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Semiconductor Equipment and Materials International

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EQUIPMENT AUTOMATION HARDWARE

Semiconductor Equipment and Materials International

SEMI E1-0697 (Reapproved 1102)^E
SPECIFICATION FOR 3 inch, 100 mm, 125 mm, AND 150 mm PLASTIC AND METAL WAFER CARRIERS

This specification was technically approved by the Global Physical Interfaces and Carriers Committee and is the direct responsibility of the North American Physical Interfaces and Carriers Committee. Current edition approved by the North American Physical Interfaces and Carriers Committee on July 21, 2002. Initially available at www.semi.org October 2002; to be published November 2002. Orignally published in 1979; previously published June 1997.

E The designation of SEMI E1 was updated during the 0303 publishing cycle to reflect the editorial modification of SEMI E1.5 via PIP form.

1 Scope

1.1 This specification covers the dimensional requirements for plastic and metal wafer carriers used for the processing and handling of 3 inch, 100 mm, 125 mm, and 150 mm diameter wafers. The specification has two classifications: General Usage and Auto Transport Usage. General Usage is a basic guideline that covers 3 inch, 100 mm, 125 mm, and 150 mm wafer sizes. Auto Transport Usage is intended to meet the in-use requirements for the interface of wafer carriers with automated wafer processing equipment. Auto Transport Usage covers the 125 mm and 150 mm sizes.

1.2 To meet these specifications, carriers must be manufactured within the dimensional limits and be dimensionally stable within the specification when used in accordance with manufacturers' recommendations.

1.3 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

NOTE 1: Recommended usage should be agreed to between user and supplier, since wafer carriers are manufactured from a number of different materials by several manufacturing methods.

2 Terminology

2.1 For a pictorial explanation of most of the selected definitions, see Figure 1. Figure 1 symbols are defined in Table 1.

2.2 *Definitions*

2.2.1 *bar* — (See "crossbar.")

2.2.2 *bar end* — The end surface of the carrier that has only one crossbar.

2.2.3 *bar radius* — The radius nearest the bar end of the carrier on the crossbar. (See Figure 1, D5b, Type II.)

2.2.4 *bar web* — The mass of material for structural support which may or may not be present on the crossbar. (See Figure 1, D5a, Type II.)

2.2.5 *bar width* — The distance or thickness of the bar when measured perpendicular to the top face. (See Figure 1, D5b.)

2.2.6 *cassette* — (See "wafer carrier.")

2.2.7 *crossbar* — The mass of material connecting the two sides of the carrier at the bar end of the carrier.

2.2.8 *edge perimeter distance* — The distance from the edge of the wafer to the top face of the carrier. (See Figure 1, D7.)

2.2.9 *end wall* — The wall of the carrier opposite the bar end of the carrier.

2.2.10 *flange* — Mass of material on the exterior and perpendicular to the side walls.

2.2.11 *hole* — The area for the pin on another carrier to enter for transferring wafers. (See Figure 1, C8.)

2.2.12 *lot* — (See "hole.")

2.2.13 *parallelism tolerance* — The minimum and maximum dimension allowance for the opposite pockets to vary in relation to their distance from the crossbar end of the carrier. (See Figure 1, D1.)

2.2.14 *pin* — The mass of material which enters the hole or slot of another carrier for transferring wafer. (See Figure 1, C7.)

2.2.15 *pin and hole center distance from pocket centerline* —The distance from centerline of either the pin or hole to the closest pocket centerline. (See Figure 1, C9.)

2.2.16 *pocket* — The area in which the wafer is located in the carrier.

2.2.17 *pocket centerline* — The imaginary line which bisects each pocket.

2.2.18 *pocket depth* — The distance from the pocket flat to its own pocket nose, not to the opposite pocket. (See Figure 1, C2.)

2.2.19 *pocket flat* — The width of the pocket along the vertical walls at its narrowest distance. (See Figure 1, C3.)

2.2.20 *pocket nose* — The top of the mass of material between adjacent pockets.

2.2.21 *pocket nose radius* — The radius on the pocket nose.

2.2.22 *pocket size* — The distance between opposite pocket flats. (See Figure 1, C4.)

2.2.23 *pocket spacing* — The distance between pocket centerlines. (See Figure 1, B2.)

2.2.24 *pocket width* — The width of the pocket at its widest distance. (See Figure 1, C1.)

2.2.25 *top face* — The plane or surface of the carrier from which side wafers enter into or out of the carrier.

2.2.26 *track clearance* — The unobstructed area between the two carrier sides on the bar end. (See Figure 1, D6; Figure 1a, D6a, D6b, D6c.)

2.2.27 *wafer carrier* — A device for the holding of wafers for various processing steps in semiconductor manufacturing.

2.2.28 *wafer tilt* — The possible unparallel position of the wafer in relation to the bar end of the carrier when the carrier is resting on the bar end. (Not shown in Figure 1.)

2.2.29 *wafer transfer* — The act of relocating wafers from one carrier into another. This can be accomplished by several methods.

Table 1 Symbols Outline General Usage

Figure 1 Reference	*Description*
	Overall Dimensions
A1	Length
A2	Width (with/without flange)
A3	Height (excluding pin)
	Capacity
B1	Pockets per carrier
B2	Pocket spacing
B3	Center distance from the 1st to last pocket
	Detail Dimensions
C1	Pocket width
C2	Pocket depth
C3	Pocket flat
C4	Pocket size
C5	Pin and hole location (width)
C6	Pin and hole location (length)
C7	Pin diameter and height
C8	Hole or slot
C9	Pin and hole center distance from pocket center line
	Machine Fit Specifications
D1	From the outside of the bar end to the center line of the 1st pocket
D2	From the center line of the 1st pocket to the closest point on the crossbar or web
D3	From the bar end of the carrier to the start of the crossbar
D4	Center of the crossbar to the top face of the carrier
D5	Crossbar specifications
D5a	Bar web width on type II crossbar, or width of the type III crossbar
D5b	Bar width
D6	Track clearance
D7	Edge perimeter distance
Not shown — Wafer Tilt	

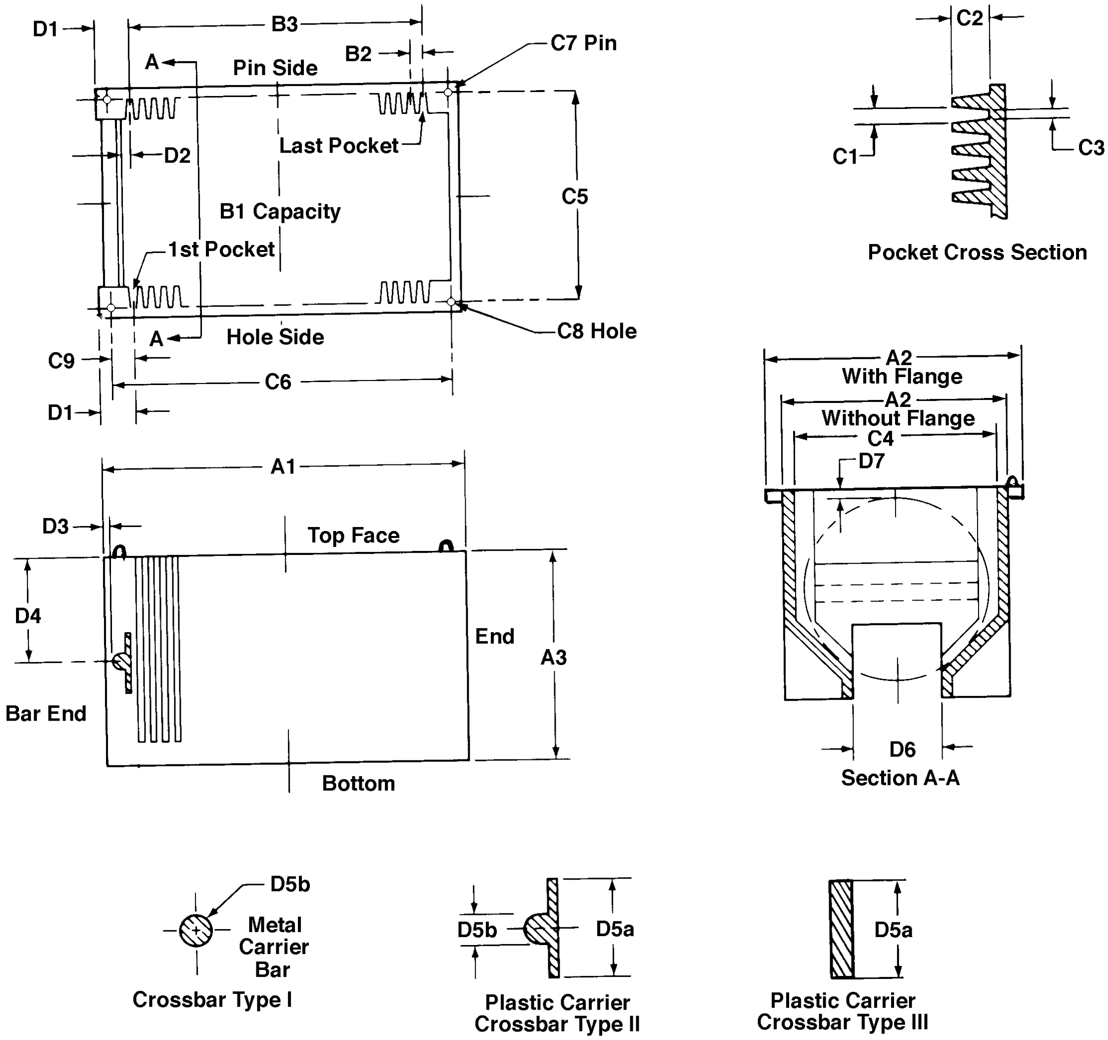


Figure 1
Wafer Carrier Outline — General Usage

NOTE: Used in conjunction with Table 1.

Table 2 Symbols Outline For Auto Transport Usage Specifications

Figure 1A Reference	*Description*
	Overall Dimensions
A1	Length
A2a	Width (with flange)
A2b	Body width (measured at the crossbar)
A3	Height (excluding pin)
	Capacity
B1	Pockets per carrier
B2	Pocket spacing (non-accumulative)
B3	Center distance from the 1st to last pocket
	Detail Dimensions
C1	Pocket width
C2	Pocket depth
C3	Pocket flat
C4	Pocket size

Figure 1A Reference	*Description*
C5	Center of pin to center of hole
C6	Center pin to pin and hole to hole
C7	Diameter of pin (2×) times height of pin
C8	Diameter of hole
C9	Center of pin/hole to center of first pocket
	Machine Fit Specifications
D1a	From the outside plane of the bar end to the center line of the 1st pocket opening
D1b	Slot parallelism-coincident tolerance for center line of slots
D2a	From the center line of the 1st pocket to the closest point on the crossbar or web
D2b	From the center of the 25th pocket to the closest point on the endwall
D3a	The step from the bar end of the carrier to the crossbar (the tolerance indicates allowable bow)
D3b	The step from the bar end of the carrier to the crossbar (the tolerance indicates the allowable deviation measured at a maximum distance of 1/2" from the crossbar/sidewall junction)
D4a	From the bottom of the carrier to the center of the crossbar, measured at the bar end of the carrier
D4b	From the bottom of the carrier to the center of a nominal 125 mm wafer, measured with wafer in place and carrier sitting on bottom
D5a	Bar web width which is the mass of material which may be present on the crossbar and is measured perpendicular to the top surface
D5b	Bar width measured perpendicular to the top surface
D5c	From the bar end of the carrier to the surface of the bar web (the tolerance indicates allowable bow)
D6a	Track clearance which is the unobstructed area between the two carrier sides on the bar end and the distance between the two sides at the bottom of the carrier for the entire length of the carrier
D6b	On the bar end surface, the distance between the two struts perpendicular to the crossbar
D6c	On the bar end surface, the thickness of each of the two struts perpendicular to the crossbar
D6d	On the bar end surface, the length of each of the two struts perpendicular to and

Figure 1A Reference	*Description*
	extending above the crossbar
D6e	On the bar end surface, the length of each of the two struts perpendicular to and extending below the crossbar
D6f	Radius allowed on the crossbar
D6g	The overall width at the bottom of the carrier measured within 3/8 inch from the bottom
Wafer Tilt	The allowable deviation of the wafer from a parallel position in relation to the plane of the bar end of the carrier, when said wafer properly positioned and carrier is resting on the bar end. Wafer is said to be properly positioned when it is fully inserted in pocket and is centered.
Wafer Center	The allowable deviation of the center point of the wafer from the center line to the carrier (see Section A.A. Figure 5) when carrier is resting on bottom and wafer is fully inserted.
	Detailed Dimensions
	Handling Slots
D7 Dimensions	The handle slots are located on the bar end and the opposite endwall of the carrier. There are two slots on each end. These slots are intended to be used as points for engaging the carrier and picking it up. Currently, these slots are used in both manual and automated systems. Dimensions D7a through D7d detail this feature.
	Pickup Flanges
D8 Dimensions	The pickup flanges are located on the endwall of the carrier only. They are not present on the bar end. There are two flanges on the endwall. These flanges are intended to be used for engaging the carrier and picking it up. Currently, these flanges are used in both manual and automated systems. Dimensions D8a through D8e detail this feature.
	Center Alignment Features
D9 Dimensions	This feature is located on the bottom sidewalls of the carrier. The center alignment feature is used to find the location of the first pocket. It is intended to be used while the carrier is resting on its bottom. This feature is used in conjunction with wafer transfer machines and pick and place equipment. Dimensions D9a through D9k detail this feature.

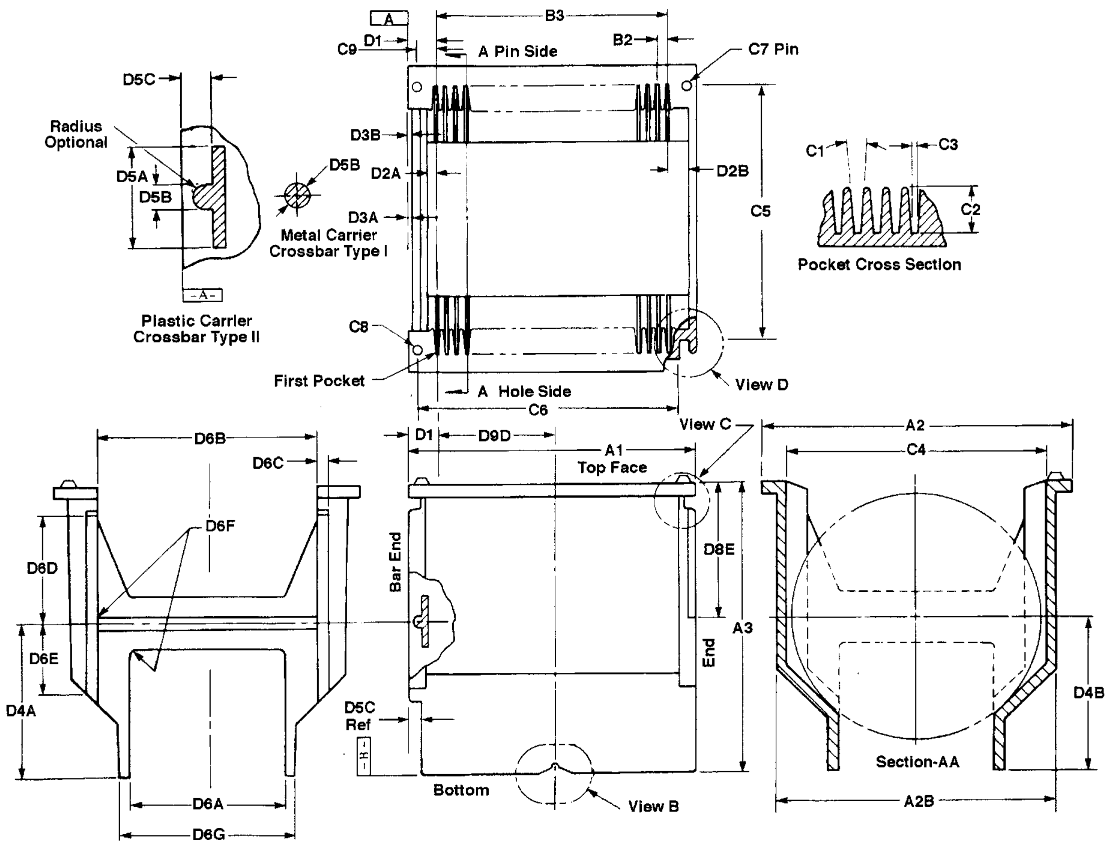
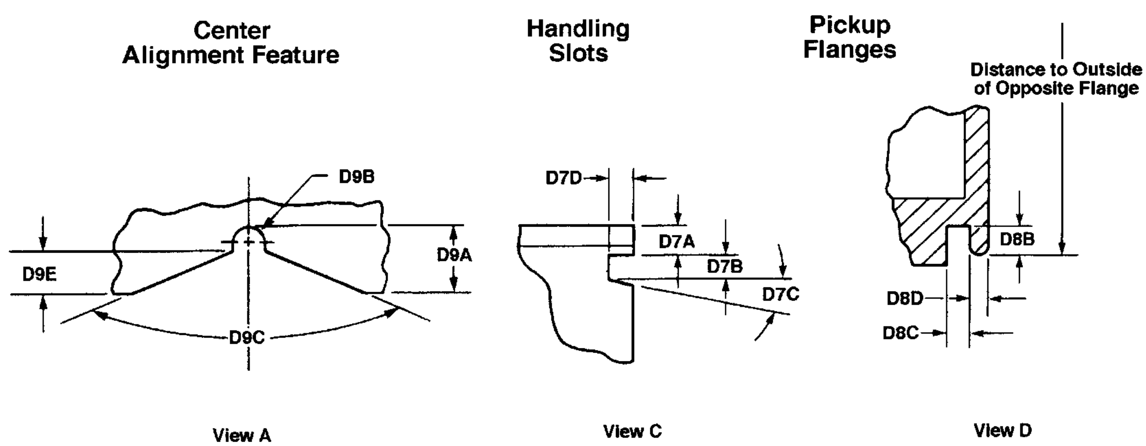


Figure 1A
Plastic & Metal Wafer Carrier Auto Transport



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SEMI E1.1-0697 (Reapproved 1102)
STANDARD FOR 3 inch PLASTIC AND METAL WAFER CARRIERS, GENERAL USAGE

This standard was technically approved by the Global Physical Interfaces and Carriers Committee and is the direct responsibility of the North American Physical Interfaces and Carriers Committee. Current edition approved by the North American Physical Interfaces and Carriers Committee on July 21, 2002. Initially available at www.semi.org October 2002; to be published November 2002. Orignally published in 1983; previously published June 1997.

