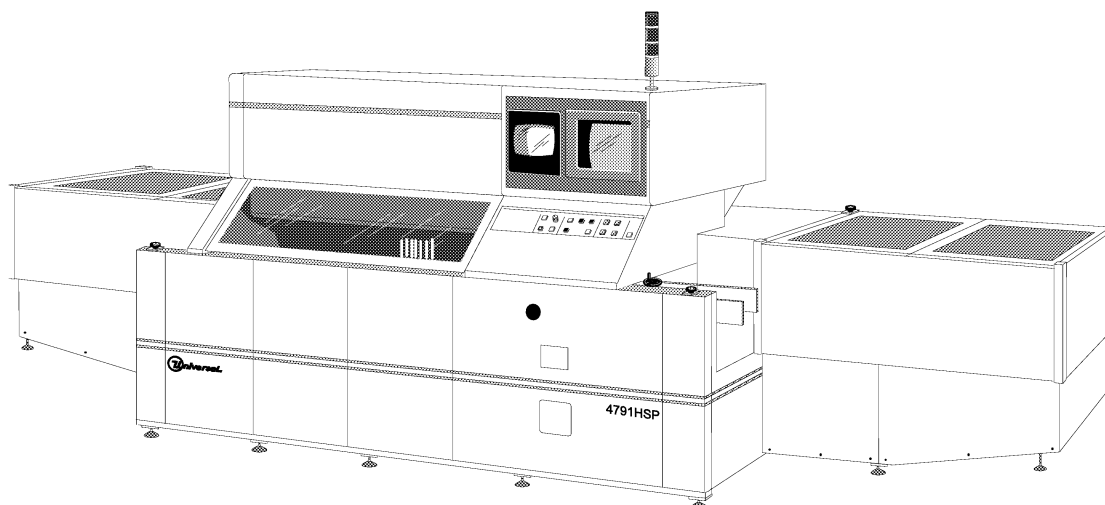


4791A HSP High Speed SMC Placement System



**Surface Mount
Product Line**

4791A HSP High Speed SMC Placement System



The SMC Solution

- 24 position rotary turret with six nozzles per head
- Down to 0.124 second per placement — 29,032 component placements per hour
- Four feeder carriages each having forty 8mm feeder locations
- Front and back lit component vision recognition
- Bulk Feeder Capability

C o n t e n t s

Introduction	1
Machine Concept	1
Functional Description	2
Standard Features	2
Board Transport	2
X-Y Positioning System	2
Turret Assembly	3
Nozzle Tooling	3
Vision Centering System	3
Control System and Machine Software	4
Pattern Programming	4
Program and Data Storage	5
Random Access Feeder Carriage System	5
Bulk Feeder Capability	5
Pattern Error Correction (P.E.C.)	6
Optional Features	7
Bad Board Reject (BBR)	7
Programmable Width Control (PWC) Conveyor	7
Extended Feeder Capacity	8
44mm Tape Feeding	8
Multiple-Pattern Programming Option	8
Generic Equipment Model Interface (GEM)	9
Gas Shock Assist Feeder Cover Doors	9
Feeder Storage Carts	9
Feeder Reload Tool	9
Supporting Documents	10
Technical Specifications	11
Nozzle Specifications	11
Component (chips/ICs)	11
Typical Component Types	12
Placement Head Specifications	13
Feeder Input	14
Carriage Weight Guidelines	15
Approximate Weight of Feeders Loaded with Components	15
Board Specifications	16
Board Handling	16
Acceptable Fiducial Shapes, industry standard	17
Acceptable Fiducial Shapes	18
Positioning System	19
Component Recognition Camera	23
Pattern Error Correction Camera	23
Installation Considerations	24
Machine Dimensions	24
Environmental Requirements	26
Service Requirements	26
Operator Activity Time Estimates	26

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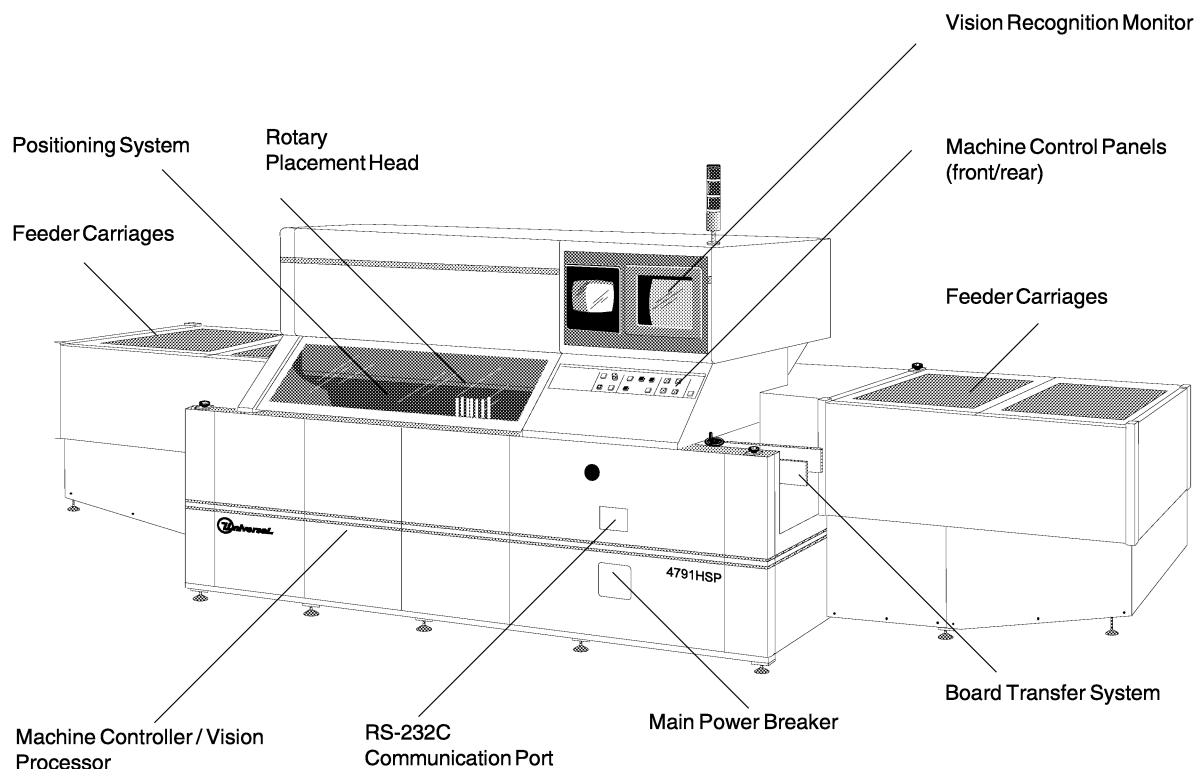
Introduction

The 4791A HSP is a high-speed surface mount component (SMC) placement machine. It places a wide range of components on boards at a maximum placement speed of 0.124 seconds/component, approximately 29,000 components per hour (cph).

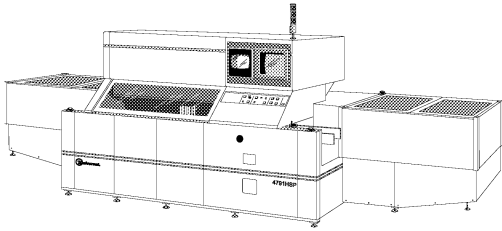
Machine Concept

The 4791A HSP uses random-access feeder carriages, a servo-driven cam-actuated rotary turret placement head, a precision X-Y positioning table, a gray scale vision recognition system, and a belt-driven board transfer system.

The 4791A HSP can be integrated with other SMC equipment to form a complete in-line SMC assembly system. It can also be used in a stand-alone workcell environment.



Functional Description



The following sequence of events describe the 4791A HSP functions.

- The board travels through the input conveyor rails to the X-Y positioning table where it is located by edge registration or tooling pins. The board is front left-edge, topside justified on the X-Y positioning system.
- The X-Y positioning table presents the board fiducials to the pattern error correction (P.E.C.) camera. The pattern program is adjusted for artwork misalignment.
- The designated feeder carriage(s) moves into position to the first feeder location specified in the pattern program.
- One of the six vacuum nozzles picks a component from the feeder according to the pattern sequence.
- The component is recognized, the center point located, and the appropriate X, Y, and theta corrections are calculated by the vision system.
- The machine controller directs the theta drivers and X-Y positioning table to make the adjustments to accurately place each component.

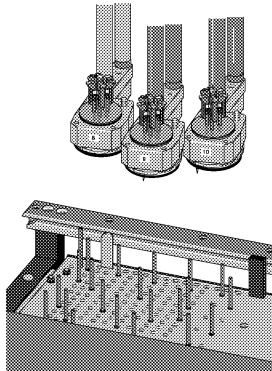
Standard Features

Board Transport

The antistatic belt-driven board transport system transfers boards to and from the X-Y positioning table. Universal Instruments Corporation's Standard Machine Parallel Interface (SMPI) provides communication with adjacent board handling equipment and upline and downline machines. Refer to GS-283 and GS-284.

X-Y Positioning System

A precision, servo-driven X-Y positioning system locates and delivers a board under the turret. The X-Y table rails are adjustable to accommodate different board widths.



