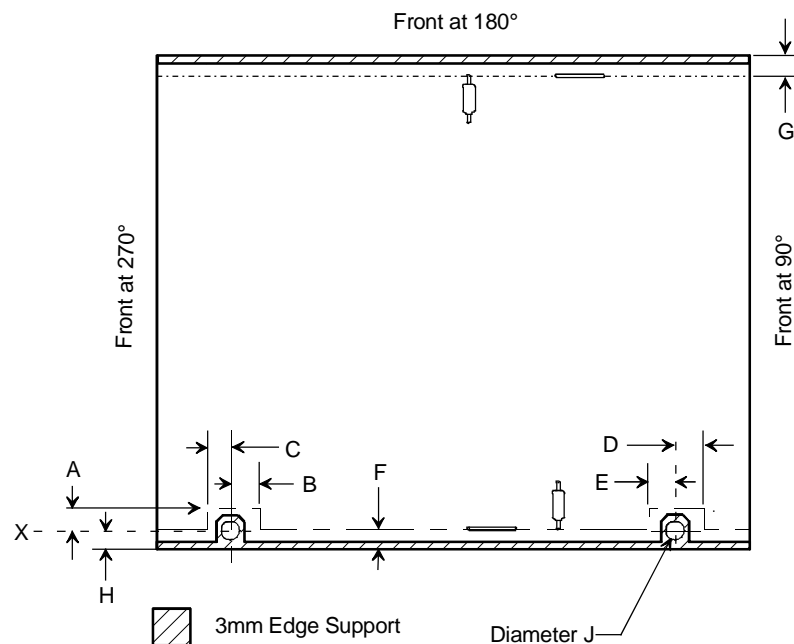
Ensure that component body does not interfere with Zone 1.

Board Handling System (BHS)

Table Rotation (Dimensions shown are for standard tooling)

| | 0° | 90° | 180° | 270° |
|----------|---|--------------------------------|--------------------------------|--------------------------------|
| A | 5.99mm (0.236") ¹ | 7.59mm (0.299") ² | 9.27mm (0.365") ¹ | 7.59mm (0.299") ² |
| B | 7.09mm (0.279") ² | 5.49mm (0.216") ¹ | 7.09mm (0.279") ² | 5.49mm (0.216") ¹ |
| C | 7.09mm (0.279") ² | 8.76mm (0.345") ¹ | 7.09mm (0.279") ² | 8.76mm (0.345") ¹ |
| D | 7.09mm (0.279") ² | 5.49mm (0.216") ¹ | 7.09mm (0.279") ² | 5.49mm (0.216") ¹ |
| E | 7.09mm (0.279") ² | 8.76mm (0.345") ¹ | 7.09mm (0.279") ² | 8.76mm (0.345") ¹ |
| F | 5.33mm (0.210") ^{1,3} | 5.38mm (0.212") ^{2,3} | 5.33mm (0.210") ^{1,3} | 5.38mm (0.212") ^{2,3} |
| G | 5.33mm (0.210") ^{1,3} | 5.38mm (0.212") ^{2,3} | 5.33mm (0.210") ^{1,3} | 5.38mm (0.212") ^{2,3} |
| H | 3.17mm (0.125") minimum 6.35mm (0.250") recommended 7.62mm (0.300") maximum | | | |
| J | 3.17mm (0.125") minimum 3.96mm (0.156") recommended 6.35mm (0.250") maximum | | | |

1. Dimensions are to centerline of lead.
2. Dimensions are to the bottom of the 'V' groove in the former.
3. Dimension shown is for 3mm edge support. If using a 5mm edge support, add 2mm (0.079") to dimension shown.

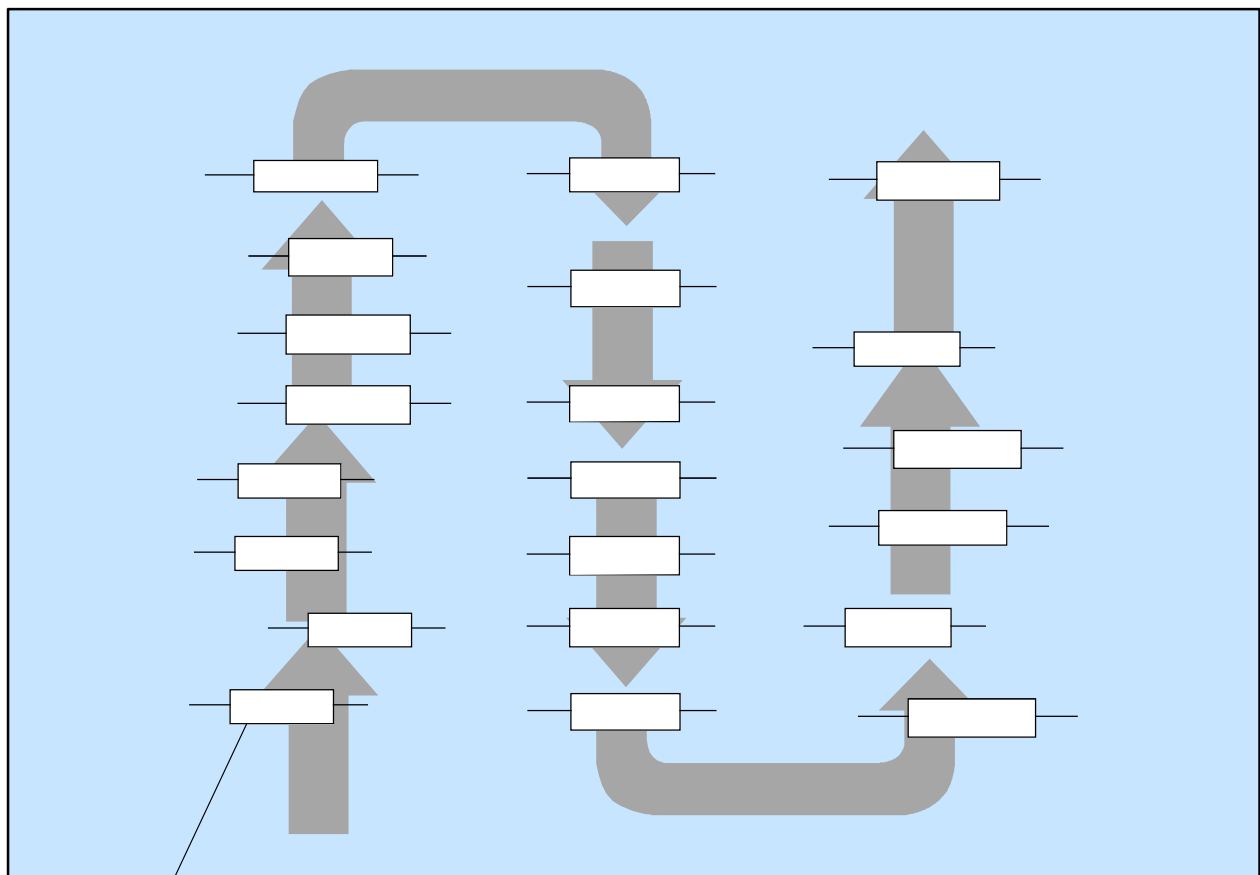


Dimensions shown are minimum distances from either the board edge or the tooling pin hole, to either the standard tooling or the clinch.

Programming Considerations

Optimum Pattern Programming

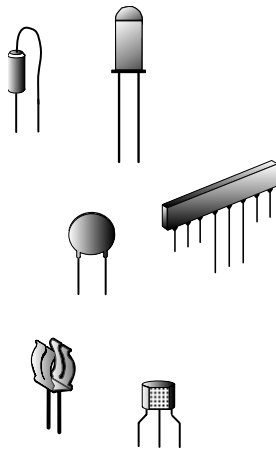
The pattern program can make optimum use of the axial lead insertion equipment by minimizing X-axis movement. Whenever possible, programming should proceed in a plus or minus Y direction and minimal hole span changes.



FRONT OF MACHINE

First Insertion

Radial Component Insertion



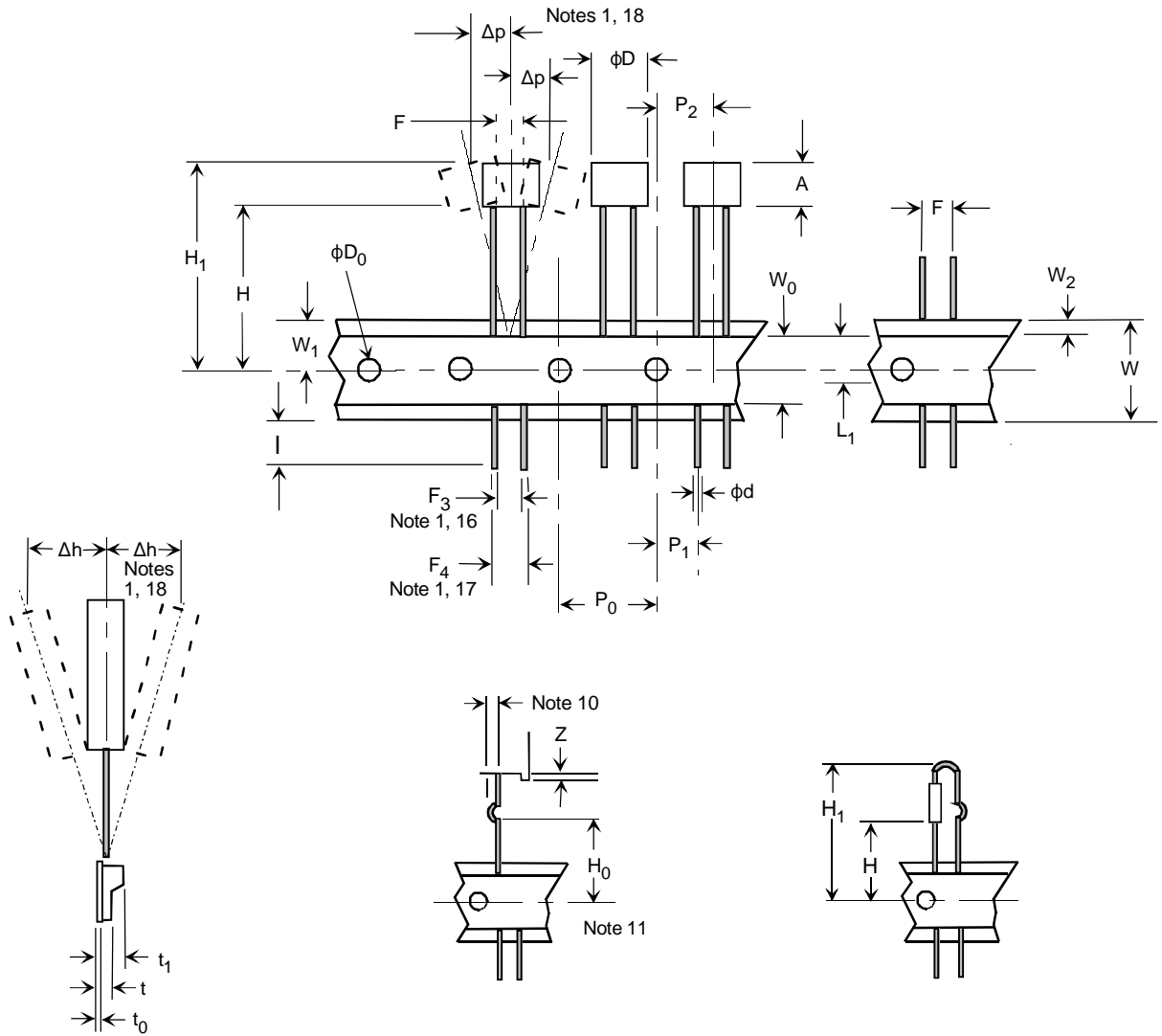
This section is written to assist in the design of boards for use on Universal's radial insertion equipment. This group of machines includes radial sequencer /inserters.

Universal's radial sequencer/inserters are designed to automatically insert randomly sequenced radial lead devices with two and three taped leads. Some components, such as SIPs, may have up to 10 leads.

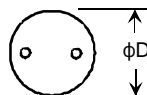
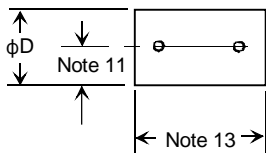
Component Input Specifications

Components prepped and taped in a radial lead configuration, which conform to the specifications described in the Input Specifications on the following pages, can be processed by Universal's radial sequencer/inserters.

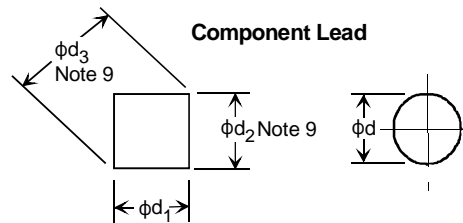
Two-Leaded Components, for 2.5mm/5.0mm Tooling



Component Body



Component Lead

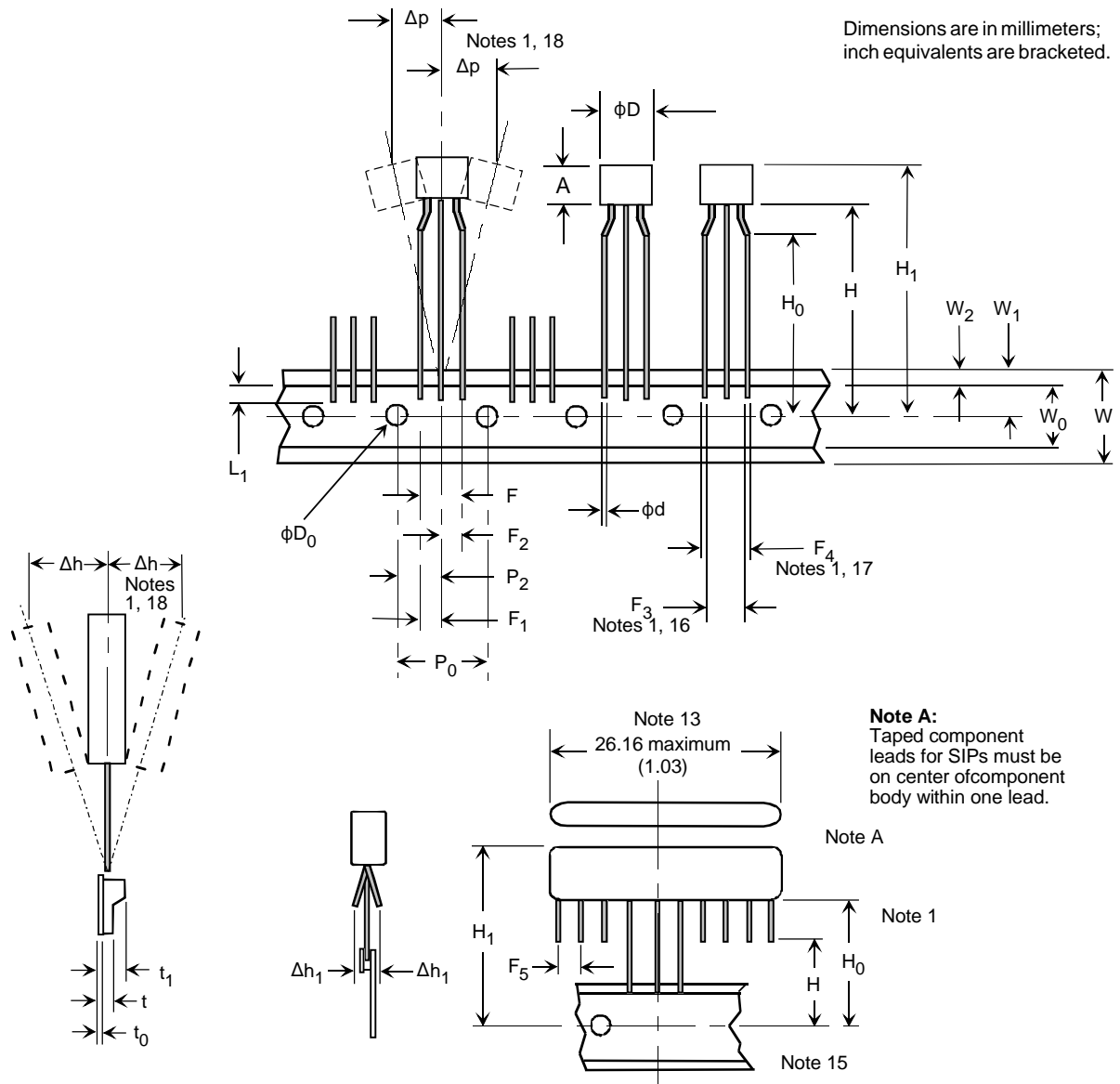


TWO-LEADED COMPONENT SPECIFICATIONS FOR 2.5mm/5.0mm TOOLING

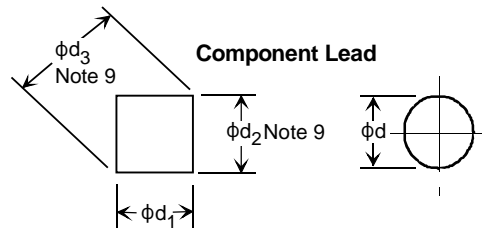
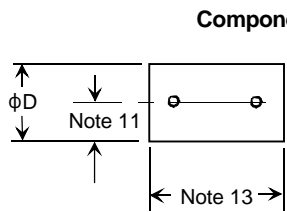
| Symbol | Item | Minimum | | Maximum | | Notes | |
|--------------|-------------------------------------|---------|-------|---------|-------|--------|----------|
| | | mm | inch | mm | inch | | |
| A | Component Body Height | 0.36 | 0.014 | 22.99 | 0.905 | | |
| ϕD | Component Body Diameter | N/A | N/A | 13.0 | 0.512 | 19 | |
| ϕD_0 | Feed Hole Diameter | 3.7 | 0.146 | 4.3 | 0.169 | | |
| ϕd | Lead Diameter (Round) | 2.5mm | 0.36 | 0.014 | 0.61 | 0.024 | 9, 12 |
| | | 5.0mm | 0.36 | 0.014 | 0.71 | 0.028 | 9, 12 |
| ϕd_1 | Lead Size (Rectangular) | 2.5mm | 0.36 | 0.014 | 0.50 | 0.020 | 9, 12 |
| | | 5.0mm | 0.28 | 0.011 | 0.66 | 0.026 | 9, 12 |
| ϕd_2 | Lead Size (Rectangular) | 2.5mm | 0.36 | 0.014 | 0.50 | 0.020 | 9, 12 |
| | | 5.0mm | 0.28 | 0.011 | 0.66 | 0.026 | 9, 12 |
| ϕd_3 | Lead Across Diagonal | 2.5mm | N/A | N/A | 0.61 | 0.024 | 9, 12 |
| | | 5.0mm | N/A | N/A | 0.71 | 0.028 | 9, 12 |
| F | Component Lead Span | 2.5mm | 2.13 | 0.084 | 3.15 | 0.124 | 1, 5 |
| | | 5.0mm | 4.67 | 0.184 | 5.69 | 0.224 | 1, 5 |
| F_1, F_2 | Component Lead Pitch* | N/A | N/A | N/A | N/A | | |
| F_3 | Minimum Inner Spacing Between Leads | 2.5mm | 2.1 | 0.083 | N/A | N/A | 1, 5, 16 |
| | | 5.0mm | 4.34 | 0.171 | N/A | N/A | 1, 5, 16 |
| F_4 | Maximum Outer Spacing | 2.5mm | N/A | N/A | 3.53 | 0.139 | |
| | | 5.0mm | N/A | N/A | 6.1 | 0.239 | |
| F_5 | Lead Pitch | 2.4 | 0.096 | 2.6 | 0.104 | | |
| H_0 | Height of Seating Plane | 15.5 | 0.610 | 22.5 | 0.886 | | |
| H | Feed Hole to Bottom of Component | 15.5 | 0.610 | 22.5 | 0.886 | 11, 20 | |
| H_1 | Component Height | 15.85 | 0.624 | 38.5 | 1.51 | 14 | |
| Δh | Front-to-Rear Deflection | 0.0 | 0.000 | 1.0 | 0.039 | 1, 18 | |
| Δh_1 | Lead Deflection * | N/A | N/A | N/A | N/A | | |
| I | Lead Protrusion | 0.0 | 0.000 | 1.0 | 0.039 | | |
| L | Lead Length After Component Removal | 8.51 | 0.335 | 11.2 | 0.441 | 3 | |
| L_1 | Lead Wire Enclosure | 2.49 | 0.098 | 18.31 | 0.721 | | |
| P_0 | Feed Hole Pitch | 12.4 | 0.488 | 13.0 | 0.512 | 4 | |
| P_1 | Lead Location | 2.5mm | 4.37 | 0.172 | 5.79 | 0.228 | |
| | | 5.0mm | 3.10 | 0.122 | 4.52 | 0.178 | 5 |
| P_2 | Ordinate to Component Center | 5.64 | 0.222 | 7.06 | 0.278 | 5 | |
| Δp | Deflection Left or Right | 00 | 0.000 | 1.3 | 0.051 | 1, 18 | |
| t | Overall Tape Thickness | 0.51 | 0.020 | 0.90 | 0.035 | 6 | |
| t_0 | Carrier Tape Thickness | 0.38 | 0.015 | 0.69 | 0.027 | | |
| t_1 | Total Taped Package Thickness | 0.86 | 0.034 | 1.50 | 0.059 | 6 | |
| W | Tape Width | 17.5 | 0.689 | 19.0 | 0.748 | 7 | |
| W_0 | Adhesive Tape Width | 5.50 | 0.216 | 19.0 | 0.748 | 7 | |
| W_1 | Feed Hole Location | 8.5 | 0.335 | 9.75 | 0.384 | | |
| W_2 | Adhesive Tape Position | 0.0 | 0.000 | 6.0 | 0.236 | 7 | |
| Z | Standoff Extensions | 0.0 | 0.000 | 1.0 | 0.039 | | |

* Applies to three-leaded components only.

Three-Leaded Components, for 2.5mm/5.0mm Tooling



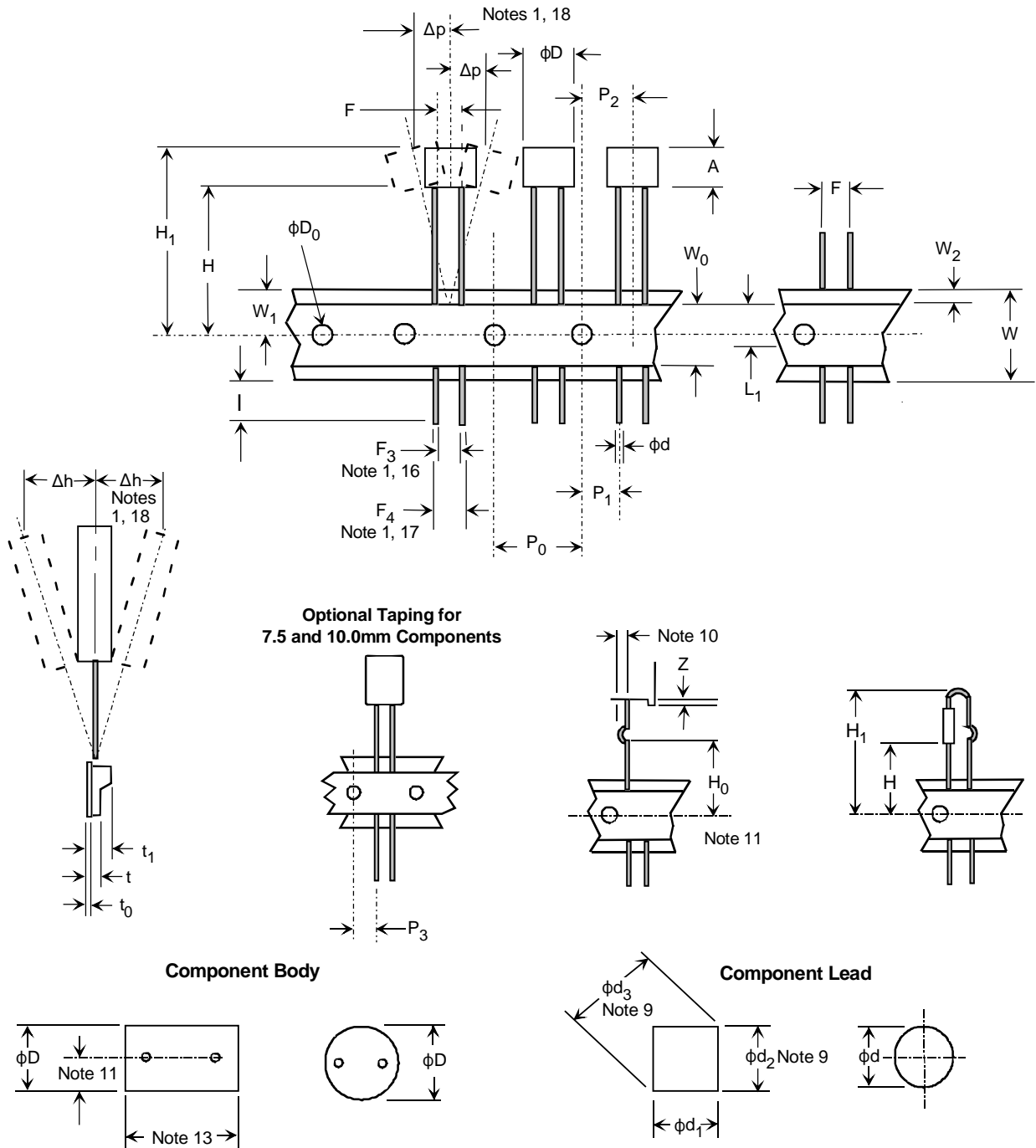
Note A:
Taped component leads for SIPs must be on center of component body within one lead.