Figure 2 Reference		*Metal Carrier with Type I Crossbar*	*Plastic Carrier with Type II or III Crossbar*
	Overall Dimensions		
A1	144.02 mm (5.670 inch) max.	X	X
A2	93.73 mm (3.690 inch) max.	X	X
A3	95.25 mm (3.750 inch) max.	X	X
	Capacity		
B1	25	X	X
B2	4.76 mm ± 0.25 mm (0.1875 inch ± 0.010 inch)	X	X
B3	114.30 mm ± 0.25 mm (4.500 inch ± 0.010 inch)	X	X
	Detail Dimensions		
C1	(C3) + 0.50 mm (0.020 inch) min.	X	X
C2	9.53 mm (0.375 inch) max./7.87 mm (0.310 inch) min.	X	X
C3	2.03 mm (0.080 inch) max./1.40 mm (0.055 inch) min.	X	X
C4	79.76 mm (3.140 inch) max./77.22 mm (3.040 inch) min.	X	X
C5	81.89 mm ± 0.25 mm (3.224 inch ± 0.010 inch)	X	X
C6	134.52 mm ± 0.25 mm (5.296 inch ± 0.010 inch)	X	X
C7	2.54 mm + 0.00 mm/– 0.25 mm (0.100 inch + 0.000 inch/– 0.010 inch) by 3.43 mm ± 0.38 mm (0.135 inch ± 0.015 inch) (0.110 inch)	X	X
C8	2.79 mm + 0.51 mm/– 0.00 mm (0.110 inch + 0.020 inch/– 0.000 inch)	X	X
C9	10.11 mm ± 0.25 mm (0.398 inch ± 0.010 inch)	X	X
D1	14.55 mm ± 0.25 mm (0.573 inch ± 0.010 inch) or 13.97 mm ± 0.25 mm (0.550 inch ± 0.010 inch) Parallelism inclusive of all pockets ± 0.25 mm (0.10 inch).	X N/A	N/A X
D2	3.18 mm (0.125 inch)	X	X
D3	1.57 mm (0.062 inch) max.	X	X
D4	47.63 mm ± 0.25 mm (1.875 inch ± 0.010 inch)	N/A	X
	or 41.28 mm ± 0.25 mm (1.625 inch ± 0.010 inch)	N/A	X
D5	Crossbar specifications		
D5a	22.23 mm (0.875 inch) max.	N/A	X
D5b	6.35 mm + 0.00 mm/– 0.38 mm (0.250 inch + 0.000 inch/– 0.015 inch)	X	X
D6	38.10 mm (1.500 inch) min.	X	X
D7	1.57 mm (0.062 inch) min.	X	X
Wafer Tilt	0.45 mm (0.081 inch) max.	X	X

Usage Note: Because of the range of wafer carrier designs and wafer carrier feature tolerances allowed by this standard, and because of the range of wafer shapes and tolerances allowed by the wafer dimensional standards, not every possible SEMI Standards wafer carrier is compatible with every possible SEMI Standard wafer. Please verify the compatibility of your specific wafer and carrier with the respective vendors.

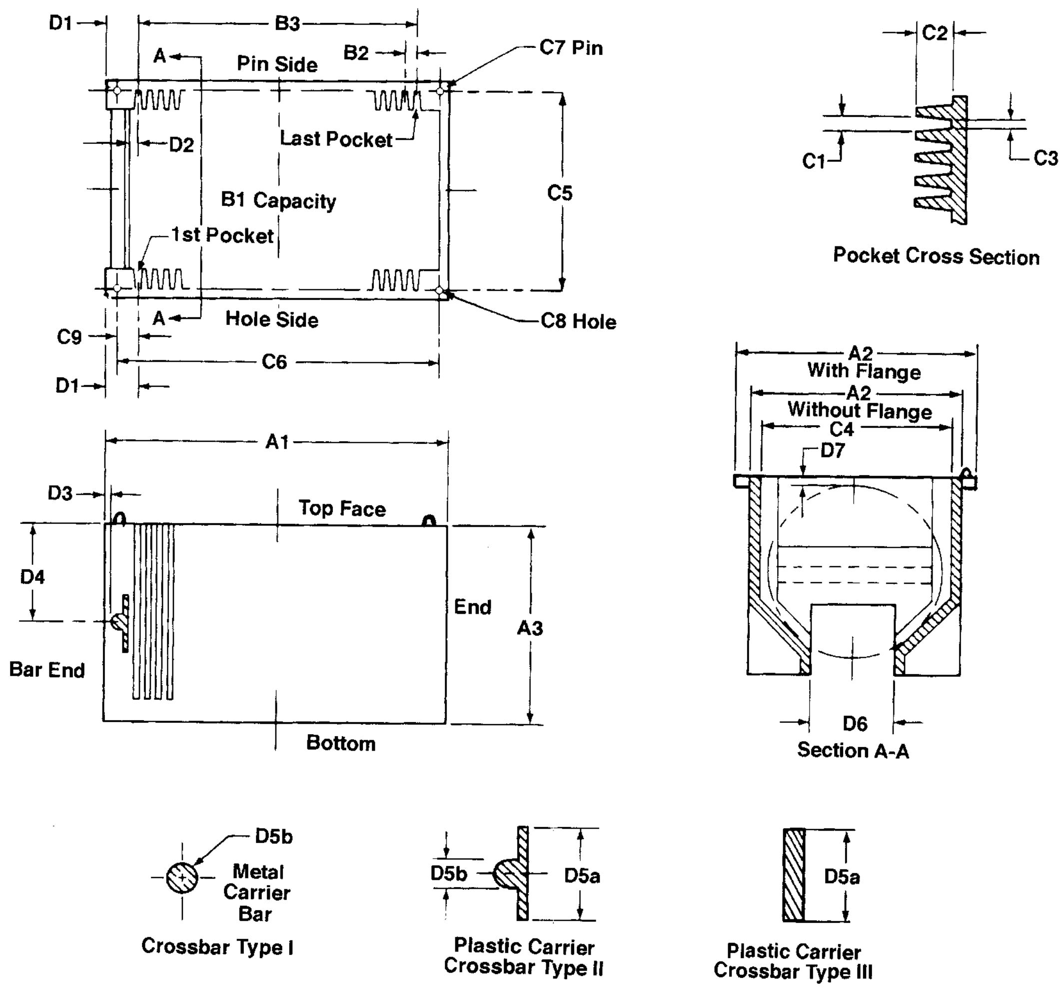

Figure 2
3 inch Plastic and Metal Wafer Carrier — General Usage

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SEMI E1.2-0697 (Reapproved 1102)
STANDARD FOR 100 mm PLASTIC AND METAL WAFER CARRIERS, GENERAL USAGE

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Figure 3 Reference		*Metal Carrier with Type I Crossbar*	*Plastic Carrier with Type II or III Crossbar*
	Overall Dimensions		
A1	144.02 mm (5.670 inch) max.	X	X
A2	125.48 mm (4.940 inch) max.	X	X
A3	114.30 mm (4.500 inch) max.	X	X
	Capacity		
B1	25	X	X
B2	4.76 mm ± 0.25 mm (0.1875" ± 0.010")	X	X
B3	114.30 mm ± 0.25 mm (4.500" ± 0.010")	X	X
	Detail Dimensions		
C1	(C3) + 0.51 mm (0.020 inch) min.	X	X
C2	11.18 mm (0.440) inch max./7.92 mm (0.312 inch) min.	X	X
C3	2.67 mm (0.105 inch) max./1.40 mm (0.055 inch) min. or 2.03 mm (0.080 inch) max./1.40 mm (0.055 inch) min.	X	N/A
		N/A	X
C4	104.65 mm (4.120 inch) max./102.62 mm (4.040 inch) min.	X	X
C5	107.29 mm ± 0.25 mm (4.224 inch ± 0.010 inch)	X	X
C6	134.52 mm ± 0.25 mm (5.296 inch ± 0.010 inch)	X	X
C7	2.54 mm + 0.00 mm/– 0.25 mm (0.100 inch + 0.000 inch/– 0.010 inch) by 3.43 mm ± 0.38 mm (0.135 inch ± 0.015 inch)	X	X
C8	3.05 mm + 0.25 mm/– 0.00 mm (0.120 inch + 0.010 inch/– 0.000 inch)	X	X
C9	10.11 mm ± 0.25 mm (0.398 inch ± 0.010 inch)	X	X
D1	14.55 mm ± 0.25 mm (0.573 inch ± 0.010 inch) or	X	X
	13.97 mm ± 0.25 mm (0.550 inch ± 0.010 inch) Parallelism ± 0.25 mm (0.010 inch) inclusive of all pockets.	N/A	X
D2	4.78 mm (0.188 inch)	X	X
D3	1.57 mm (0.062 inch) max.	X	X
D4	53.98 mm ± 0.25 mm (2.125 inch ± 0.10 inch)	X	X
D5	Crossbar specifications		
D5a	25.40 mm (1.000 inch) max.	N/A	X
D5b	6.35 mm + 0.00 mm/– 0.38 mm (0.250 inch + 0.000 inch/– 0.015 inch)	X	X
D6	60.33 mm (2.375 inch) min.	X	X
D7	1.57 mm (0.062 inch) min.	X	X
Wafer Tilt	0.51 mm (0.020 inch) max.	X	X

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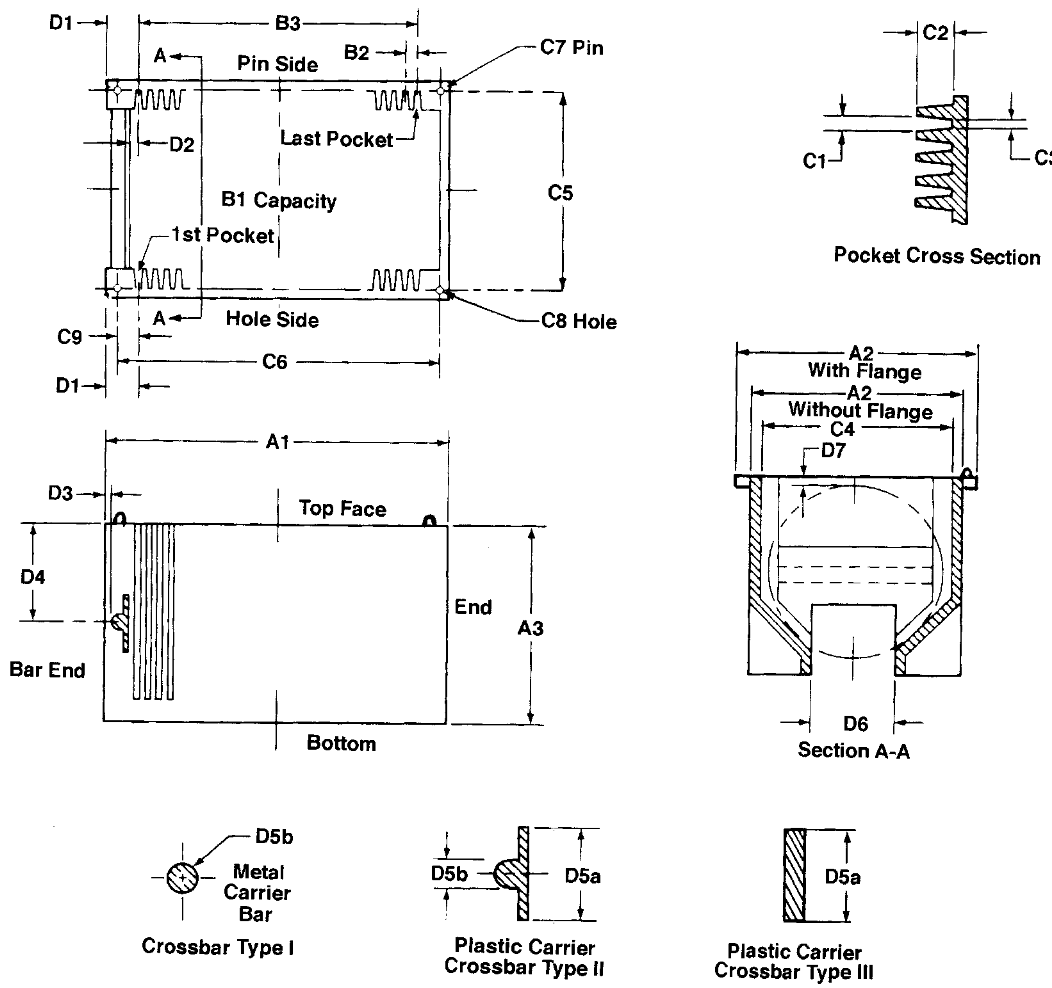

Figure 3
100 mm Plastic and Metal Wafer Carrier General Usage

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SEMI E1.3-0697 (Reapproved 1102)
STANDARD FOR 125 mm PLASTIC AND METAL WAFER CARRIERS, GENERAL USAGE

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Figure 4 Reference		*Metal Carrier with Type I Crossbar*	*Plastic Carrier with Type II Crossbar*
	Overall Dimensions		
A1	See section for 20 or 25 capacity carriers.	X	X
A2	152.40 mm (6.000 inch) max.	X	X
A3	146.05 mm (5.75 inch) max.	X	X
	Capacity		
B1	See section for 20 or 25 capacity carriers.	X	X
B2	See section for 20 or 25 capacity carriers.	X	X
B3	See section for 20 or 25 capacity carriers.	X	X
	Detail Dimensions		
C1	(C3) + 0.50 mm (0.020 inch) min.	X	X
C2	9.53 mm (0.375 inch) min./ 12.70 mm (0.500 inch) max.	X	X
C3	2.67 mm (0.105 inch) max./ 1.38 mm (0.055 inch) min. or 2.03 mm (0.080 inch) max./ 1.38 mm (0.055 inch) min.	X N/A	N/A X
C4	128.5 mm ± 1.0 mm (5.06 inch ± 0.040 inch)	X	X
C5	See section for 20 or 25 capacity carriers.	X	X
C6	See section for 20 or 25 capacity carriers.	X	X
C7	3.56 mm + 0.50 mm – 0.00 mm (0.140 inch + 0.000 inch – 0.015 inch) by 4.32 mm ± 0.50 mm (0.170 inch ± 0.020 inch) high	X	X
C8	3.96 mm + 0.50 mm – 0.00 mm (0.156 inch + 0.020 inch – 0.000 inch)	X	X
C9	10.11 mm ± 0.25 mm (0.398 inch ± 0.010 inch)	X	X
	Machine Fit Specifications		
D1	14.54 mm ± 0.25 mm (0.5725 inch ± 0.010 inch) or	X	X
	13.97 mm ± 0.25 mm (0.550 inch ± 0.010 inch)	N/A	X
D2	4.76 mm (0.188 inch) min.	X	X
D3	1.57 mm (0.062 inch) max.	X	X
D4	68.25 mm ± 0.25 mm (2.687 inch ± 0.10 inch)	X	X
D5	Crossbar specifications	X	X
D5a	25.40 mm (1.000 inch) max.	NA	X
D5b	6.35 mm + 0.00 mm – 0.38 mm (0.250 inch + 0.00 inch – 0.15 inch)	X	X
D6	Track clearance specifications	X	X
D6a	66.68 mm (2.625 inch) min.	X	X
D6b	102.11 mm (4.020 inch) min.	X	X
D6c	45° min.	X	X
D7	1.57 mm (0.062 inch) min.	X	X
Wafer Tilt	0.64 mm (0.025 inch) max.	X	X
The following applies to 20-capacity carriers with 6.35 mm spacing:			
A1	150.37 mm (5.920 inch) max.		
B1	20 capacity		
B2	6.35 mm ± 0.25 mm (0.250 inch ± 0.010 inch)		
B3	120.65 mm ± 0.25 mm (4.750 inch ± 0.010 inch)		
C5	132.69 mm ± 0.38 mm (5.224 inch ± 0.015 inch)		
C6	140.87 mm ± 0.25 mm (5.546 inch ± 0.010 inch)		
The following applies to 25-capacity carriers with 4.76 mm spacing:			
A1	144.02 mm (5.670 inch) max.		
B1	25 capacity		
B2	4.76 mm ± 0.25 mm (0.1875 inch ± 0.010 inch)		
B3	114.30 mm ± 0.25 mm (4.500 inch ± 0.010 inch)		

Figure 4 Reference		*Metal Carrier with Type I Crossbar*	*Plastic Carrier with Type II Crossbar*
C5	130.66 mm ± 0.38 mm (5.144 inch ± 0.015 inch)		
C6	134.52 mm ± 0.25 mm (5.296 inch ± 0.010 inch)		

Usage Note: Because of the range of wafer carrier designs and wafer carrier feature tolerances allowed by this standard, and because of the range of wafer shapes and tolerances allowed by the wafer dimensional standards, not every possible SEMI Standards wafer carrier is compatible with every possible SEMI Standard wafer. Please verify the compatibility of your specific wafer and carrier with the respective vendors.