Turret Assembly

The 24-station servo-driven, cam-actuated turret assembly places components on boards. Each turret head is equipped with up to six different nozzle types. The machine automatically selects nozzles to match components programmed for each cycle. Component handling errors and recognition errors are detected and automatically repaired.

Nozzle Tooling

Components are picked from the feeder tape pocket and placed on the board using nozzles on each turret placement head. The placement head nozzle configurations may be varied from head to head for products requiring more than six nozzle types.

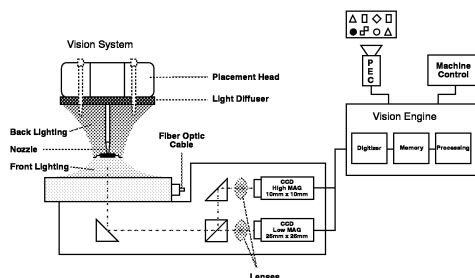
Each nozzle and its corresponding component-handling capability is listed in the Nozzle Specifications table.

NOTE

Actual throughput will be decreased if nozzle configuration is not the same for all 24 heads.

Vision Centering System

The 4791A HSP vision centering system provides contact-free component recognition and centering using either front or back lighting illumination methods. Component recognition may be performed in manual test mode (nonproduction operation), or in automatic recognition mode (full production operation).



Fiber optic light cables provide high intensity light to produce a sharp frontlit or backlit image. The image is captured by one of two high resolution CCD cameras and optics and processed by the machine vision controller. Applicable components must fit within the vision window of 20mm (0.787 inch) square and down to 20 mil lead pitch. (optional: up to 32mm square)

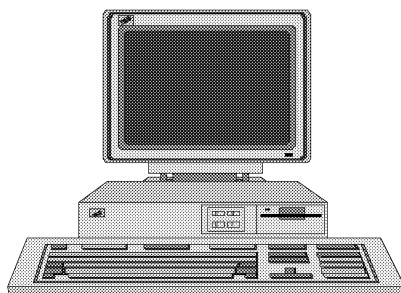
The vision processor uses 256 level gray-scale image analysis to accurately locate the component and calculate the appropriate X, Y, and theta adjustments.

The theta correction is done by rotating the placement head to orient the component. The X-Y corrections are made by the X-Y table before placing the component.

Control System and Machine Software

The control system and machine software regulate machine operations using a 68000-based microprocessor with VMEbus architecture. The machine control software initiates, monitors, and reports operations through the touch screen machine control panel (MCP) interface and vision system monitor.

Pattern Programming



Pattern programs may be generated off-line using one of three methods:

- Manual keyboard entry using a personal computer (P.C.) loaded with WINDOWS* -based UCT51 software and its complementary pattern optimization and simulation functions. (UCT51 is provided free of charge with each machine.)
- Utilizing Universal's CIMBridge* CBPro Module to convert various CAD system outputs to HSP-ready pattern programs. (See GS-355-00.)
- Utilizing Universal's UniScan® Machine Programming Station to create pattern programs when there is no CAD or hard-copy data available. (See GS-356-00.)

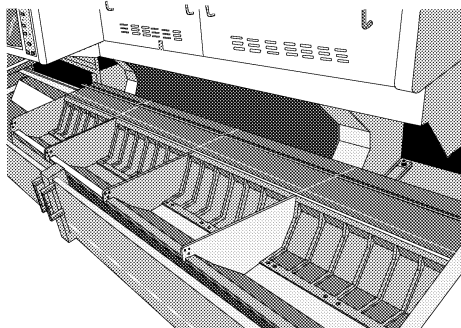
UCT51 software also provides the ability to communicate between the machine and the P.C. Pattern programs, management data, and device data may be transferred between each by an RS-232C serial port and cable.

UCT51 software also contains a Component Library database containing parameters for each component used in the vision recognition and placement process. Entries in the Component Library may be copied, edited, and transferred between the machine and off-line P.C. Component Library ID names may coincide with user's internal part numbers.

Pattern programs may be generated for individual boards or breakaway boards with up to 128 pattern offsets. Once pattern programs are created, they may be edited at the machine or off-line P.C.

Program and Data Storage

Active machine memory stores up to 24 pattern programs or 5000 program steps as well as up to 800 component ID records. Additional pattern program and component library storage is available with the off-line P.C.



Random Access Feeder Carriage System

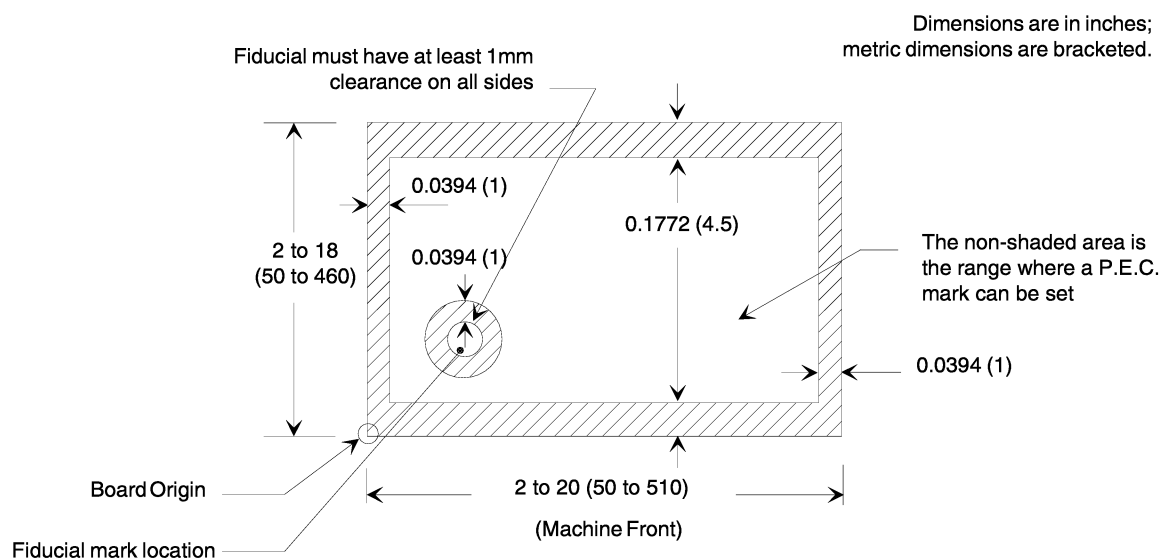
The feeder system, consisting of four feeder carriages, moves reeled components to the turret as specified in the placement program. Feeder carriages connect in configurations of 1, 2, 3, or 4 units. Each feeder carriage contains 80 locating slots for mounting up to forty 8mm feeders per carriage (up to a total of one hundred sixty 8mm feeders). Larger feeders require more locating slots.

Bulk Feeder Capability

Bulk feeders may be loaded with rectangular cassettes containing chip and MELF components. This capability greatly reduces overall component replenishment time while eliminating issues related to paper and embossed carrier tape scrap disposal. Bulk feeders do not require special mounting assemblies.

Pattern Error Correction (P.E.C.)

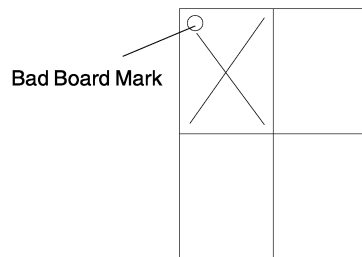
P.E.C. corrects for artwork misalignment using a high-resolution camera that is tied to the machine's vision processor. The vision processor uses correlation models to analyze the gray-scale image and locate the fiducial mark. From the fiducial recognition process, a proper offset is established and the placement pattern is adjusted accordingly. Fiducial recognition may be selected for single boards or individual boards in a breakaway.



Optional Features

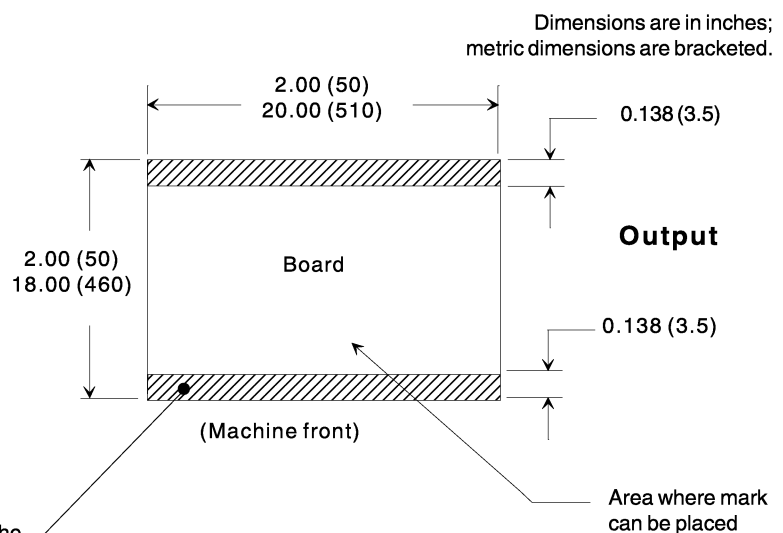
Bad Board Reject (BBR)

Bad board reject allows good breakaway boards to be populated while bad boards, individually marked, are detected and bypassed in the placement sequence. A "global" bad board mark can also be used to reduce overall bad board mark detection time. The drawing below shows a typical area where the bad board reject mark can be placed.