THREE-LEADED COMPONENT SPECIFICATIONS FOR 2.5mm/5.0mm TOOLING

| Symbol | Item | Minimum | | Maximum | | Notes | |
|--------------|-------------------------------------|---------|-------|---------|-------|--------|----------|
| | | mm | inch | mm | inch | | |
| A | Component Body Height | 0.36 | 0.014 | 22.99 | 0.905 | | |
| ϕD | Component Body Diameter | N/A | N/A | 13.0 | 0.512 | 19 | |
| ϕD_0 | Feed Hole Diameter | 3.7 | 0.146 | 4.3 | 0.169 | | |
| ϕd | Lead Diameter (Round) | 2.5mm | N/A | N/A | N/A | 9, 12 | |
| | | 5.0mm | 0.36 | 0.014 | 0.61 | 0.024 | 9, 12 |
| ϕd_1 | Lead Size (Rectangular) | 2.5mm | N/A | N/A | N/A | 9, 12 | |
| | | 5.0mm | 0.28 | 0.011 | 0.50 | 0.020 | 9, 12 |
| ϕd_2 | Lead Size (Rectangular) | 2.5mm | N/A | N/A | N/A | 9, 12 | |
| | | 5.0mm | 0.28 | 0.011 | 0.50 | 0.20 | 9, 12 |
| ϕd_3 | Lead Across Diagonal | 2.5mm | N/A | N/A | 0.61 | 0.024 | 9, 12 |
| | | 5.0mm | N/A | N/A | 0.71 | 0.028 | 9, 12 |
| F | Component Lead Span | 2.5mm | 2.13 | 0.084 | 3.15 | 0.124 | 1, 5 |
| | | 5.0mm | 4.67 | 0.184 | 5.69 | 0.224 | 1, 5 |
| F_1, F_2 | Component Lead Pitch | 2.4 | 0.094 | 2.9 | 0.114 | | |
| F_3 | Minimum Inner Spacing Between Leads | 2.5mm | 2.11 | 0.083 | N/A | N/A | 1, 5, 16 |
| | | 5.0mm | 4.34 | 0.171 | N/A | N/A | 1, 5, 16 |
| F_4 | Maximum Outer Spacing | 2.5mm | N/A | N/A | 3.53 | 0.139 | |
| | | 5.0mm | N/A | N/A | 6.1 | 0.239 | |
| F_5 | Lead Pitch | 2.4 | 0.096 | 2.6 | 0.104 | | |
| H_0 | Height of Seating Plane | 15.5 | 0.610 | 22.5 | 0.886 | | |
| H | Feed Hole to Bottom of Component | 15.5 | 0.610 | 22.5 | 0.886 | 11, 20 | |
| H_1 | Component Height | 15.85 | 0.624 | 38.4 | 1.51 | 14 | |
| Δh | Front-to-Rear Deflection | 0.0 | 0.000 | 1.0 | 0.039 | 1, 18 | |
| Δh_1 | Lead Deflection | N/A | N/A | 0.1 | 0.004 | | |
| I | Lead Protrusion | 0.0 | 0.000 | 1.0 | 0.039 | | |
| L | Lead Length After Component Removal | 8.51 | 0.335 | 11.2 | 0.441 | 3 | |
| L_1 | Lead Wire Enclosure | 2.49 | 0.098 | 18.31 | 0.721 | | |
| P_0 | Feed Hole Pitch | 12.4 | 0.488 | 13.0 | 0.512 | 4 | |
| P_1 | Lead Location | 2.5mm | N/A | N/A | N/A | N/A | |
| | | 5.0mm | N/A | N/A | N/A | N/A | 5 |
| P_2 | Ordinate to Component Center | 5.64 | 0.222 | 7.06 | 0.278 | 5 | |
| Δp | Deflection Left or Right | 0.0 | 0.000 | 1.3 | 0.051 | 1, 18 | |
| t | Overall Tape Thickness | 0.51 | 0.020 | 0.89 | 0.035 | 6 | |
| t_0 | Carrier Tape Thickness | 0.38 | 0.015 | 0.69 | 0.027 | | |
| t_1 | Total Taped Package Thickness | 0.86 | 0.034 | 1.50 | 0.059 | 6 | |
| W | Tape Width | 17.5 | 0.689 | 19.0 | 0.748 | 7 | |
| W_0 | Adhesive Tape Width | 5.50 | 0.216 | 19.0 | 0.748 | 7 | |
| W_1 | Feed Hole Location | 8.5 | 0.335 | 9.75 | 0.384 | | |
| W_2 | Adhesive Tape Position | 0.0 | 0.000 | 6.0 | 0.236 | 7 | |
| Z | Standoff Extensions | 0.0 | 0.000 | 1.0 | 0.039 | | |

Two-Leaded Components, for 2.5mm/5.0mm/7.5mm and 5.0mm/7.5mm/10.0mm Tooling



TWO-LEADED COMPONENT SPECIFICATIONS FOR 2.5mm/5.0mm/7.5mm and 5.0mm/7.5mm/10.0mm TOOLING

| Symbol | Item | Minimum | | Maximum | | Notes | |
|----------------------|-------------------------------------|---------|-------|---------|-------|--------|-----------|
| | | mm | inch | mm | inch | | |
| A | Component Body Height | 0.36 | 0.014 | 22.99 | 0.905 | | |
| ϕD | Component Body Diameter | N/A | N/A | 13.0 | 0.512 | 19 | |
| ϕD_0 | Feed Hole Diameter | 3.7 | 0.146 | 4.3 | 0.169 | | |
| ϕd | Lead Diameter (Round) | 0.36 | 0.014 | 0.86 | 0.034 | 9, 12 | |
| $\phi d_1, \phi d_2$ | Lead Size (Rectangular) | 0.28 | 0.011 | 0.81 | 0.032 | 9, 12 | |
| ϕd_3 | Lead Across Diagonal | 0.38 | 0.015 | 0.86 | 0.034 | 9,12 | |
| F | Component Lead Span | 2.5mm | 2.13 | 0.084 | 3.15 | 0.124 | 1, 5 |
| | | 5.0mm | 4.67 | 0.184 | 5.69 | 0.224 | 1, 5 |
| | | 7.5mm | 7.22 | 0.284 | 8.22 | 0.324 | 1, 5 |
| | | 10.0mm | 9.76 | 0.384 | 10.76 | 0.424 | 1, 5 |
| F_1, F_2 | Component Lead Pitch* | N/A | N/A | N/A | N/A | | |
| F ₃ | Minimum Inner Spacing Between Leads | 2.5mm | 1.52 | 0.060 | N/A | N/A | 1, 5, 16 |
| | | 5.0mm | 4.06 | 0.160 | N/A | N/A | 1, 5, 16 |
| | | 7.5mm | 6.71 | 0.264 | N/A | N/A | 1, 5, 16 |
| | | 10.0mm | 9.25 | 0.364 | N/A | N/A | 1, 5, 16 |
| F ₄ | Maximum Outer Spacing | 2.5mm | N/A | N/A | 3.81 | 0.150 | 1, 5 |
| | | 5.0mm | N/A | N/A | 6.35 | 0.250 | 1, 5 |
| | | 7.5mm | N/A | N/A | 8.84 | 0.348 | 1, 5 |
| | | 10.0mm | N/A | N/A | 11.38 | 0.448 | 1, 5 |
| F ₅ | Lead Pitch | 2.4 | 0.096 | 2.6 | 0.104 | | |
| H ₀ | Height of Seating Plane | 15.5 | 0.610 | 22.5 | 0.886 | | |
| H | Feed Hole to Bottom of Component | 15.5 | 0.610 | 22.5 | 0.886 | 11, 20 | |
| H ₁ | Component Height | 15.85 | 0.624 | 38.5 | 1.51 | 14 | |
| Δh | Front-to-Rear Deflection | 0.0 | 0.000 | 1.0 | 0.039 | 1, 18 | |
| Δh_1 | Lead Deflection | N/A | N/A | 0.1 | 0.004 | | |
| I | Lead Protrusion | 0.0 | 0.000 | 1.0 | 0.039 | | |
| L | Lead Length After Component Removal | 8.51 | 0.335 | 11.2 | 0.441 | 3 | |
| L ₁ | Lead Wire Enclosure | 2.49 | 0.098 | 18.31 | 0.721 | | |
| P ₀ | Feed Hole Pitch | 12.4 | 0.488 | 13.0 | 0.512 | 4 | |
| P ₁ | Lead Location | 2.5mm | 4.37 | 0.172 | 5.79 | 0.228 | 5, 18 |
| | | 5.0mm | 3.10 | 0.122 | 4.52 | 0.178 | 5, 18 |
| | | 7.5mm | 1.84 | 0.072 | 3.24 | 0.128 | 5, 18 |
| | | 10.0mm | 0.56 | 0.022 | 1.98 | 0.078 | 5, 18 |
| P ₂ | Ordinate to Component Center | 5.64 | 0.222 | 7.06 | 0.278 | 5 | |
| P ₃ | Alternate Lead Location | 7.5mm | 8.19 | 0.322 | 9.59 | 0.378 | 5, 17, 18 |
| | | 10.0mm | 6.92 | 0.272 | 8.32 | 0.328 | 5, 17, 18 |
| Δp | Deflection Left or Right | 0.0 | 0.000 | 1.3 | 0.051 | 1, 18 | |
| t | Overall Tape Thickness | 0.51 | 0.020 | 0.90 | 0.035 | 6 | |
| t ₀ | Carrier Tape Thickness | 0.38 | 0.015 | 0.69 | 0.027 | | |
| t ₁ | Total Taped Package Thickness | 0.86 | 0.034 | 1.50 | 0.059 | 6 | |
| W | Tape Width | 17.5 | 0.689 | 19.0 | 0.748 | 7 | |
| W ₀ | Adhesive Tape Width | 5.50 | 0.216 | 19.0 | 0.748 | 7 | |
| W ₁ | Feed Hole Location | 8.5 | 0.335 | 9.75 | 0.384 | | |
| W ₂ | Adhesive Tape Position | 0.0 | 0.000 | 6.0 | 0.236 | 7 | |
| Z | Standoff Extensions | 0.0 | 0.000 | 1.0 | 0.039 | | |

* Applies to three-leaded components only.

THREE-LEADED COMPONENT SPECIFICATIONS FOR 2.5mm/5.0mm/7.5mm and 5.0mm/7.5mm/10.0mm TOOLING

| Symbol | Item | Minimum | | Maximum | | Notes | |
|----------------------|-------------------------------------|---------|-------|---------|-------|--------|----------|
| | | mm | inch | mm | inch | | |
| A | Component Body Height | 0.36 | 0.014 | 22.99 | 0.905 | | |
| ϕD | Component Body Diameter | N/A | N/A | 13.0 | 0.512 | 19 | |
| ϕD_0 | Feed Hole Diameter | 3.7 | 0.146 | 4.3 | 0.169 | | |
| ϕd | Lead Diameter (Round) | 0.36 | 0.014 | 0.86 | 0.034 | 9, 12 | |
| $\phi d_1, \phi d_2$ | Lead Size (Rectangular) | 0.28 | 0.011 | 0.81 | 0.032 | 9, 12 | |
| ϕd_3 | Lead Across Diagonal | N/A | N/A | 0.86 | 0.034 | 9, 12 | |
| F | Component Lead Span | 2.5mm | 2.13 | 0.084 | 3.15 | 0.124 | 1, 5 |
| | | 5.0mm | 4.67 | 0.184 | 5.69 | 0.224 | 1, 5 |
| F_1, F_2 | Component Lead Pitch | 2.4 | 0.094 | 2.9 | 0.114 | 1, 5 | |
| F ₃ | Minimum Inner Spacing Between Leads | 2.5mm | 1.52 | 0.060 | N/A | N/A | 1, 5, 16 |
| | | 5.0mm | 4.06 | 0.160 | N/A | N/A | 1, 5, 16 |
| F ₄ | Maximum Outer Spacing | 2.5mm | N/A | N/A | 3.81 | 0.150 | |
| | | 5.0mm | N/A | N/A | 6.35 | 0.250 | |
| F ₅ | Lead Pitch | 2.4 | 0.096 | 2.6 | 0.104 | | |
| H ₀ | Height of Seating Plane | 15.5 | 0.610 | 22.5 | 0.886 | | |
| H | Feed Hole to Bottom of Component | 15.5 | 0.610 | 22.5 | 0.886 | 11, 20 | |
| H ₁ | Component Height | 15.85 | 0.624 | 38.4 | 1.51 | 14 | |
| Δh | Front-to-Rear Deflection | 0.0 | 0.000 | 1.0 | 0.039 | 1, 18 | |
| Δh_1 | Lead Deflection | N/A | N/A | 0.1 | 0.004 | | |
| I | Lead Protrusion | 0.0 | 0.000 | 1.0 | 0.039 | | |
| L | Lead Length After Component Removal | 8.51 | 0.335 | 11.2 | 0.441 | 3 | |
| L ₁ | Lead Wire Enclosure | 2.49 | 0.098 | 18.31 | 0.721 | | |
| P ₀ | Feed Hole Pitch | 12.4 | 0.488 | 13.0 | 0.512 | 4 | |
| P ₁ | Lead Location | 3.11 | 0.122 | 4.51 | 0.178 | 5 | |
| P ₂ | Ordinate to Component Center | 5.64 | 0.222 | 7.06 | 0.278 | 5 | |
| P ₃ | Alternate Lead Location * | N/A | N/A | N/A | N/A | | |
| Δp | Deflection Left or Right | 0.0 | 0.000 | 1.3 | 0.051 | 1, 18 | |
| t | Overall Tape Thickness | 0.51 | 0.020 | 0.89 | 0.035 | 6 | |
| t ₀ | Carrier Tape Thickness | 0.38 | 0.015 | 0.69 | 0.027 | | |
| t ₁ | Total Taped Package Thickness | 0.86 | 0.034 | 1.50 | 0.059 | 6 | |
| W | Tape Width | 17.5 | 0.689 | 19.0 | 0.748 | 7 | |
| W ₀ | Adhesive Tape Width | 5.50 | 0.216 | 19.0 | 0.748 | 7 | |
| W ₁ | Feed Hole Location | 8.5 | 0.335 | 9.75 | 0.384 | | |
| W ₂ | Adhesive Tape Position | 0.0 | 0.000 | 6.0 | 0.236 | 7 | |
| Z | Standoff Extensions | 0.0 | 0.000 | 1.0 | 0.039 | | |

* Applies to two-leaded components only.

Notes:

1. Maximum alignment deviation or parallelism between leads shall not be greater than 0.2mm (0.008"). This dimension also applies to the component leads after the cardboard has been removed and to all untaped leads.
2. The distance between the tape feed hole and the bottom of the component, and the distance between the tape feed hole and the leads standoff form, shall be equal within 1.0mm (0.039").
3. When defective components are clipped from the carrier tape, the remaining protrusion of the leads shall not exceed $W_1 + 1.0\text{mm}$ ($W_1 + 0.039"$).
4. Maximum cumulative variation between tape feed holes shall not exceed + 0.5mm (+ 0.020") over four pitches.
5. P_1 and F are measured at the lead egress from the carrier tape on the component side (P_1 shall not deviate more than $\pm 0.13\text{mm}$ (0.005") on the same component reel). P_2 is measured at the seating plane.
6. Overall tape package thickness (t_1), including component leads and tape splices, shall not exceed 1.5mm (0.059").
7. Hold-down tape not to extend beyond the edge(s) of the carrier tape and there shall not be exposure of the adhesive.
8. For components with standoffs, the dimension is measured from the centerline of the feed hole to the inside radius of the form.
9. To determine which dimension to use in designing the PC board, please refer to "Component Lead Hole Considerations" section of this GS.
10. Dimension to be 0.38mm (0.015") larger than hole diameter in the board.
11. If leads are off center of component body, effective ϕD dimension = 2x distance from center line of component leads to furthestmost edge of component body.
12. Steel leads may not exceed 0.64mm (0.025") in diameter when using an N-type cutter head for 2.5mm/5.0mm tooling. For 2.5mm/5.0mm/7.5mm tooling, running steel leads with 0.81mm (0.032") will decrease tooling life. (See Note 9)
13. Parts longer than 12.39mm (0.488"), for example, SIP type components, must be taped 25.4mm (1") on center. Parts taped in this manner result in an increase in transfer time from dispenser head to carrier clip. Consult your Universal Sales Engineer for 15mm (0.59") or 30mm (1.18") pitch.
14. The distance between the bottom of the guide jaw to bottom of the pusher tip when in full up position is 30.73mm (1.210"). Full downward travel of the insertion pusher extends to surface of printed circuit board or top of component, whichever is greater.
15. Dimension applies to untaped leads.
16. F_3 dimension is designed to limit the minimum lead span of taped components.
17. F_4 dimension is designed to limit the maximum lead span of the taped component.
18. Component deflection (Δh , Δp) is measured from the centerline of the component at the center top of the component.
19. ϕD max is 13.0mm.

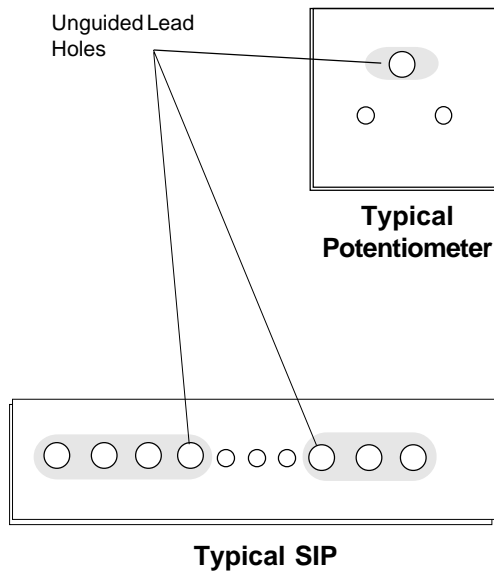
Notes: (continued)

20. Minimum H dimension increases with body diameter. See below. Maximum H dimension is not affected.

| Tooling Style | ϕ D Rectangle Note 11 | | ϕ D Round | | H Min | |
|---------------|-------------------------------|-------|----------------|-------|-------|-------|
| | mm | inch | mm | inch | mm | inch |
| 10.5mm | | | | | | |
| | 4.57 | 0.180 | 5.46 | 0.215 | 15.49 | 0.610 |
| | 4.90 | 0.193 | 6.00 | 0.236 | 15.88 | 0.625 |
| | 6.20 | 0.244 | 8.00 | 0.315 | 16.87 | 0.664 |
| | 8.26 | 0.325 | 10.50 | 0.413 | 18.44 | 0.726 |
| 13.0mm | | | | | | |
| | 6.15 | 0.242 | 6.15 | 0.242 | 15.49 | 0.610 |
| | 7.00 | 0.276 | 7.00 | 0.276 | 15.98 | 0.629 |
| | 10.00 | 0.394 | 10.00 | 0.394 | 17.50 | 0.689 |
| | 13.00 | 0.512 | 13.00 | 0.512 | 19.03 | 0.749 |

Component Lead Hole Considerations

PC boards should be punched or drilled for component lead insertion to the following recommended hole diameters.



Unguided leads require larger hole-to-lead relationships.

- Hole Diameter = Maximum Lead Diameter + 0.48mm (0.019")
±0.08mm (0.003")

Hole sizes less than the recommended size may result in a degradation of insertion reliability, while holes that are greater than recommended may result in loose components in the printed circuit board.

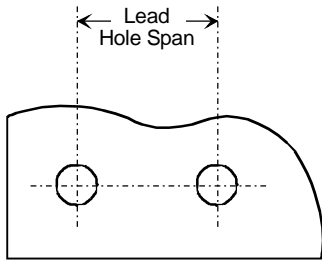
Unguided leads require larger hole-to-lead relationships. For triangular or in-line layout (such as potentiometers and SIPs), PC boards should be punched for the unguided lead(s) to the following recommended hole diameter.

- Hole Diameter = Maximum Lead Diameter + 0.58mm (0.023")
±0.08mm (0.003")

Note:

For maximum lead diameter, use ϕd , ϕd_1 , ϕd_2 , or ϕd_3 , whichever is largest.

For further considerations and examples of lead-to-hole relationships, see Pages 41 - 54 for the particular cut and clinch you are interested in.



Recommended Lead Hole Span (2.5mm/5.0mm Components)

Insertion performance is maximized by considering the jaw tooling design when laying out the PC board hole patterns (the jaw clamps secure the component leads against the fixed surfaces of the jaw guide).

For best results, the insertion hole spans in the PC board should be designed at 2.54mm (0.100") for 2.5mm components, and one lead diameter plus 4.5mm (0.177") for 5mm components.

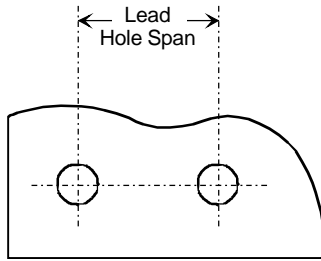
Use the following table for a reference.

| Lead Diameter | Recommended Lead Hole Span | Lead Diameter | Recommended Lead Hole Span |
|-----------------|----------------------------|-----------------|----------------------------|
| 2.5mm | | 5.0mm | |
| 0.36mm (0.014") | 2.34mm (0.092") | 0.36mm (0.014") | 4.85mm (0.191") |
| 0.41mm (0.016") | 2.37mm (0.094") | 0.41mm (0.016") | 4.9mm (0.193") |
| 0.46mm (0.018") | 2.44mm (0.096") | 0.46mm (0.018") | 4.95mm (0.195") |
| 0.51mm (0.020") | 2.49mm (0.098") | 0.51mm (0.020") | 5.0mm (0.197") |
| 0.56mm (0.022") | 2.54mm (0.100") | 0.56mm (0.022") | 5.05mm (0.199") |
| 0.61mm (0.024") | 2.59mm (0.102") | 0.61mm (0.024") | 5.11mm (0.201") |
| | | 0.66mm (0.026") | 5.16mm (0.203") |
| | | 0.71mm (0.028") | 5.21mm (0.205") |

Note:

These dimensions apply only to holes for leads that are captured by the insertion tooling. All remaining holes should be drilled according to component manufacturers' specified spacing requirements.

Recommended Lead Hole Span (2.5mm/ 5.0mm/7.5mm/10.0mm Components)



Insertion performance is maximized by considering the jaw tooling design when laying out the PC board hole patterns (the jaw clamps secure the component leads against the fixed surfaces of the jaw guide).

For best results, the insertion hole spans in the PC board should be designed as follows:

- 2.54mm (0.100") for 2.5mm components
- one lead diameter + 4.5mm (0.177") for 5.0mm components
- one lead diameter + 7.04mm (0.277") for 7.5mm components
- one lead diameter + 9.58mm (0.377") for 10.0mm components

Use the following table for a reference.

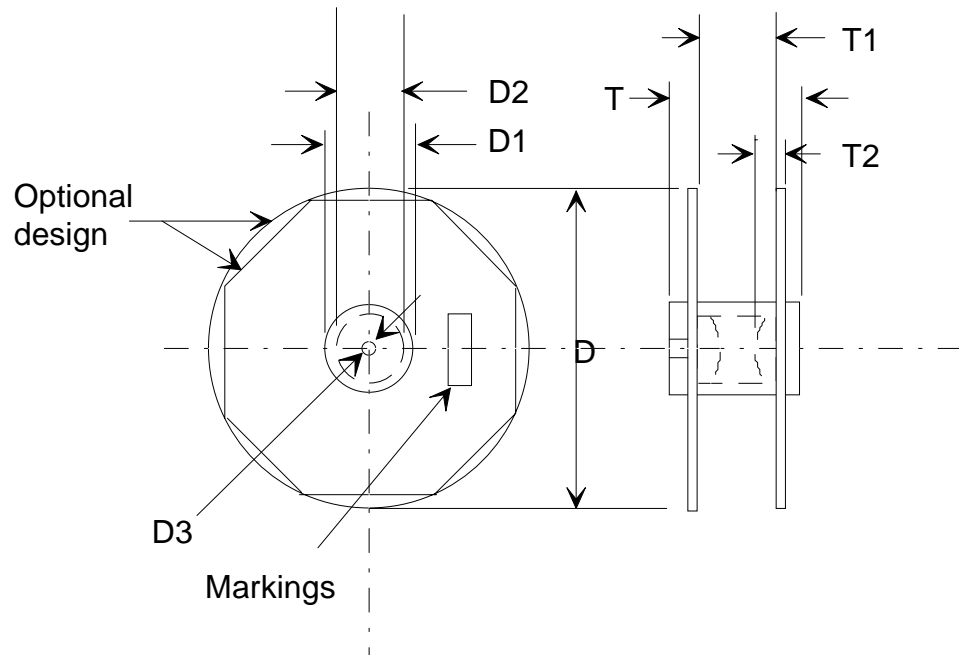
| Lead Diameter | Recommended Lead Hole Span | Lead Diameter | Recommended Lead Hole Span |
|-----------------|----------------------------|-----------------|----------------------------|
| 2.5mm | | 5.0mm | |
| 0.36mm (0.014") | 2.54mm (0.100") | 0.36mm (0.014") | 4.85mm (0.191") |
| 0.41mm (0.016") | 2.54mm (0.100") | 0.41mm (0.016") | 4.90mm (0.193") |
| 0.46mm (0.018") | 2.54mm (0.100") | 0.46mm (0.018") | 4.95mm (0.195") |
| 0.51mm (0.020") | 2.54mm (0.100") | 0.51mm (0.020") | 5.00mm (0.197") |
| 0.56mm (0.022") | 2.54mm (0.100") | 0.56mm (0.022") | 5.05mm (0.199") |
| 0.61mm (0.024") | 2.54mm (0.100") | 0.61mm (0.024") | 5.11mm (0.201") |
| 0.66mm (0.026") | 2.54mm (0.100") | 0.66mm (0.026") | 5.16mm (0.203") |
| 0.71mm (0.028") | 2.54mm (0.100") | 0.71mm (0.028") | 5.21mm (0.205") |
| 0.76mm (0.030") | 2.54mm (0.100") | 0.76mm (0.030") | 5.26mm (0.207") |
| 0.81mm (0.032") | 2.54mm (0.100") | 0.81mm (0.032") | 5.31mm (0.209") |
| 0.86mm (0.034") | 2.54mm (0.100") | 0.86mm (0.034") | 5.36mm (0.211") |
| 7.5mm | | 10.0mm | |
| 0.36mm (0.014") | 7.39mm (0.291") | 0.36mm (0.014") | 9.93mm (0.391") |
| 0.41mm (0.016") | 7.44mm (0.293") | 0.41mm (0.016") | 9.98mm (0.393") |
| 0.46mm (0.018") | 7.49mm (0.295") | 0.46mm (0.018") | 10.03mm (0.395") |
| 0.51mm (0.020") | 7.54mm (0.297") | 0.51mm (0.020") | 10.08mm (0.397") |
| 0.56mm (0.022") | 7.59mm (0.299") | 0.56mm (0.022") | 10.13mm (0.399") |
| 0.61mm (0.024") | 7.65mm (0.301") | 0.61mm (0.024") | 10.18mm (0.401") |
| 0.66mm (0.026") | 7.70mm (0.303") | 0.66mm (0.026") | 10.23mm (0.403") |
| 0.71mm (0.028") | 7.75mm (0.305") | 0.71mm (0.028") | 10.29mm (0.405") |
| 0.76mm (0.030") | 7.80mm (0.307") | 0.76mm (0.030") | 10.34mm (0.407") |
| 0.81mm (0.032") | 7.85mm (0.309") | 0.81mm (0.032") | 10.39mm (0.409") |
| 0.86mm (0.034") | 7.90mm (0.311") | 0.86mm (0.034") | 10.44mm (0.411") |

Note:

These dimensions apply only to holes for leads that are captured by the insertion tooling. All remaining holes should be drilled according to component manufacturers' specified spacing requirements.