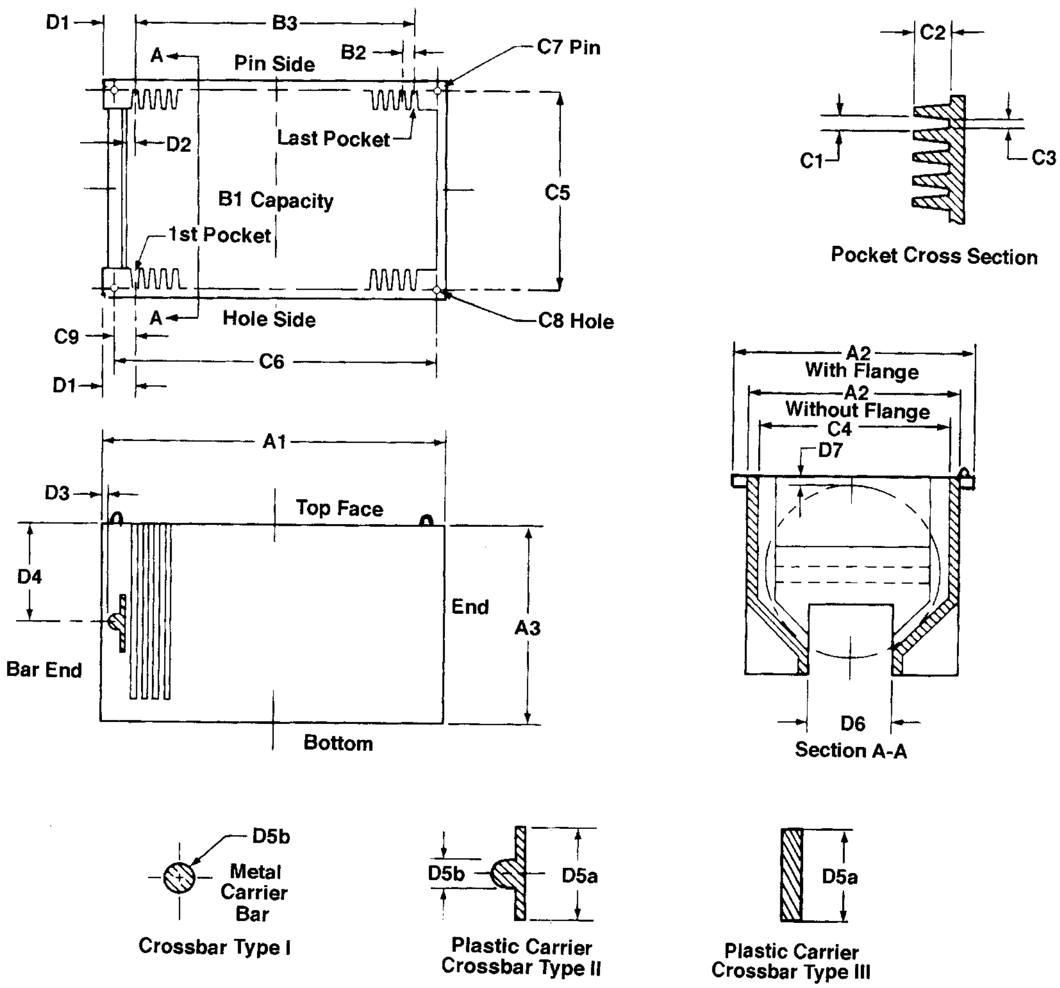

Figure 4
125 mm Plastic & Metal Wafer Carrier — General Usage

SEMI

SEMI E1.4-0697 (Reapproved 1102)
STANDARD FOR 125 mm PLASTIC AND METAL WAFER CARRIERS, AUTO TRANSPORT USAGE

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This standard is intended to meet the in use requirements necessary for the interface of wafer carriers with automated wafer processing equipment. Specifications for carriers intended for general use are outlined in SEMI E1.3. The complete specification for this product includes all general requirements of SEMI E1.

Figure 5 Reference	
	Overall Dimensions
A1	143.38 mm ± 0.25 mm (5.645 inch ± 0.010 inch)
A2a	152.4 mm ± 1.0 mm (6.00 inch ± 0.04 inch)
A2b	135.9 mm ± 1.0 mm (5.350 inch ± 0.04 inch)
A3	146.05 mm ± 0.76 mm (5.75 inch ± 0.03 inch)
	Capacity
B1	25 capacity
B2	4.76 mm ± 0.08 mm (0.1875 inch ± 0.003 inch)
B3	114.3 mm ± 0.25 mm (4.500 inch ± 0.010 inch)
	Detail Dimensions
C1	10° ± 2°
C2	11.18 mm ± 0.38 mm (0.440 inch ± 0.015 inch)
C3	1.52 mm ± 0.08 mm (0.060 inch ± 0.003 inch)
C4	128.52 mm ± 1.0 mm (5.060 inch ± 0.04 inch)
C5	130.66 mm ± 0.38 mm (5.144 inch ± 0.015 inch)
C6	134.52 mm ± 0.25 mm (5.296 inch ± 0.010 inch)
C7	3.56 mm – 0.38 mm (0.140 + 0.000 inch/– 0.015 inch) by 4.32 mm ± 0.5 mm (0.170 inch ± 0.020 inch) high
C8	3.96 mm + 0.5 mm/– 0.0 mm(0.156 inch + 0.020 inch/– 0.000 inch)
C9	10.11 mm ± 0.25 mm (0.398 inch ± 0.010 inch)
	Machine Fit Specifications
D1a	14.53 mm ± 0.13 mm (0.572 inch ± 0.005 inch)
D1b	± 0.13 mm (± 0.005 inch)
D2a	4.78 mm (0.188 inch) min.
D2b	6.35 mm (0.250 inch) min.
D3a	1.53 mm ± 0.77 mm (0.060 inch ± 0.030 inch)
D3b	1.53 mm ± 0.25 mm (0.060 inch ± 0.010 inch)
D4a	77.80 mm ± 0.51 mm (3.063 inch ± 0.020 inch)
D4b	77.80 mm ± 1.27 mm (3.063 inch ± 0.050 inch)
D5a	25.40 mm ± 0.25 mm (1.000 inch ± 0.010 inch)
D5b	6.10 mm ± 0.13 mm (0.240 inch ± 0.005 inch)
D5c	5.33 mm ± 0.76 mm (0.210 inch ± 0.030 inch)
D6a	76.2 mm ± 1.0 mm (3.00 inch ± 0.04 inch)
D6b	107.44 mm ± 0.76 mm (4.230 inch ± 0.030 inch)
D6c	3.17 mm/6.35 mm (0.125 inch/0.250 inch) min./max.
D6d	31.75 mm (1.25 inch) min.
D6e	31.75 mm (1.25 inch) min.
D6f	3.2 mm radius (0.125 inch radius) max.
D6g	85.34 mm ± 1.0 mm (3.360 inch ± 0.04 inch)
Wafer Tilt	Within ± 0.38 mm (0.015 inch)
Wafer Center Horizontal	Within ± 0.38 mm (0.015 inch)
	Handling Slots
D7a	6.60 mm ± 0.25 mm (0.260 inch ± 0.010 inch)
D7b	5.59 mm ± 0.25 mm (0.220 inch ± 0.010 inch)
D7c	10° ± 2°
D7d	5.99 mm ± 0.25 mm (0.236 inch ± 0.010 inch)
	Pickup Flanges
D8a	133.35 mm ± 1.0 mm (5.25 inch ± 0.04 inch)
D8b	6.85 mm ± 0.25 mm (0.270 inch ± 0.010 inch)
D8c	5.1 mm (0.20 inch) min.
D8d	3.56 mm ± 0.25 mm (0.140 inch ± 0.010 inch)
D8e	68.33 mm ± 0.5 mm (2.69 inch ± 0.02 inch)
	Center Alignment Feature
D9a	5.08 mm ± 0.25 mm (0.200 inch ± 0.010 inch)
D9b	1.27 mm ± 0.05 mm (0.050 inch ± 0.002 inch)
D9c	135° included angle
D9d	57.15 mm ± 0.13 mm (2.250 inch ± 0.005 inch)

Usage Note: Because of the range of wafer carrier designs and wafer carrier feature tolerances allowed by this standard, and because of the range of wafer shapes and tolerances allowed by the wafer dimensional standards, not every possible SEMI Standards wafer carrier is compatible with every possible SEMI Standard wafer. Please verify the compatibility of your specific wafer and carrier with the respective vendors.

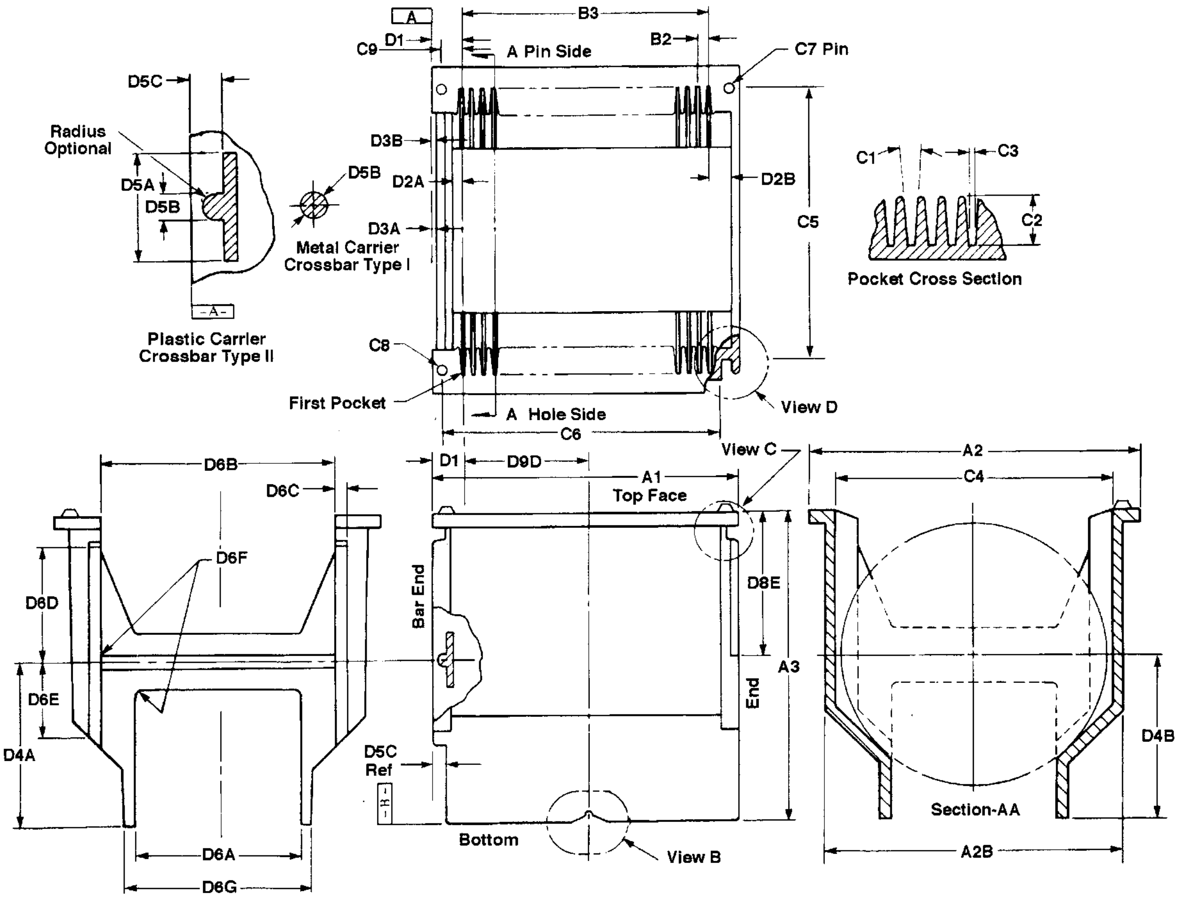
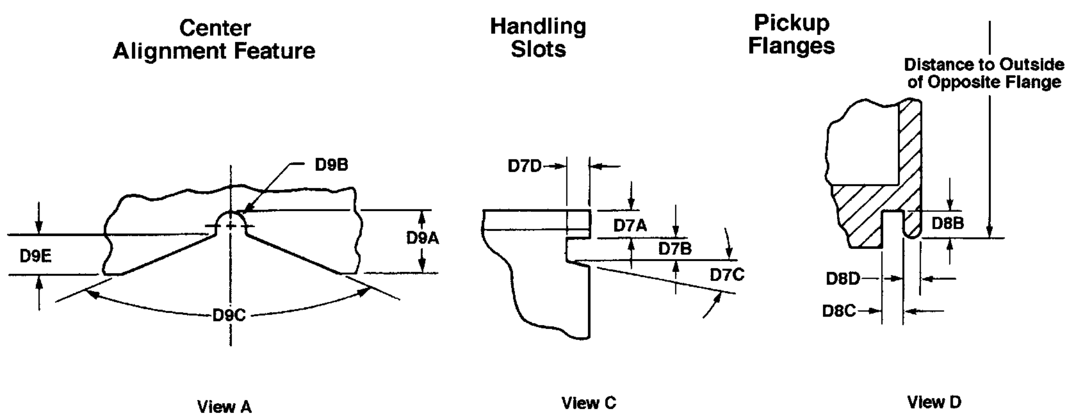


Figure 5
125 mm Plastic & Metal Wafer Carrier — Auto Transport Usage



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SEMI E1.5-91 (Reapproved 1102)[E]
STANDARD FOR 150 mm PLASTIC AND METAL WAFER CARRIERS, GENERAL USAGE

This standard was technically approved by the Global Physical Interfaces and Carriers Committee and is the direct responsibility of the North American Physical Interfaces and Carriers Committee. Current edition approved by the North American Physical Interfaces and Carriers Committee on July 21, 2002. Initially available at www.semi.org October 2002; to be published November 2002. Orignally published in 1984; previously published February 1999.

[E] This document was editorially modified in January 2003 to correct editorial errors that were introduced into the document in earlier editions. Changes were made to the table header and the last two rows of the table.

Figure 6 Reference	*Overall Dimensions*
A1	143.4 mm + 0.64 mm/– 0.5 mm (5.645 inch + 0.025 inch/– 0.020 inch)
A2	177.80 mm (7.000 inch) maximum
A3	171.40 mm (6.750 inch) maximum
B1	25
B2	4.76 mm ± 0.25 mm (0.1875 inch ± 0.010 inch)
B3	114.30 mm ± 0.025 mm (4.500 inch ± 0.010 inch)
C1	(C3) + 0.50 mm (0.020 inch) minimum
C2	9.53 mm (0.375 inch) minimum / 12.70 mm (0.500 inch) maximum
C3	1.52 mm ± 0.13 mm (0.060 inch ± 0.005 inch) for plastic
	2.03 mm + 0.00 mm/– 0.50 mm (0.080 inch + 0.000 inch/– 0.020 inch) for metal
C4	153.5 mm ± 1.0 mm (6.043 inch ± 0.040 inch)
C5	156.0 mm ± 0.5 mm (6.142 inch ± 0.020 inch)
C6	134.52 mm ± 0.25 mm (5.296 inch ± 0.010 inch)
C7	3.56 mm + 0.13 mm/– 0.38 mm (0.140 inch + 0.005 inch/– 0.015 inch) diameter by 4.32 mm ± 0.50 mm (0.170 inch ± 0.020 inch) high
C8	3.96 mm + 0.50 mm/– 0.00 mm (0.156 inch + 0.020 inch/– 0.000 inch) diameter by 5.0 mm (0.197 inch) minimum depth

Figure 6 Reference	*Overall Dimensions*
C9	10.11 mm ± 0.25 mm (0.398 inch ± 0.010 inch)
D1	14.54 mm ± 0.25 mm (0.572 inch ± 0.010 inch)
D2	4.57 mm (0.18 inch) minimum
D3	1.57 mm ± 0.5 mm (0.062 inch ± 0.020 inch)
D4a	79.76 mm ± 0.50 mm (3.140 inch ± 0.020 inch) This specification is applicable only to full-depth wafer carriers, i.e., the wafer sits below the top of the carrier.
D4b	On center within ± 3.18 mm (± 0.125 inch) This specification describes the center point of the wafer in relationship to the centerline of the crossbar (for a 150 mm nominal wafer).
D5a	25.40 mm + 0.0 mm/– 0.5 mm (1.000 inch + 0.000 inch/– 0.020 inch)
D5b	6.35 mm + 0.00 mm/– 0.38 mm (0.250 inch + 0.000 inch/– 0.020 inch)
D5c	4.45 mm ± 0.75 mm (0.175 inch ± 0.030 inch)
D6	76.2 mm (3.000 inch) minimum
Wafer Tilt	0.64 mm (0.025 inch) maximum

Usage Note: Because of the range of wafer carrier designs and wafer carrier feature tolerances allowed by this standard, and because of the range of wafer shapes and tolerances allowed by the wafer dimensional standards, not every possible SEMI Standards wafer carrier is compatible with every possible SEMI Standard wafer. Please verify the compatibility of your specific wafer and carrier with the respective vendors.