Note: Bad board marks must have good contrast with the board for accurate detection and have a diameter greater than 10mm (0.39 inch). Rectangular shaped marks are acceptable.

Shaded areas are the clearance needed for board transport rails on top and bottom sides



Programmable Width Control (PWC) Conveyor

This option allows the operator to program the board width into the pattern program. When the pattern program is activated, the input and output conveyor rear rails and the X-Y positioning table rear rails automatically adjust to the programmed width.

Extended Feeder Capacity

With the addition of two feeder carriage containment modules, total machine feeder capacity is increased to 240 from 160. Two feeder carriages, each accommodating 40 feeder locations are added to the system, allowing a greater range of component part types to be stored on-line.

Note: Only four carriages (160 feeders) can be used in operation at one time.

44mm Tape Feeding

Component size placement range is expanded by handling larger leaded components packaged in 44mm embossed tape. Maximum component size is thus increased from 20mm² (standard) to 32mm². (Placement rate depends upon complexity of the component.)

Multiple-Pattern Programming Option

Up to 99 different patterns may exist within one P.C. board in a breakaway board array. Each pattern may have a different set of fiducial marks. This option also supports all functions of the Bad Board Reject option.

Generic Equipment Model Interface (GEM)

GEM provides an industry standard machine communication protocol over a TCP/IP-based network. GEM compliance is based upon SEMI International Standard E30-93.

Gas Shock Assist Feeder Cover Doors



Shocks mounted to the rear feeder cover door assemblies provide mechanical assistance while opening and closing.

Feeder Storage Carts



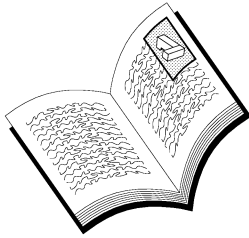
- Movable cart features three shelves for off-line storage of up to 180, 8mm feeders.
- Single tier cart for production setup and handles 80, 8mm feeders per cart.

Feeder Reload Tool



This free standing reload tool may be placed on any flat surface. Feeders are mechanically gripped and held stationary by the unit, allowing machine operators to load components.

Supporting Documents



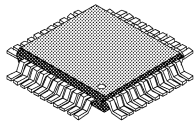
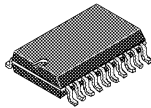
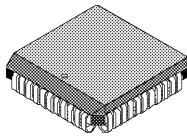
GS-256	Quality Assurance Terms and Applications Standards, Series 0000
GS-283	Standard Machine Parallel Interface (SMPI) Board Processing Protocol (BPP), Series 8000
GS-284	Standard Machine Parallel Interface (SMPI), Series 6000
GS-356-00	UniScan Machine Programming Station, Model 86741
EIAJ	EIA Standard for Taping Surface Mount Components for Automatic Placement. (Japan Issue)
EIA-481	EIA Standard for Taping Surface Mount Components for Automatic Placement
JIS CO806-1990	Embossed Carrier Taping Standard
QAP4791A	Quality Assurance Criteria
SMEMA	Standards 1.1 and 3.1
SEMI	E30-93

Technical Specifications

Nozzle Specifications

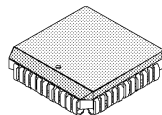
Nozzle Type Number	Applicable Components	Typical Component Thickness	Standard Configuration *
1	0603 (1608) Chips	0.018 to 0.031 (0.45 to 0.8mm)	Yes
2	1206 (3216), 1210 (3225) Chips SOT-23, Tantalum A	0.018 to 0.098 (0.45 to 2.5mm)	Yes
3	SOIC 14+, QFP, PLCC	0.039 to 0.197 (1.0 to 5.0mm)	Yes
4	Tantalum B, C, D, SOIC 8	0.039 to .256 (1.0 to 6.5mm)	Yes
5	Small MELF	0.078 x 0.039 (2.0 x 1.0mm) 0.078 x 0.049 (2.0 x 1.25mm) 0.138 x 0.055 (3.5 x 1.4mm)	Yes
6	Large MELF	0.138 x 0.055 (3.5 x 1.4mm) 0.23 x 0.087 (5.9 x 2.2mm)	No
7	0805 (2125)	0.018 to 0.049 (0.45 to 1.25mm)	Yes
8	0402 (1005)	0.011 to 0.023 (0.3 to 0.6mm)	No

* Standard configuration denotes nozzles which come with the machine if user preferences are not indicated at the time of order.

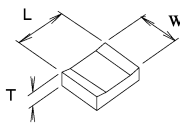
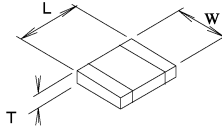
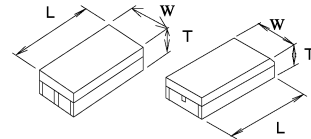
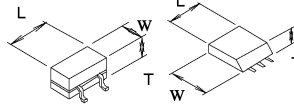


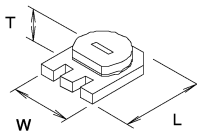
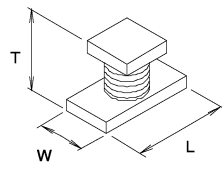
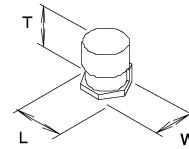
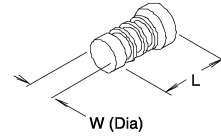
Component (chips/ICs)

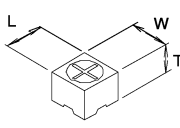
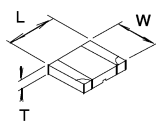
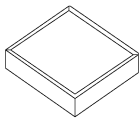
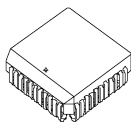
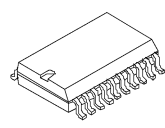
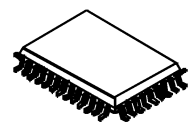
	Minimum	Maximum
Width	0.040" (1.0mm)	1.259" (32mm), open loop
Length	0.020" (0.5mm)	1.259" (32mm), open loop
Thickness	0.014" (0.35mm)	0.256" (6.5mm)
Lead pitch	0.020" (0.5mm)	0.050" (1.27mm)
Lead width	0.007" (0.18mm)	Not Specified
MELF diameter	0.031" (0.8mm)	0.087" (2.2mm)
MELF length	0.063" (1.6mm)	0.232" (5.9mm)



Typical Component Types

	Flat Chip Resistors		Ceramic Capacitors		Tantalum Capacitors		Small Outline Transistors	
Shape								
Tape Size:	8mm	8mm	12mm	8mm	12mm	8mm	12mm	
L	Min. 0.04" (1.0mm) Max. 0.16" (4.0mm)	0.04" (1.0mm) 0.16" (4.0mm)	0.18" (4.5mm) 0.22" (5.7mm)	0.13" (3.2mm) 0.15" (3.8mm)	0.19" (4.7mm) 0.28" (7.3mm)	0.08" (2.0mm) 0.11" (2.9mm)	0.18" (4.5mm)	
W	Min. 0.02" (0.5mm) Max. 0.12" (3.0mm)	0.02" (0.5mm) 0.12" (3.0mm)	0.13" (3.2mm) 0.20" (5.0mm)	0.06" (1.6mm) 0.11" (2.8mm)	0.10" (2.6mm) 0.17" (4.3mm)	0.05" (1.25mm) 0.06" (1.5mm)	0.17" (4.3mm)	
T	Min. 0.02" (0.5mm) Max. 0.10" (2.5mm)	0.02" (0.5mm) 0.10" (2.5mm)	0.08" (2.0mm) 0.08" (2.0mm)	0.06" (1.6mm) 0.07" (1.9mm)	0.08" (2.1mm) 0.11" (2.8mm)	0.03" (0.9mm) 0.04" (1.1mm)	0.06" (1.5mm)	

	Trimmer Potentiometer	Coil	Aluminum Electrolytic Capacitors		Cylindrical Chip	
Shape						
Tape Size:	12mm	8mm	12mm	12mm	16mm	8mm 12mm
L	0.18" (4.5mm)	0.13" (3.2mm)	0.18" (4.5mm)	0.17" (4.3mm)	0.26" (6.6mm)	0.08" (2.0mm) 0.23" (5.9mm)
W	0.15" (3.8mm)	0.10" (2.5mm)	0.13" (3.2mm)	0.17" (4.3mm)	0.26" (6.6mm)	0.04" (1.0mm) 0.09" (2.2mm)
T	0.09" (2.25mm)	0.08" (2.0mm)	0.10" (2.6mm)	0.22" (5.7mm)	0.22" (5.7mm)	