Radial Lead Taped Component Packaging Specifications

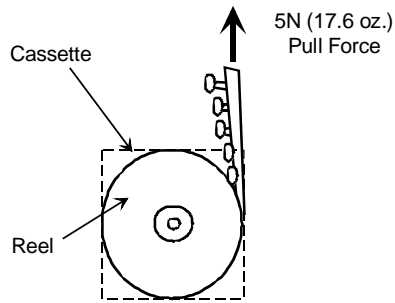
Applicable to reel, cassette, and ammo-pack (fold-pack) containers for radial lead taped components. A tape trailer having at least 3 feed holes is required at the end of the tape to feed the last component into the dispensing head.



| SYMBOL | ITEM | SPECIFICATION | | | |
|--------|------------------------------|---------------|-------|---------|------|
| | | MINIMUM | | MAXIMUM | |
| | | MM | INCH | MM | INCH |
| D | Reel Diameter | 76.2 | 3.0 | 360 | 14.0 |
| D1 | Core Diameter | 34.9 | 1.4 | 102 | 4.0 |
| D2 | Hub Recess Inside Diameter | 28.6 | 1.12 | 86 | 3.4 |
| D3 | Arbor Hole Diameter | 13.8 | 0.54 | 38.1 | 1.5 |
| T | Overall Reel Thickness | - | - | 57.2 | 2.5 |
| T1 | Inside Reel Flange Thickness | 30 | 1.2 | 50 | 2.0 |
| T2 | Hub Recess Depth | 9.5 | 0.374 | - | - |

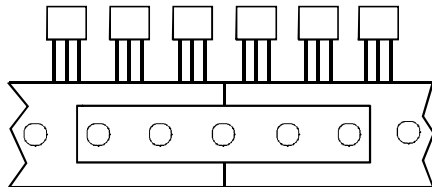
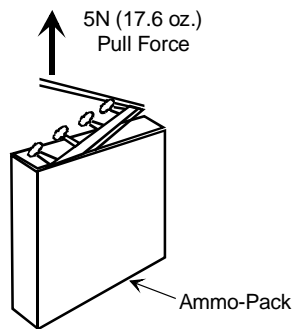
Notes:

1. No more than 3 consecutive missing components are permitted.
2. Polarized components will be oriented in one direction on the input reel, cassette, or ammo-pack container.



Taped Component Removal Pull Testing

The taped components shall unwind (reel and cassette) or unfold (ammo-pack) with a force not to exceed 5 Newtons (17.6 oz.). Pull test shall be applied as illustrated.



Input Tape Splicing

Component may be spliced with an acceptable splicing tape. Universal splicing tape is recommended.

Splices must not interfere with tape feed holes and overall tape thickness may not exceed 1.5mm (0.059").

Maximum Component Weight

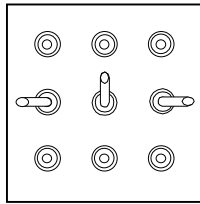
The Radial 8 inserts components weighing up to 5 grams. Mass and the center of gravity affect these limitations. A short 5 gram component with a center of gravity 20.32mm (0.80") above the feed hole may run, but a tall 5 gram component with a center of gravity 35.56mm (1.40") above the feed hole may move up or down in the chain clip, affecting reliability.

Maximum Reel Weight

To handle reels of components in excess of 1.8 kg (4 lbs.), consult the factory.

Cut and Clinch Footprints

The cut and clinch cuts the component leads after they are inserted through the PC board and then clinches them against the underside of the PC board, securing the component in place.

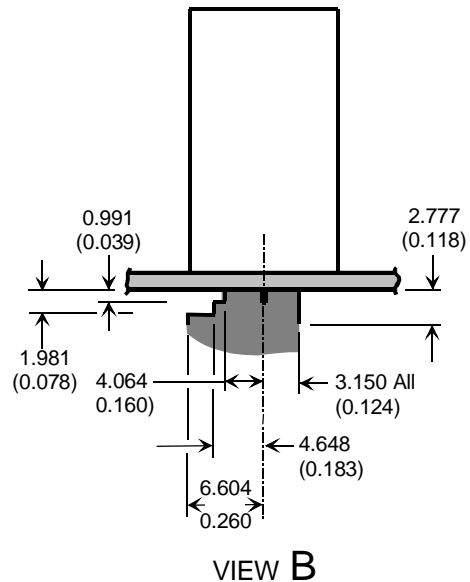
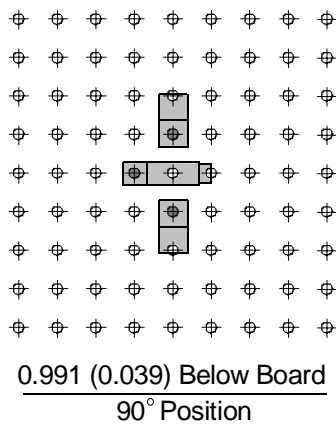
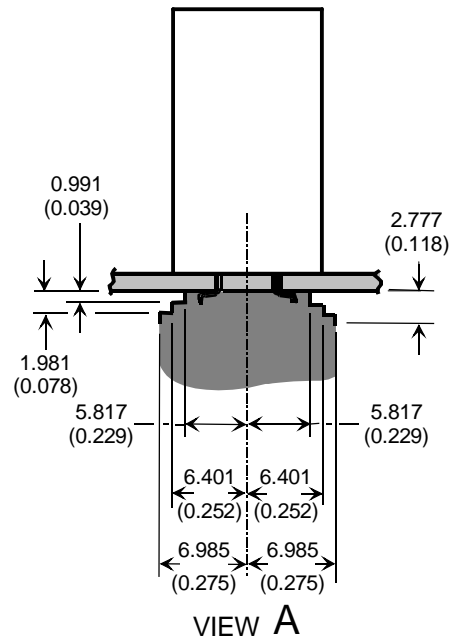
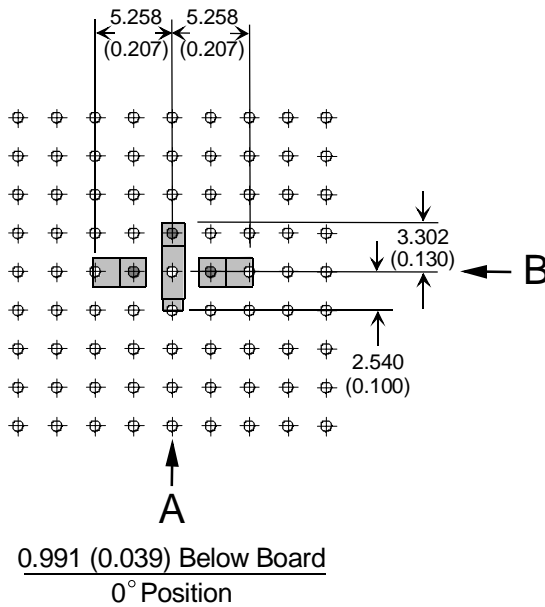


Cut and Clinch, "T-Type"

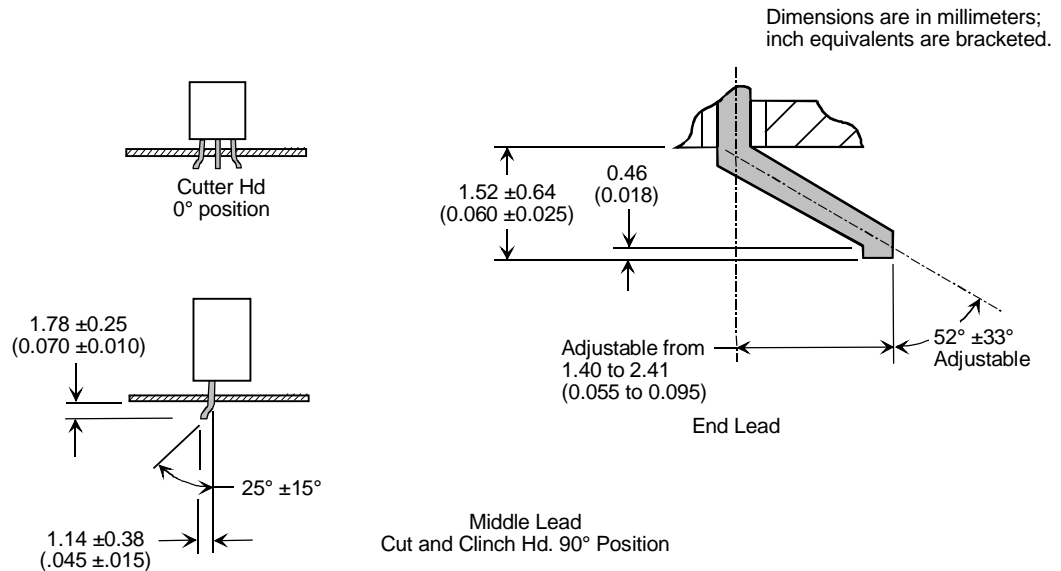
The T-type cut and clinch can cut and clinch two- or three- leaded devices at 5.0mm lead span. The cut and clinch footprint is shown below.

"T-Type" Cut and Clinch Footprint (5mm and Three-Leaded Devices Only) Holes Represent PC Board Holes at 2.54mm (0.100") Spacing

Dimensions are in millimeters;
inch equivalents are bracketed



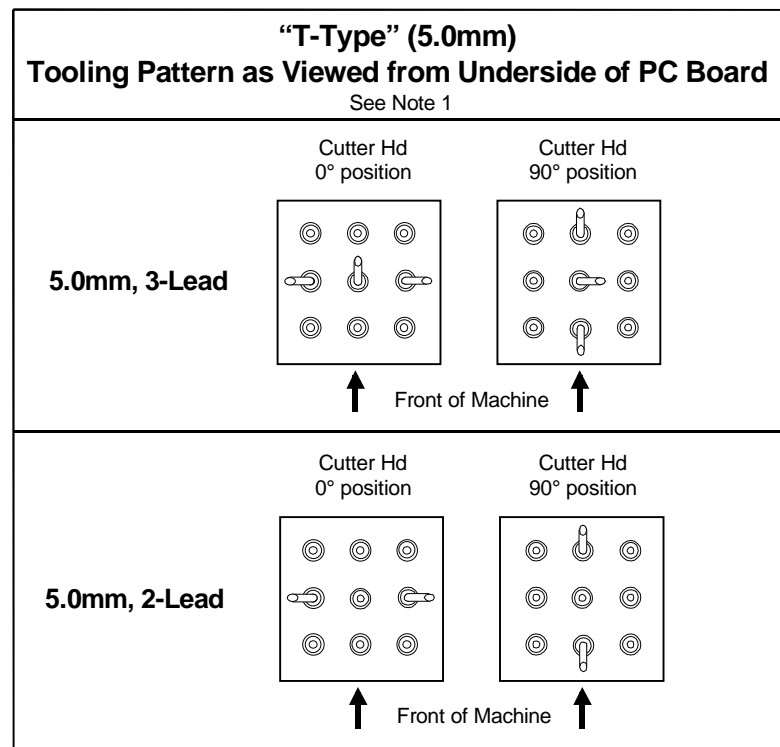
“T-Type” (5.0mm)

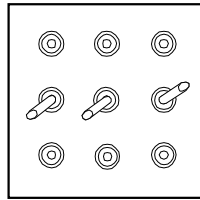


Note:
Specifications for this cut and clinch (lead angles, lengths, and heights) vary based on PC board hole diameters, component lead diameters, component lead material composition, and component lead shape (round, square, and flat).

Notes:

1. Dimensions shown reflect factory setup dimensions and will vary with lead diameter, materials, hole diameter, spacing, and specific setup requirements.
2. Refer to specific machine dimensions. (PC board warpage, board and anvil clearance, lead material, and variations of hole or lead diameters cause variations in lead angle, form, and length dimensions.) Cut and clinch tooling parameters shown are examples for reference only.
3. Parameters based on theoretical values.
4. Dimensions shown apply only to the center lead.
5. Lead angles are measured from the vertical position.

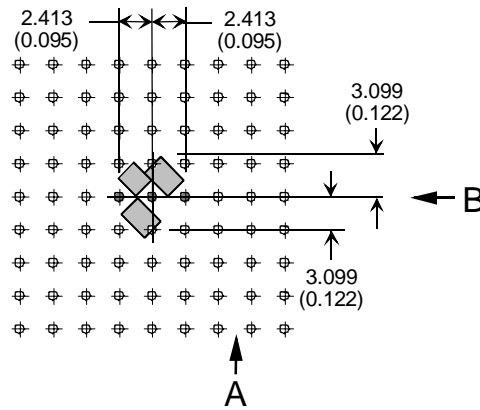




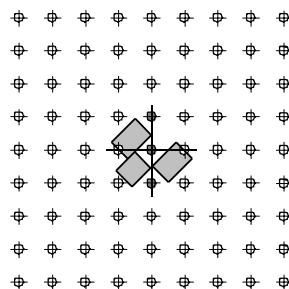
Cut and Clinch, "N-Type," 90° Long Lead for 2.5mm/5.0mm Components

The N-type cut and clinch can cut and clinch 2-and 3-leaded components (2.5mm/5.0mm, or 5.0mm-only). The cut and clinch footprint and recommended clearances are shown below.

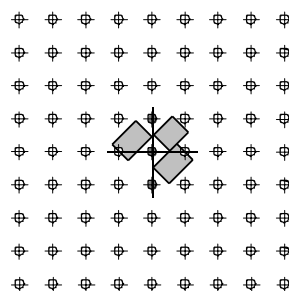
Footprint and Clearances for "N-Type" 90° Long Lead Cut and Clinch Holes Represent PC Board Holes at 2.54mm (0.100") Spacing



0.991 (0.039) Below Board
0° Position



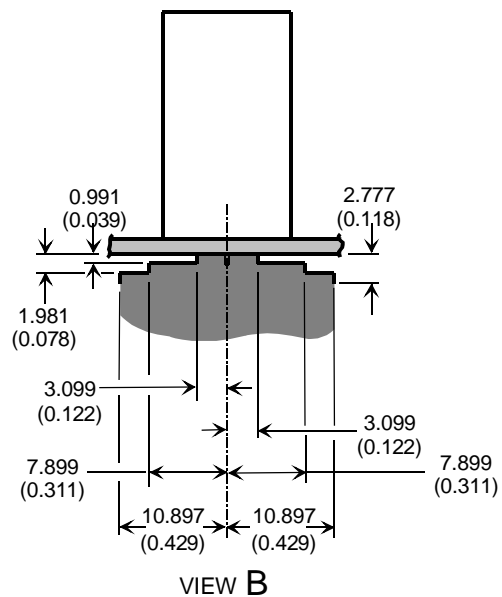
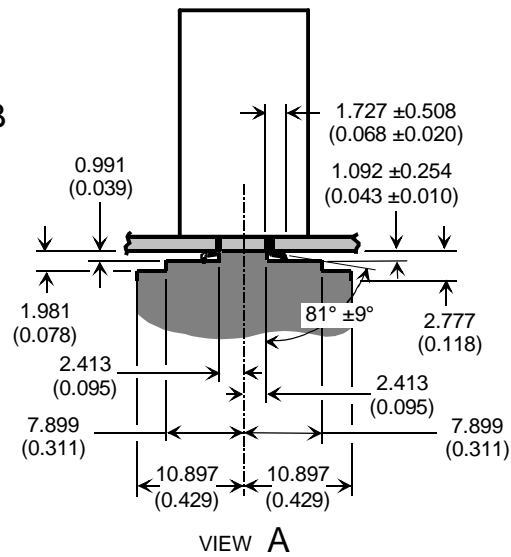
0.991 (0.039) Below Board
90° Position Right



0.991 (0.039) Below Board
90° Position Left



Dimensions are in millimeters;
inch equivalents are bracketed



“N-Type” 90° Long Lead (2.5mm/5mm)

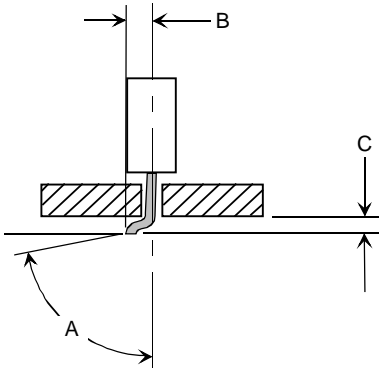
Lead \varnothing - 0.635mm (0.025")

Hole \varnothing - 0.99mm (0.039")

“A” Lead Angle $81^{\circ} \pm 9^{\circ}$

“B” Lead Length 1.73mm ± 0.51 mm
(0.068" ± 0.020 ")

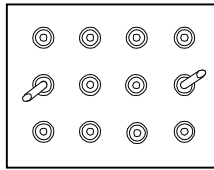
“C” Lead Height 1.09mm ± 0.25 mm
(0.043" ± 0.010 ")



Notes:

1. Values A, B, and C were obtained with the difference between hole and lead diameter of 0.36mm (0.014").
2. Specifications for this cut and clinch (lead angles, lengths, and heights) vary based on PC board hole diameters, component lead diameters, component lead material composition, and component lead shape (round, square, and flat).

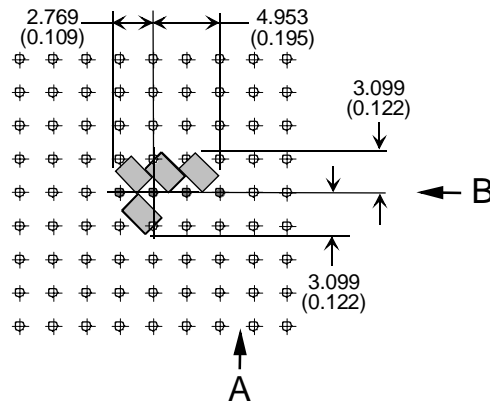
Lead length is also dependent on tooling window openings.



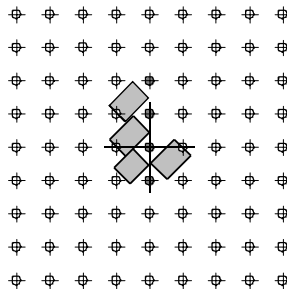
Cut and Clinch, "N-Type," 90° Long Lead for 2.5mm/5.0mm/7.5mm Components

The N-type cut and clinch can cut and clinch 2- and 3-leaded components (2.5mm/5.0mm/7.5mm). The cut and clinch footprint and recommended clearances are shown below.

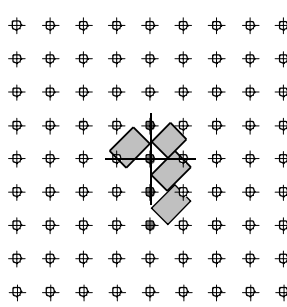
Footprint and Clearances for "N-Type" 90° Long Lead Cut and Clinch Holes Represent PC Board Holes at 2.54mm (0.100") Spacing



0.991 (0.039) Below Board
0° Position



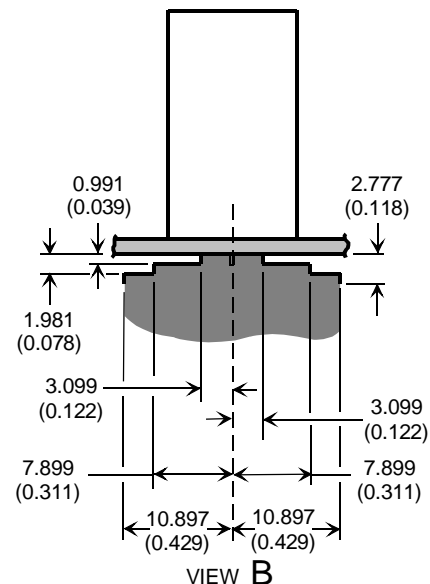
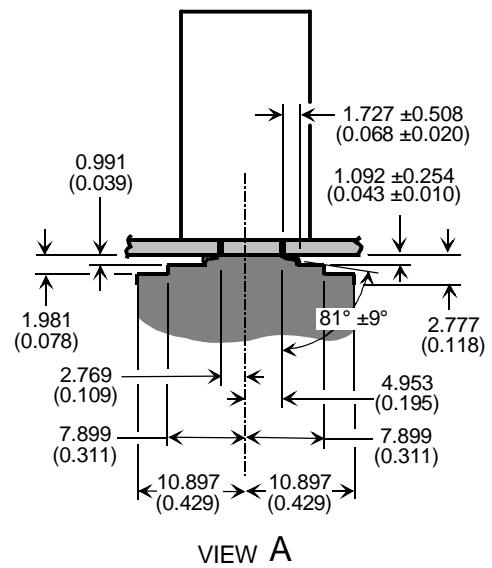
0.991 (0.039) Below Board
90° Position Right

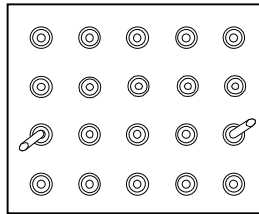


0.991 (0.039) Below Board
90° Position Left



Dimensions are in millimeters;
inch equivalents are bracketed

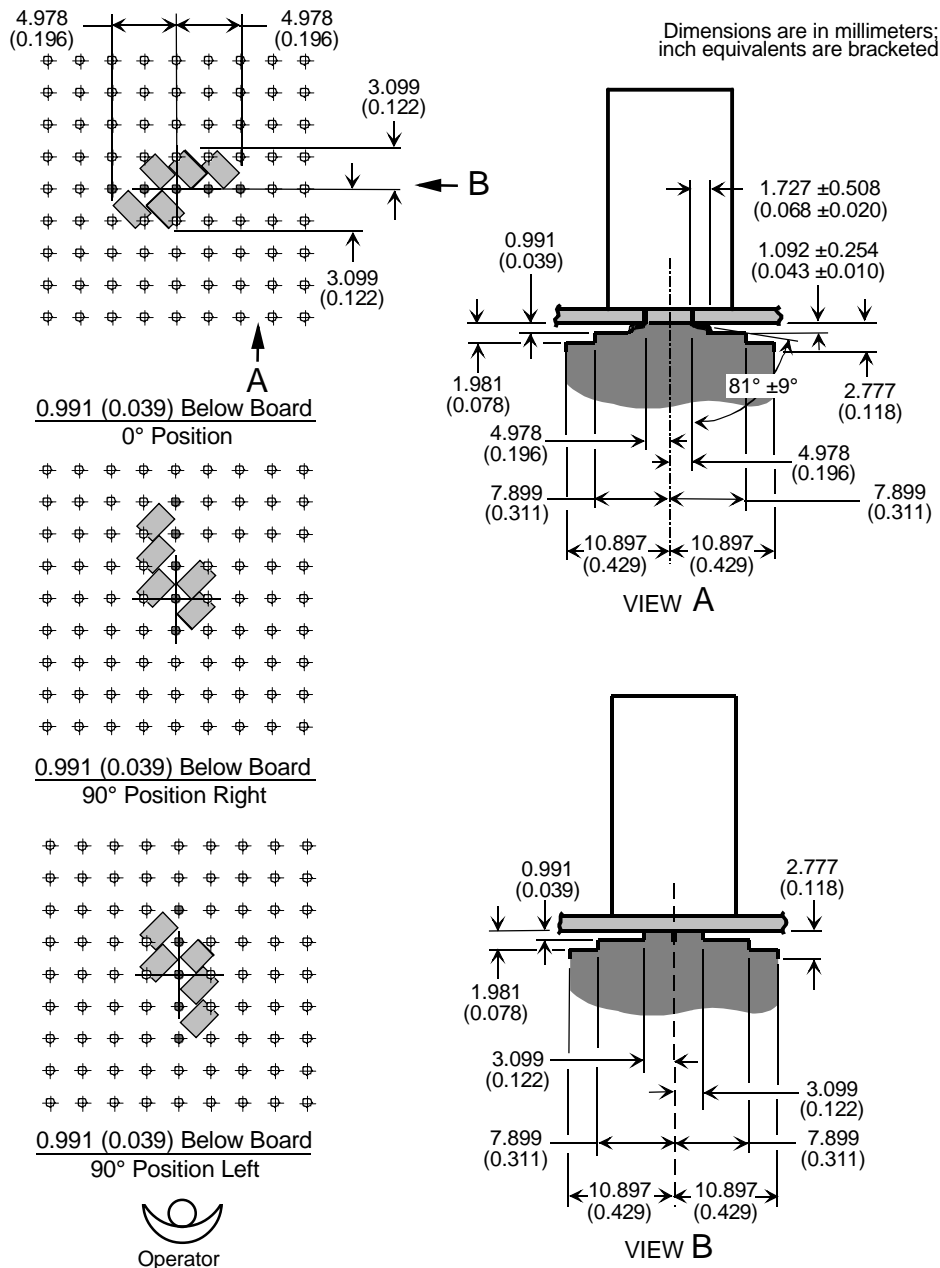


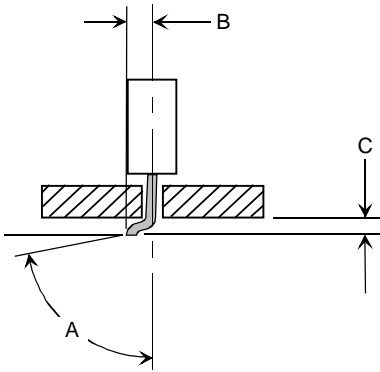


Cut and Clinch, "N-Type," 90° Long Lead for 5.0mm/7.5mm/10.0mm Components

The N-type cut and clinch can cut and clinch 2- and 3-leaded components (5.0mm/7.5mm/10.0mm). The cut and clinch footprint and recommended clearances are shown below.

Footprint and Clearances for "N-Type" 90° Long Lead Cut and Clinch Holes Represent PC Board Holes at 2.54mm (0.100") Spacing





Radial Cut and Clinch Specifications

“N-Type” 90° Long Lead (2.5mm/5.0mm/ 7.5mm or 5.0mm/7.5mm/10.0mm)

Lead Ø - 0.635mm (0.025")

Hole Ø - 1.12mm (0.044")

“A” Lead Angle 81° ±9°

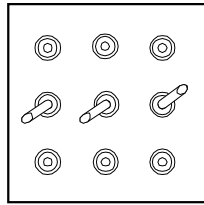
“B” Lead Length 1.73mm ±0.51mm
(0.068" ±0.020")

“C” Lead Height 1.09mm ±0.25mm
(0.043" ±0.010")

Notes:

1. Values A, B, and C were obtained with the difference between hole and lead diameter of 0.483mm (0.019").
2. Specifications for this cut and clinch (lead angles, lengths, and heights) vary based on PC board hole diameters, component lead diameters, component lead material composition, and component lead shape (round, square, and flat).

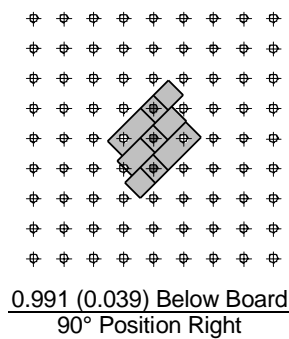
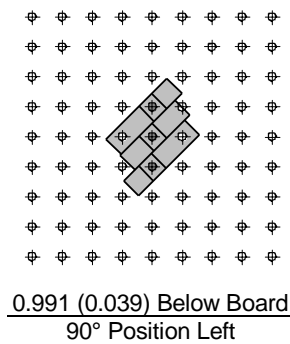
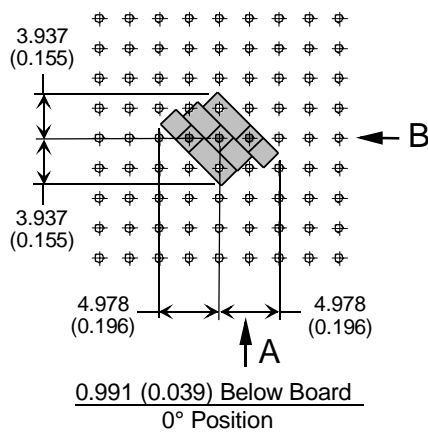
Lead length is also dependent on tooling window openings.