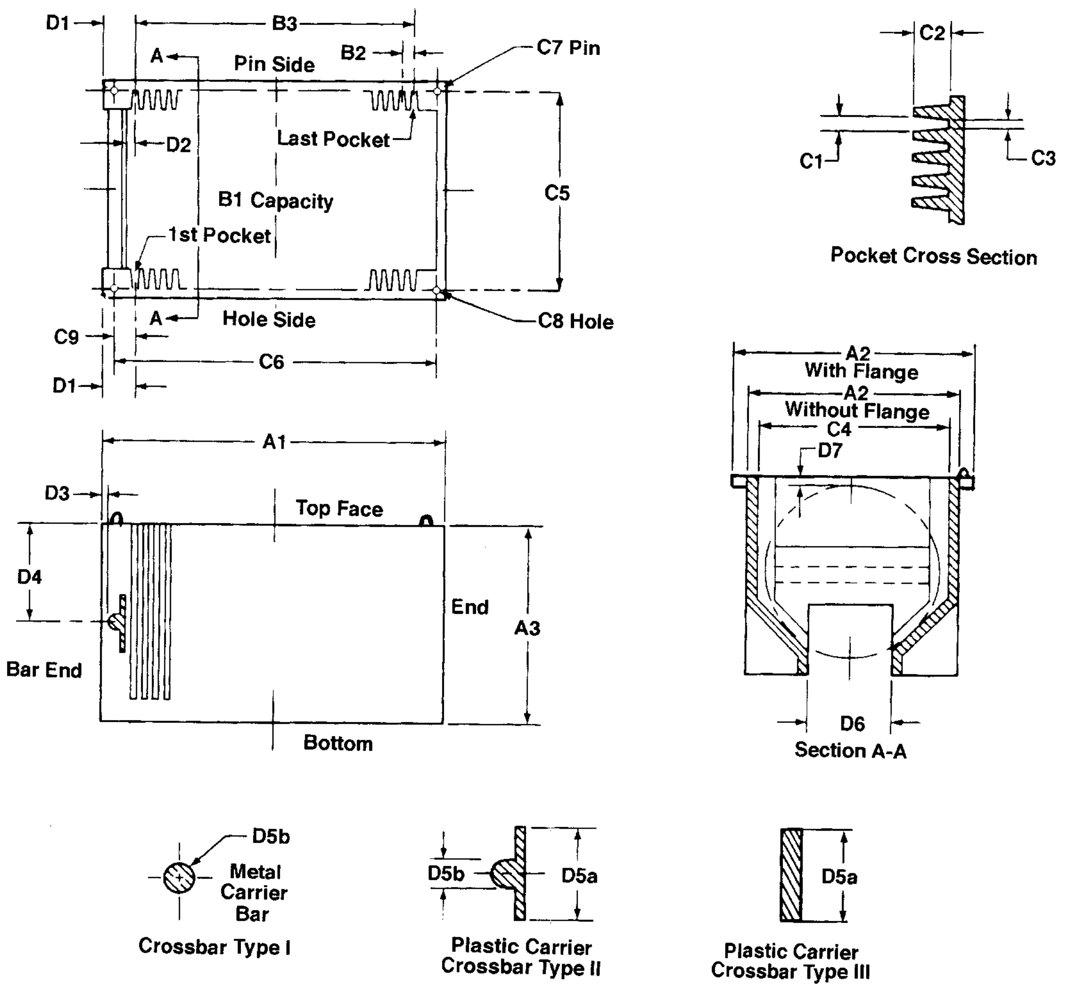

Figure 6
150 mm Plastic & Metal Wafer Carrier General Usage

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The user's attention is called to the possibility that compliance with this standard may require use of copyrighted material or of an invention covered by patent rights. By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI E1.9-0701^{E2}
MECHANICAL SPECIFICATION FOR CASSETTES USED TO TRANSPORT AND STORE 300 mm WAFERS

This specification was technically approved by the Global Physical Interfaces & Carriers Committee and is the direct responsibility of the North American Physical Interfaces & Carriers Committee. Current edition approved by the North American Regional Standards Committee on March 22 and April 30, 2001. Initially available at www.semi.org May 2001; to be published July 2001. Originally published in 1994; previously published June 1999.

E This document was editorially modified in January 2003 to reflect the withdrawal of SEMI E44. Changes were made to Sections 3.1, 4.2, 4.4, and 4.17. This document was also editorially modified in May 2004 to reflect the withdrawal of SEMI E19.5. Changes were made to Section 7.1.

1 Purpose

1.1 This standard specifies the cassettes used to transport and store 300 mm wafers in an IC manufacturing facility. This includes both manual and auto-transport use as well as high-speed extraction of the wafers in processing equipment.

2 Scope

2.1 This standard is intended to set an appropriate level of specification that places minimal limits on innovation while ensuring modularity and interchangeability at all mechanical interfaces. Most of the requirements given in this specification are in the form of maximum or minimum dimensions wit very few required surfaces. Only the mechanical interfaces for cassettes are specified; no materials requirements or micro-contamination limits are given. However, this standard has been written so that both metal and injection-molded plastic cassettes can be manufactured in conformance with it.

2.2 The cassette has the following components and sub-components, and other features. A "† " symbol indicates components or features that include dimensions required for boxes with non-removable cassettes.

Key:

- Required feature
- ◊ Optional feature

- 1 top domain
- 2 optical wafer sensing paths
  - ◊ 4 robotic handling flanges (optional)
  - ◊ 1 top cassette identification tag area (optional)
- 2 or 4 side domains (2 in front and 2 in rear, if needed)
- supports (for 13 or 25 wafers) with correct wafer pitch (10 mm) †
- 1 optical cassette sensing hole on each front side domain
  - ◊ 1 side cassette identification tag area on front right side domain only (optional)
  - ◊ features that prevent wafer creep-out (optional)
  - ◊ 2 pentagonal side grip pits on each front side domain (optional)
- 1 bottom domain
- 2 optical wafer sensing paths
- 5 carrier sensing pads †
- 4 info pads †
- 1 pod latch-pin hole
- 2 conveyor rails
- 2 fork-lift pick-up areas
- 2 fork-lift pin holes
- 3 features that mate with kinematic coupling pins and provide a 10 mm lead in †
  - ◊ 3 features that mate with kinematic coupling pins and provide a 15 mm lead in (optional)
  - ◊ 1 bottom cassette identification tag area (optional)
- Other features
- multiple horizontal wafer sensing paths
- 2 end-effector exclusion zones †

3 Referenced Documents

3.1 *SEMI Standards*

SEMI E15 — Specification for Tool Load Port

SEMI E19 — Standard Mechanical Interface (SMIF)

SEMI E57 — Provisional Mechanical Specification for Kinematic Couplings Used to Align and Support 300 mm Wafer Carriers

4 Terminology

4.1 *bilateral datum plane* — a vertical plane that bisects the wafers and that is perpendicular to both the horizontal and facial datum planes (as defined in SEMI E57).

4.2 *box* — a protective portable container for a cassette and/or substrate(s).

4.3 *carrier capacity* — the number of substrates that a carrier holds.

4.4 *cassette* — an open structure that holds one or more substrates.

4.5 *cassette bottom domain* — volume (below *z*6 above the horizontal datum plane) that contains the bottom of the cassette.

4.6 *cassette sensing pads* — surfaces on the bottom of the cassette for triggering optical or mechanical sensors.

4.7 *cassette side domains* — volumes (from *z*6 above the horizontal datum plane to *z*15 above the top nominal wafer seating plane) that contain the mizo teeth or slots that support the wafer and the supporting columns on the sides and rear of the cassette.

4.8 *cassette top domain* — volume (higher than *z*15 above the top wafer) that contains the top of the cassette.

4.9 *conveyor rails* — parallel edges on the bottom of the cassette for supporting the cassette on roller conveyors.

4.10 *facial datum plane* — a vertical plane that bisects the wafers and that is parallel to the front side of the carrier (where wafers are removed or inserted). On tool load ports, it is also parallel to the load face plane specified in SEMI E15 on the side of the tool where the carrier is loaded and unloaded (as defined in SEMI E57).

4.11 *fork-lift slots* — rectangular holes (open to the front and rear) in the bottom of the cassette for picking up the cassette with a fork.

4.12 *front-opening unified pod (FOUP)* — a box (that complies with SEMI E47.1) with a non-removable cassette (so that its interior complies with SEMI E1.9) and with a front-opening interface (that mates with a FIMS port that complies with SEMI E62) (as defined in SEMI E47.1).

4.13 *horizontal datum plane* — a horizontal plane from which projects the kinematic-coupling pins on which the carrier sits. On tool load ports, it is at the load height specified in SEMI E15 and might not be physically realized as a surface (as defined in SEMI E57).

4.14 *nominal wafer center line* — the line that is defined by the intersection of the two vertical datum planes (facial and bilateral) and that passes through the nominal centers of the seated wafers (which must be horizontal when the carrier is placed on the coupling) (as defined in SEMI E57).

4.15 *nominal wafer seating plane* — horizontal plane that bisects the wafer pick-up volume.

4.16 *optical wafer sensing paths* — lines of sight for optically sensing the positions of the wafers. Several horizontal optical wafer sensing paths are present in between the cassette side domains. In addition, two vertical optical wafer sensing paths are created by rectangular exclusion zones in the front of the cassette top and bottom.

4.17 *pod* — a box having a Standard Mechanical Interface (SMIF) per SEMI E19.

4.18 *process batch* — a set of substrates that are processed simultaneously in a process chamber.

4.19 *robotic handling flanges* — four horizontal projections on top of the cassette for lifting and rotating the cassette.

4.20 *sensor hole* — an indentation on the bottom of the cassette for inserting optical sensors.

4.21 *side grip pits* — two rectangular indentations on each side of the cassette for lifting and rotating the cassette.

4.22 *transport group* — a set of substrates that are transported together between tools.

4.23 *virtual tracking unit* — an entity (which could be a number of substrates or an individual die or mask group) that the factory floor control system treats as a single unit for tracking purposes.

4.24 *wafer carrier* — any cassette, box, pod, or boat that contains wafers (as defined in SEMI E15).

4.25 *wafer extraction volume* — the open space for extracting a wafer from the cassette.

4.26 *wafer pick-up volume* — the space that contains entire bottom of a wafer if the wafer has been pushed to the rear of the cassette.

4.27 *wafer set-down volume* — the open space for inserting and setting down a wafer in the cassette.

5 Ordering Information

5.1 *Intended Use* — This standard is intended to specify 300 mm cassettes over a reasonable lifetime of use, not just those in new condition. For this reason, the purchaser needs to specify a time period and the number and type of uses to which the cassettes will be put. It is under these conditions that the cassettes must remain in compliance with the requirements listed in Section 6.

5.2 *Temperature Ranges* — The purchaser of 300 mm cassettes needs to specify two sets of temperatures to which the cassettes might be exposed. An operating temperature range is the set of environmental temperatures in which the cassettes will remain in compliance with the requirements listed in Section 6. A temporary temperature range is the set of environmental temperatures to which the cassettes can be exposed such that when the cassettes return to the operating temperature range, the cassettes will be in compliance with the requirements listed in Section 6. Limits on exposure times to elevated temperatures should be specified. Also, the purchaser needs to specify a range of temperatures for the wafers that might be inserted in the cassettes.

5.3 *Info Pad Configurations* — The purchaser of 300 mm carriers needs to specify the desired info pad configuration (up or down). See Appendix 1 (Application Notes).

6 Requirements

6.1 *Kinematic Couplings* — The physical alignment interface on the bottom of the cassette consists of features (not specified in this standard) that mate with six pins underneath as defined in SEMI E57. Most of the dimensions of the cassette are determined with respect to the three orthogonal datum planes defined in that standard: the horizontal datum plane, the facial datum plane, and the bilateral datum plane. All of the dimensions for the cassette are bilaterally symmetric about the bilateral datum plane. The three features that mate with the pins must provide a lead-in capability that corrects a cassette misalignment no greater than *r*19 in any horizontal direction. However, it is recommended that robots placing cassettes on kinematic couplings use as little of this lead-in capability as possible to avoid wear.

6.2 *Wafer Orientation and Numbering* — The wafers must be horizontal when the carrier is placed on the coupling, and the wafers are numbered in increasing order from bottom to top (so the bottom wafer is wafer number 1, the next wafer up is wafer number 2, etc.). After processing at a tool, each wafer should be returned to the same slot from which it was taken.

6.3 *Cassette Sides* — Figure 1 shows a cross-section of the horizontal boundaries of the cassette side domains (which contain the parts of the cassette higher than *z*6 above the horizontal datum plane and lower than *z*15 above the top wafer). In this and following figures, the most heavy lines are used for surfaces that have tolerances (not surfaces that have only maximum or minimum dimensions). Table 1 defines the dimensions shown in this and following figures. The maximum protrusions of any part of the cassette from the nominal wafer center line and from the bilateral datum plane is *r*5 and *x*9, respectively. There are two optional side grip pits on each side. For optically sensing whether a cassette is properly in place, from left to right under the bottom wafer is an optical cassette sensing hole. The radius of this hole is given with both upper and lower tolerances, but the upper tolerance is only to define a minimum aperture that must be met at only one section on each side. Other than through the optical cassette sensing holes, the cassette bottom and side domains must block any line of sight passing through both of the two rectangles at *x*10 on each side bounded by *z*4, *z*20, *y*2, and *y*3.

6.4 *Cassette Top* — Figure 2 shows a top view of the horizontal boundaries of the cassette top domain which contains any part of the cassette higher than *z*15 above the top nominal wafer plane. The top robotic handling flanges (optional), the side grip pits (optional), and optical cassette sensing hole on the side can be seen in Figure 3, which is an oblique view of the maximum cassette dimensions (see Figure 14 to see how cassettes need not take up all of that volume). The maximum radial protrusions of the cassette top in the front and rear are *r*6 and *r*12, respectively. Dimensions *x*6, *x*12 (shown in Figure 4), and *y*15 define a vertical path for optically sensing wafers through the top and bottom domains.