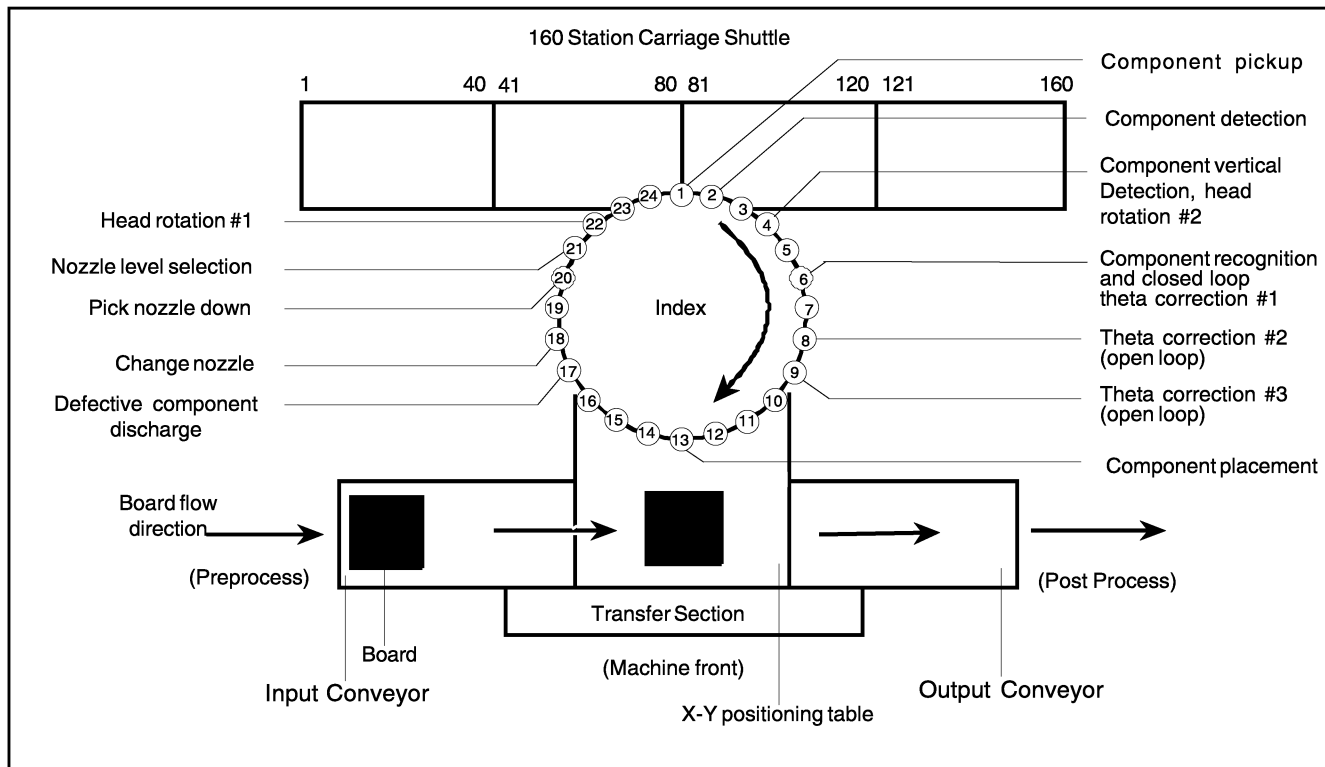
	Trimmer Capacitors	Ceramic Chip Filter	LCC	PLCC	SOP/SOIC	QFP
Shape						
Tape Size:	12mm	12mm	12mm, 16mm, 24mm, 32mm, 44mm			24mm, 32mm 44mm
L	0.18" (4.5mm)	0.27" (6.9mm)	Variable	18p, 20p, 22p, 28p, 32p, 44p, 52p	8p, 10p, 14p, 16p, 20p, 24p, 28p	Up to 0.787 inch (20mm) Square
W	0.16" (4.0mm)	0.18" (4.6mm)	0.17" (4.3mm)	0.26" (6.6mm)	0.04" (1.0mm)	0.09" (2.2mm)
T	0.12" (3.0mm)	0.06" (1.6mm)	0.22" (5.7mm)	0.22" (5.7mm)		

Placement Head Specifications

24 Station Turret		
Programmable placement cycle rate		
maximum	0.124 sec/comp ¹	Up to 29,032 comp/hr
minimum	1.50 sec/comp	2,400 comp/hr
Maximum placement accuracy	Chips	±0.006 inch (0.15mm)
	IC (open loop)	±0.006 inch (0.15mm)
	IC (closed loop)	±0.004 inch (0.1mm)
Placement orientation	Open Loop Recognition	0 - 359.9 degrees in 0.1 degree increments
	Closed Loop Recognition	0°, 90°, 180°, and 270° in 90° increments
Component placement pressure	Adjustable through the programmable Z-height setting and 200 gram nominal force compliant nozzle tip.	
Placement performance	100 ppm	99.99%
	Intrinsic Availability ² 95%	

1. Within the X, Y table movement of 20mm and feeder increment of one lane.

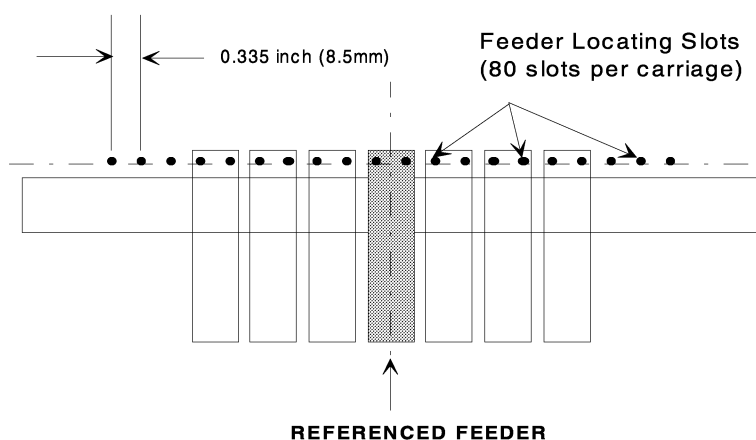
2. Refer to GS-256.



4791A HSP Turret and Stations

Feeder Input

Tape Size	Carrier Type	Standard (Max.)	Extended Feeder option (Max.)
8mm x 2 - 4mm	Paper	160	240
8mm x 4 - 8mm	Embossed	160	240
12mm x 4 - 12mm	Embossed	108	162
16mm x 4 - 16mm	Embossed	80	120
24mm x 8 - 24mm	Embossed	64	96
32mm x 12 - 24mm	Embossed	44	66
32mm x 12 and 24mm	Adhesive	44	66
44mm x 12 - 36mm	Embossed	36	54
Bulk Feeder	Cassette	160	240



Number of slots adjacent feeders require

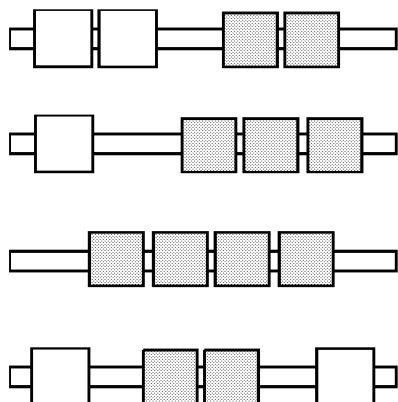
44mm Emb	32mm Adh	32mm Emb	24mm Emb	16mm Emb	12mm Emb	8mm Pap/Emb	Referenced feeder type	8mm Pap/Emb	12mm Emb	16mm Emb	24mm Emb	32mm Emb	32mm Adh	44mm Emb
6	5	4	3	3	2	2	8mm (P/E)	2	3	3	4	5	4	6
6	6	4	4	3	3	3	12mm (E)	2	3	3	4	5	4	6
6	6	5	4	4	3	3	16mm (E)	3	3	4	4	6	5	6
7	7	5	5	4	4	4	24mm (E)	3	4	4	5	6	5	7
8	8	7	6	6	5	5	32mm (E)	4	4	5	5	7	6	7
8	7	6	5	5	4	4	32mm (A)	5	6	6	7	8	7	9
9	9	7	7	6	6	6	44mm (E)	6	6	6	7	8	8	9

* For this chart it is assumed that no available slots are skipped.

Feeder Spacing within Feeder Carriages

Carriage Weight Guidelines

The following feeder carriage weight guidelines are recommended in order to maintain optimum long-term machine performance and reliability. Exceeding these guidelines, while operating the machine at maximum placement speeds may produce unwanted vibration and/or cause premature wear and damage to internal operating mechanisms.



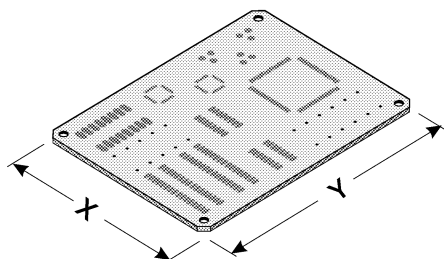
Carriages Connected	Weight Guideline at 0.124 sec tact time	Weight Guideline at 0.160 sec tact time
1 and 2 or 3 and 4	Max. 160 kg (spread across 2 carriages)	*Max. 216 kg (spread across 2 carriages)
1, 2 and 4 or 2, 3 and 4	Max. 214 kg (spread across 3 carriages)	Max. 324 kg (spread across 3 carriages)
1, 2, 3 and 4	Max. 212 kg (spread across 4 carriages)	Max. 320 kg (spread across 4 carriages)
2 and 3	*Max. 216 kg (spread across 2 carriages)	-----

*40 mounted 8mm, large pan feeders weigh approximately 108 kg. This is the heaviest conceivable combination of mounted feeders.

If it is necessary to exceed these weight guidelines for any reason, optimization of pattern programs and maximized usage of small reel tape feeders (or bulk cassette feeders, weighing ~ 500g each) will reduce the occurrence of vibration and potential damage to the machine.