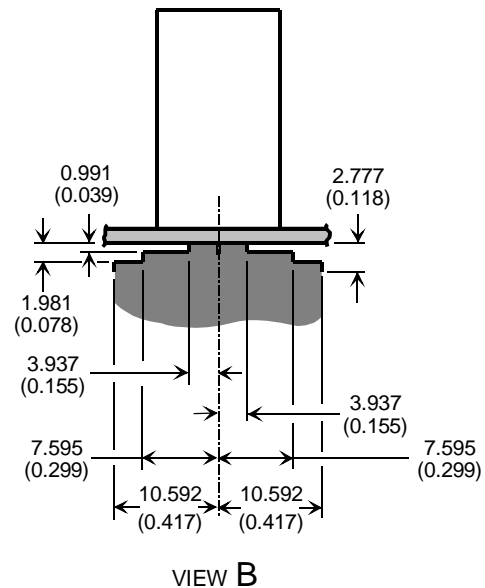
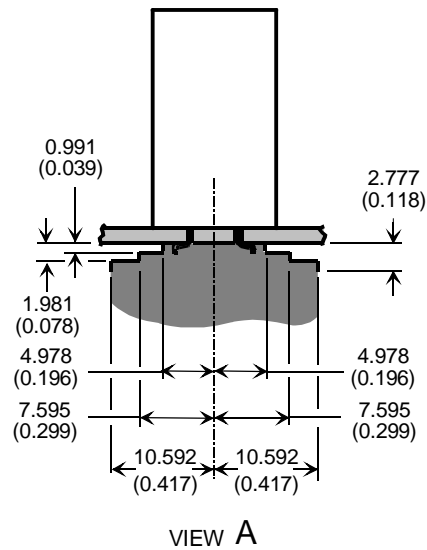
Cut and Clinch, "N-Type," 90° Short Lead for 2.5mm/5.0mm Components

The N-type cut and clinch can cut and clinch 2-and 3-leaded components (2.5mm/5.0mm, or 5.0mm-only). The cut and clinch footprint and recommended clearances are shown below.

Footprint and Clearances for "N-Type" 90° Short Lead Cut and Clinch Holes Represent PC Board Holes at 2.54mm (0.100") Spacing



Dimensions are in millimeters;
inch equivalents are bracketed



“N-Type” 90° Short Lead (2.5mm/5mm)

Lead \varnothing - 0.635mm (0.025")

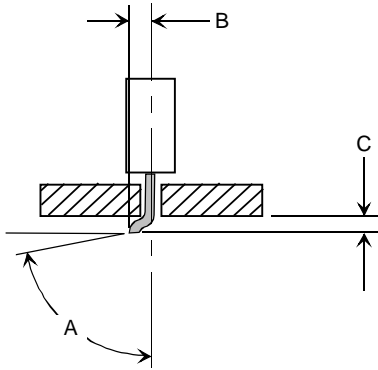
Hole \varnothing - 0.99mm (0.039")

“A” Lead Angle $81^\circ \pm 9^\circ$

“B” Lead Length 1.52mm ± 0.38 mm
(0.060" ± 0.015 ")

“C” Lead Height 0.76mm ± 0.25 mm
(0.030" ± 0.010 ")

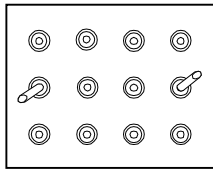
Hole to lead diameters must be maintained when using this cut and clinch option.



Notes:

1. Values A, B, and C were obtained with the difference between hole and lead diameter of 0.36mm (0.014").
2. Specifications for this cut and clinch (lead angles, lengths, and heights) vary based on PC board hole diameters, component lead diameters, component lead material composition, and component lead shape (round, square, and flat).

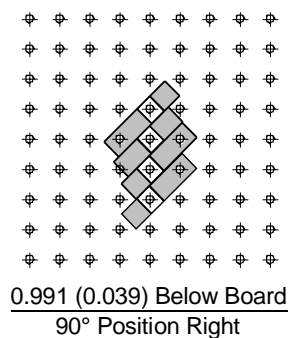
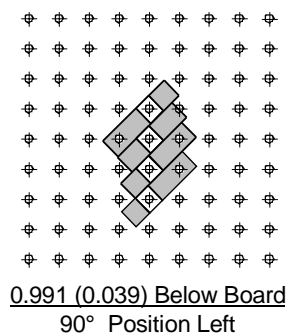
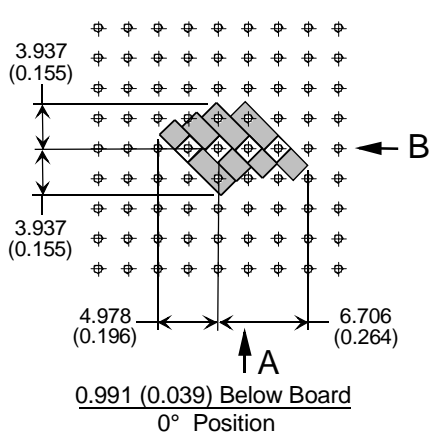
Lead length is also dependent on tooling window openings.



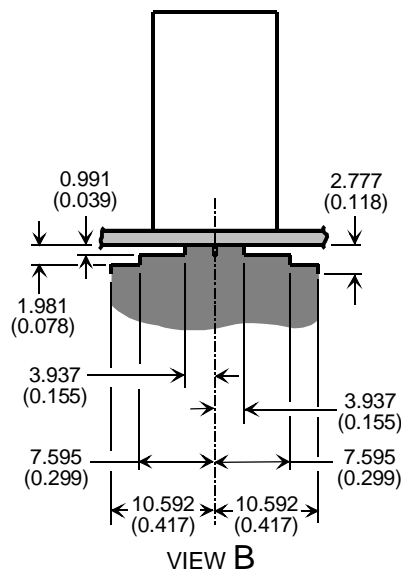
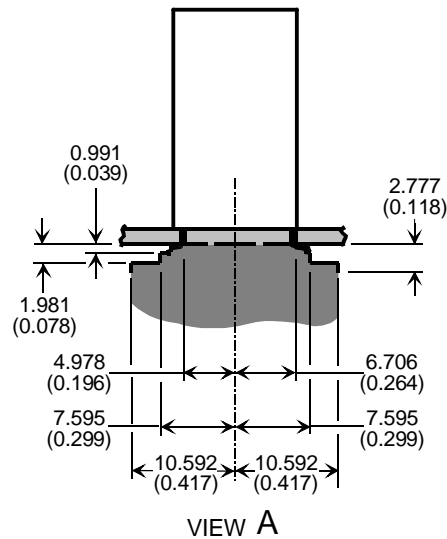
Cut and Clinch, "N-Type," 90° Short Lead for 2.5mm/5.0mm/7.5mm Components

The N-type cut and clinch can cut and clinch 2- and 3-leaded components (2.5mm/5.0mm/7.5mm). The cut and clinch footprint and recommended clearances are shown below.

Footprint and Clearances for "N-Type" 90° Short Lead Cut and Clinch Holes Represent PC Board Holes at 2.54mm (0.100") Spacing

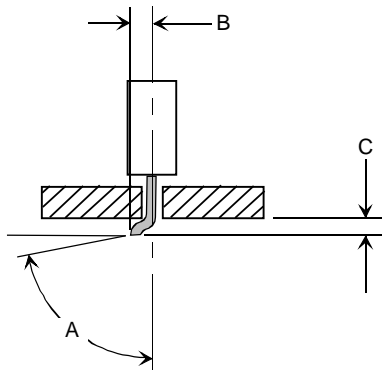


Dimensions are in millimeters;
inch equivalents are bracketed



“N-Type” 90° Short Lead (2.5mm/5.0mm/7.5mm)

Hole to lead diameters must be maintained when using this cut and clinch option.



Lead \varnothing - 0.635mm (0.025")

Hole \varnothing - 1.12mm (0.044")

“A” Lead Angle $81^\circ \pm 9^\circ$

“B” Lead Length 1.52mm ± 0.38 mm
(0.060" ± 0.015 ")

“C” Lead Height 0.76mm ± 0.25 mm
(0.030" ± 0.010 ")

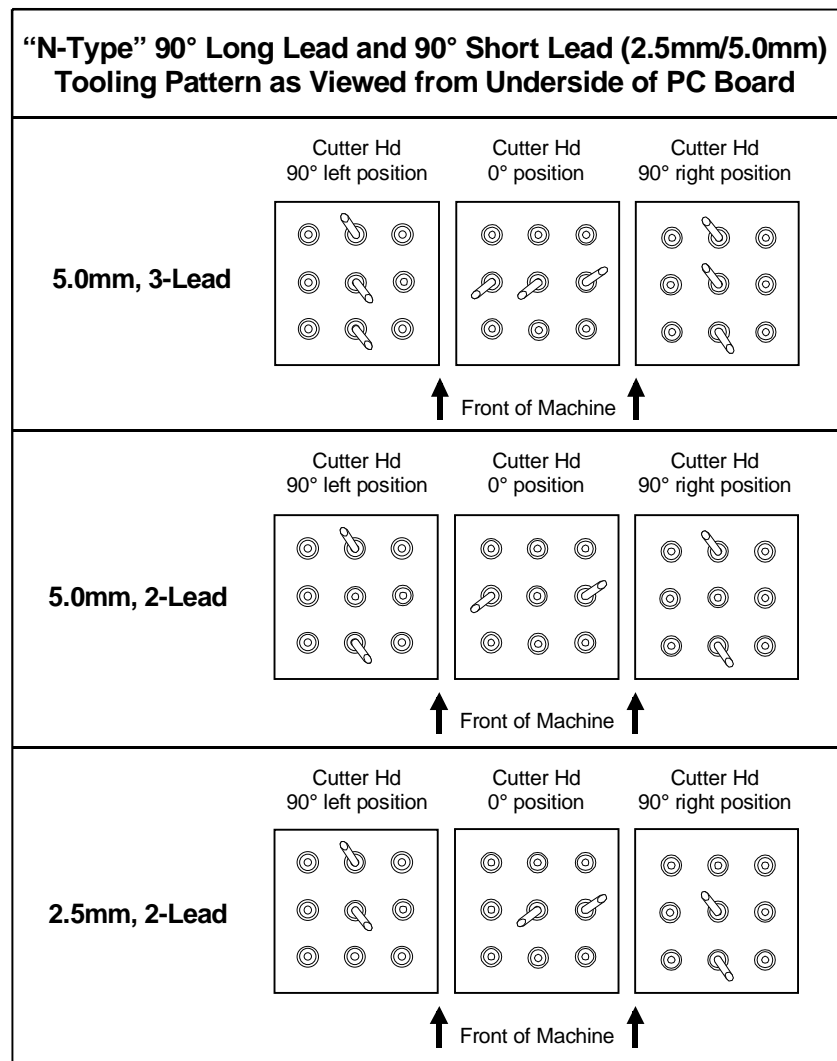
Notes:

1. Values A, B, and C were obtained with the difference between hole and lead diameter of 0.483mm (0.19").
2. Specifications for this cut and clinch (lead angles, lengths, and heights) vary based on PC board hole diameters, component lead diameters, component lead material composition, and component lead shape (round, square, and flat).

Lead length is also dependent on tooling window openings.

Cut and Clinch Specifications for 2.5mm/5.0mm Components

The cut and clinch tooling matrix that follows is provided as a comparison of current standard Universal cut and clinch tooling. Compared are cut and clinch tooling patterns as viewed from the underside of the printed circuit board. Parameters are based on theoretical values.

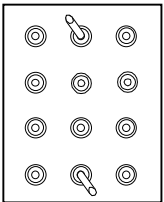
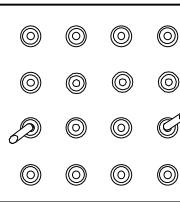
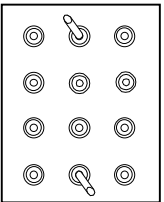
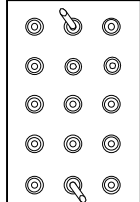
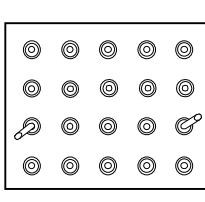
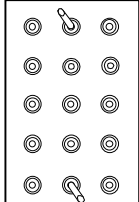
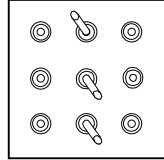
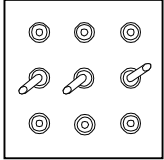
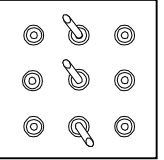
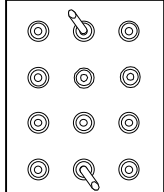
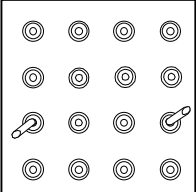
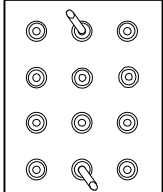
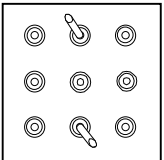
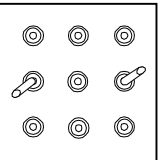
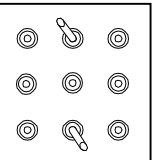
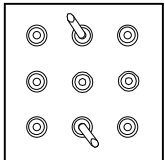
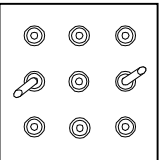
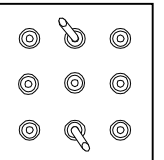
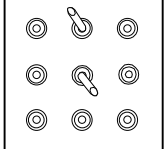
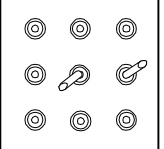
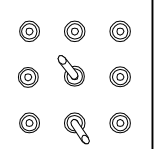


Notes:

1. Dimensions shown reflect factory setup dimensions and will vary with lead diameter, materials, hole diameter, spacing, and specific setup requirements.
2. Refer to specific machine dimensions. (PC board warpage, board and anvil clearance, lead material, and variations of hole or lead diameters cause variations in lead angle, form, and length dimensions.) Cut and clinch tooling parameters shown are examples for reference only.
3. Parameters based on theoretical values.
4. Dimensions shown apply only to the center lead.
5. Lead angles are measured from the vertical position.

Cut and Clinch Specifications for 2.5mm/ 5.0mm/7.5mm and 5.0mm/7.5mm/10.0mm Components

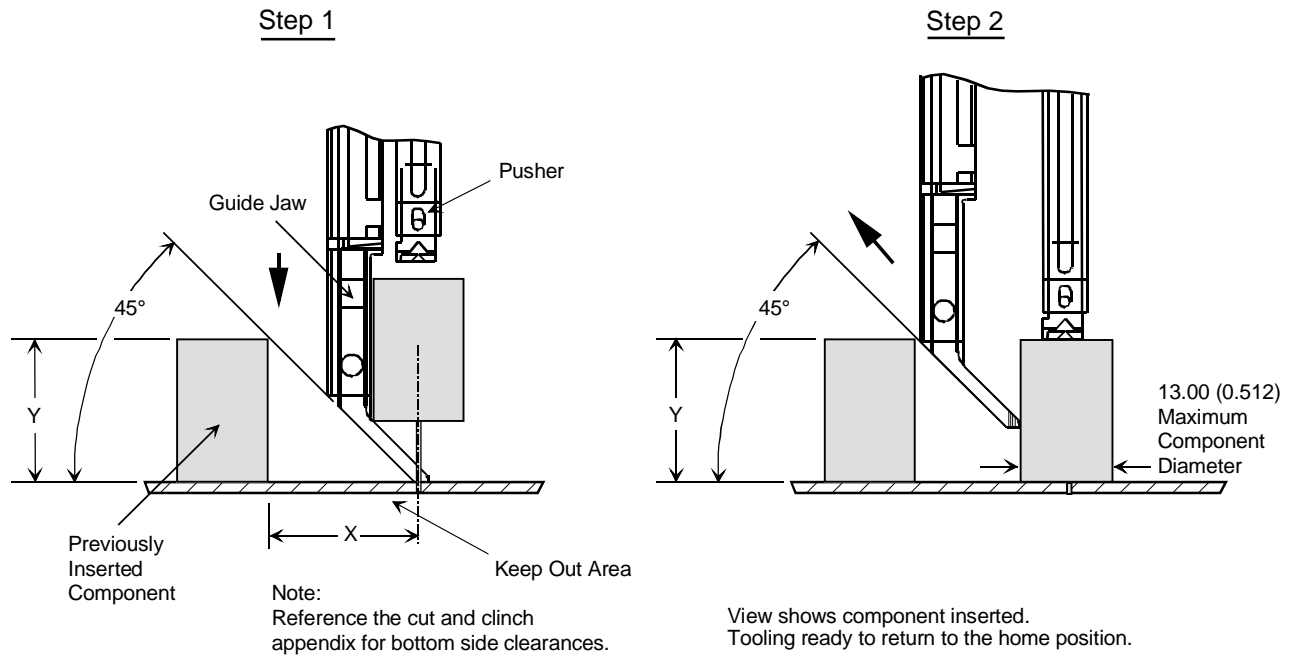
The cut and clinch tooling matrix that follows is provided as a comparison of current standard Universal cut and clinch tooling. Compared are cut and clinch tooling patterns as viewed from the underside of the printed circuit board. Parameters are based on theoretical values.

| Tooling Pattern as Viewed from Underside of PC Board | | | | | |
|---|---|---|---|---|---|
| “N-Type” 90° Long Lead and Short Lead (2.5mm/5.0mm/7.5mm) | | | “N-Type” 90° Long Lead (5.0mm/7.5mm/10.0mm) | | |
| 7.5mm, 2-Lead | | | 10mm, 2-Lead | | |
| Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position | Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position |
|  |  |  |  |  |  |
| 5.0mm, 3-Lead | | | 7.5mm, 2-Lead | | |
| Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position | Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position |
|  |  |  |  |  |  |
| 5.0mm, 2-Lead | | | 5.0mm, 2-Lead | | |
| Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position | Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position |
|  |  |  |  |  |  |
| 2.5mm, 2-Lead | | | Notes: | | |
| Cutter Hd 90° Left Position | Cutter Hd 0° Position | Cutter Hd 90° Right Position | 1. Dimensions shown reflect factory setup dimensions and will vary with lead diameter, materials, hole diameter, spacing, and specific setup requirements. | | |
|  |  |  | 2. Refer to specific machine dimensions. (PC board warpage, board and anvil clearance, lead material, and variations of hole or lead diameters cause variations in lead angle, form, and length dimensions.) Cut and clinch tooling parameters shown are examples for reference only. | | |
| | | | 3. Parameters based on theoretical values. | | |
| | | | 4. Dimensions shown apply only to the center lead. | | |
| | | | 5. Lead angles are measured from the vertical position. | | |

Insertion Head Footprints

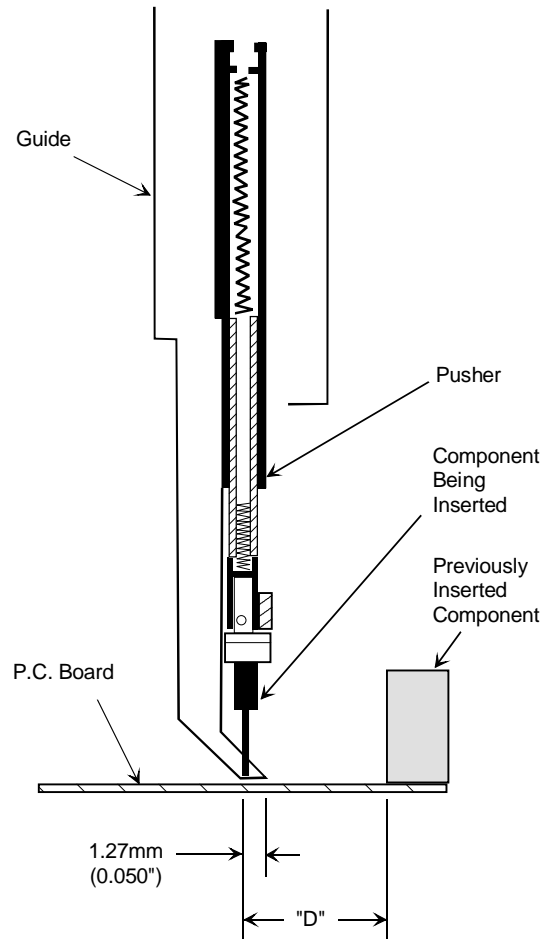
Backside Density (13.0mm Body Diameter Tooling)

Dimensions are in millimeters; inch equivalents are bracketed.



Formula: X (Keep Out Area) = Y (Previously Inserted Component Height) + 0.48mm (0.019")

Frontside Density



Note: Reference the cut and clinch appendix for bottom side clearances.

1. For components being inserted with body diameter *or* width $\geq 6.35\text{mm}$ (0.250").

$$D = \frac{\text{Body Diameter or Width}}{2} + 0.2\text{mm (0.008")}$$

2. For components being inserted with body diameter *or* width $< 6.35\text{mm}$ (0.250")
and

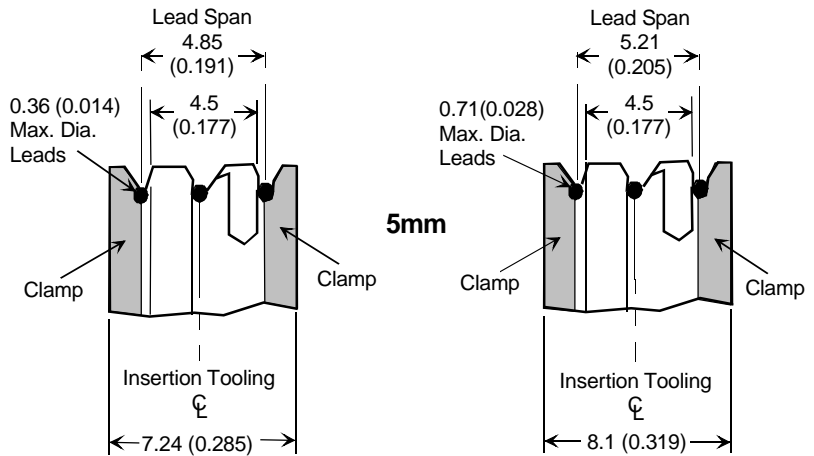
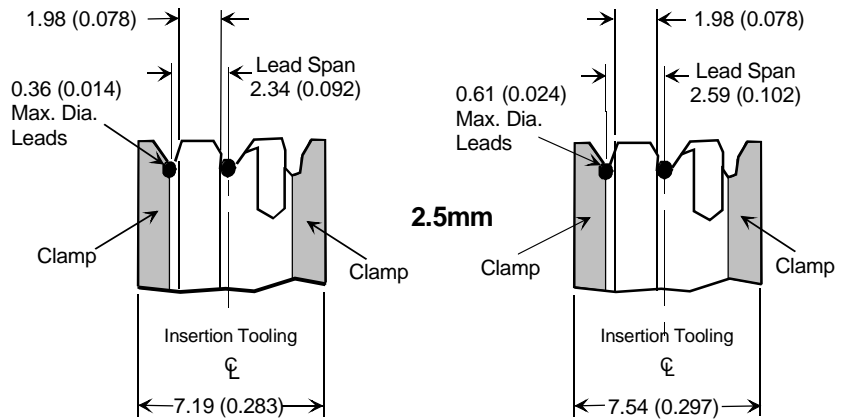
- a. same height or taller than adjacent device;

$$D = \frac{\text{Body Diameter or Width}}{2} + 0.2\text{mm (008") Min 1.47mm (Min 0.058")}$$

- b. Shorter than adjacent device; $D = 3.38\text{mm}$ (0.133")

Lead Diameter-to-Tooling Footprint: 2.5mm/ 5.0mm Tooling

Dimensions are in millimeters;
inch equivalents are bracketed

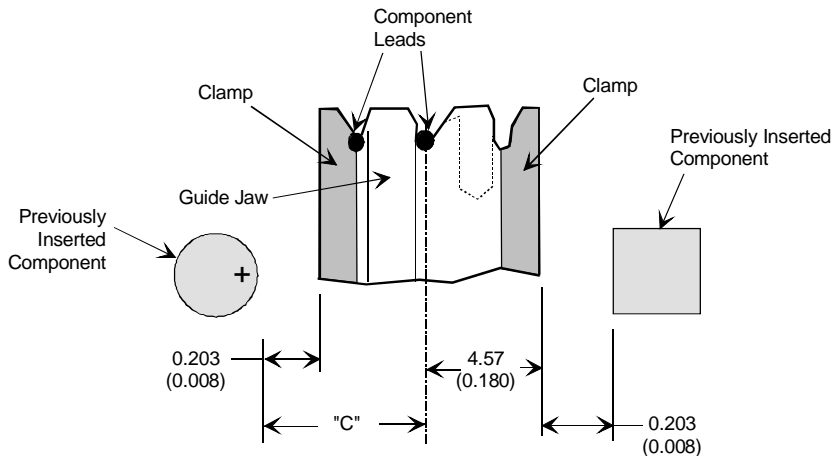


Note:

View shows minimum and maximum diameter leads clamped, overall dimensions, and lead span relationship to lead diameter. View is top side of the tooling.