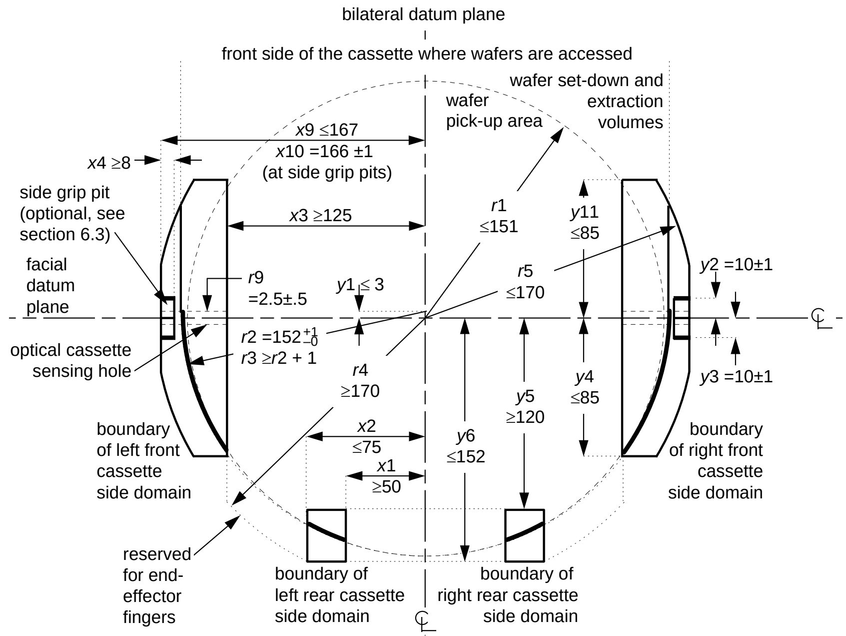

Figure 1
Cassette Side Domains

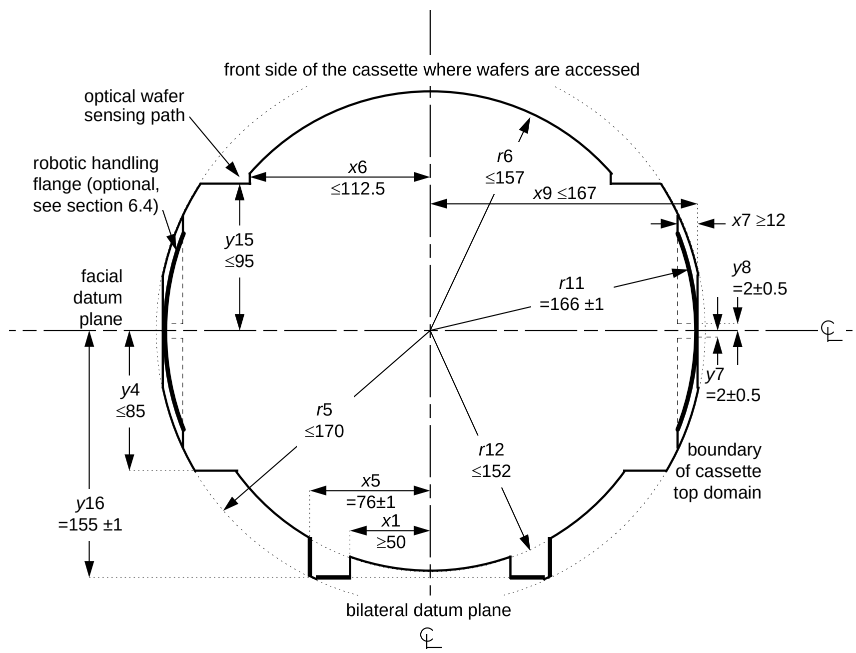

Figure 2
Cassette Top Domain

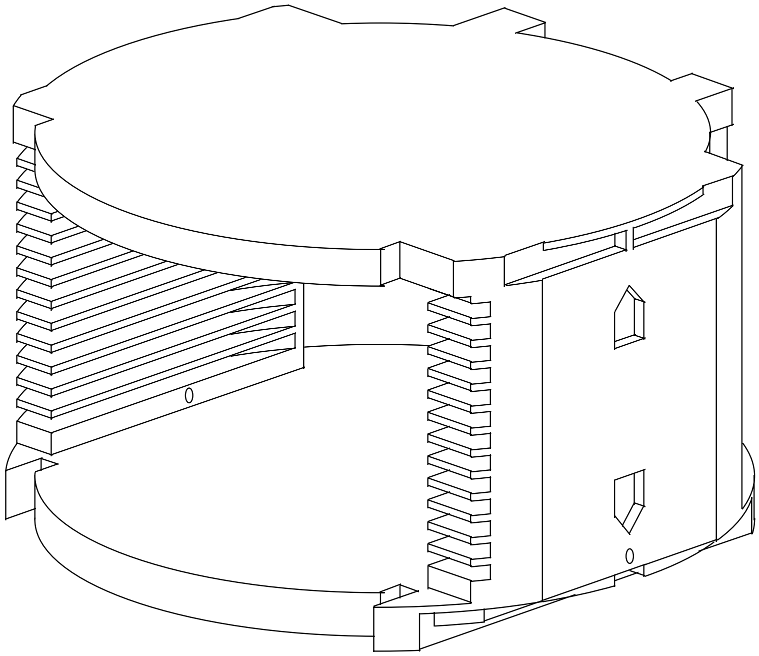

Figure 3
Oblique View of Maximum Cassette Dimensions

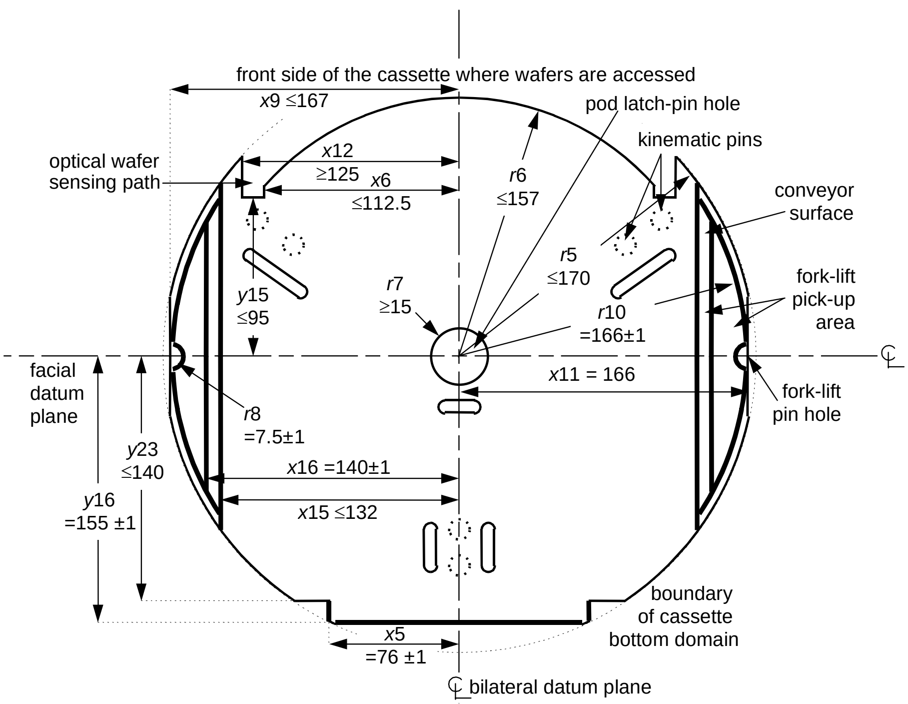

Figure 4
Cassette Bottom Domain

6.5 *Cassette Bottom* — Figure 4 shows a bottom view of the horizontal boundaries of the cassette bottom domain (which contains any part of the cassette lower than $z6$ above the horizontal datum plane). At the nominal wafer center line, a circular hole with a radius of $r7$ must be present (up to a height of $z5$) in the cassette bottom to avoid interfering with pod latch pins. For moving the cassette on roller conveyors and for picking up the cassette with a fork lift, the cassette must have surfaces on the left and right open to the bottom and outside bounded by $x15$, $x16$, $r10$, $z3$ and $z4$. A cylindrical section of radius $r8$ and axis at $x11$ on the facial datum plane must be clear up to a height of $z22$ to hold the cassette firmly on the lifting forks by the use of a cylindrical pin.

6.6 *Carrier Sensing Pads and Info Pads* — When the cassette is fully down, the carrier sensing pads (shown in Figure 5) must be $z2$ above the horizontal datum plane. It is recommended that the areas surrounding all of the carrier sensing pads be designed in conjunction with the features that mate with kinematic coupling pins so that a mechanical sensor pin cannot interfere with the lead-in function of the kinematic couplings. Other sensing pads (called info pads and given letter names) communicate information about the carrier. Carrier types that might need differentiation include the open cassette, the front-opening unified pod (FOUP), the single-wafer interface (SWIF), and the front-opening shipping box (FOSB) in both 13-wafer and 25-wafer capacities (and possibly other capacities if reduced-pitch versions are later standardized). Note that since this is a bottom view, the positions of sensors on a load port will be switched, with the sensor for info pad A on the right and the sensor for info pad B on the left as one faces the tool from the front.

6.7 *Vertical Dimensions* — Figures 6 through 13 show the vertical dimensions of the cassette. Note that $z8$ (the height of the bottom nominal wafer seating plane above the horizontal datum plane) and $z12$ (the distance between adjacent nominal wafer seating planes) are given as absolute distances with no tolerance. This means that the sum of actual height variations in the cassette from the kinematic coupling to the supporting features holding each wafer must be contained within the tolerance of $z10$ with no further stack-up at each higher wafer. The method for meeting this requirement is left up to the cassette supplier.

6.7.1 The open space for the wafer set-down volume consists of a cylindrical section with radius $r2$ and a main axis parallel to and $y1$ in front of the nominal wafer center line. The top of this cylindrical section is $z11$ above the nominal wafer seating plane and its bottom is $z10$ above the nominal wafer seating plane. The implications for wafer positioning of the tolerance on $r2$ are as follows. The wafers should be placed in the cassette within a circle of radius corresponding to the smaller bound on $r2$ to avoid touching the edge of the wafer to the side of the cassette. Once the wafer has been placed, the cassette must not allow a wafer to move outside of a circle of radius corresponding to the larger bound on $r2$. There are two exceptions to this limit on wafer movement. When the wafer is pushed toward the rear of the cassette, the location of the wafer is defined by the wafer pick-up volume (see Section 6.7.3). When the cassette is gently tilted forward up to 45° , the wafers may slide forward, but it is recommended that they not extend further than $y20$ from the facial datum plane. This may be accomplished by designing the teeth supporting the wafers to include a "wafer stopper" at the front (as shown in Figure 11) that is outside of $r2$ and under $z29$. Note that use of this feature will reduce the height of the wafer extraction volume.

6.7.2 The open space for the wafer extraction volume includes a cylindrical section with radius $r3$ and a main axis parallel to and $y1$ in front of the nominal wafer center line. The top of this cylindrical section is $z11$ above the nominal wafer seating plane and its bottom is $z23$ above the nominal wafer seating plane. The wafer extraction volume also includes the extrusion out the front of the cassette of this cylindrical section and the portion of the wafer set-down volume above $z29$. The implications for wafer extraction of the definition of dimension $r3$ ($r3 \geq r2 + 1$) are as follows. The cassette must give an extra 1 mm (0.04 in.) of horizontal clearance once the wafer is picked up from wherever it ends up (within the bounds of $r2$) after transport in the cassette.