Approximate Weight of Feeders Loaded with Components

Tape size	8mm (S)	8mm (L)	12mm (S)	12mm (L)	16mm (L)	24mm (L)	32mm (L)	44mm (L)
Pounds	2.93	5.91	3.09	6.08	6.22	6.48	6.94	7.04
Kilograms	1.33	2.68	1.40	2.76	2.82	2.94	3.15	3.20



Board Specifications

		Inch	Metric
Width	Min	1.968"	50mm
	Max	18.110"	460mm
Length	Min	1.968"	50m
	Max	20.079"	510mm
Thickness	Min	0.032" ¹	0.8mm
	Max	0.197"	5.0mm
Weight	Min	N/A	N/A
	Max	5.3 pounds	2.4 kg
Top Side Clearance		0.256"	6.5mm
Standard Bottom Side Clearance		0.886"	22.5mm
Allowable Warp		Not to exceed 0.008 inch (0.2mm) in 1.968 inches (50mm), 0.039 inch (1.0mm) maximum. If greater warpage is expected, contact Universal for appropriate board testing.	

For pallet applications, it is recommended that the top surface of the board in process be in the same plane as the top surface of the pallet it is mounted on. Board support pins must be sized to support the pallet and the board. For applications where the surface of the board and pallet are not in the same plane, refer to component height restrictions for actual component clearance allowable.

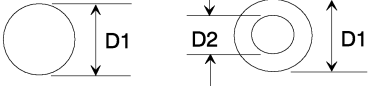
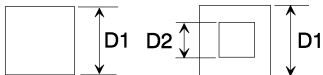
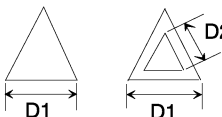
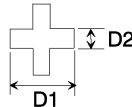
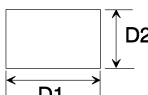
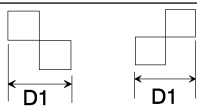
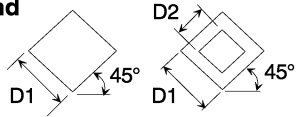
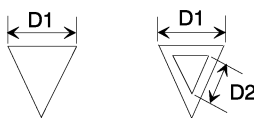
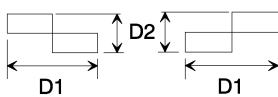
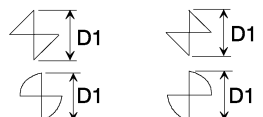
Note:

1. PCMCIA and ceramic board applications are special options.

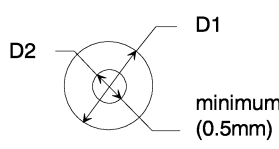
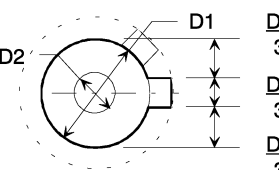
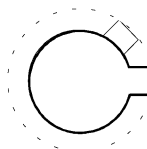
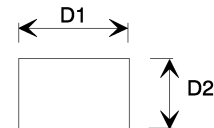
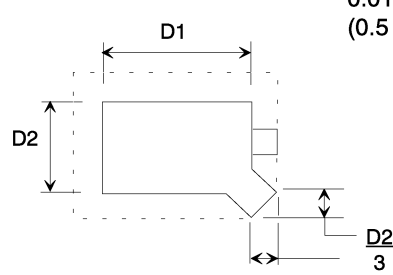
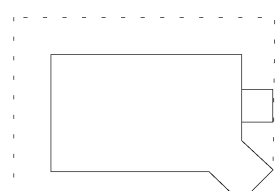
Board Handling

		Available	
		Yes	No
Board registration	Top edge register	X	
	Front edge register	X	
	Tooling pin	X	
	Vision (P.E.C.)	X	
Board transfer direction	Left to right	X	
	Right to left, option	X	
	In/out same side		X
Transfer height	37.88 +/-0.20 inch (962.2mm ±5mm)		
Board transfer time	4 seconds without P.E.C., minimum. Approximately 5 seconds with P.E.C.		

Acceptable Fiducial Shapes, industry standard

Shapes		D1	D2	Remarks
Standard Artwork (various shapes)	Round 	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0 - .0709 inch $\pm 10\%$ (0 - 1.8mm) [D1 minus .0079 inch > D2] [D1 minus 0.2mm > D2]	Fiducial Reference: Center D2: Size of a punched hole
	Square  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0 - .0709 inch $\pm 10\%$ (0 - 1.8mm) [D1 minus .0079 inch > D2] [D1 minus 2.0mm > D2]	Fiducial Reference: Center D2: Size of a punched hole
	Equilateral Triangle  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0 - .0709 inch $\pm 10\%$ (0 - 1.8mm) [D1 - .0079 inch (0.2mm) > D2]	Fiducial Reference: Center D2: Size of a punched hole
	Cross  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0.0079 - .0394 inch (0.2-1.0mm) $\pm 10\%$ (D1/2 > D2)	Fiducial Reference: Center
	Rectangle  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0.0079 - .0787 inch (0.2 - 2.0mm) $\pm 10\%$	Fiducial Reference: Center
	Double Box  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	—	Fiducial Reference: Contact of two squares
	Diamond  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0 - .0709 inch (0 - 1.8mm) $\pm 10\%$ [D1 - .0079 inch (0.2mm) > D2]	Fiducial Reference: Center
	Equilateral Triangle  (Machine Front)	0.0197 - .0787 inch (0.5 - 2.0mm) $\pm 10\%$	0 - .0709 inch (0 - 1.8mm) $\pm 10\%$ [D1 - .0079 inch (0.2mm) > D2]	Fiducial Reference: Center D2: Size of a punched hole
	Double Rectangle  (Machine Front)	0.0197-0.0787 inch (0.5-2.0mm) $\pm 10\%$	0.0197-0.0787 inch (0.5-2.0mm) $\pm 10\%$	Fiducial Reference: Contact of two rectangles
	Bow Tie  (Machine Front)	0.0197-0.0787 inch (0.5-2.0mm) $\pm 10\%$	—	Fiducial Reference: Two triangles or two sectors D1: Diameter of a fiducial size
Note:		The preferred fiducial material is copper plated. Nickel, gold and silver plated fiducials are also acceptable as long as good contrast is obtained. Highly reflective mirror surfaces cannot be used. Board patterns, similar to the actual fiducial mark cannot exist within the fiducial recognition window.		

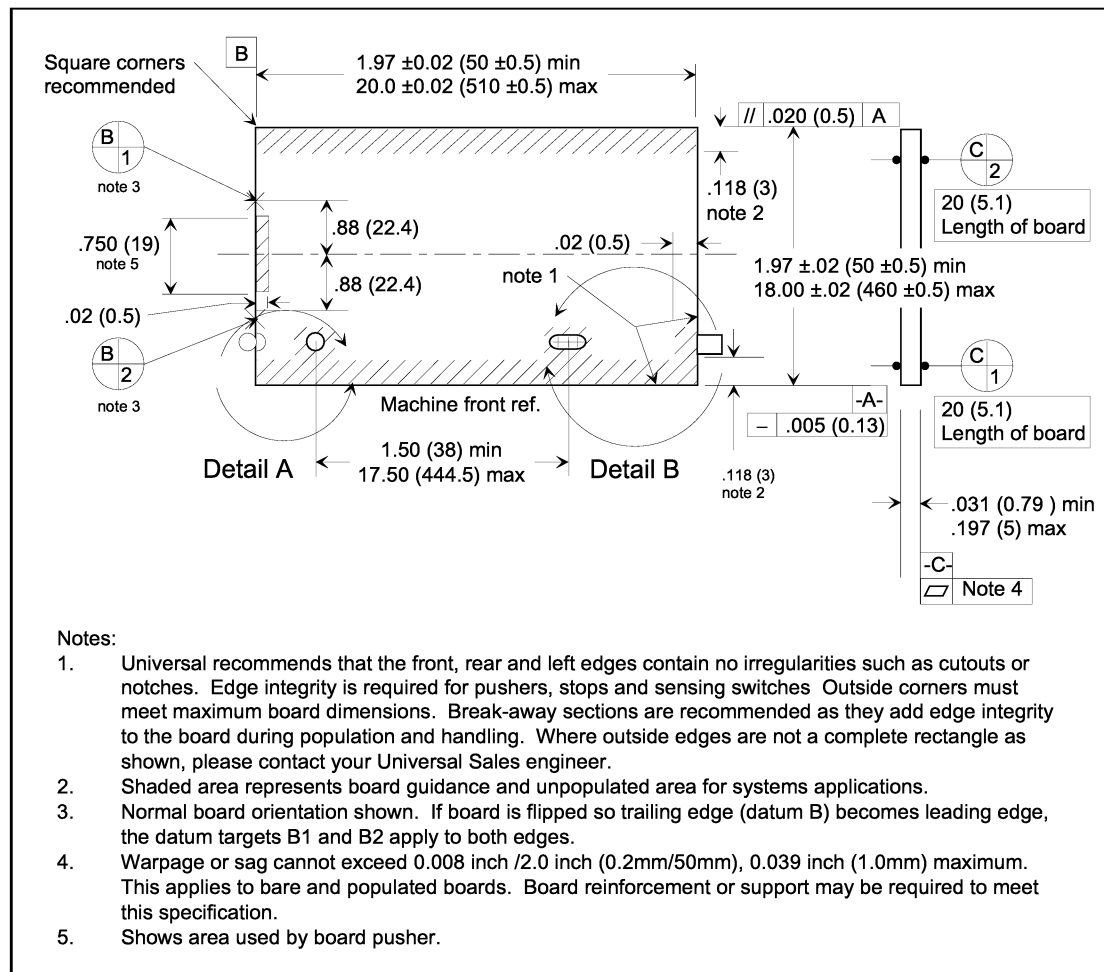
Acceptable Fiducial Shapes

	Shapes	D1	D2	Remarks
Through Holes (round)	Round 	0.0394 to 0.0787" (1.0 to 2.0mm)	0.0197 to 0.0787" (0.5 to 1.5mm)	Minimum D1
	Round 	0.0394 to 0.0787" (1.0 to 2.0mm)	0.0197 to 0.0787" (0.5 to 1.5mm)	 ← Trace may be located at 45 degree increments around shape
Pad Marks with Lands (rectangular)	Rectangle 	0.0197 to 0.0787" (0.5 to 2.0mm)	0.0197 to 0.0787" (0.5 to 2.0mm)	
	Rectangle 	0.0197 to 0.0787" (0.5 to 2.0mm)	0.0197 to 0.0787" (0.5 to 2.0mm)	D2 is the shorter side.  ← Trace may be located at 45 degree increments around shape