Side-to-Side Density: 2.5mm/5mm Tooling

2.5mm Component Top View



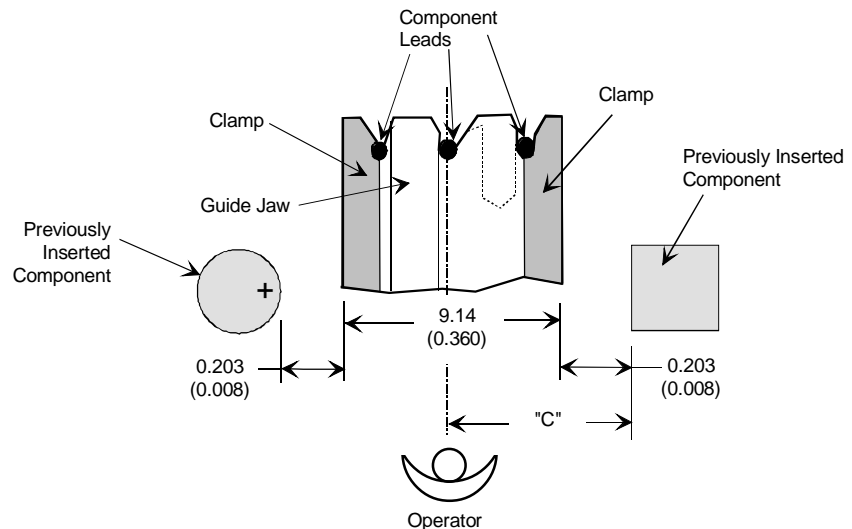
For body diameter or length of component being inserted ≤ 9.14 (0.360),

$$C = 4.78 \text{ (0.188) } \textit{or}$$

For body diameter or length of component being inserted > 9.14 (0.360),

$$C = \frac{(\text{Body Diameter})}{2} + 0.203 \text{ (0.008)}$$

5.0mm Component Top View



For body diameter or length of component being inserted ≤ 6.60 (0.260),

$$C = 4.78 \text{ (0.188) } \textit{or}$$

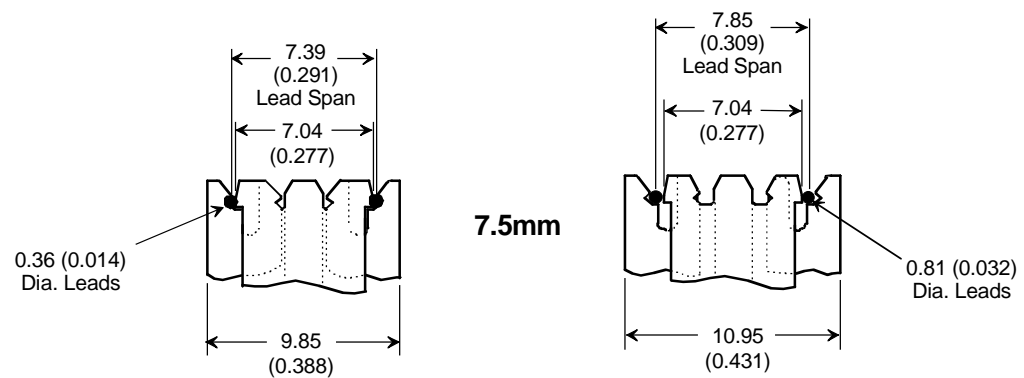
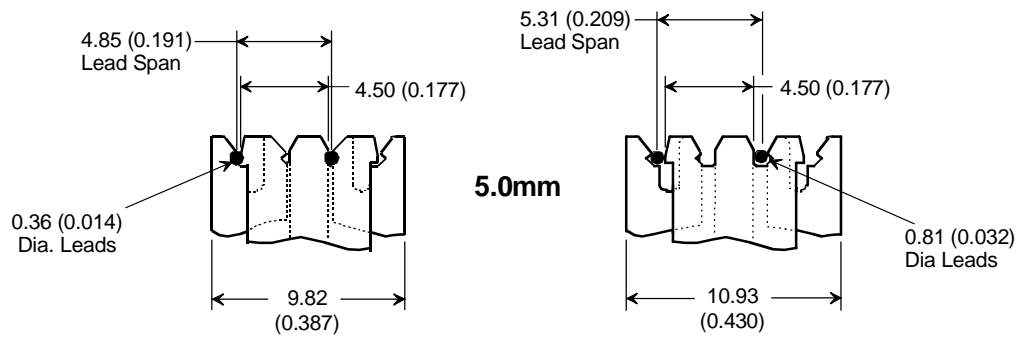
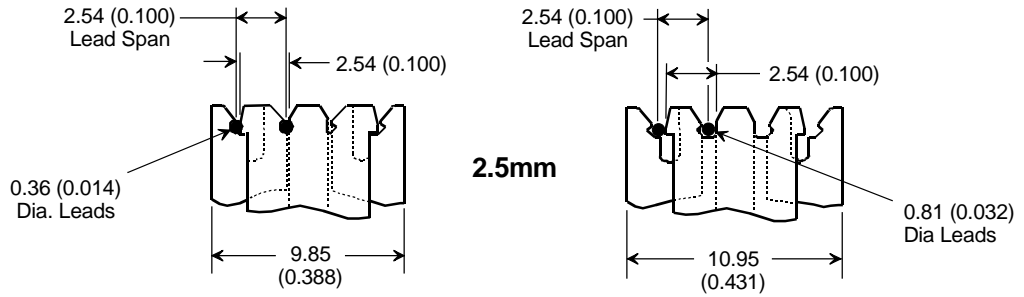
For body diameter or length of component being inserted > 6.60 (0.260),

$$C = \frac{(\text{Body Diameter})}{2} + 1.47 \text{ (0.058)}$$

Note: Tooling shown in open position, top side of tooling.

Lead Diameter-to-Tooling Footprint: 2.5mm/ 5.0mm/7.5mm Tooling

Dimensions are in millimeters;
inch equivalents are bracketed.

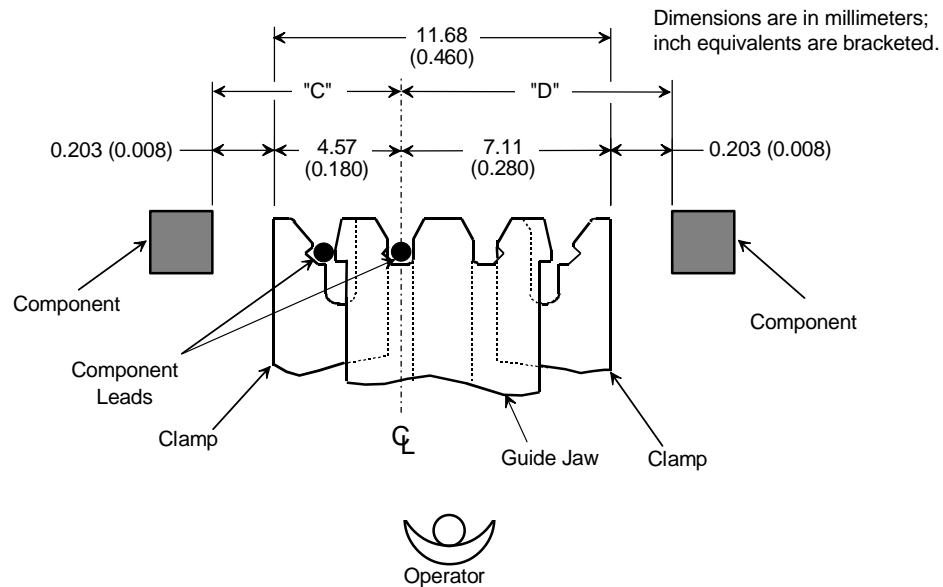


Note:

View shows minimum and maximum diameter leads clamped, overall dimensions, and lead span relationship to lead diameter. View is top side of the tooling.

Side-to-Side Density: 2.5mm/5.0mm/7.5mm Tooling

2.5mm Component Top View



For body diameter or length of component being inserted $\leq 6.60\text{mm}$ (0.260")

$$C = 4.78\text{mm} (0.188") \text{ or}$$

For body diameter or length of component being inserted $> 6.60\text{mm}$ (0.260")

$$C = \frac{(\text{Body Diameter})}{2} + 0.20\text{mm} (0.008") \text{ or}$$

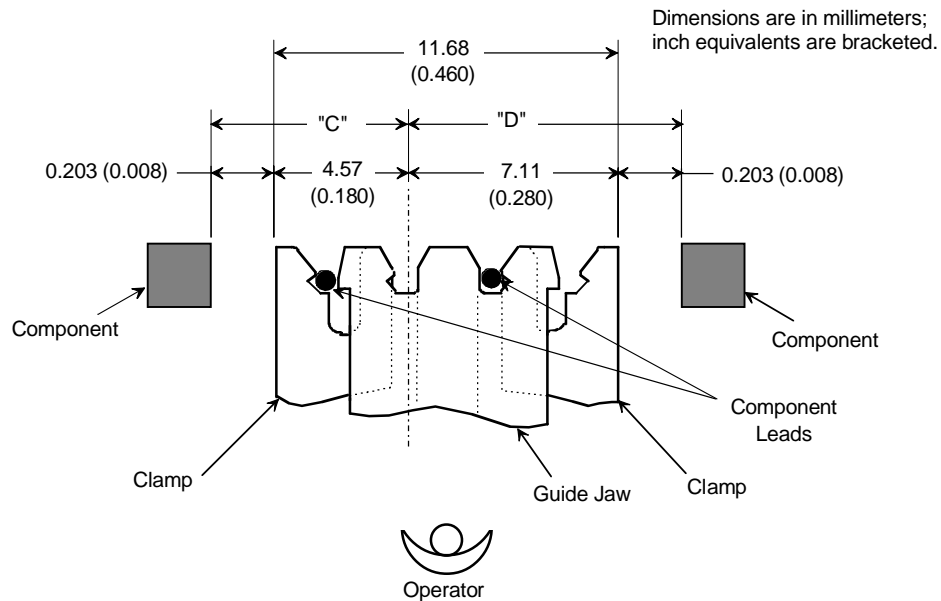
For body diameter or length of component being inserted $> 16.76\text{mm}$ (0.660")

$$D = \frac{(\text{Body Diameter})}{2} + 0.20\text{mm} (0.008")$$

Tooling shown in unclamped position, top side of tooling.

Side-to-Side Density: 2.5mm/5.0mm/7.5mm Tooling

5.0mm Component Top View



For body diameter or length of component being inserted $\leq 9.14\text{mm}$ (0.360")
 $C = 4.78\text{mm}$ (0.188") *or*

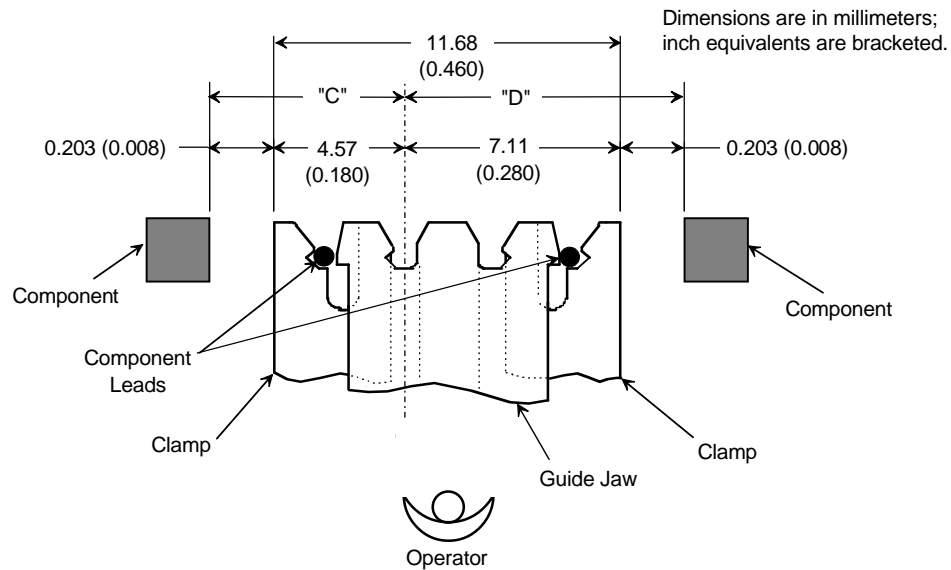
For body diameter or length of component being inserted $> 9.14\text{mm}$ (0.360")
 $C = \frac{(\text{Body Diameter})}{2} + 0.20\text{mm}$ (0.008") *or*

For body diameter or length of component being inserted $> 14.22\text{mm}$ (0.560")
 $D = \frac{(\text{Body Diameter})}{2} + 0.20\text{mm}$ (0.008")

Tooling shown in unclamped position, top side of tooling.

Side-to-Side Density: 2.5mm/5.0mm/7.5mm Tooling

7.5mm Component Top View



For body diameter or length of component being inserted $\leq 11.68\text{mm}$ (0.460")

$$C = 4.78\text{mm} (0.188")$$

$$D = 7.32\text{mm} (0.288") \text{ or}$$

For body diameter or length of component being inserted $>11.68\text{mm}$ (0.460")

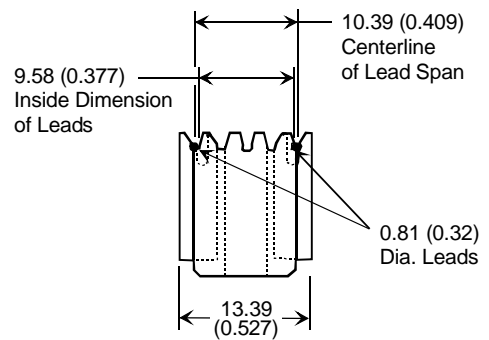
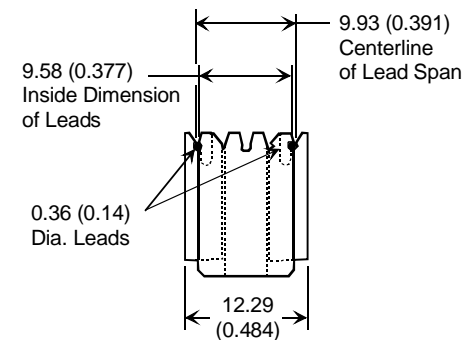
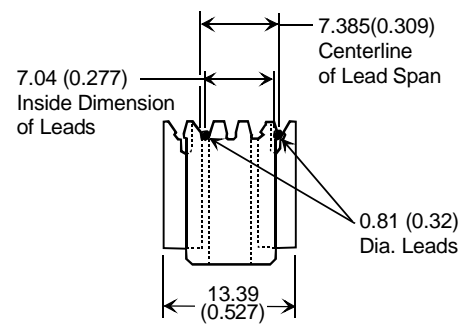
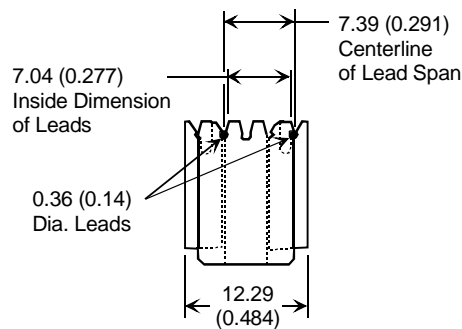
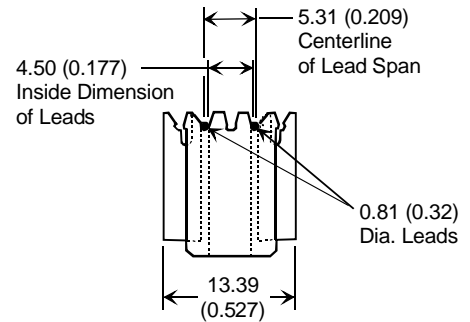
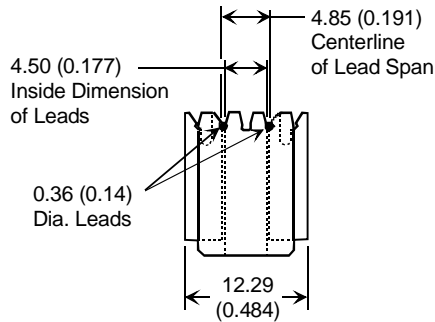
$$C = \frac{(\text{body diameter})}{2} - 1.07\text{mm} (0.042") \text{ or}$$

$$D = \frac{(\text{body diameter})}{2} + 1.47\text{mm} (0.058")$$

Tooling shown in unclamped position, top side of tooling.

Lead Diameter-to-Tooling Footprint: 5.0mm/ 7.5mm/10.0mm Tooling

Dimensions are in millimeters;
inch equivalents are bracketed.

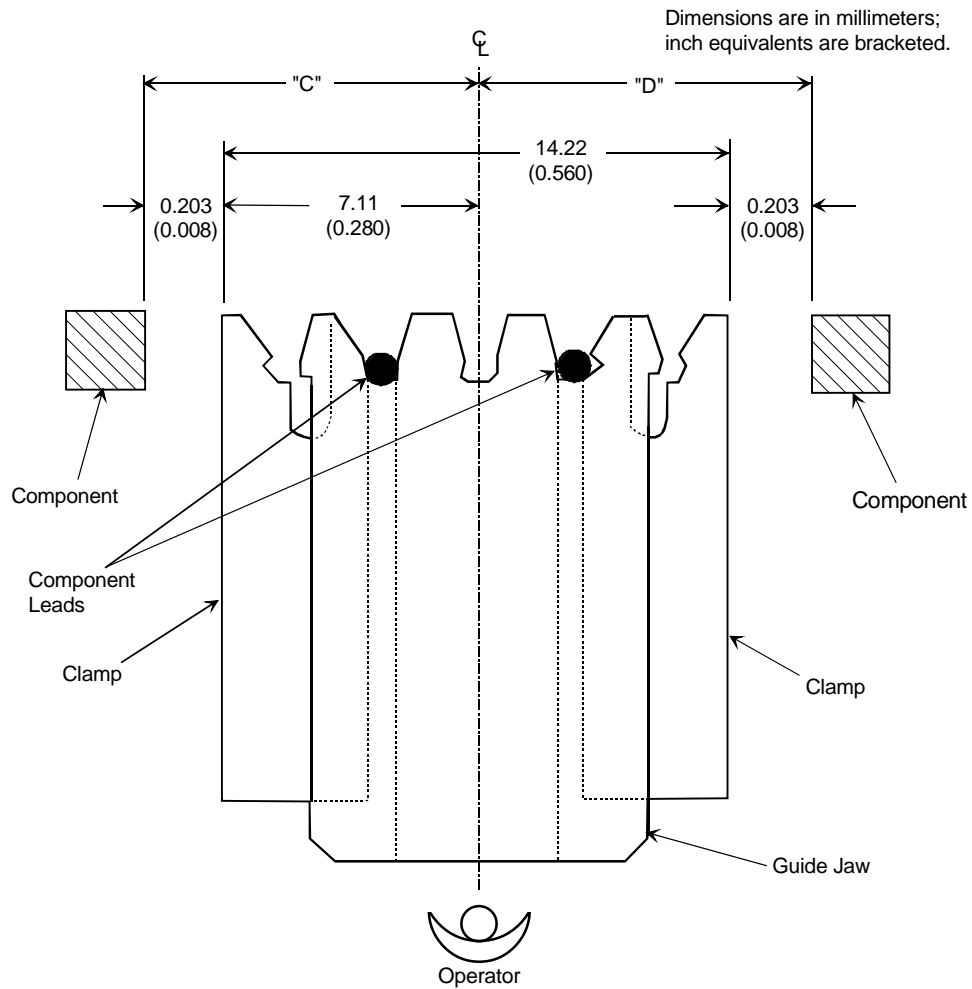


Note:

View shows minimum and maximum diameter leads clamped, overall dimensions, and lead span relationship to lead diameter. View is top side of tooling.

Side-to-Side Density: 5.0mm/7.5mm/ 10.0mm Tooling

5.0mm Component Top View



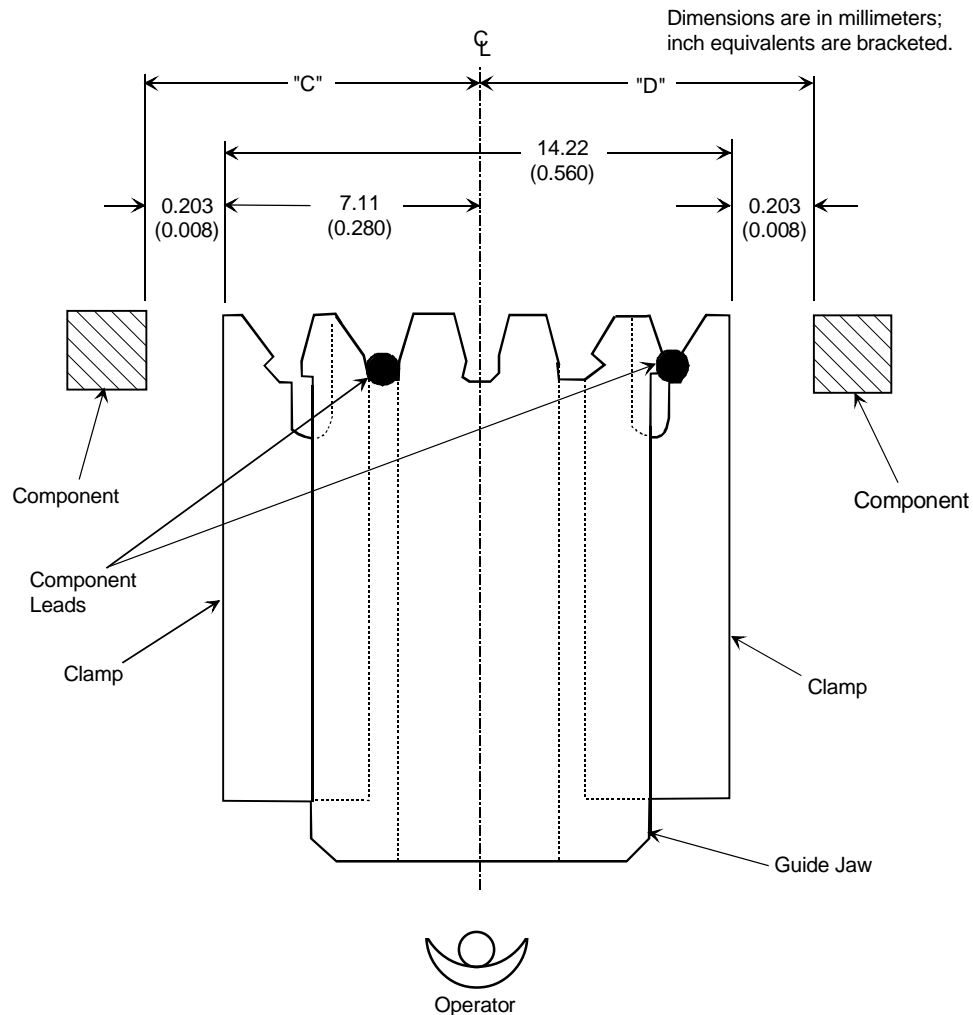
For body diameter or length of component being inserted $\leq 14.22\text{mm}$ (0.560")
 $C = 7.32\text{mm}$ (0.288") or

For body diameter or length of component being inserted $\geq 14.22\text{mm}$ (0.560")
 $C = \frac{\text{Body Diameter}}{2} + 0.20\text{mm}$ (0.008")

Note: Tooling shown in unclamped position, top side of tooling.

Side-to-Side Density: 5.0mm/7.5mm/ 10.0mm Tooling

7.5mm Component Top View



For body diameter or length of component being inserted $\leq 11.68\text{mm}$ (0.460")
 $C = 7.32\text{mm}$ (0.288") or

For body diameter or length of component being inserted $> 11.68\text{mm}$ (0.460")
 $C = \frac{(\text{Body Diameter})}{2} + 1.47\text{mm}$ (0.058")

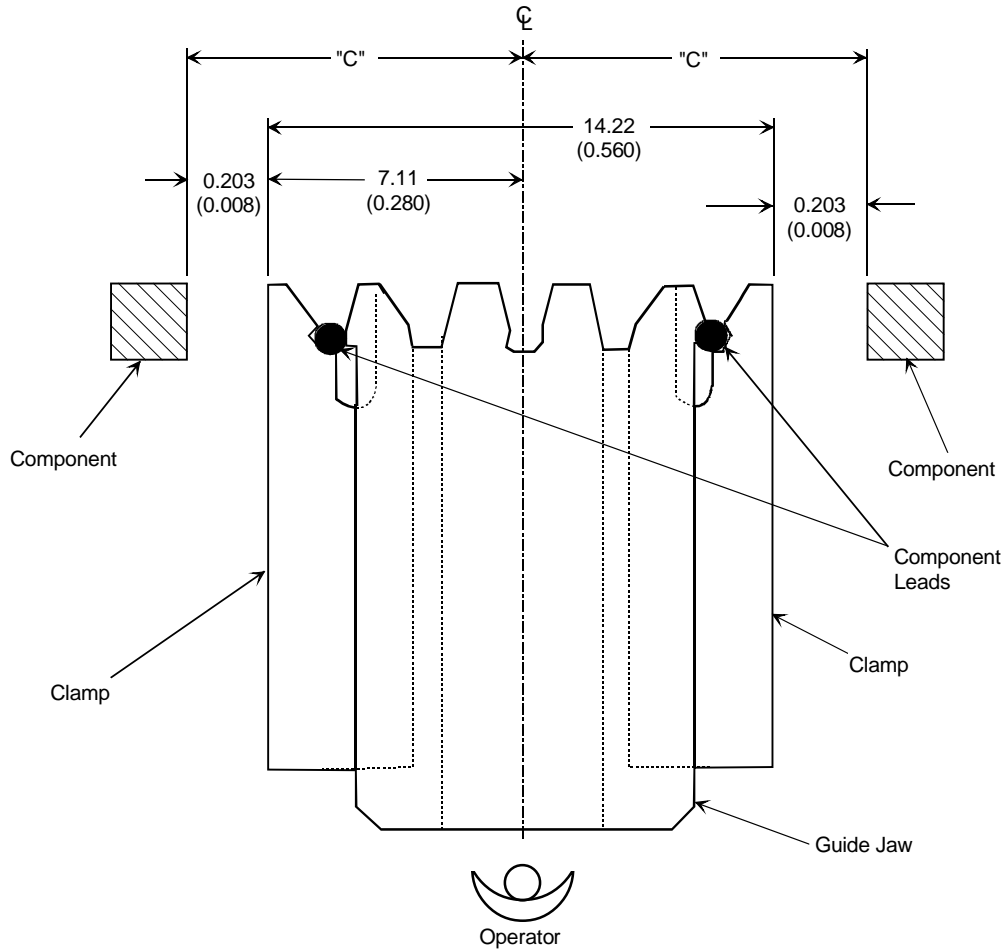
For body diameter or length of component being inserted $> 16.76\text{mm}$ (0.660")
 $D = \frac{(\text{Body Diameter})}{2} + 1.07\text{mm}$ (0.042")

Note: Tooling shown in unclamped position, top side of tooling.

Side-to-Side Density: 5.0mm/7.5mm/ 10.0mm Tooling

10.0mm Component Top View

Dimensions are in millimeters;
inch equivalents are bracketed.



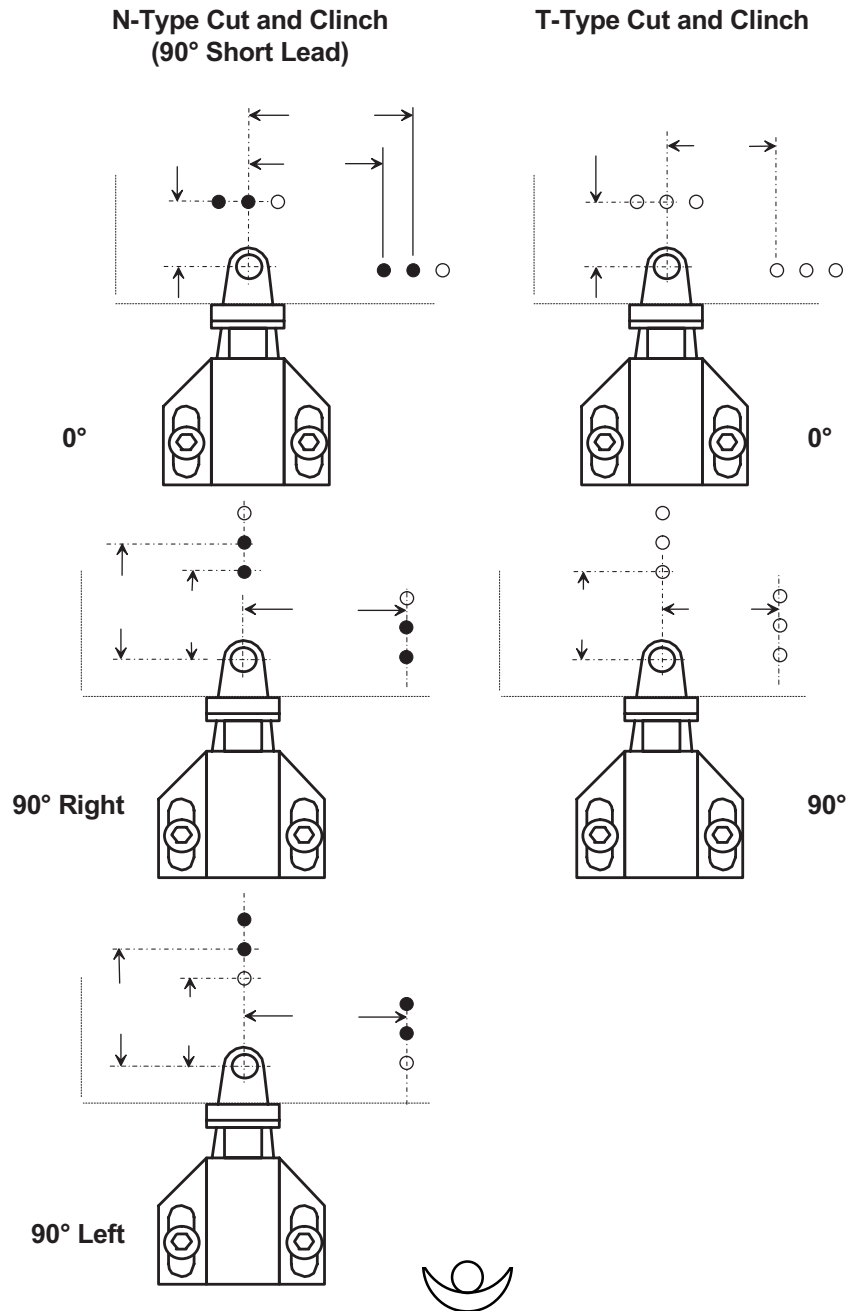
For body diameter or length of component being inserted $\leq 14.22\text{mm}$ (0.560")
 $C = 7.32\text{mm}$ (0.288") or

For body diameter or length of component being inserted $> 14.22\text{mm}$ (0.560")
 $C = \frac{(\text{Body Diameter})}{2} + 0.20\text{mm}$ (0.008")

Note: Tooling shown in unclamped position, top side of tooling.