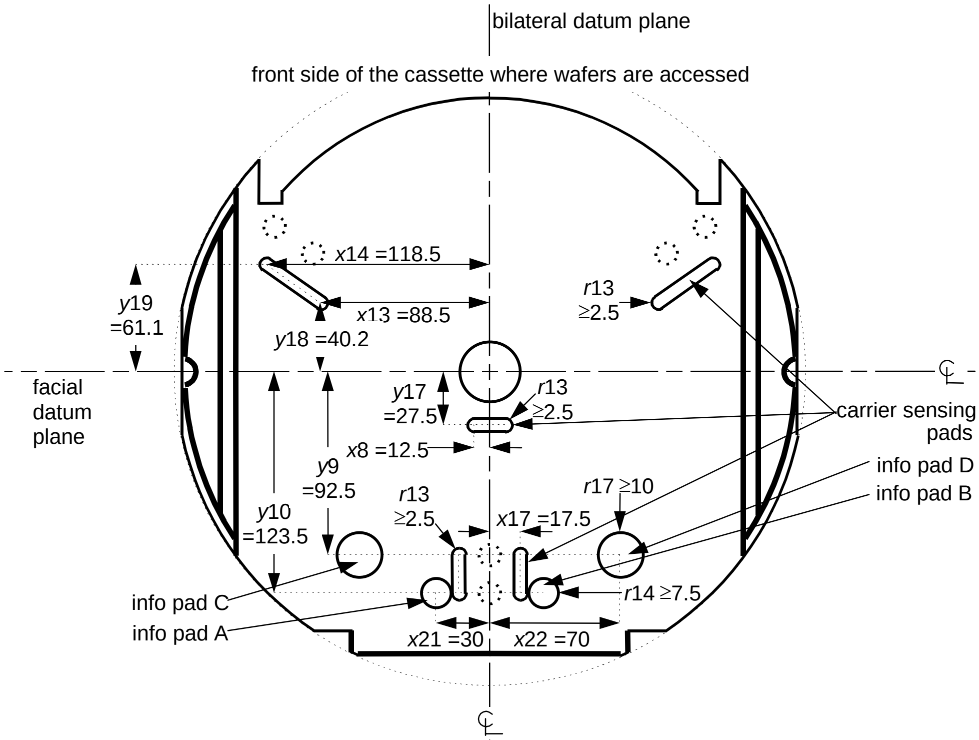

Figure 5
Carrier Sensing Pads in Bottom View

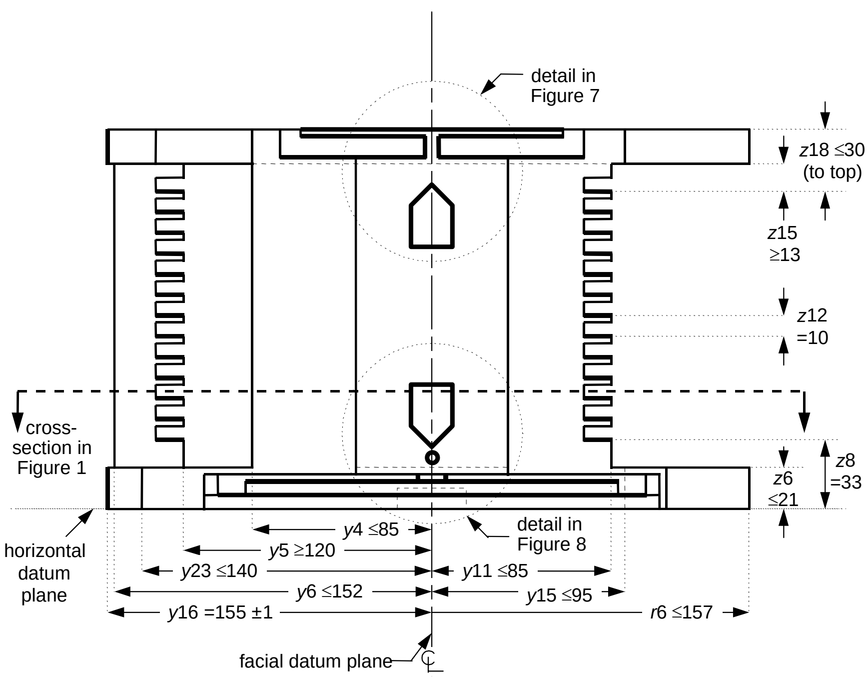

Figure 6
Side View of Cassette

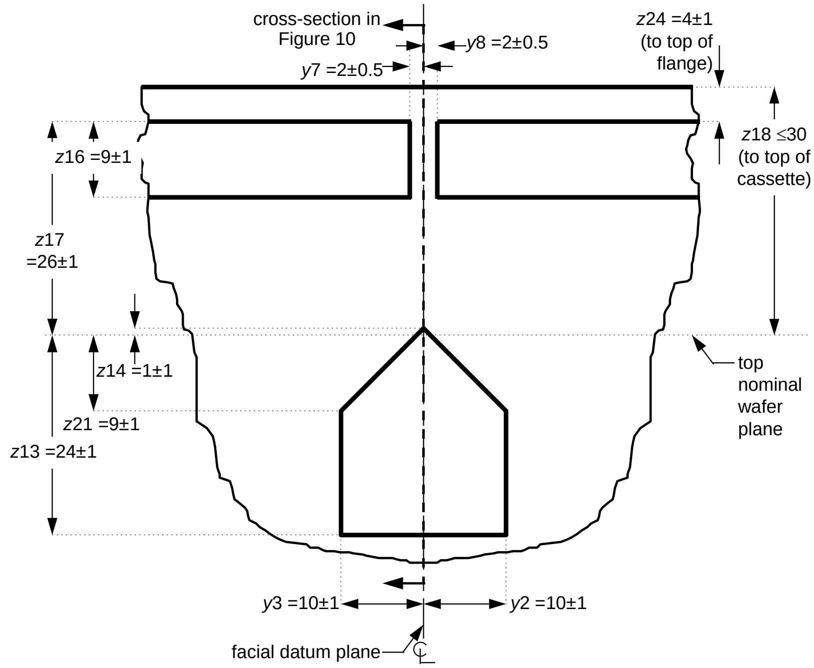

Figure 7
Top Side View Detail

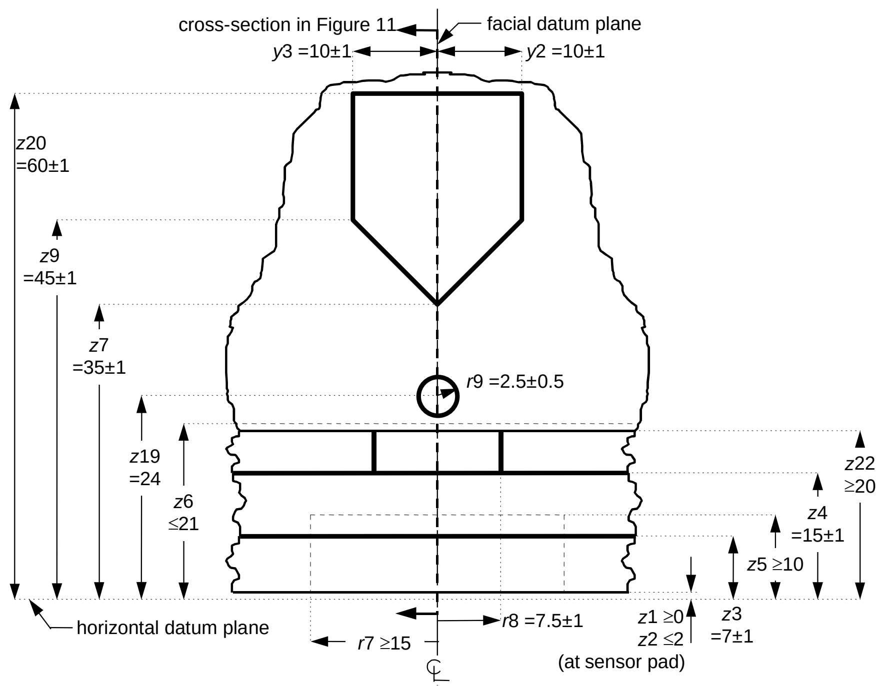

Figure 8
Bottom Side View Detail

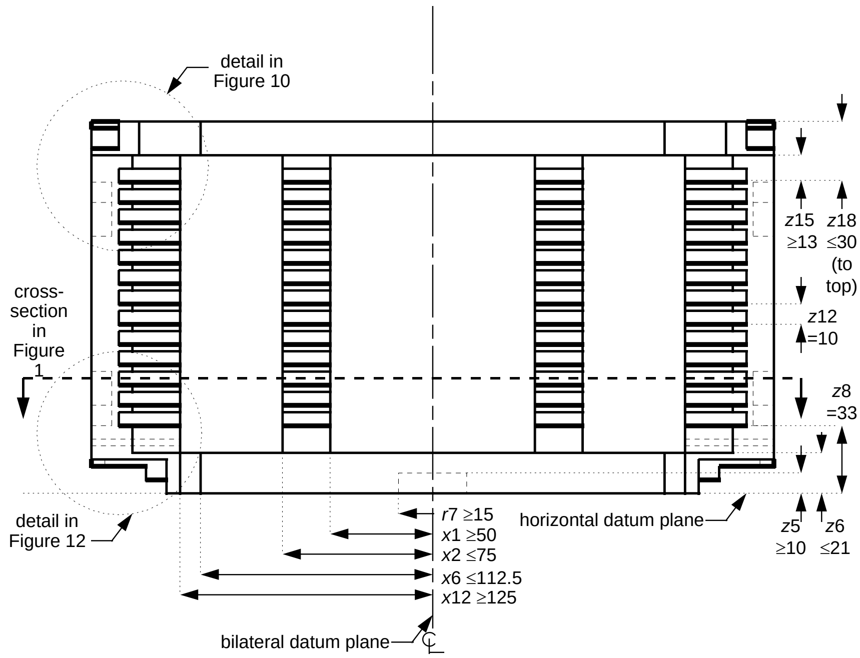

Figure 9
Front View of Cassette

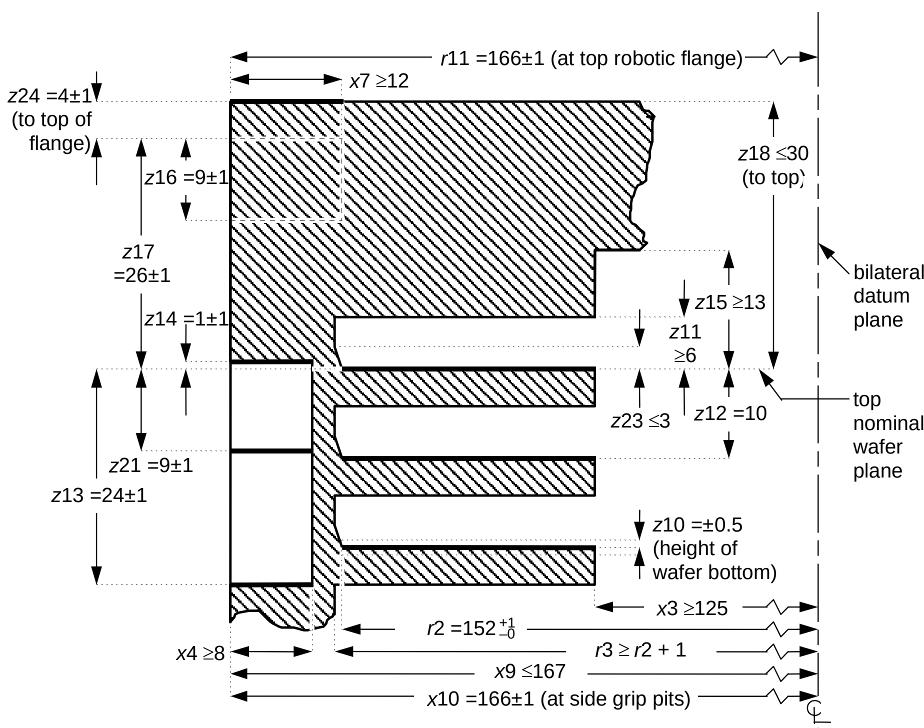

Figure 10
Upper Cross-Section at Facial Datum Plane

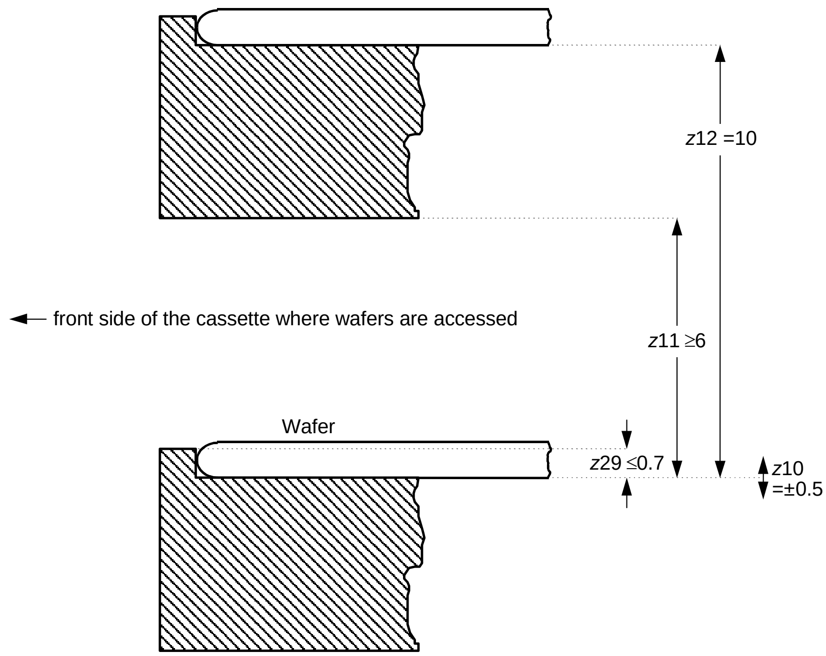

Figure 11
Optional Feature to Prevent Wafer Creep-Out

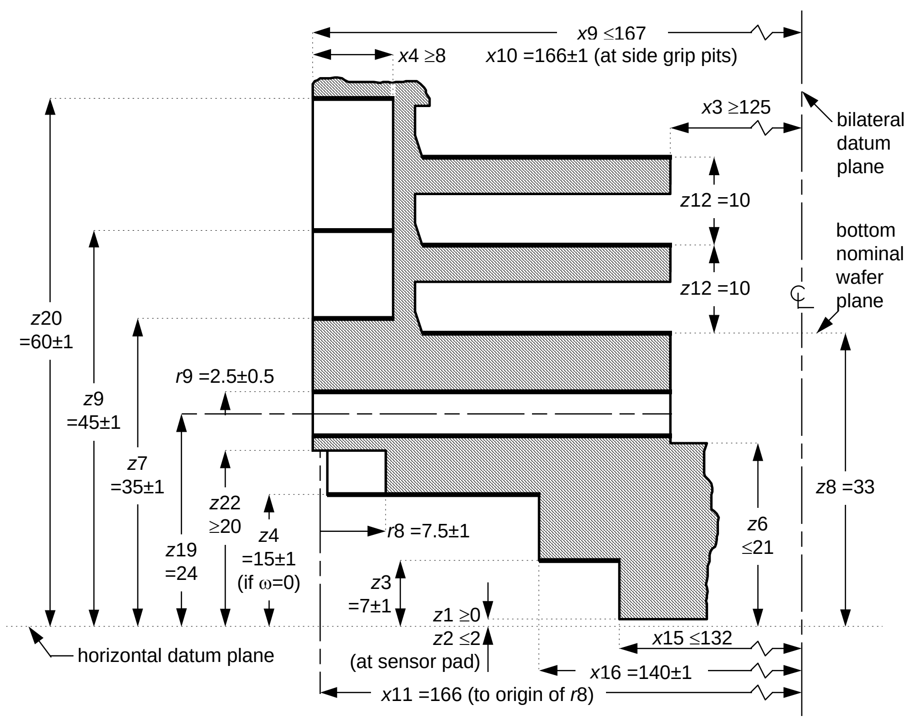

Figure 12
Lower Cross-Section at Facial Datum Plane

6.7.3 If a wafer is placed in the wafer set-down volume and is then pushed toward the rear of the cassette, then the entire bottom of the wafer must be contained in the wafer pick-up volume. However, if the wafer is not pushed toward the rear of the cassette (or the cassette is not tilted back during transport), then the wafer may only be somewhere within the wafer extraction volume. The wafer pick-up volume is defined by a cylindrical section with radius *r*1 and a main axis at the nominal wafer center line. Its top and bottom are the upper and lower tolerance of $z10$ around the nominal wafer seating plane.

6.7.4 To prevent wafers from creeping out of the cassette during transport, the fork-lift area may be slanted so that the front of the cassette is higher than the rear. Specifically, the surface defined by $z4$ may be rotated by an angle ω about the line where $z4$ intersects $y29$ (as shown in Figure 13). Only the surface behind y29 may be rotated. Thus, the height of $z4$ shown in Figure 12 might only be defined at $y29$, and $z4$ can be greater than 15 ± 1 behind$y29$. However, the flatness of the resulting tilted surface must still fall within the tolerance given for $z4$.

6.8 *Cassette Identification Tag Area* — The following areas are provided for putting identification tags on the cassette. Examples of such tags include thin electronic modules and printed labels designed to be read by either humans or machines. It is recommended that such tags be contained within the 18 mm by 60 mm (0.71 in. by 2.36 in.) region defined when the bounds are tight. It is also recommended that if such tags are smaller than the minimum bounds of the tag area, they should be centered within those bounds.

6.8.1 An optional place for an identification tag on the top of the cassette is shown in Figure 14. Although the height of this surface is not specified, the surface must be completely visible from above. The parallelism of the top identification tag with respect to the horizontal datum plane is given by $z25$. It is recommended that the identification tag should be centered on the bilateral datum plane at a point $y21$ behind the facial datum plane.

6.8.2 An optional place for an identification tag on the right-hand side of the cassette is shown in Figure 15 (where “right-hand” is defined as the right side of the cassette when it is oriented correctly and it is viewed from the rear). Although the left-right location of this surface is not specified, the surface must be completely visible from the right of the cassette. The parallelism of the side identification tag with respect to the bilateral datum plane is given by $x27$. It is recommended that the identification tag should be centered on the facial datum plane at a point $z99$ above the horizontal datum plane.

6.8.3 An optional place for an identification tag on the bottom of the cassette is shown in Figure 16. Although the height of this surface is not specified, the surface must be completely visible from below. The parallelism of the bottom identification tag with respect to the horizontal datum plane is given by $z25$. It is recommended that the identification tag should be centered on the bilateral datum plane at a point $y22$ behind the facial datum plane.

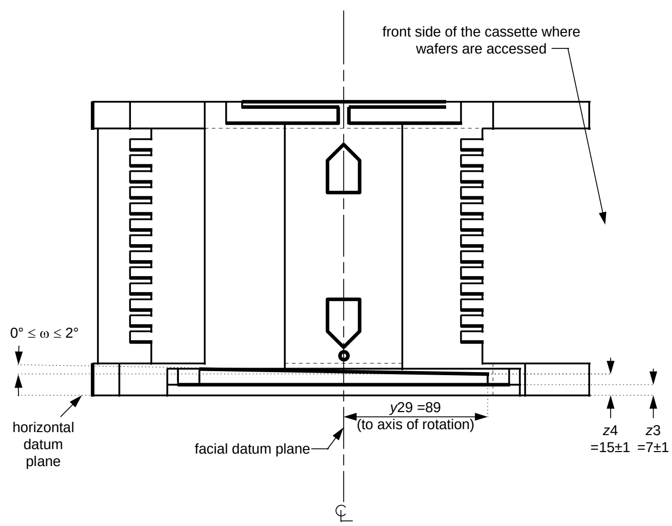

Figure 13
Slanting of Fork-Lift Area

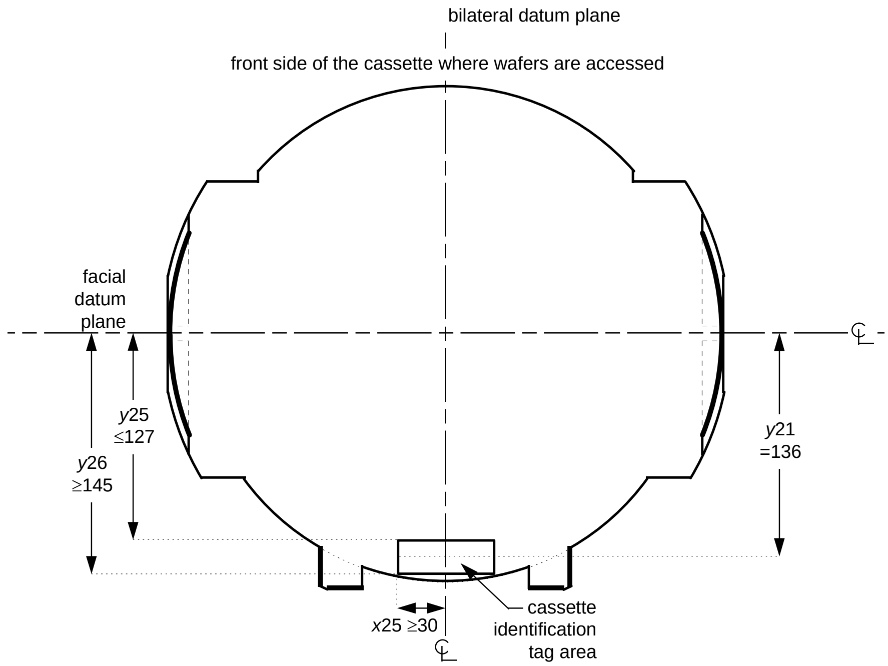

Figure 14
Optional Top Cassette Identification Tag Area

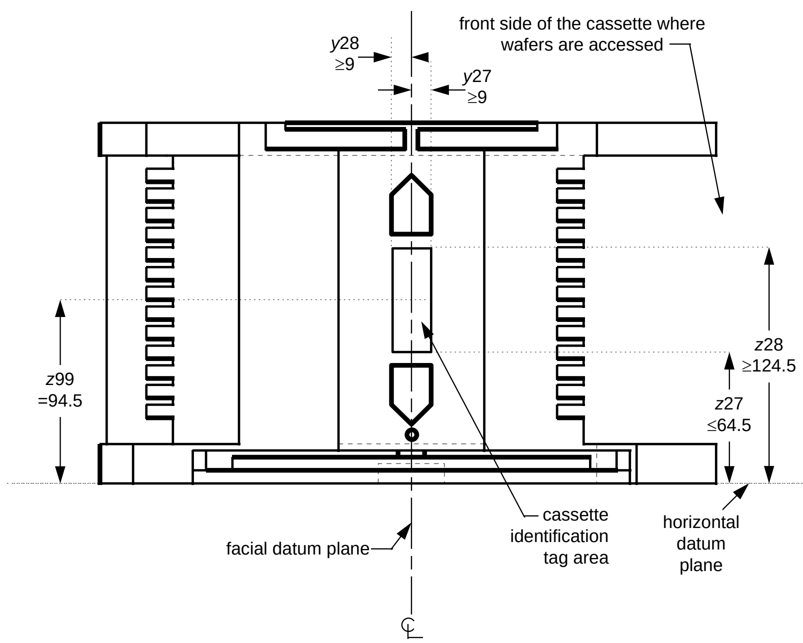

Figure 15
Optional Side Cassette Identification Tag Area

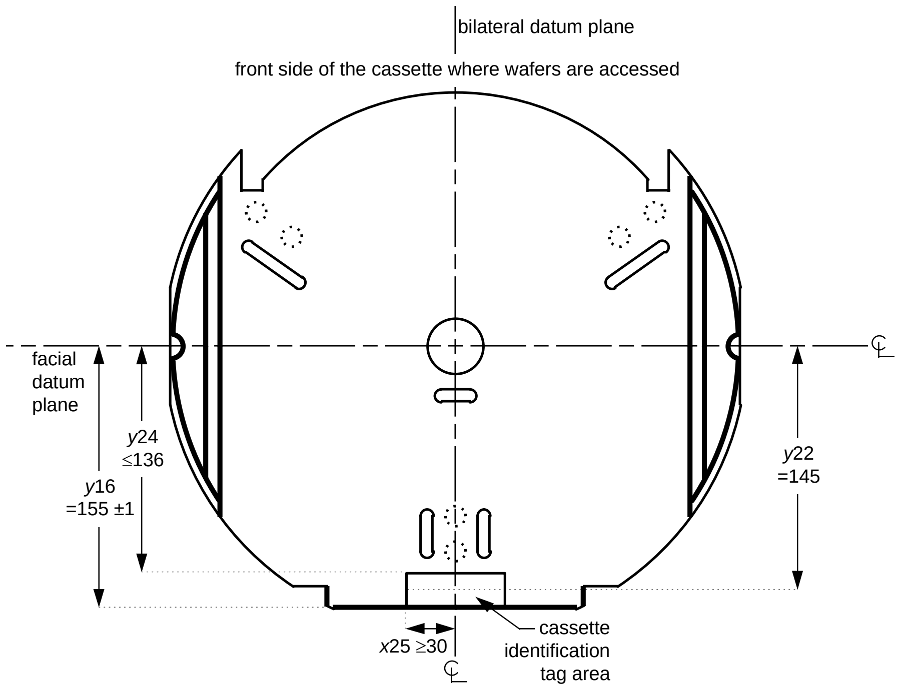

Figure 16
Optional Bottom Cassette Identification Tag Area

6.9 *Pitch and Capacity* — Table 2 shows the different options with regard to the wafer pitch (spacing) and the cassette capacity. Again, no tolerance is given on the wafer pitch (*z*12), for reasons given in Section 6.7.