Positioning System

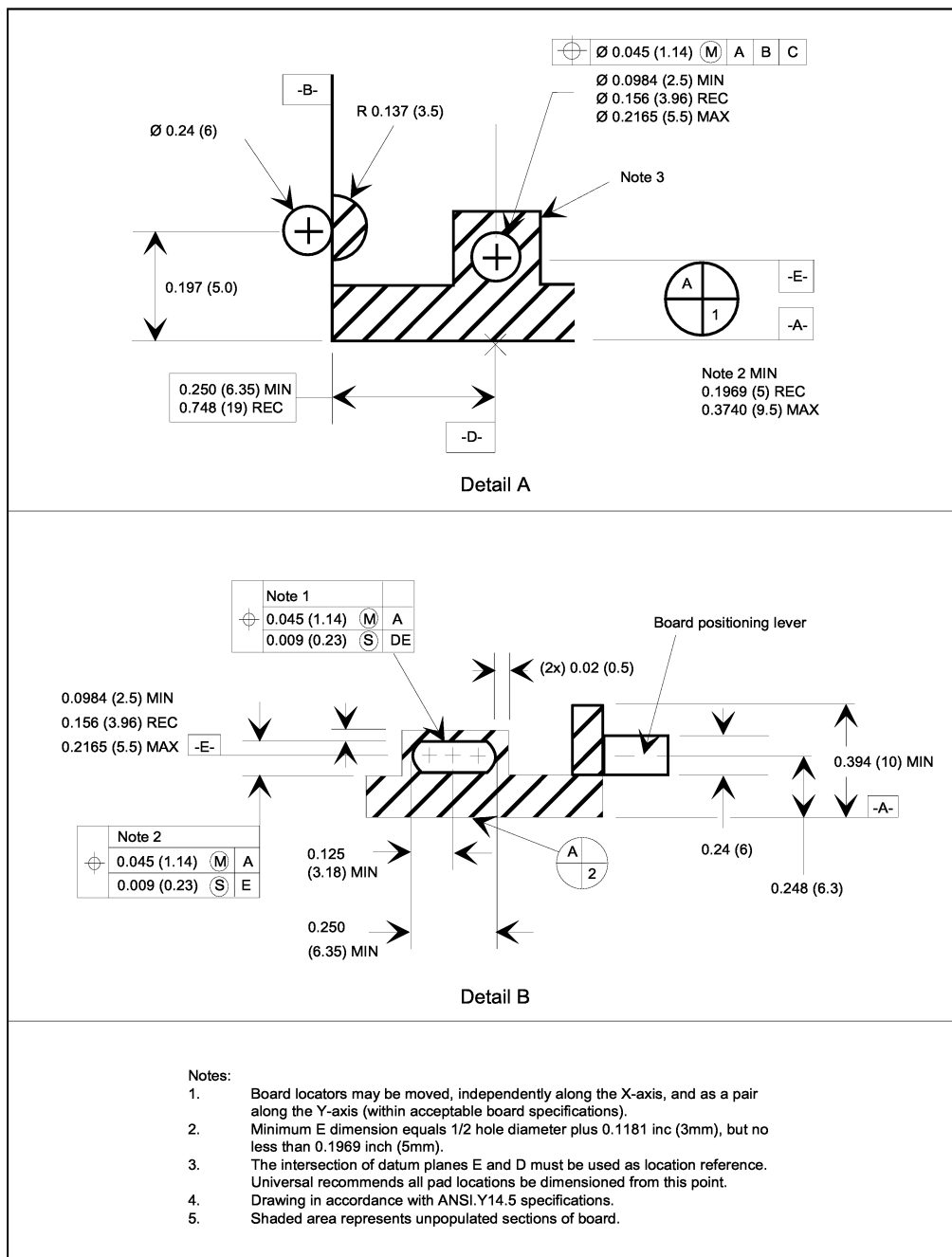
X-axis travel	28.5" (725mm)
Y-axis travel	20.6" (525mm)
Resolution	1 Pulse = 0.0004" (1 Pulse = 0.01mm)

Dimensions are in inches;
metric equivalents are bracketed.

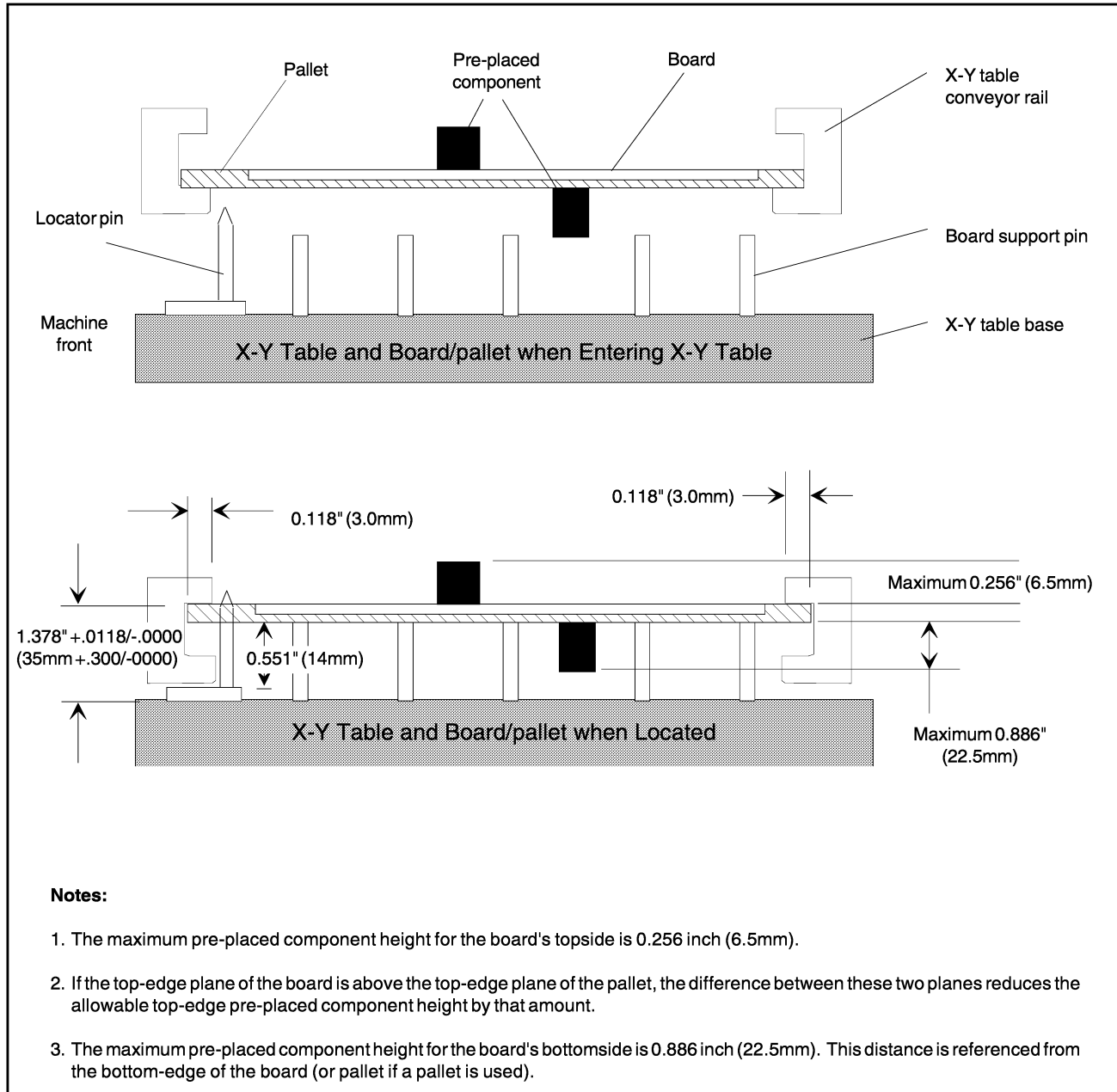


Positioning System Board Locating Specifications

Dimensions are in inches;
metric equivalents are bracketed.