Stand Alone Workboard Holder

Custom Workboard Holder

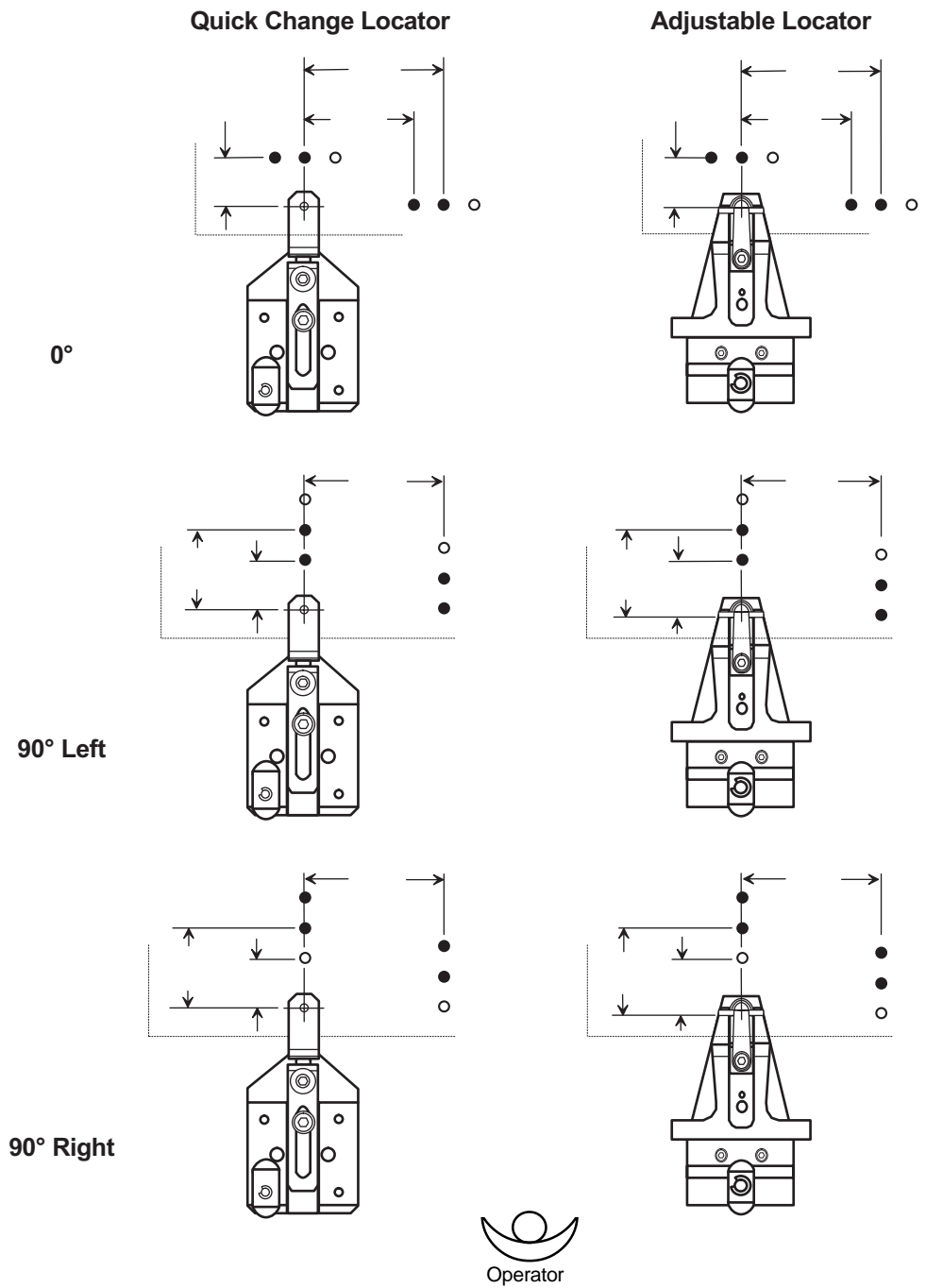


Note:

2.5mm components are represented by the shaded holes.

Adjustable Workboard Holder

“N-Type” Cut and Clinch (90° Long Lead, 90° Short Lead)

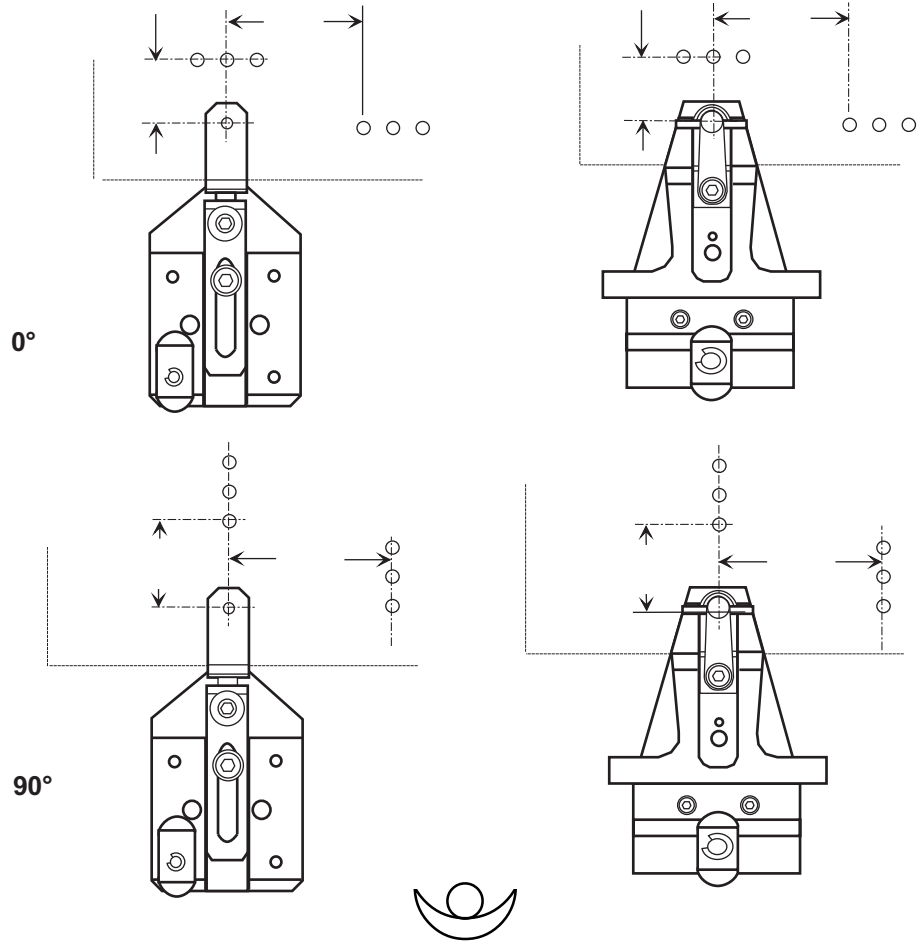


Note: 2.5mm components are represented by the shaded holes.

“Type” Cut and Clinch

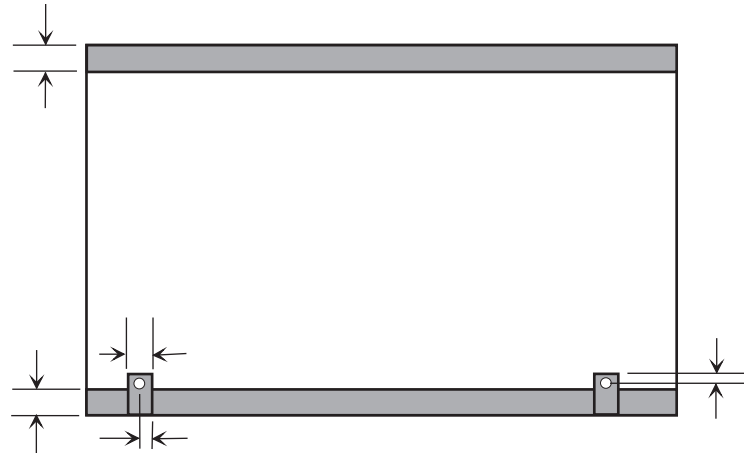
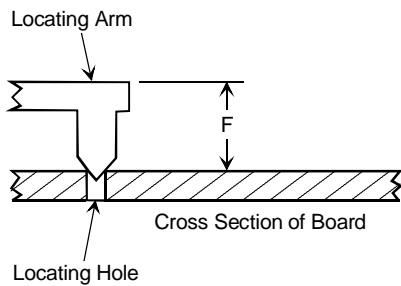
Quick Change Locator

Adjustable Locator



Board Handling

Board Handling System (BHS) Cut and Clinch Edge Clearance Specifications



| | |
|----------|--|
| A | 7.12mm (0.280") |
| B | 3.56mm (0.140") |
| C | 4.06mm (0.160") |
| F | Approx. 14.0mm (0.55"), varies according to locating hole diameter |

PCB Locating Arm Dimensions

Cut and Clinch PCB Edge Clearances

D and E = The area that a component insertion center line must not cross when BHS is set to a standard 3mm edge clearance. If BHS is set to 5mm edge clearance, add 2mm (0.08") to the dimensions below.

“N-Type” Cut and Clinch (90° Long Lead and 90° Short Lead)

| | Head Rotation | | |
|-----------------|--|--|--|
| | 0° | 90° Left | 90° Right |
| 2.5mm Lead Span | D=8.80mm (0.345") E=8.80mm (0.345") | D=10.0mm (0.394") E=7.52mm (0.296") | D=7.52mm (0.296") E=10.0mm (0.394") |
| 5mm Lead Span | D=8.80mm (0.345") E=8.80mm (0.345") | D=8.80mm (0.345") E=8.80mm (0.345") | D=8.80mm (0.345") E=8.80mm (0.345") |

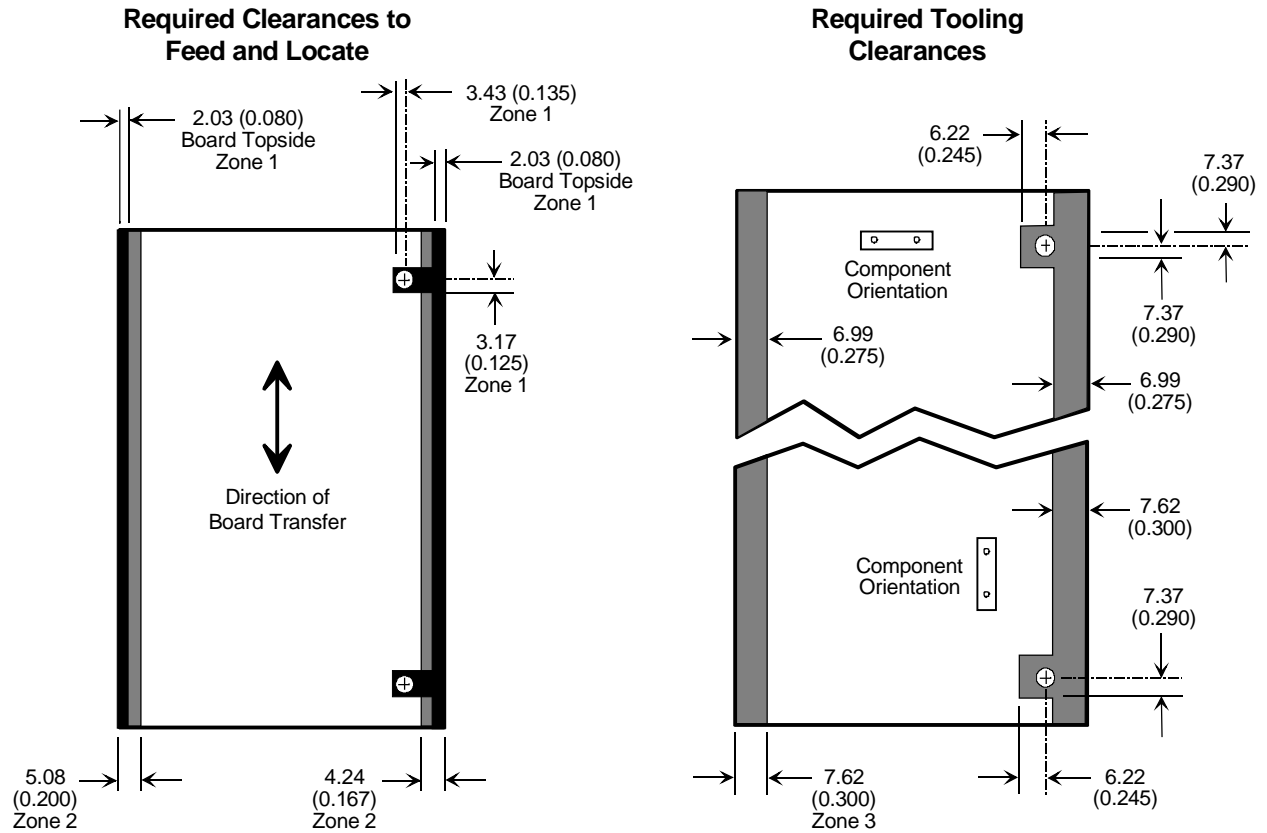
“T-Type” Cut and Clinch

| | |
|--------------|---------------------------|
| 0° Rotation | D and E = 4.62mm (0.182") |
| 90° Rotation | D and E = 8.43mm (0.332") |

| “N-Type” 2.5mm/5.0mm/7.5mm (Long Lead, Short Lead) | | | |
|---|--|---|---|
| | 0° | 90°L | 90°R |
| 2.5mm | D = 7.5mm (0.295") E = 7.5mm (0.295") | D = 7.3mm (0.287") E = 11.6mm (0.457") | D = 11.6mm (0.457") E = 7.3mm (0.287") |
| 5.0mm | D = 7.5mm (0.295") E = 7.5mm (0.295") | D = 8.6mm (0.339") E = 10.3mm (0.405") | D = 10.3mm (0.405") E = 8.6mm (0.339") |
| 7.5mm | D = 7.5mm (0.295") E = 7.5mm (0.295") | D = 9.8mm (0.386") E = 9.0mm (0.354") | D = 9.0mm (0.354") E = 9.8mm (0.386") |
| “N-Type” 5.0mm/7.5mm/10.0mm (Long Lead) | | | |
| | 0° | 90°L | 90°R |
| 5.0mm | D = 6.5mm (0.256") E = 6.5mm (0.256") | D = 8.6mm (0.339") E = 8.6mm (0.339") | D = 8.6mm (0.339") E = 8.6mm (0.339") |
| 7.5mm | D = 6.5mm (0.256") E = 6.5mm (0.256") | D = 9.8mm (0.386") E = 7.3mm (0.287") | D = 7.3mm (0.287") E = 9.8mm (0.386") |
| 10.0mm | D = 6.5mm (0.256") E = 6.5mm (0.256") | D = 8.6mm (0.339") E = 8.6mm (0.339") | D = 8.6mm (0.339") E = 8.6mm (0.339") |

Single Board Transfer Workboard Holder: Radial Machines

Dimensions are in millimeters;
inch equivalents are bracketed.



NOTES:

- ZONE 1 - Minimum clear area required on top side of board to feed and locate in the SBT system.
- ZONE 2 - Minimum clear area required on bottom side of board to feed and locate in the SBT system.
- ZONE 3 - The insertion limitation imposed by the insertion head and cut and clinch tooling.

Pattern Program Considerations

Optimum Pattern Programming

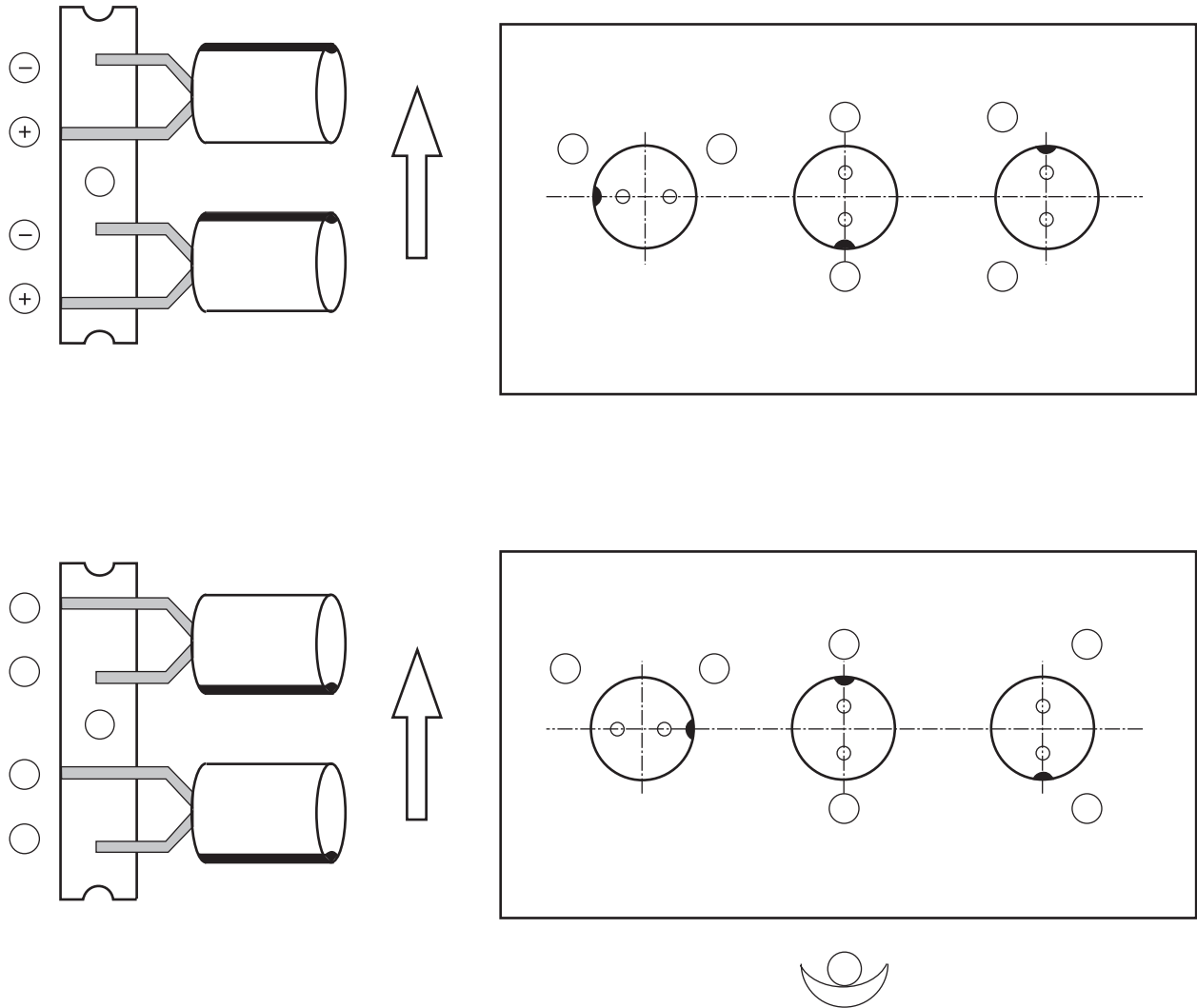
When possible, component insertion should proceed from the back of the board to the front. The kick out motion of the insertion jaw should be considered when programming. The insertion jaw moves away from the inserted component as the pusher applies pressure. When the jaw is oriented in the 0° position, it will move toward the front of the machine (toward the operator). When oriented 90° in the clockwise direction, the jaw moves to the left, while a 90° counter-clockwise orientation results in an insertion jaw movement to the right.

Minimum clearance should be considered when a pattern program is written to optimize throughput, minimize table rotation and movement, except where required by density.

Note: By inserting polarized components in the Y axis, only one dispensing head is necessary because the insertion head can be programmed to rotate the component during the insertion process.

Insertion Tooling Rotation and Component Polarity

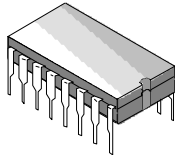
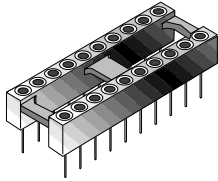
The following information may be used to optimize feeder selection and pattern programming. 0°, 90°, and 270° rotations are possible using a single feeder. 180° rotation is possible using a table rotation or by using two feeders with components oriented in opposite directions.



Component Supply Orientation

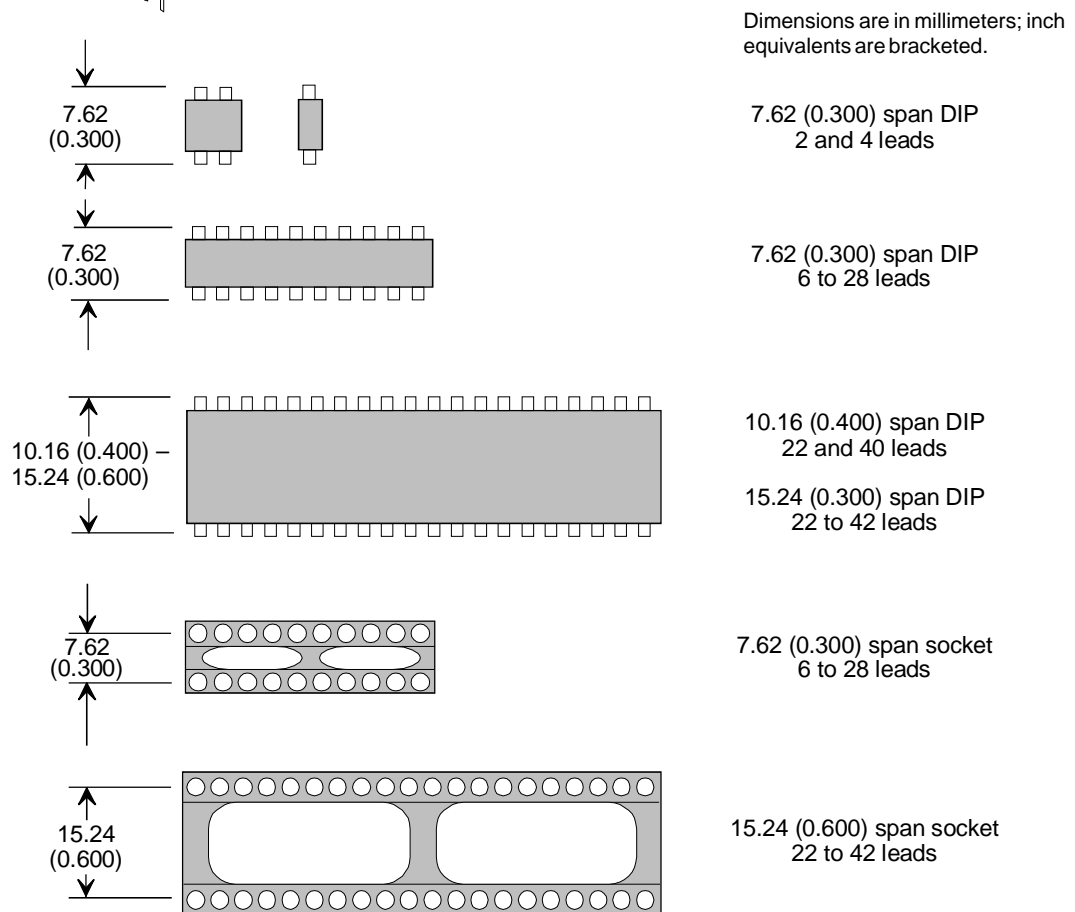
Inserted Component Orientation (Top View)

Dual In-Line Package Insertion



This section has been prepared to assist in the design of printed circuit boards for use with Universal's Multi-Module[®] and Uni-Module[®] DIP Insertion machines. It is specifically written for Models 6772A and 6774A Multi-Module II machines.

The Multi-Module family includes insertion systems which are capable of processing a combination of two of the following devices. With optional tooling, the insertion of both DIPs and sockets is possible.

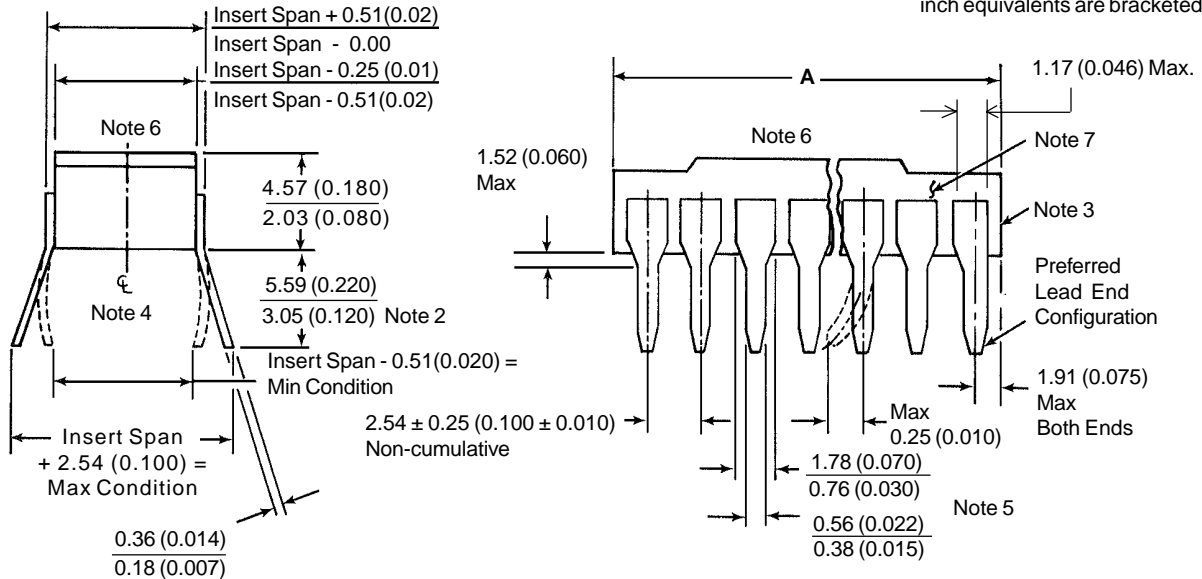


- If the design requires DIP components only, use DIP tooling specifications.
- If DIP and socket components are required, use socket tooling specifications.