6.10 *Inner and Outer Radii* — All concave features may have a radius no greater than *r*15 to allow cleaning and to prevent contaminant build-up. All required convex features must also have a radius of *r*16 to prevent small contact patches with large stresses that might cause wear and particles. Here a required feature is an area on the surface of the carrier specified by a dimension (or intersections of dimensions) that has a tolerance and not just a maximum or minimum (such as the rim of the fork-lift pin hole, the edges of the robotic handling flanges, and the corners at the rear of the cassette top and bottom domains).

6.11 *Vertical Wafer Access* — This standard does not cover accessing wafers in a vertical orientation.

7 Related Documents

7.1 *SEMI Standards*

SEMI E22.1 — Cluster Tool Module Interface 300 mm: Transport Module End Effector Exclusion Volume Standard

SEMI E47.1 — Provisional Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers

SEMI E62 — Provisional Specification for 300 mm Front-Opening Interface Mechanical Standard (FIMS)

SEMI E63 — Provisional Mechanical Specification for 300 mm Box Opener/Loader to Tool Standard (BOLTS-M) Interface

SEMI E103 — Provisional Mechanical Specification for a 300 mm Single-Wafer Box System that Emulates a FOUP

SEMI M28 — Specification for Developmental 300 mm Diameter Polished Single Crystal Silicon Wafers

SEMI M31 — Provisional Mechanical Specification for Front-Opening Shipping Box Used to Transport and Ship 300 mm Wafers

Table 1 Cassette Dimensions

Symbol Used	*Figure Number*	*Value Specified*	*Datum Measured from*	*Boundary or Feature Measured to*
ω	13	0° minimum 2° maximum	horizontal datum plane	fork-lift area
*r*1†	1	151 mm (5.94 in.) maximum	nominal wafer center line	outer edge of wafer pick-up volume
*r*2†	1, 10	152 + 1 – 0 mm (5.99 + 0.03 – 0 in.)	*y*1 in front of nominal wafer center line	encroachment of cassette side domains on wafer set-down volume
*r*3†	1, 10	*r*2 + 1 mm (0.04 in.) minimum	*y*1 in front of nominal wafer center line	encroachment of cassette side domains on wafer extraction volume
*r*4†	1	170 mm (6.69 in.) minimum	nominal wafer center line	encroachment of tools or front-opening box on end effector exclusion zone between front and rear cassette side domains
*r*5	1, 2, 4	170 mm (6.69 in.) maximum	nominal wafer center line	outside of cassette domains
*r*6	2, 4, 6	157 mm (6.18 in.) maximum	nominal wafer center line	front of cassette top and bottom domains
*r*7	4, 8, 9	15 mm (0.59 in.) minimum	nominal wafer center line	encroachment of cassette bottom domain on pod latch-pin hole
*r*8	4, 8, 12	7.5 ± 1 mm (0.30 ± 0.04 in.)	vertical line contained in facial datum plane and *x*11 from bilateral datum plane	sides of fork-lift pin hole
*r*9	1, 8, 12	2.5 ± 0.5 mm (0.10 ± 0.02 in.)	horizontal line contained in facial datum plane and *z*19 above horizontal datum plane	surface of optical cassette sensing hole
*r*10	4	166 ± 1 mm (6.54 ± 0.04 in.)	nominal wafer center line	cassette bottom outside of *x*15 and below *z*22
*r*11‡	2, 10	166 ± 1 mm (6.54 ± 0.04 in.)	nominal wafer center line	outside of top robotic flange
*r*12	2	152 mm (5.98 in.) maximum	nominal wafer center line	rear of the cassette top domain above the area between the cassette side domains
*r*13*	5	2.5 mm (0.10 in.) minimum	line segment along center of cassette sensing pad	edge of cassette sensing pad
*r*14*	5	7.5 mm (0.30 in.) minimum	intersection of *x*21 and *y*10	edge of info pads A and B
*r*15	None	1 mm (0.04 in.) maximum	not applicable	all concave features (radius)
*r*16	None	2 ± 1 mm (0.08 ± 0.04 in.)	not applicable	all required convex features (radius)
*r*17*	5	10 mm (0.39 in.) minimum	intersection of *x*22 and *y*9	edge of info pads C and D
*r*19	None	10 mm (0.4 in.) minimum (required) 15 mm (0.6 in.) (recommended for ergonomic reasons)	not applicable	correctable cassette misalignment in any horizontal direction
*x*1†	1, 2, 9	50 mm (1.97 in.) minimum	bilateral datum plane	inside of rear cassette side domains and the part of the cassette top domain above them
*x*2†	1, 9	75 mm (2.95 in.) maximum	bilateral datum plane	outside of rear cassette side domains

Symbol Used	*Figure Number*	*Value Specified*	*Datum Measured from*	*Boundary or Feature Measured to*
*x*3†	1, 10, 12	125 mm (4.92 in.) minimum	bilateral datum plane	inside of front cassette side domains
*x*4‡	1, 10, 12	8 mm (0.31 in.) minimum	farthest protrusion of cassette from bilateral datum plane	encroachment of cassette side domain on side grip pits
*x*5	2, 4	76 ± 1 mm (2.99 ± 0.04 in.)	bilateral datum plane	outside of cassette top and bottom domains above and below rear cassette side domains
*x*6	2, 4, 9	112.5 mm (4.43 in.) maximum	bilateral datum plane	encroachment of cassette top and bottom domains on near side of vertical optical wafer sensing paths
*x*7‡	2, 10	12 mm (0.47 in.) minimum	farthest protrusion of cassette from bilateral datum plane	encroachment of cassette top domain on space underneath robotic handling flanges
*x*8*	5	12.5 mm (0.49 in.)	bilateral datum plane	end of line segment along center of center cassette sensing pad
*x*9	1, 2, 4, 10, 12	167 mm (6.57 in.) maximum	bilateral datum plane	left and right side of cassette
*x*10‡	1, 10, 12	166 ± 1 mm (6.54 ± 0.04 in.)	bilateral datum plane	rim of opening of side grip pits
*x*11	4, 12	166 mm (6.54 in.)	bilateral datum plane	origin of radius of fork-lift pin hole
*x*12	4, 9	125 mm (4.92 in.) minimum	bilateral datum plane	encroachment of cassette bottom domain on far side of vertical optical wafer sensing paths
*x*13*	5	88.5 mm (3.48 in.)	bilateral datum plane	near end of line segment along center of front cassette sensing pads
*x*14*	5	118.5 mm (4.67 in.)	bilateral datum plane	far end of line segment along center of front cassette sensing pads
*x*15	4, 12	132 mm (5.2 in.) maximum	bilateral datum plane	intersection of cassette bottom domain and conveyor rail
*x*16	4, 12	140 ± 1 mm (5.51 ± 0.04 in.) (required) 140 ± 0.25 mm (5.512 ± 0.010 in.) (recommended for roller conveyors)	bilateral datum plane	end of conveyor rail and encroachment of cassette bottom domain on fork-lift area
*x*17*	5	17.5 mm (0.69 in.)	bilateral datum plane	line segment along center of rear cassette sensing pads
*x*21*	5	30 mm (1.18 in.)	bilateral datum plane	origin of radius *r*14 at center of info pads A and B
*x*22*	5	70 mm (2.76 in.)	bilateral datum plane	origin of radius *r*17 at center of info pads C and D
*x*25‡	14, 16	30 mm (1.18 in.) minimum	bilateral datum plane	far end of top and bottom cassette identification tag areas
*x*27	None	± 1 mm (± 0.04 in.) flatness over tag area	bilateral datum plane	surface of side cassette identification tag area
*y*1†	1	3 mm (0.12 in.) maximum	facial datum plane	origin of *r*2 and *r*3 on bilateral datum plane
*y*2‡	1, 7, 8	10 ± 1 mm (0.39 ± 0.04 in.)	facial datum plane	front wall of side grip pits
*y*3‡	1, 7, 8	10 ± 1 mm (0.39 ± 0.04 in.)	facial datum plane	rear wall of side grip pits

Symbol Used	*Figure Number*	*Value Specified*	*Datum Measured from*	*Boundary or Feature Measured to*
*y*4	1, 2, 6	85 mm (3.35 in.) maximum	facial datum plane	rear of front cassette side domains and the part of the cassette top domain above them
*y*5†	1, 6	120 mm (4.72 in.) minimum	facial datum plane	front of rear cassette side domains
*y*6	1, 6	152 mm (5.98 in.) maximum	facial datum plane	rear of rear cassette side domains
*y*7‡	2, 7	2 ± 0.5 mm (0.08 ± 0.02 in.)	facial datum plane	rear side of top robotic handling flange supports
*y*8‡	2, 7	2 ± 0.5 mm (0.08 ± 0.02 in.)	facial datum plane	front side of top robotic handling flange supports
*y*9*	5	92.5 mm (3.64 in.)	facial datum plane	front end of the line segment along center of rear carrier sensing pads and origin of radius *r*17 at center of info pads C and D
*y*10*	5	123.5 mm (4.86 in.)	facial datum plane	rear end of the line segment along center of rear carrier sensing pads and origin of radius *r*14 at center of info pads A and B
*y*11†	1, 6	85 mm (3.35 in.) maximum	facial datum plane	front of front cassette side domains
*y*14‡	None	142 mm (5.59 in.) maximum	facial datum plane	front of the cassette top
*y*15	2, 4, 6	95 mm (3.74 in.) maximum	facial datum plane	encroachment of cassette top and bottom domains on vertical optical wafer sensing paths
*y*16	2, 4, 6, 16	155 ± 1 mm (6.10 ± 0.04 in.)	facial datum plane	rear end of cassette top and bottom domains
*y*17*	5	27.5 mm (1.08 in.)	facial datum plane	line segment along center of center cassette sensing pad
*y*18	5	40.2 mm (1.58 in.)	facial datum plane	near end of line segment along center of front cassette sensing pads
*y*19*	5	61.1 mm (2.41 in.)	facial datum plane	far end of line segment along center of front cassette sensing pads
*y*20‡	None	158 mm (6.22 in.)	facial datum plane	maximum protrusion of wafers toward the front of the cassette
*y*21	14	136 mm (5.35 in.)	facial datum plane	recommended center of label on top cassette identification tag area
*y*22	16	145 mm (5.71 in.)	facial datum plane	recommended center of label on bottom cassette identification tag area
*y*23	4, 6	140 mm (5.51 in.) maximum	facial datum plane	rear of cassette bottom domain outside of *x*5
*y*24‡	16	136 mm (5.35 in.) maximum	facial datum plane	near side of bottom cassette identification tag area
*y*25‡	14	127 mm (5.00 in.) maximum	facial datum plane	near side of top cassette identification tag area
*y*26‡	14	145 mm (5.71 in.) minimum	facial datum plane	far side of top cassette identification tag area
*y*27‡	15	9 mm (0.35 in.) minimum	facial datum plane	front side of side cassette identification tag area
*y*28‡	15	9 mm (0.35 in.) minimum	facial datum plane	rear side of side cassette identification tag area
*y*29	13	89 mm (3.50 in.)	facial datum plane	axis of rotation of fork-lift area
*z*1	8, 12	0 mm (0 in.) minimum	horizontal datum plane	bottom of cassette bottom domain

Symbol Used	*Figure Number*	*Value Specified*	*Datum Measured from*	*Boundary or Feature Measured to*
*z*2*	5, 8, 12	2 mm (0.08 in.) maximum	horizontal datum plane	bottom of carrier sensing pads and info pads (when down) and advancing box sensing pads (on FOUP only, see *SEMI E47.1*)
*z*3	8, 12	7 ± 1 mm (0.28 ± 0.04 in.)	horizontal datum plane	bottom of conveyor rail between *x*15 and *x*16
*z*4	8, 12	15 ± 1 mm (0.59 ± 0.04 in.)	horizontal datum plane	cassette bottom outside of *x*16
*z*5	8, 9	10 mm (0.39 in.) minimum)	horizontal datum plane	top of pod latch-pin hole
*z*6†	6, 8, 9, 12	21 mm (0.83 in.) maximum	horizontal datum plane	top of cassette bottom domain
*z*7‡	8, 12	35 ± 1 mm (1.38 ± 0.04 in.)	horizontal datum plane	bottom point of bottom side grip pits
*z*8†	6, 9, 12	33 mm (1.30 in.)	horizontal datum plane	bottom nominal wafer seating plane
*z*9‡	8, 12	45 ± 1 mm (1.77 ± 0.04 in.)	horizontal datum plane	bottom of vertical sides of bottom side grip pits
*z*10†	10, 11	0 ± 0.5 mm (0.00 ± 0.02 in.)	each nominal wafer seating plane	entire bottom of the wafer
*z*11†	10, 11	see Table 2	each nominal wafer seating plane	encroachment of cassette side domains on clearance above the wafer
*z*12†	6, 9, 10, 11, 12	see Table 2	each nominal wafer seating plane	adjacent nominal wafer seating planes
*z*13‡	7, 10	24 ± 1 mm (0.94 ± 0.04 in.)	top nominal wafer seating plane	bottom wall of top side grip pits
*z*14‡	7, 10	1 ± 1 mm (0.04 ± 0.04 in.)	top nominal wafer seating plane	top point of top side grip pits
*z*15†	6, 9, 10	13 mm (0.51 in.) minimum	top nominal wafer seating plane	bottom of cassette top domain
*z*16‡	7, 10	9 ± 1 mm (0.35 ± 0.04 in.)	lowest point of underside of top robotic flange	encroachment of cassette top domain on space underneath robotic handling flange
*z*17‡	7, 10	26 ± 1 mm (1.02 ± 0.04 in.)	top nominal wafer seating plane	bottom of top robotic handling flanges
*z*18	6, 7, 9, 10	30 mm (1.18 in.) maximum	top nominal wafer seating plane	top of cassette top domain
*z*19	8, 12	24 mm (0.94 in.)	horizontal datum plane	origin of radius of cassette sensing hole
*z*20‡	8, 12	60 ± 1 mm (2.36 ± 0.04 in.)	top nominal wafer seating plane	top wall of bottom side grip pits
*z*21‡	7, 10	9 ± 1 mm (0.35 ± 0.04 in.)	top nominal wafer seating plane	top of vertical sides of top side grip pits
*z*22	8, 12	20 mm (0.79 in.) minimum	horizontal datum plane	top of fork-lift pin hole and upper limit of volume bounded by *r*10
*z*23†	10	3 mm (0.12 in.) maximum	each nominal wafer seating plane	bottom of wafer extraction volume
*z*24‡	7, 10	4 ± 1 mm (0.16 ± 0.04 in.)	lowest point of underside of top robotic flange	top of top robotic handling flange
*z*25‡	None	± 1 mm (± 0.04 in.) flatness over tag area	horizontal datum plane	surface of top and bottom cassette identification tag areas
*z*26*	5	9 mm (0.35 in.) minimum	horizontal datum plane	bottom of info pads (when up)
*z*27‡	15	64.5 mm (2.54 in.) maximum	horizontal datum plane	bottom end of side cassette identification tag area

Symbol Used	*Figure Number*	*Value Specified*	*Datum Measured from*	*Boundary or Feature Measured to*
*z*28‡	15	124.5 mm (4.90 in.) minimum	horizontal datum plane	top end of side cassette identification tag area
*z*29	11	0.7 mm (0.028 in.) maximum	each nominal wafer seating plane	encroachment of cassette side domains under wafer extraction volume
*z*99	15	94.5 mm (3.72 in.)	horizontal datum plane	recommended center of label on side cassette identification tag area

* These dimensions define external features that are also required for boxes.

† These dimensions define internal features thatare also required for boxes with non-removable cassettes.

‡ These dimensions define optional features.

Table 2 Pitch and Capacity Options

Option Number	*Cassette Capacity (c)*	*Wafer Pitch (z12)*	*Wafer Clearance (z11)*	*Resulting Cassette Height (z8 – z1 + z12* (c – 1) + z18)*
1	13 wafers	10 mm (0.39 in.)	6 mm (0.24 in.) minimum	183 mm (7.20 in.) maximum
2	25 wafers	10 mm (0.39 in.)	6 mm (0.24 in.) minimum	303 mm (11.93 in.) maximum
3	not yet defined			
4	not yet defined			

APPENDIX 1
APPLICATION NOTES

NOTE: The material in this appendix is an official part of SEMI E1.9 and was approved by full letter ballot procedures on December 18, 1998. The recommendations in this appendix are optional and are not required to conform to this standard.

A1-1 The cassette capacity is intended to include one test wafer. It is recommended that process equipment be designed for 12 or 24 product wafers, but tool robotics should reach all slots.

NOTE: The carrier capacity need not be the same as the transport group size, the process batch size, or the virtual tracking unit size.

A1-2 The shape of the features holding the wafers is not specified in this standard. However, a mizo tooth shape (an exaggerated version of which is shown in Figure A1-1) is recommended. It is also recommended that the surface that touches the wafer have a large radius to minimize stress on the wafer and the supporting feature. It is recommended that the supporting feature touch the wafer only on the back side and far enough away from the edge to avoid contact with the wafer notch (if any) in any radial orientation.