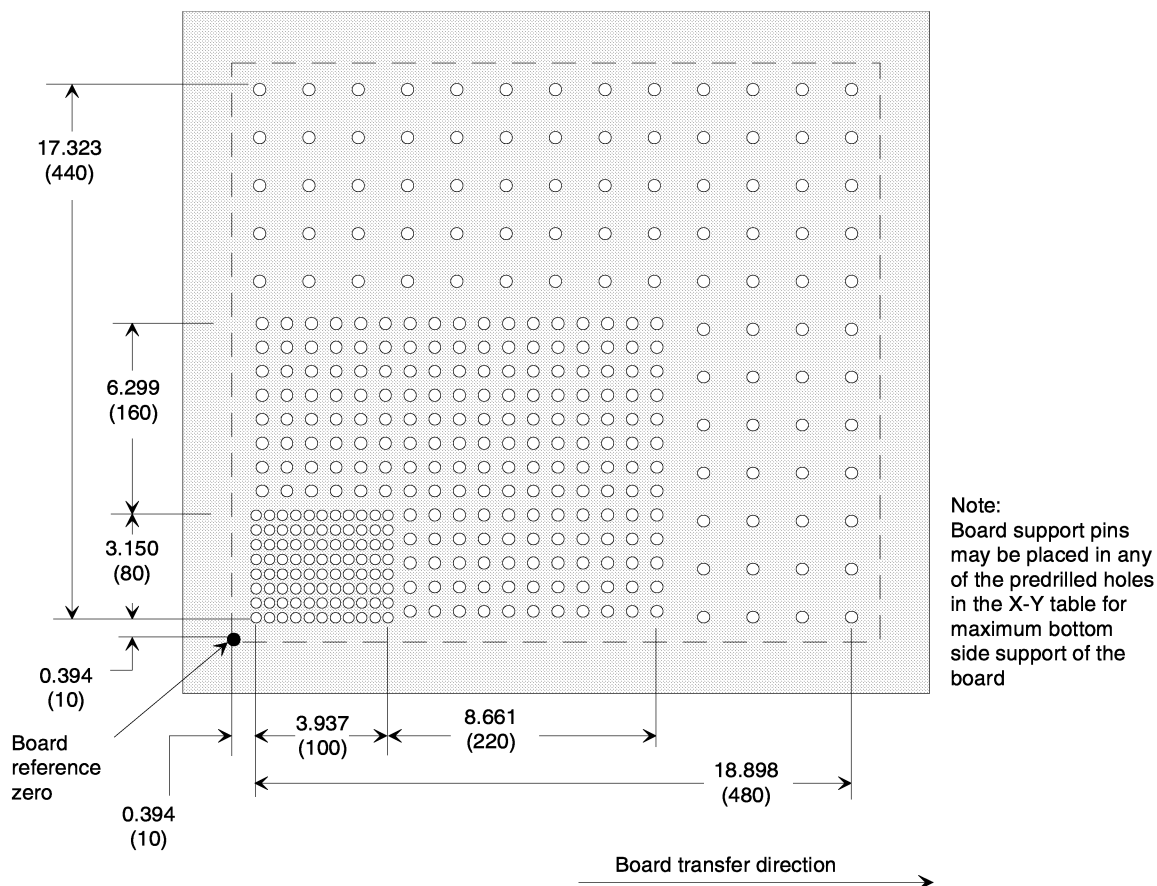


Board Locating Specifications

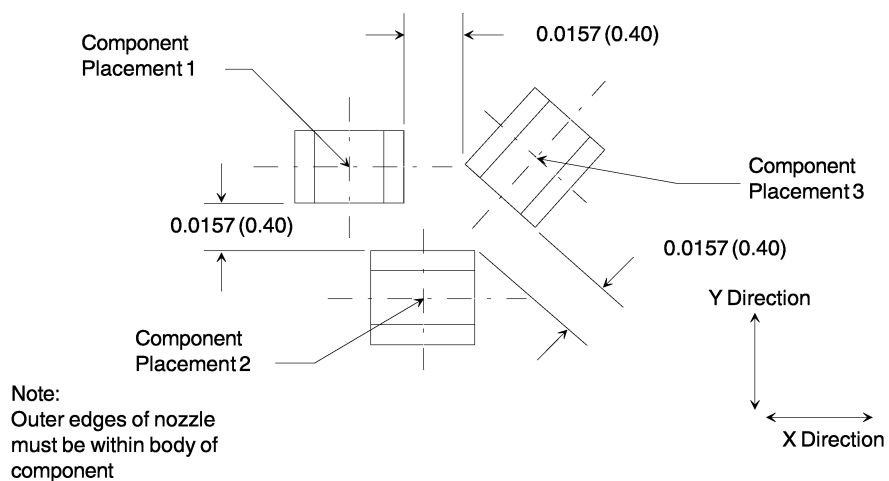


Topside/bottomside Board Clearance

Dimensions are in inches;
metric equivalents are bracketed.

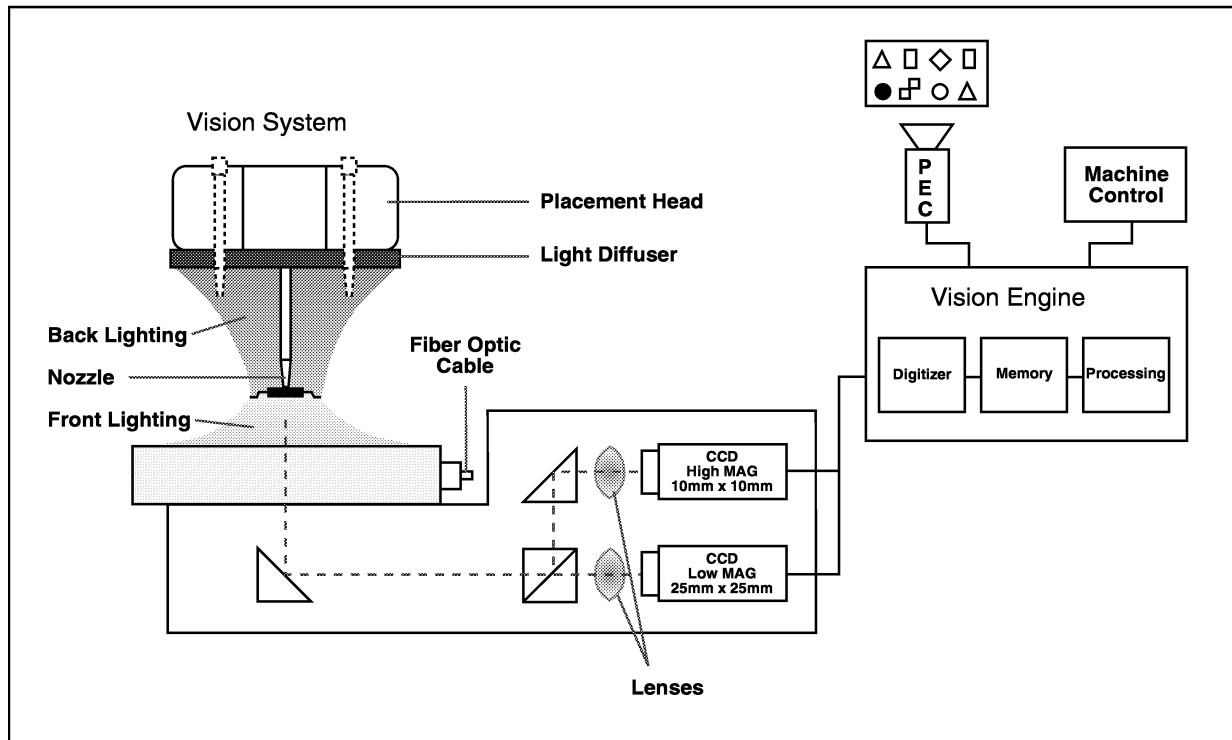


Board Support Pin Layout on X-Y Table Base



Component Placement Specifications

Dimensions are in inches;
metric equivalents are bracketed.



Vision System Configuration

Component Recognition Camera

Fields of view	High: 0.394 x 0.394 inch (10 x 10mm) Low: 0.984 x 0.984 (25 x 25mm)
Camera resolution	High: 20 micrometer/pixel Low: 54 micrometer/pixel

Pattern Error Correction Camera

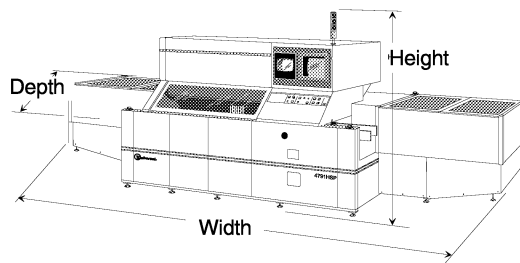
Field of view	0.47 x 0.47 inch (12 x 12mm)
Camera resolution	0.001 inch/pixel (27 micrometer/pixel)
Window size	0.0394 x 0.0394 inch (1 x 1mm) to 0.197 x 0.197 inch (5 x 5mm)
Recognition time	Approximately 200 ms/mark