Side-Brazed DIP IC Modules

Side-Brazed DIP Integrated Circuit Module, 6 Through 42 Leads

Dimensions are in millimeters; inch equivalents are bracketed.



| DIP LEAD INSERT SPAN | NUMBER OF LEADS | DIMENSION A | |
|----------------------|-----------------|---------------|---------------|
| | | MINIMUM | MAXIMUM |
| 7.62 (0.300) | 6-28 | 7.62 (0.300) | 36.83 (1.450) |
| 10.16 (0.400) | 22-40 | 27.94 (1.100) | 52.07 (2.050) |
| 15.24 (0.600) | 22-42 | 27.94 (1.100) | 54.61 (2.150) |

Maximum/Minimum dimensions are expressed as:

$$\frac{\text{Millimeter (Inch)}}{\text{Millimeter (Inch)}} = \text{Maximum Condition}$$

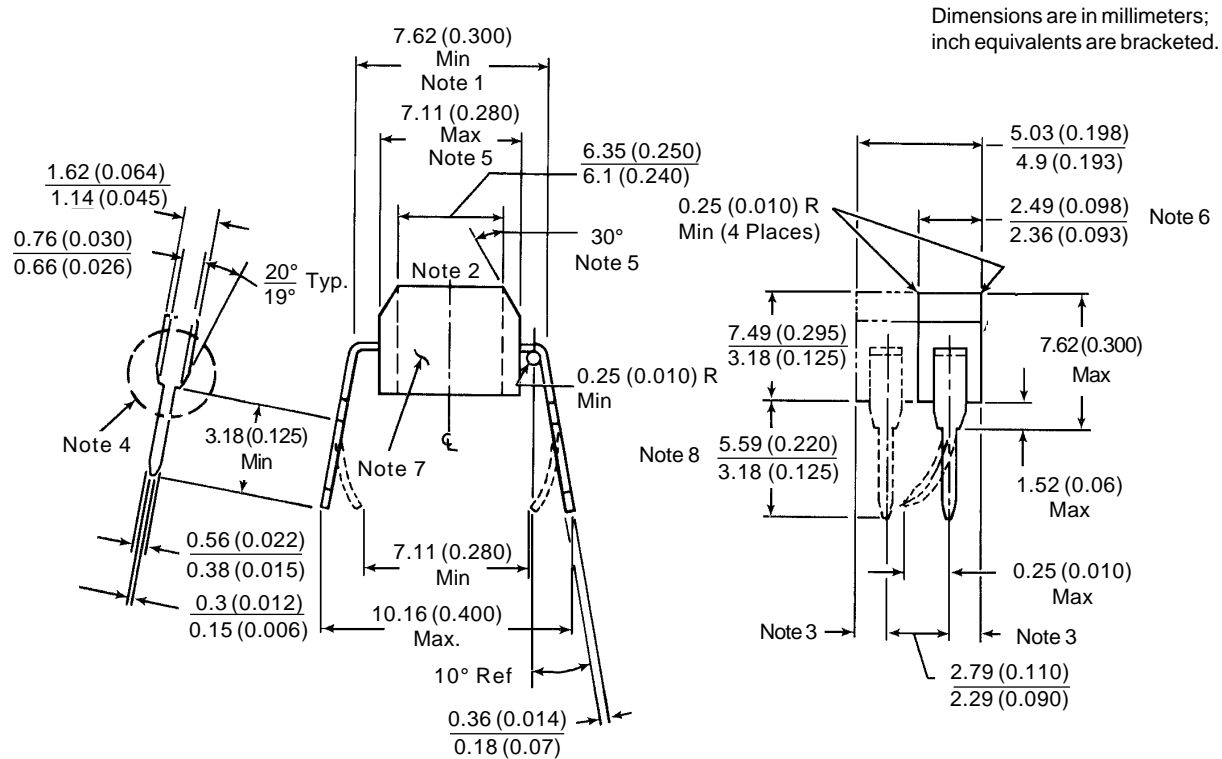
$$\frac{\text{Millimeter (Inch)}}{\text{Millimeter (Inch)}} = \text{Minimum Condition}$$

Notes:

1. NA
2. For DIP Lead Sense machines, 0.89 (0.035) lead length below the board is required.
3. Ends to be free of flash and irregularities.
4. Bottom to be flat and smooth.
5. Lead form to be symmetric about 2.54 (0.100) lead pitch within 0.1 (0.004).
6. All dimensions shown in this view are to be central of centerline within 0.25 (0.010).
7. Component body must be non-transparent.

2- and 4-Lead DIP Modules

2 and 4 Lead DIP Integrated Circuit Modules



Notes:

- Measured at tangent of formed radius.
- All dimensions shown in this view are to be central to centerline within 0.25 (0.010).
- Leads shall be on centerline of DIP module body within 0.25 (0.010) total indicator reading.
- Preferred lead configuration.
- If body width exceeds 6.35 (0.250), 30° chamfer required.
- Includes all body surface irregularities.
- Component body must be non-transparent.
- For DIP Lead Sense machines, 0.89 (0.035) lead length below the board is required.

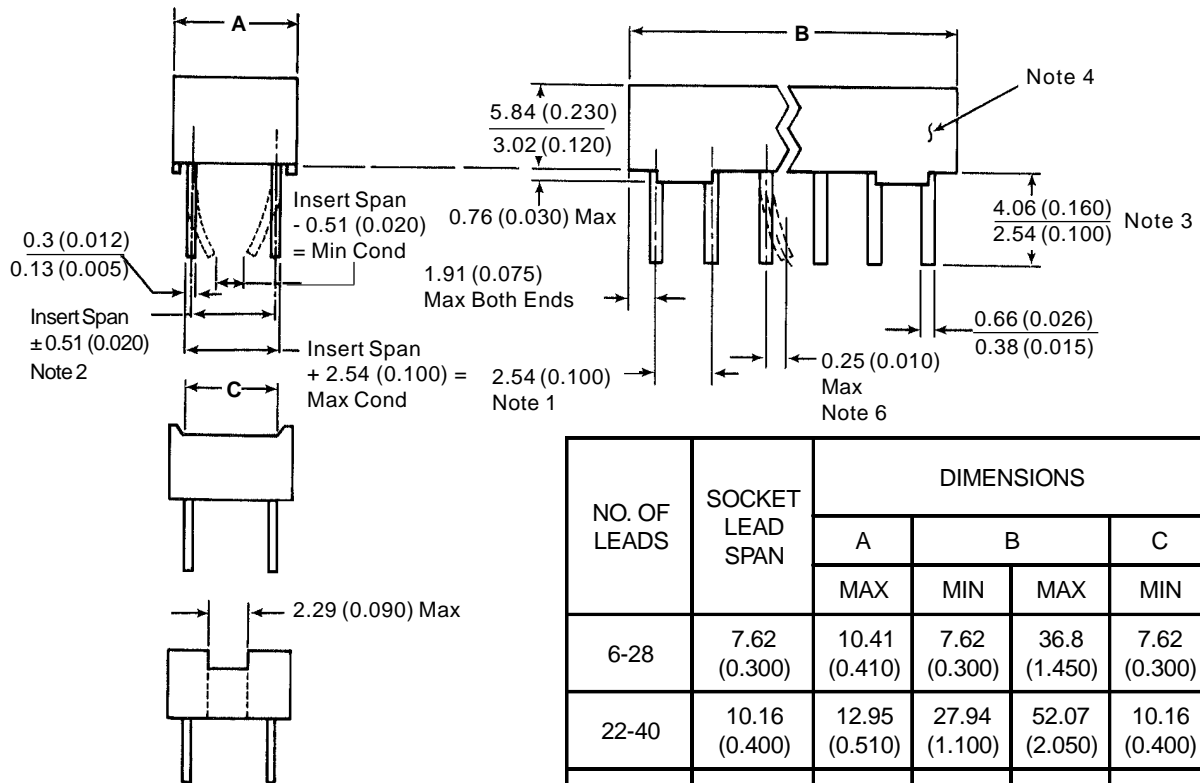
Maximum/Minimum dimensions are expressed as:

Millimeter (Inch) = Maximum Condition

Millimeter (Inch) = Minimum Condition

DIP Socket Modules

Dimensions are in millimeters;
inch equivalents are bracketed.



| NO. OF LEADS | SOCKET LEAD SPAN | DIMENSIONS | | | |
|--------------|------------------|------------------|------------------|------------------|------------------|
| | | A | B | | C |
| | | MAX | MIN | MAX | MIN |
| 6-28 | 7.62 (0.300) | 10.41 (0.410) | 7.62 (0.300) | 36.8 (1.450) | 7.62 (0.300) |
| 22-40 | 10.16 (0.400) | 12.95 (0.510) | 27.94 (1.100) | 52.07 (2.050) | 10.16 (0.400) |
| 22-42 | 15.24 (0.600) | 18.03 (0.710) | 27.94 (1.100) | 54.61 (2.150) | 15.24 (0.600) |

Maximum/Minimum dimensions are expressed as:

Millimeter (Inch) = Maximum Condition

Millimeter (Inch) = Minimum Condition

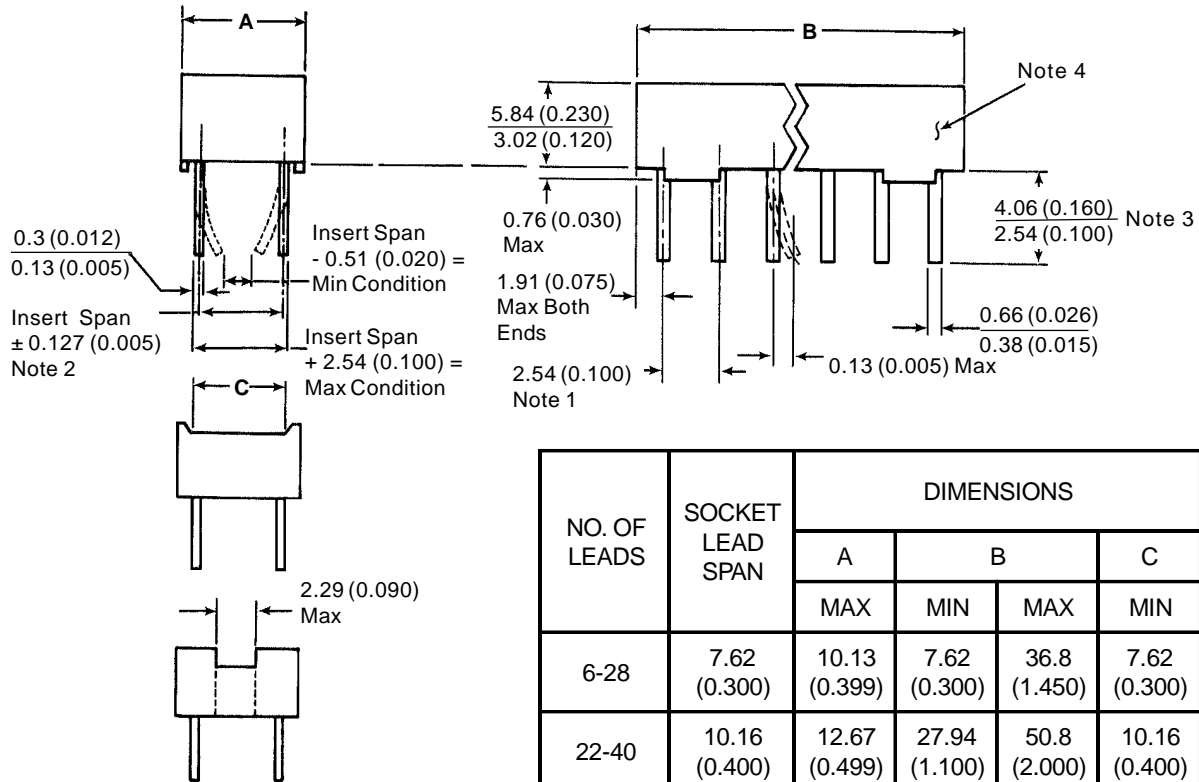
Notes:

1. Tolerances are non-cumulative.
2. Leads are to be formed central and parallel with the component body within 0.25 (0.010).
3. For DIP Lead Sense machines, 0.89 (0.035) lead length below the board is required.
4. Socket body must be non-transparent.

Brickwall DIP Socket Modules

Brickwall insertion requires placing socket modules side by side with minimal clearance (for example, 0.25mm or 0.010").

Dimensions are in millimeters;
inch equivalents are bracketed.



| NO. OF LEADS | SOCKET LEAD SPAN | DIMENSIONS | | | |
|--------------|------------------|------------------|------------------|------------------|------------------|
| | | A | B | | C |
| | | MAX | MIN | MAX | MIN |
| 6-28 | 7.62 (0.300) | 10.13 (0.399) | 7.62 (0.300) | 36.8 (1.450) | 7.62 (0.300) |
| 22-40 | 10.16 (0.400) | 12.67 (0.499) | 27.94 (1.100) | 50.8 (2.000) | 10.16 (0.400) |
| 22-42 | 15.24 (0.600) | 17.75 (0.699) | 27.94 (1.100) | 54.61 (2.150) | 15.24 (0.600) |

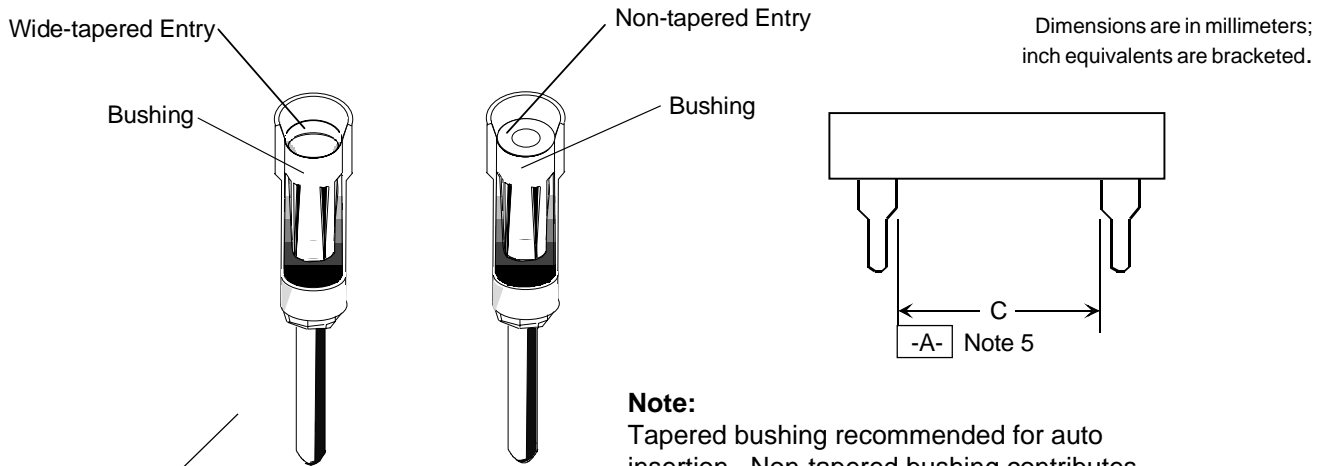
Maximum/Minimum dimensions are expressed as:

Millimeter (Inch) = Maximum Condition
Millimeter (Inch) = Minimum Condition

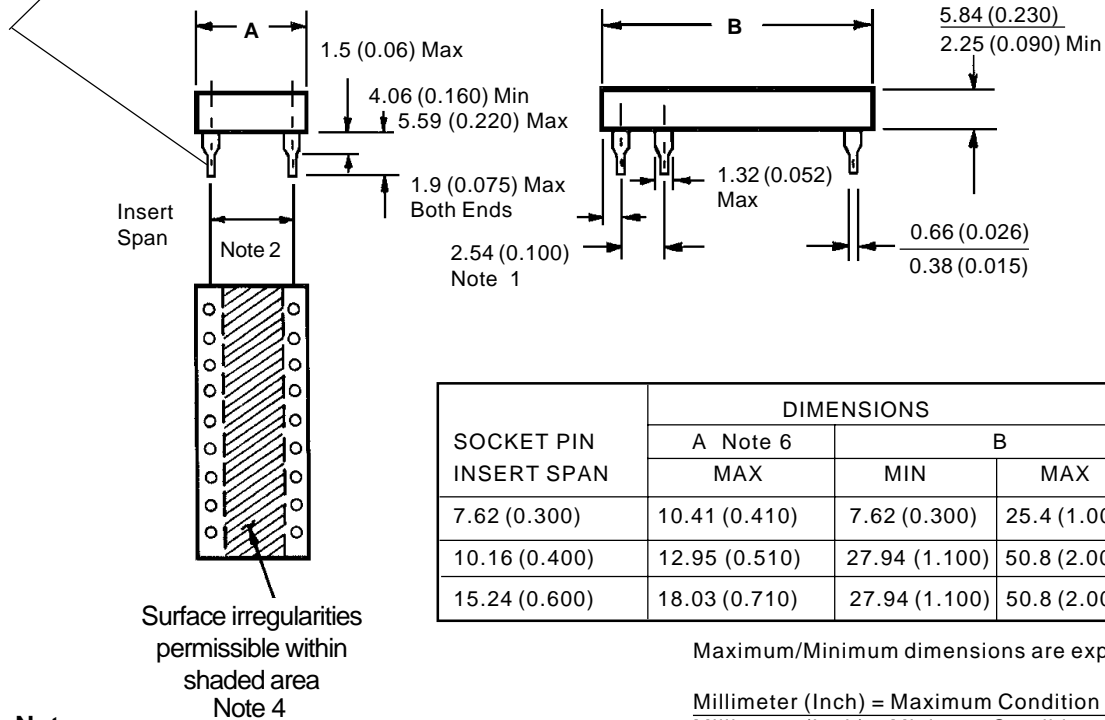
Notes:

1. Tolerances are non-cumulative.
2. Leads are to be formed central and parallel with the component body within 0.25 (0.010).
3. For DIP Lead Sense machines:
 - 0.89 (0.035) lead length below the board is required, and
 - when brickwalling sockets, machined pin type sockets are required.
4. Socket body must be non-transparent.

Machined Pin DIP Socket Modules



Note:
Tapered bushing recommended for auto insertion. Non-tapered bushing contributes to reduced insertion reliability.



| SOCKET PIN INSERT SPAN | DIMENSIONS | | | |
|---------------------------|---------------|---------------|-------------|-------|
| | A Note 6 | B | | C |
| | MAX | MIN | MAX | MIN |
| 7.62 (0.300) | 10.41 (0.410) | 7.62 (0.300) | 25.4 (1.00) | 6.35 |
| 10.16 (0.400) | 12.95 (0.510) | 27.94 (1.100) | 50.8 (2.00) | 8.89 |
| 15.24 (0.600) | 18.03 (0.710) | 27.94 (1.100) | 50.8 (2.00) | 13.97 |

Maximum/Minimum dimensions are expressed as:

$$\frac{\text{Millimeter (Inch)}}{\text{Millimeter (Inch)}} = \frac{\text{Maximum Condition}}{\text{Minimum Condition}}$$

Notes:

1. Tolerances are non-cumulative.
2. Pins to be parallel with the component body within 0.25 (0.010).
3. For DIP Lead Sense machines, 0.89 (0.035) min. lead length below the board is required.
4. Socket body must be non-transparent.
5. Dimension developed from datum A at left lead row and measure to closest pin of right lead row.
6. Machine pin sockets may be brickwall inserted if dimension A conforms to brickwall socket specifications.

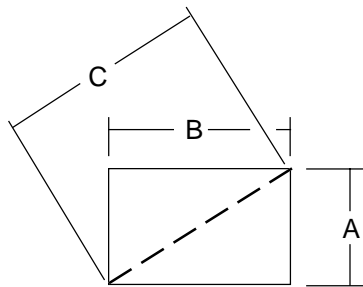
Insertion Hole Diameter Considerations

When determining lead hole diameters, two primary factors must be considered:

- The holes must be large enough to consistently accept component lead insertion.
- The holes must be small enough to assure a secure lead clinch.

The minimum component lead hole size required for reliable DIP module insertion is a function of:

1. Component lead cross-sectional area and lead-end configuration.
2. Machine tolerance and accuracy.
3. Workboard holder accuracy.
4. Board pattern and tooling reference accuracy.
5. Printed circuit board hole positional tolerance.



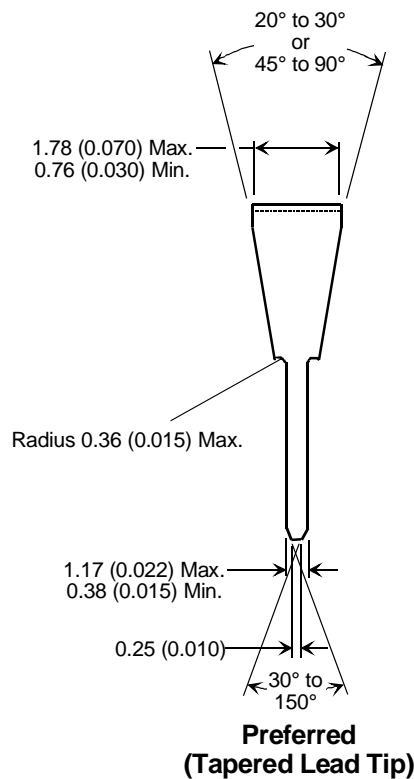
Minimum Hole Diameter =

Maximum Lead Diameter + Hole Location Tolerance + 0.25mm (0.010")

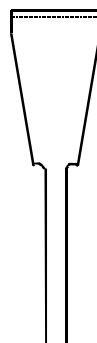
Maximum Lead Diameter = C

$$C = \sqrt{A^2 + B^2}$$

Component Lead Considerations



Insertion reliability for DIP modules is also influenced by the condition of the component leads as well as by the lead tip configuration.

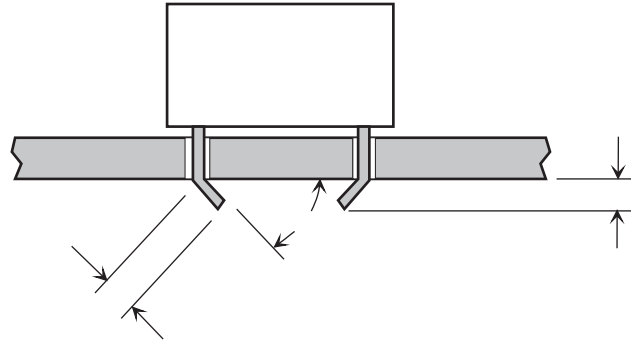


**Acceptable
(Squared Lead Tip)**

**Preferred
(Tapered Lead Tip)**

Clinch Lengths and Angles

Inward Clinch



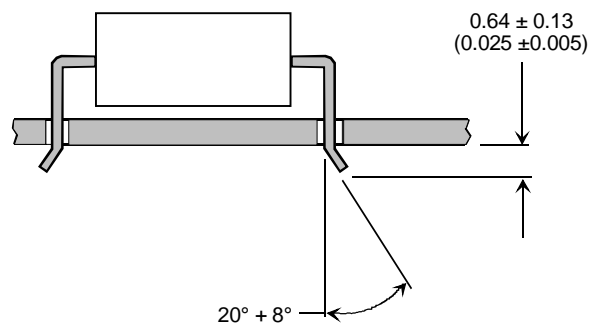
| | DIP | SOCKET |
|---|--|----------------------------|
| A | $0^{\circ} +10^{\circ}, -0^{\circ}$ | $40^{\circ} \pm 8^{\circ}$ |
| B | 1.02mm (0.040") | 1.02mm (0.040") |
| C | Minimum Dimension will be lead thickness up to 0.64mm (0.025") | 0.64mm (0.025") |

Notes:

1. Tooling change is required to change lead clinch angle or length.
2. Angle may vary depending on lead hardness and hole diameter.

Outward Clinch

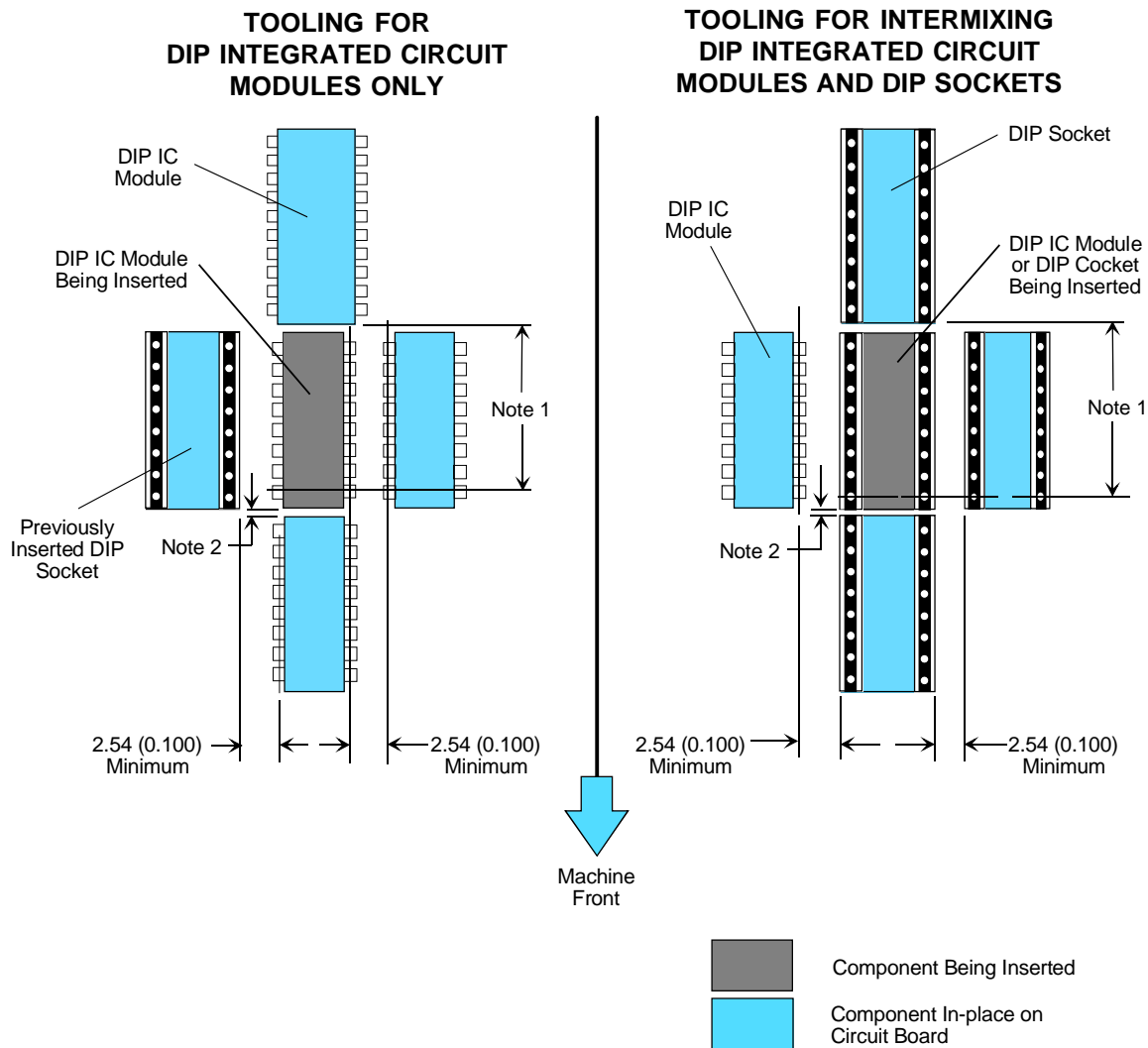
The outward clinch pattern is NOT recommended for DIP socket module insertion.



Density Considerations

DIP or DIP Socket Insertion

Dimensions are in millimeters;
inch equivalents are bracketed.



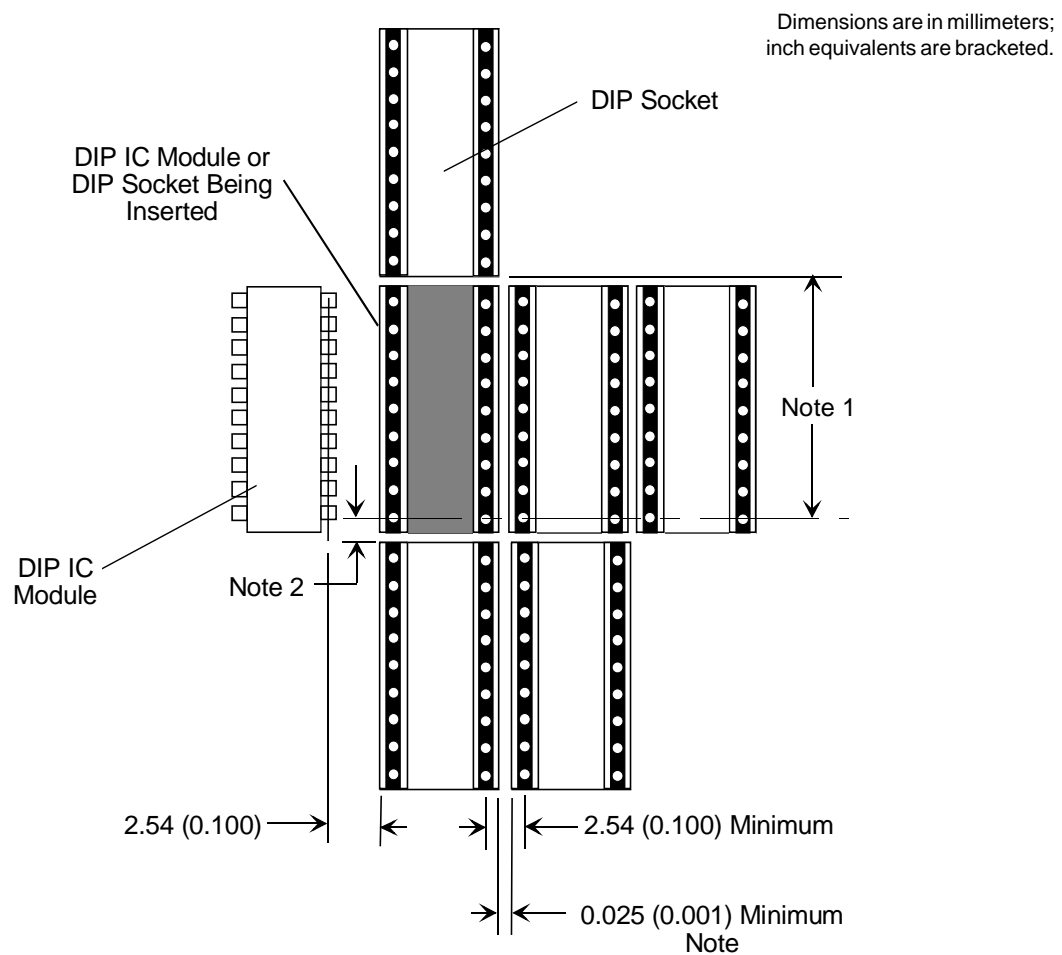
Notes:

- Dimensions must clear tooling. Minimum clearance is:
 - 7.63mm (0.300"), 6-20 leads = 25.4mm (1.000")
 - * 7.62mm (0.300"), 6-24 leads = 30.48mm (1.200")
 - 10.16mm (0.400"), 22-40 leads = 50.8mm (2.000")
 - 15.24mm (0.600"), 22-40 leads = 50.8mm (2.000")
 - * 15.24mm (0.600"), 22-42 leads = 53.34mm (2.100")

* Indicates optional tooling.
- Maximum body tolerance plus 0.254mm (0.010") is recommended.

Brickwall Insertion

Brickwalling is the high density insertion of DIP sockets into workboards. Shown below is an example of socket insertion density considerations.



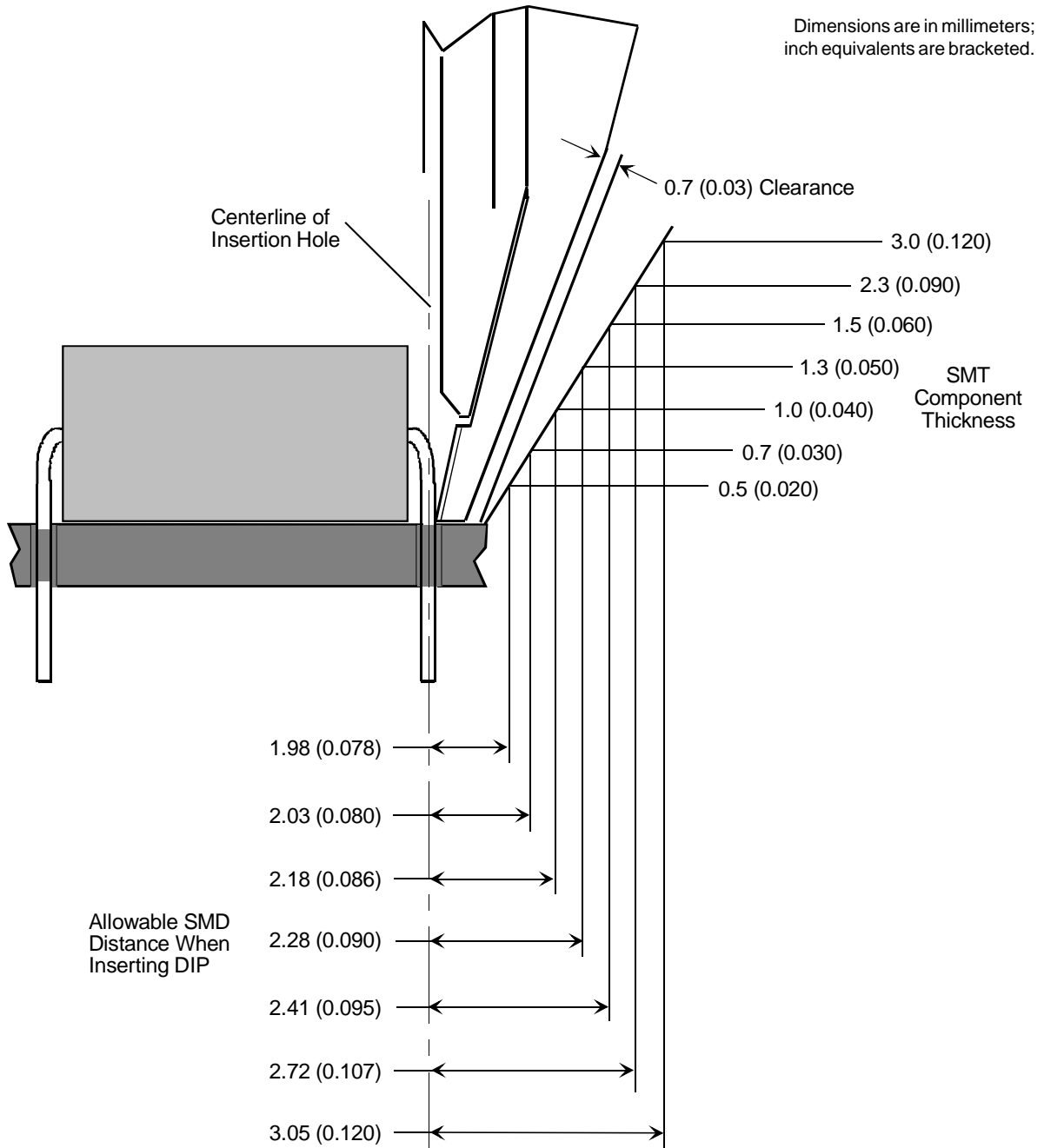
Notes:

- Dimensions must clear tooling. Minimum clearance is:

| | | |
|---|---|-------------------------------------|
| 7.62mm (0.300") 2 leads = 2.54mm (0.100") | } | Applicable to Model 6774 Tooling |
| 7.62mm (0.300") 4 leads = 5.1mm (0.200") | | |
| 7.62mm (0.300") 6-20 leads = 25.4mm (1.000") | | |
| * 7.62mm (0.300") 6-24 leads = 30.48mm (1.200") | | |
| 15.24mm (0.600") 22-40 leads = 50.8mm (2.000") | | |
| * 15.24mm (0.600") 22-42 leads = 53.34mm (2.100") | | |

* Indicates optional tooling
- Maximum body tolerance plus 0.254mm (0.010") is recommended.
- Total tolerance accumulation must be considered with specified socket widths, socket lead location, printed circuit board hole location, and positioning system accuracy to ensure proper clearances.

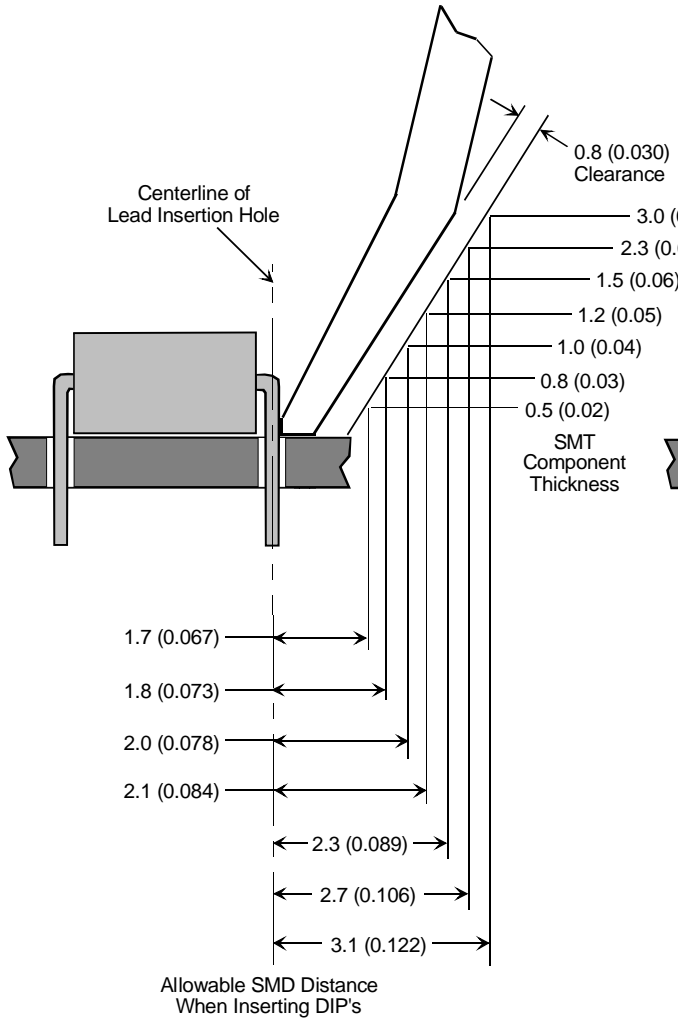
DIP Tooling to SMT Clearance (Topside)



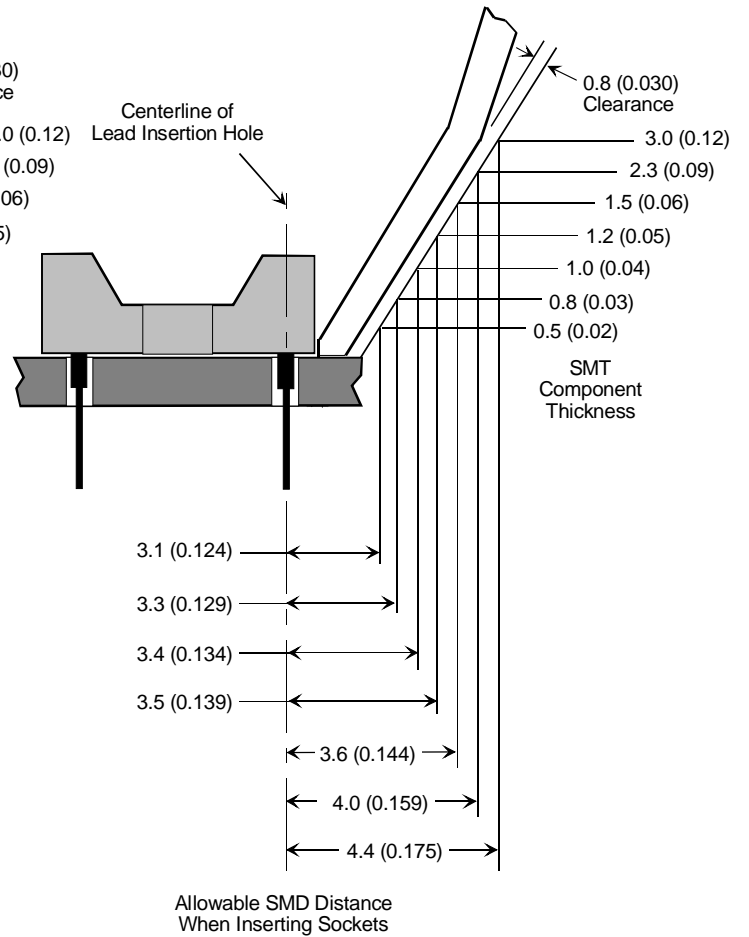
Socket Tooling to SMT Clearance (Topside)

Dimensions are in millimeters;
inch equivalents are bracketed.

DIP INSERTION

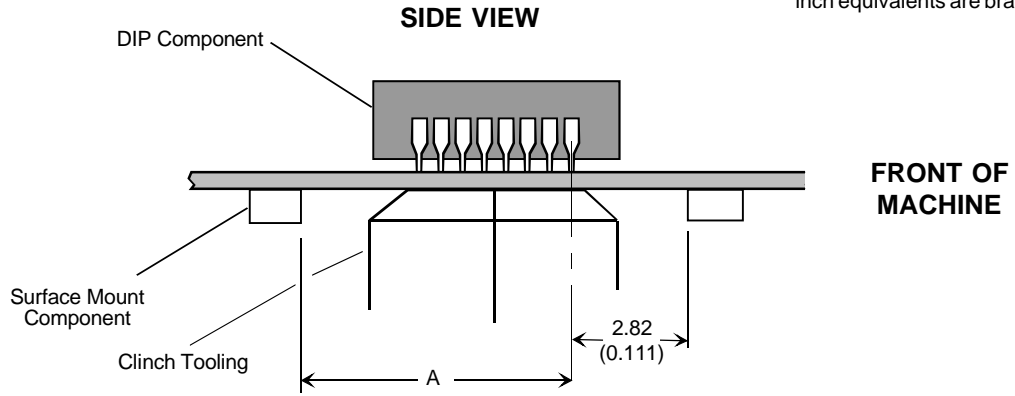


SOCKET INSERTION



Clinch Tooling to SMT Clearance (Bottomside)

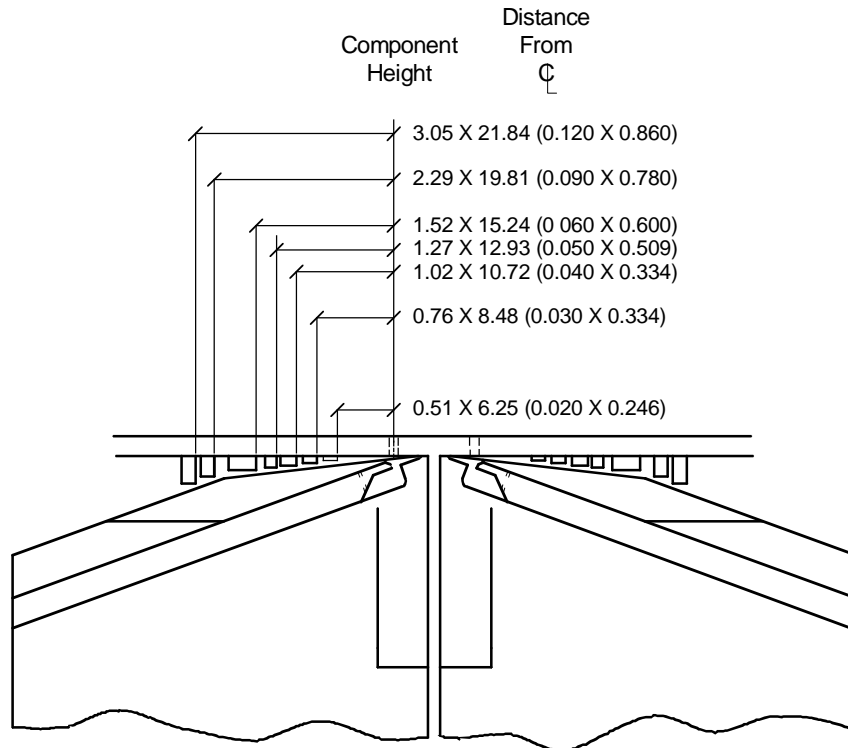
Dimensions are in millimeters;
inch equivalents are bracketed.



Metric Formula: $A = \frac{(\text{Tooling Lead Count})}{2} \times 2.54 + 2.81$

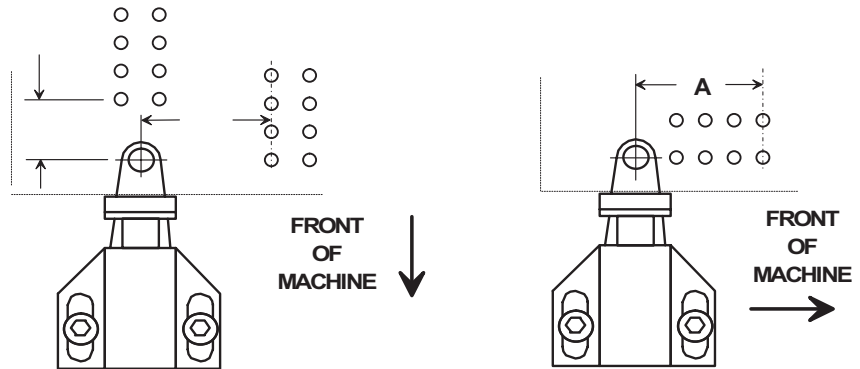
Inch Formula: $A = \frac{(\text{Tooling Lead Count})}{2} \times 0.100 + 0.111$

END VIEW



Stand Alone Workboard Holder

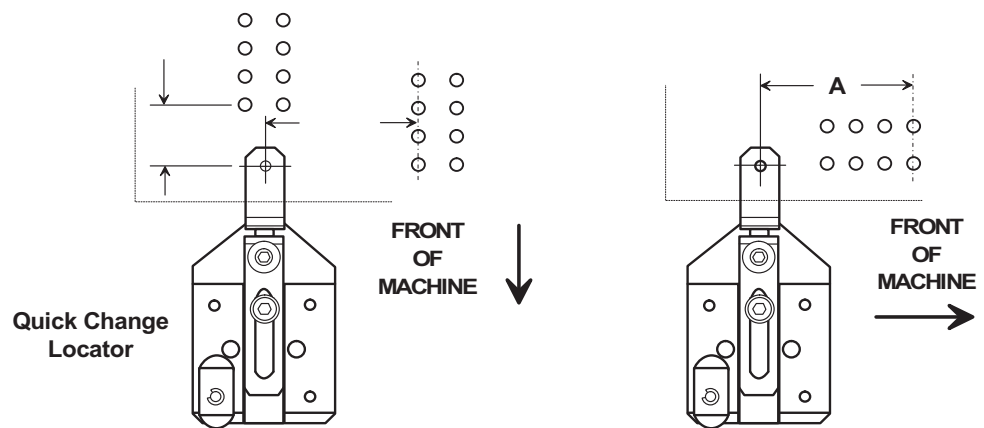
Custom Workboard Holder



Metric formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 2.54 + 5.71$

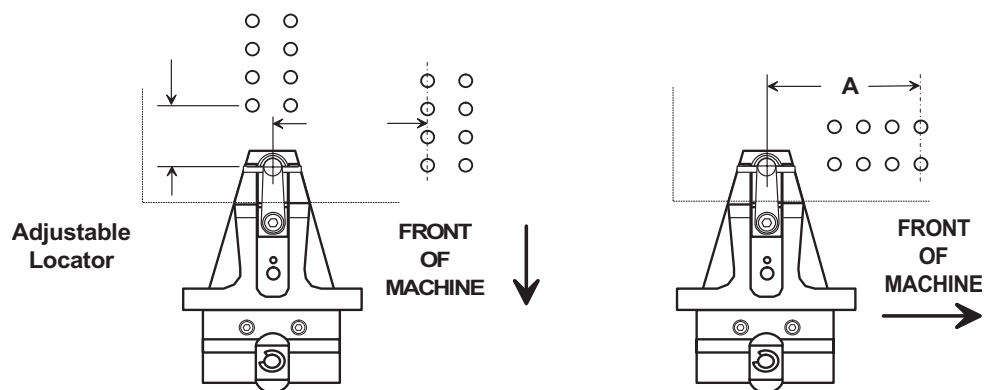
Inch formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 0.1 + 0.225$

Adjustable Workboard Holder



Metric Formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 2.54 + .813$

Inch Formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 0.1 + 0.320$

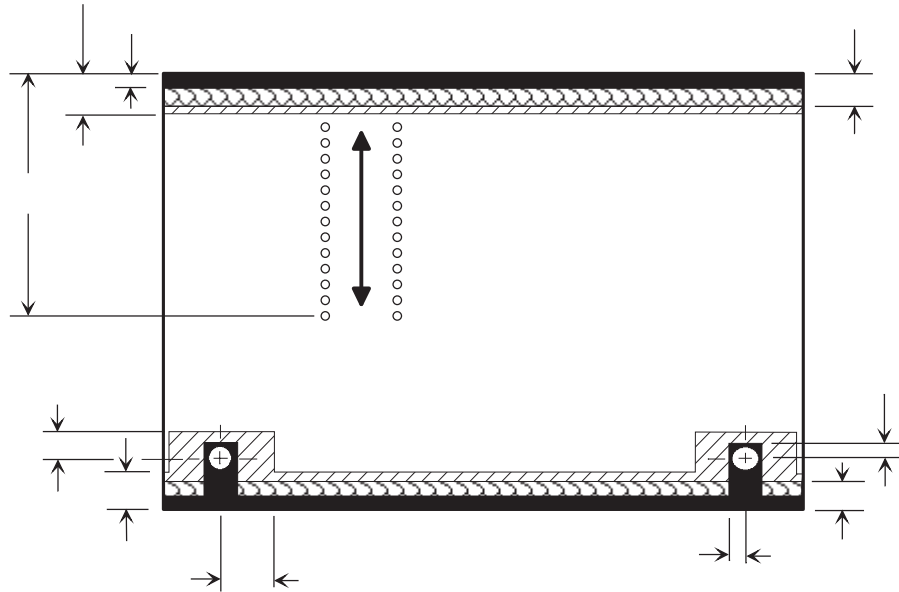


Metric Formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 2.54 + 12.50$

Inch Formula: $A = \frac{\text{TOOLING LEAD COUNT}}{2} \times 0.1 + 0.492$

Board Handling

**Single Board Transfer Workboard Holder:
Dual In-Line Packages
(Table Positioned at 0° Rotation)**

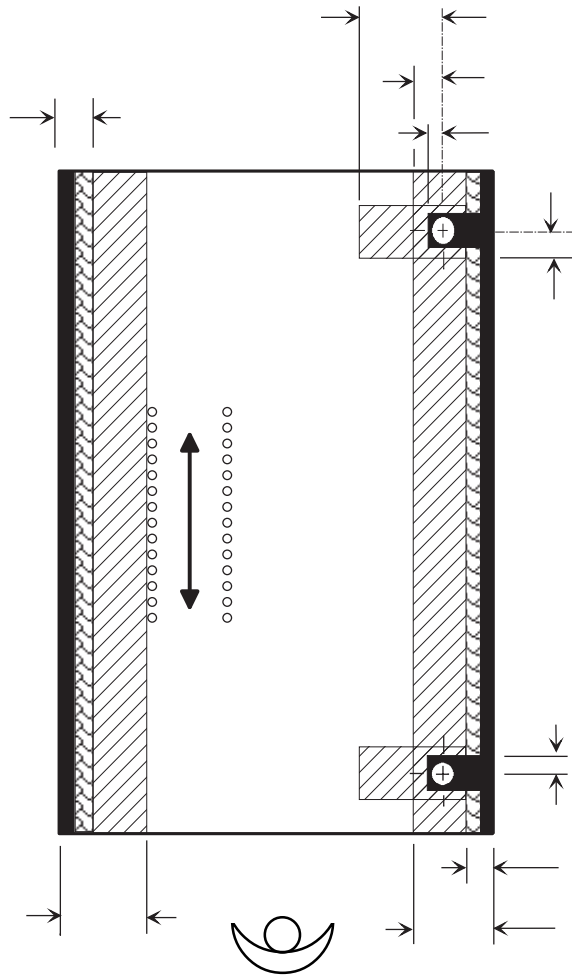


Metric formula: $A = \frac{\text{TOOLING LEAD COUNT CAPACITY}}{2} \times 2.54 + 5.56$

Inch formula: $A = \frac{\text{TOOLING LEAD COUNT CAPACITY}}{2} \times 0.100 + 0.219$



**Single Board Transfer Workboard Holder:
Dual In-Line Packages
(Table Positioned at 90° Rotation)**



Programming Considerations

Optimum Pattern Programming

When designing boards with DIP components, it is important to consider component spacing and orientation for optimum manufacturing throughput. By minimizing Y axis table moves and placing DIP components as close as possible in the X axis, maximum insertion throughput can be achieved. See the illustration below. Deviations from this type of layout or excessive component spacing in the X and Y axis will impact machine throughput.