Installation Considerations

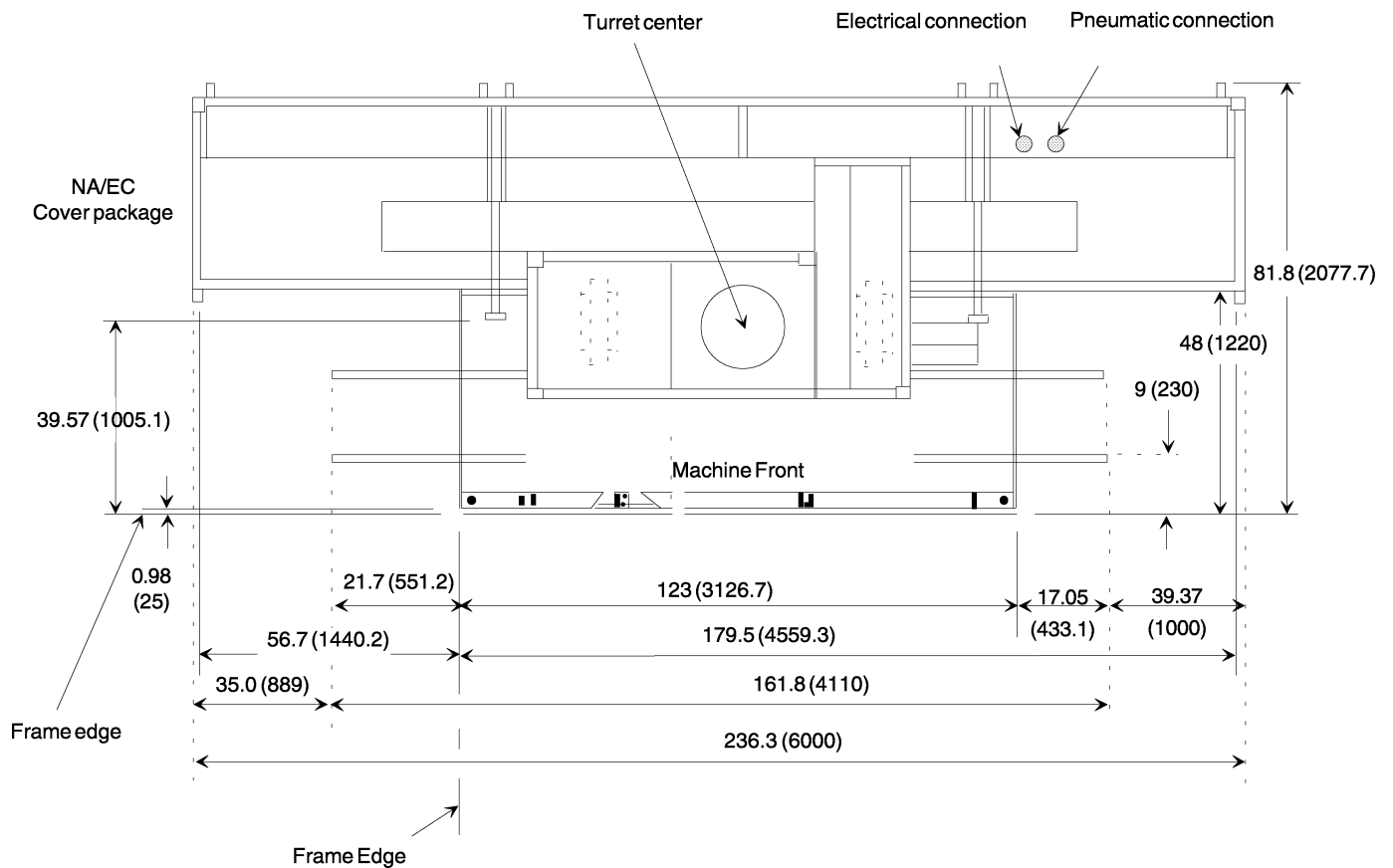
Machine Dimensions

	Width	Depth	Height	Weight
Machine	236.2" (6000mm)	81.77" (2077mm)	84.8" (2155mm)	11,013 pounds (5000kg)
Domestic shipping ¹	245" (6223mm)	85" (2159mm)	76" (1930mm)	12,846 pounds (5832 kg)
Drop ship ²	250" (6350mm)	94" (2388mm)	85.4" (2170mm)	13,220 pounds (6002 kg)

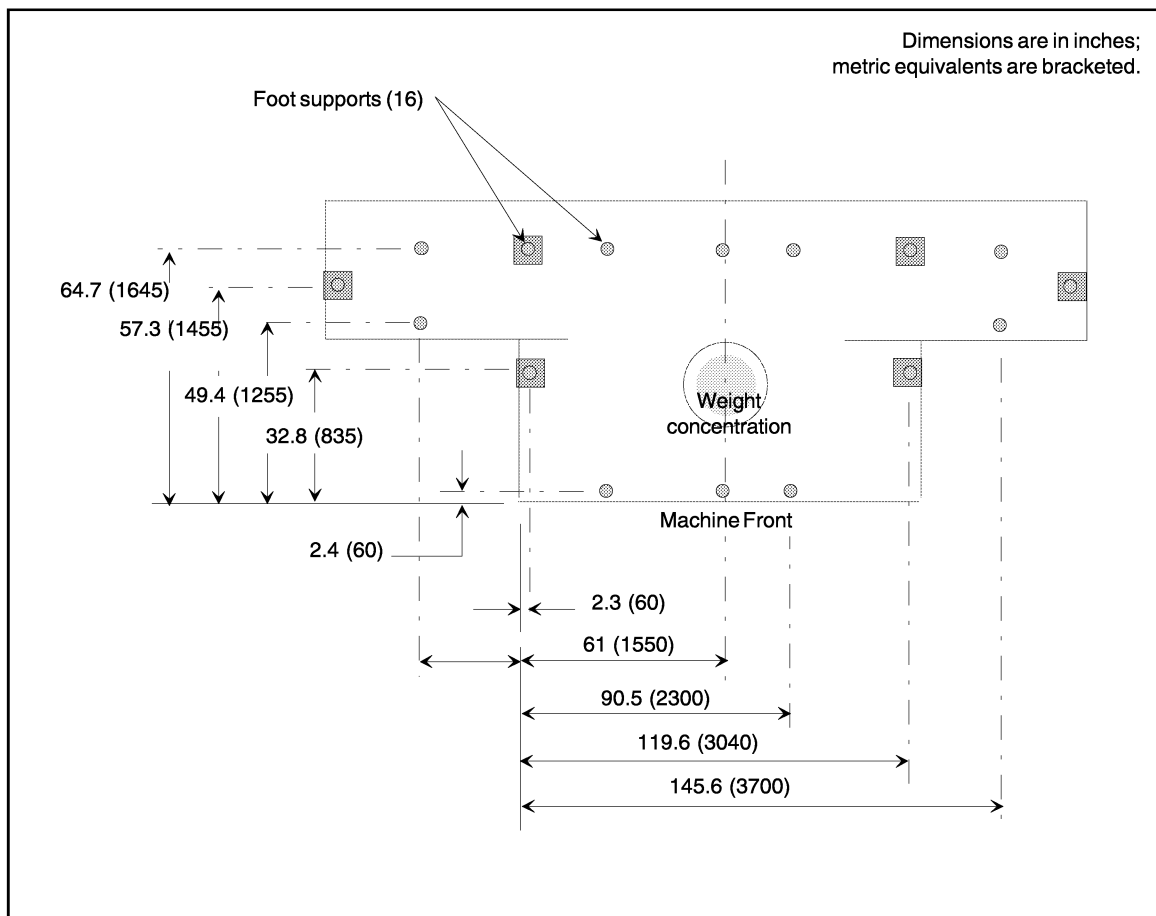
1. Includes outer dimensions with transport wheels mounted
2. Shipping dimensions of crate.

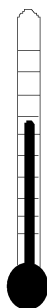


Dimensions are in inches;
metric equivalents are bracketed.



4791A HSP Footprint

**4791A HSP Foot Support Locations**



Environmental Requirements

	Minimum	Maximum
Operating Temperature	50° F (10° C)	86° F (30° C)
Storage Temperature	-4° F (-20° C)	140° F (60° C)
Operating Humidity	30% noncondensing	80%
Noise Level	60 dbA	80 dbA

Service Requirements

Electrical supply	200 VAC (+20/-10 VAC), 3-phase, 50/60Hz, 30 amperes (6 kVA, kilovolt-ampere)
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When calculating the minimum and maximum voltage requirements, consider the power utility's voltage fluctuations, line losses, transformer losses, and a safety margin. The minimum voltage of 190 volts does not infer that connecting a 190 volt service is acceptable.

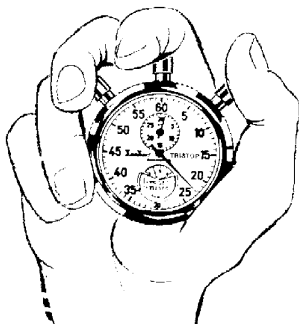
Power consumption	Approximately, 7 kVA maximum
Air supply (clean air *)	60 to 100 psi (4 to 7 kgf/cm ² or 4.1 to 6.9 bar)
Air pressure	60 psi (4 kgf/cm ² or 4.1 bar)
Air consumption	Approximately, 1 cfm at 60 psi (25 liters per minute at 4.1 bar)

*Clean air is defined as:

Water: -17° or less (dew point under atmospheric pressure)

Oil: 0.08 ppm at 28° C.

Dust (solid): 0.01 micron



Operator Activity Time Estimates

Activity	Approximate Time
Change board width	30 seconds (PWC)
Change feeder	15 seconds
Replace feeder reel	less than 1 minute