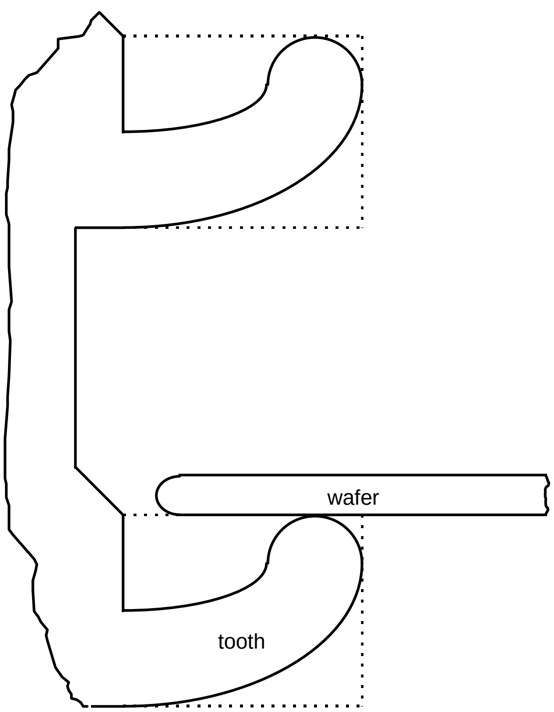

Figure A1-1
Mizo Tooth

A1-3 In general, it is recommended that the wafer notch and/or its fiducial identification marks be kept toward the front of the cassette and the front of the cassette top extend no farther than *y*14 from the facial datum plane, so that the identification marks on the top wafer can be read without removing the wafer.

A1-4 Extra clearance (larger than the pitch) has been added below the bottom wafer (for non-random sequential access to the wafers with a faster or less precise robot) and above the top wafer (for accessing the wafers in a vertical orientation), see Section 6.11.

A1-5 If wear at the kinematic couplings is a concern with plastic cassettes, ceramic or metal inserts can be used for the mating features.

A1-6 Skewness, warp, rock, and stiffness are implicitly defined in the geometric tolerances.

A1-7 To increase the stability of the cassette on the kinematic couplings, the points on the cassette bottom that are the most distant from the lines connecting each pair of coupling pins can be made as close as practical to the horizontal datum plane so that the cassette cannot tip very far off of the kinematic coupling pins.

A1-8 Figure A1-2 shows several paths for optically sensing the presence and planarity of wafers in the cassette. Also shown are the two vertical paths for sensing how far the wafers protrude.

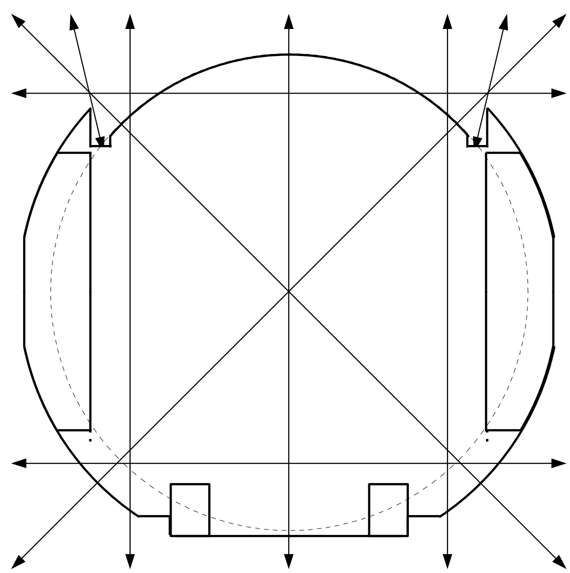

Figure A1-2
Optical Sensing Paths

A1-9 Figure A1-3 shows a small-footprint cassette that conforms to the requirements of this specification. In order to prevent such a small cassette from being set on the kinematic couplings in the wrong orientation, a frame such as shown in Figure A1-4 can be placed around the couplings. In order to not interfere with the kinematic couplings alignment function, the frame can extend no further than *r*19 from the maximum boundaries of a cassette.

NOTE: If the bottom of the cassette does not extend below the bottom conveyor rail, the conveyor rail may become contaminated and may distribute particles.

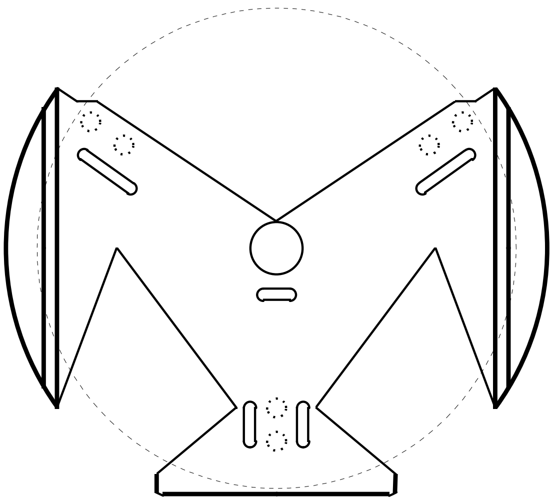

Figure A1-3
Small-Footprint Cassette

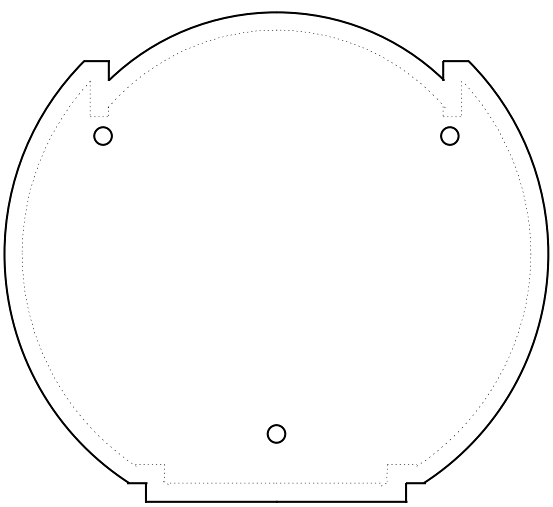

Figure A1-4
Frame to Prevent Misalignment

A1-10 Conveyor rail edges need to be well defined for smooth guidance and to avoid vibration. Thus, the minimum radius on the edge that does not create particles is recommended. For similar reasons, the tolerance on conveyor rail parallelism and on dimension *x*16 should be kept as small as possible for the materials used.

A1-11 Table A1-1 can be used for communicating which optional features are present on cassettes that comply with this specification.

A1-12 In general, info pad A (on the lower left in Figure 5) was intended to indicate~~s~~ the carrier capacity (the number of wafers). For example, info pad A was previously defined to be in the down position (at *z*2 above horizontal datum plane) if the carrier holds 13 wafers and was previously defined to be in the up position (at *z*26 above horizontal datum plane) if the carrier holds 25 wafers. Info pad A is intended to be read with a mechanical switch or optical sensor.

A1-13 In general, info pad B (on the lower right in Figure 5) was intended to indicate~~s~~ the carrier type (cassette or box, etc.). For example, info pad B was previously defined to be in the down position (at *z*2 above horizontal datum plane) if the carrier is a cassette and was previously defined to be in the up position (at *z*26 above horizontal datum plane) if the carrier is a box. Info pad B is intended to be read with a mechanical switch or optical sensor.

A1-14 Info pads C and D (slightly forward and to the outside of info pads A and B) are intended to show whether the carrier is dedicated to the front-end-of-line (FEOL) part of the fabrication process (before any metal layers have been deposited on the wafer) or to the back-end-of-line (BEOL) part of the fabrication process (during which metal contamination may be present). If such carrier differentiation is required by the user, info pads C and D are recommended to be down and up (respectively) for a front-end-of-line carrier and the opposite for a back-end-of-line carrier. Info pads C and D are intended to interact with a mechanical pin. See application note R1-2 in SEMI 15.1 for a discussion of how to use pins to differentiate FEOL and BEOL carriers.

Table A1-1 Open Cassette Optional Features Checklist

Section	*Optional Feature*	*Choice*
6.9	carrier capacity (c)	☐ 13 wafers or ☐ 25 wafers
6.7.4	slant on 2 required fork-lift pick-up areas	angle ω = ____ ($0° \leq \omega \leq 2°$)
6.4	4 robotic handling flanges	☐ yes or ☐ no
6.3	4 pentagonal side grip pits	☐ yes or ☐ no
6.7.1	features that prevent wafer creep-out	☐ yes or ☐ no
6.1	full 15 mm lead in provided by 3 features that mate with kinematic coupling pins	primary kinematic coupling pins ☐ yes or ☐ no and secondary kinematic coupling pins ☐ yes or ☐ no
6.8.1	top cassette identification tag area	☐ yes or ☐ no
6.8.3	bottom cassette identification tag area	☐ yes or ☐ no
6.8.2	side cassette identification tag area (on front right side domain)	☐ yes or ☐ no

RELATED INFORMATION 1

NOTE: This related information is not an official part of SEMI E1.9, and it is not intended to modify or supersede the standard in any way. This information was inserted by the North America Physical Interfaces and Carriers Committee to alert the readers to potential changes to this provisional standard.

R1-1 A revision ballot will be submitted to insert a statement that application of info pads C and D are reserved to be defined by the user (for example, distinguishing between FEOL and BEOL carriers).

SEMI E2-93 (Withdrawn 1103)
SPECIFICATIONS FOR QUARTZ AND HIGH TEMPERATURE WAFER CARRIERS

These specifications were technically reapproved by the Physical Interfaces & Carriers Committee and are the direct responsibility of the North American Physical Interfaces & Carriers Committee. Current edition approved by the North American Regional Standards Committee in October 1998. Initially available at www.semi.org February 1999; to be published February 1999. Originally published in 1986; previous published revision in 1996.

NOTICE: This document was balloted and approved for withdrawal in 2003.

1 Scope

1.1 These specifications cover the dimensional requirements for quartz and high temperature wafer carriers used in processing wafers. These general requirements assist in the compatibility of wafer carriers and most automated wafer processing equipment. Wafer pre-orientation is recommended before transferring wafers into quartz carriers to avoid interference between the flat fiducial(s) and carrier slots. These standards are intended to promote the interchangeability of wafer carriers and encourage the production of equipment suitable to a greater percentage of the market.

1.2 The design definitions of SEMI Wafer Carrier Specifications assume compliance to wafer dimensions defined in SEMI M1, M3, or M9. For a wafer carrier to be said to “meet the SEMI specifications,” it must be manufactured within the dimensional limits of the given specification, and in addition be dimensionally stable within specification when used in accordance with manufacturer' s recommendations. Since wafer carriers are manufactured from a number of different raw materials and several different manufacturing methods, it is up to each manufacturer to determine the recommended usage for each wafer carrier type. The specifications were not established nor do they represent or suggest a means to obtain any ideal efficiencies in wafer processing results or quality of end product.

1.3 For referee purposes, SI (System International, commonly called metric) units shall be used for 80 mm and larger diameter wafers.

2 Selected Definitions

2.1 For illustrations of terms, see Figure 1 for Carrier Style 1, and Figure 2 for Carrier Style 2. Dimensions and tolerances are given in Table 1 of the standards for carriers of the appropriate wafer diameter.

2.1.1 *base* — the material at the bottom of the carrier that the carrier rests on when placed on a flat reference surface.

2.1.2 *bottom plane* — a horizontal plane tangent to the base.

2.1.3 *end* — either end of carrier parallel to wafer plane.

2.1.4 *lift access* — the clearance space used to insert an implement to pick up a wafer carrier.

2.1.5 *side* — either one of the sides perpendicular to the wafer plane.

3 Dimension Definitions

Symbol

A	Wafer Height — distance from the horizontal center line of the wafer to the bottom plane
B	Base Width — the outside dimension of the base from side to side
C	Base Length — length of the base from end to end
D	Lift Access Height — distance from horizontal centerline of lift access opening to bottom plane
E	Lift Access Spacing — distance from center line to center line of lift access opening
F	Lift Access Opening — size of opening for the insertion of an implement to pick up the carrier
G	Base End to First Slot — the distance from either end of the carrier to the first slot on same end
H	Slot Spacing — the distance from the center line of one slot to the center line of the adjacent slot
I	End Slot to other End Slot — the center line of the first slot on either end to the center line of the slot on the other end
J	Pocket Size — the diameter of a circle coincident to the bottom of all wafer slots in a wafer position
K	Base Side to Wafer Center line — horizontal distance from the vertical wafer center line to either side of the base
L	Carrier Region — region enclosed by the greatest included angle between a line drawn from the center point of the wafer and the outermost member of the carrier on one side and a similar line on the other side
P	Separation — separation of wafers when placed in slots

4 Referenced Documents

SEMI M1 — Specifications for Polished Monocrystalline Silicon Wafers

SEMI M3 — Specifications for Polished Mono-crystalline Sapphire Substrates

SEMI M9 — Specifications for Polished Mono-crystalline Gallium Arsenide Slices

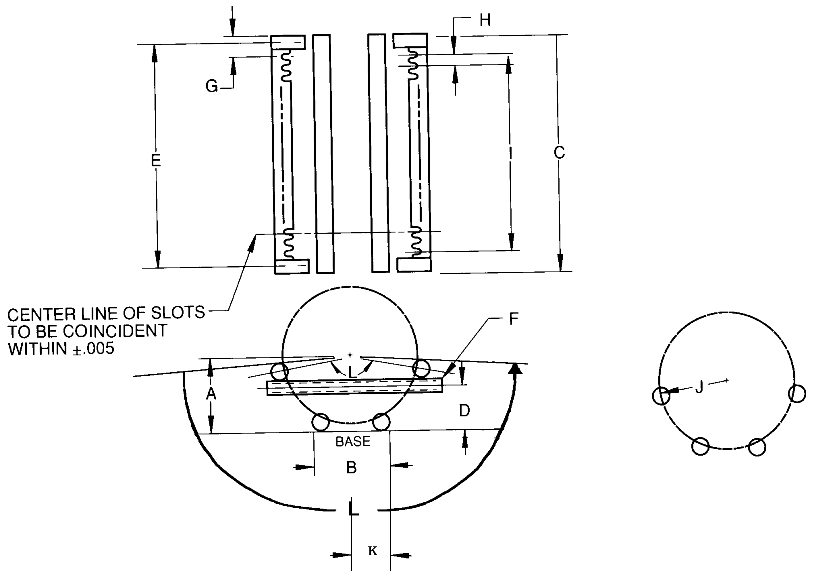

Figure 1
Style 1: Non-Contiguous 25 & 50 Slot

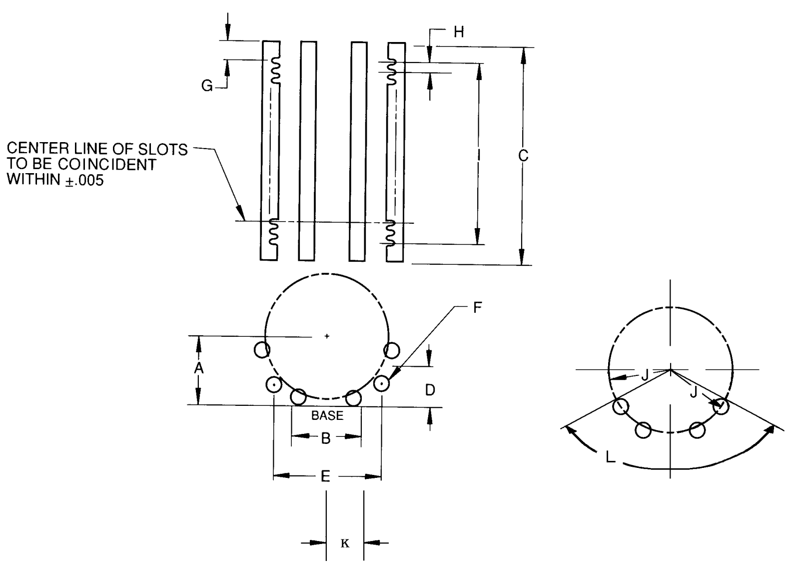

Figure 2
Style 2: Contiguous 25 & 50 Slot

APPLICATION NOTE

NOTE: The material contained in these application notes is not an official part of SEMI E2 and is not meant to modify or supersede it in any way. Rather, these notes are provided primarly as a source of information to aid in the application of the standard, as such, they are to be considered as reference material only. The standard should be referred to in all cases.

Table A1-1 lists the dimensions in linear, versus angular, measurements for ease of dimensional verification. The dimensions fall within SEMI specification; however, they correspond closer to an "L" angular dimension of 140 degrees versus the 150 degrees. The figures A1-1 and A1-2 illustrate these dimensions for non-contiguous and contiguous style quartz carriers.

A1-1 *Carrier — Dimension L*

Automated mass transfer of silicon wafers requires edge contact below the centerline of the wafer according to Table 1. These dimensions have been determined as the minimum distance below the wafer center line allowing the gripping mechanism to overlap the vertical tangent of the wafer edge below the centerline. This overlap allows the wafers to be passively crattled. Contacting the wafer any higher toward the centerline will require clamping force on the wafers.

Table A1-1

Wafer Size	*100 mm*	*125 mm*	*150 mm*	*200 mm*
A	18 mm	21 mm	25 mm	32 mm
Style I & II	(0.70")	(0.82")	(1.00")	(1.25")

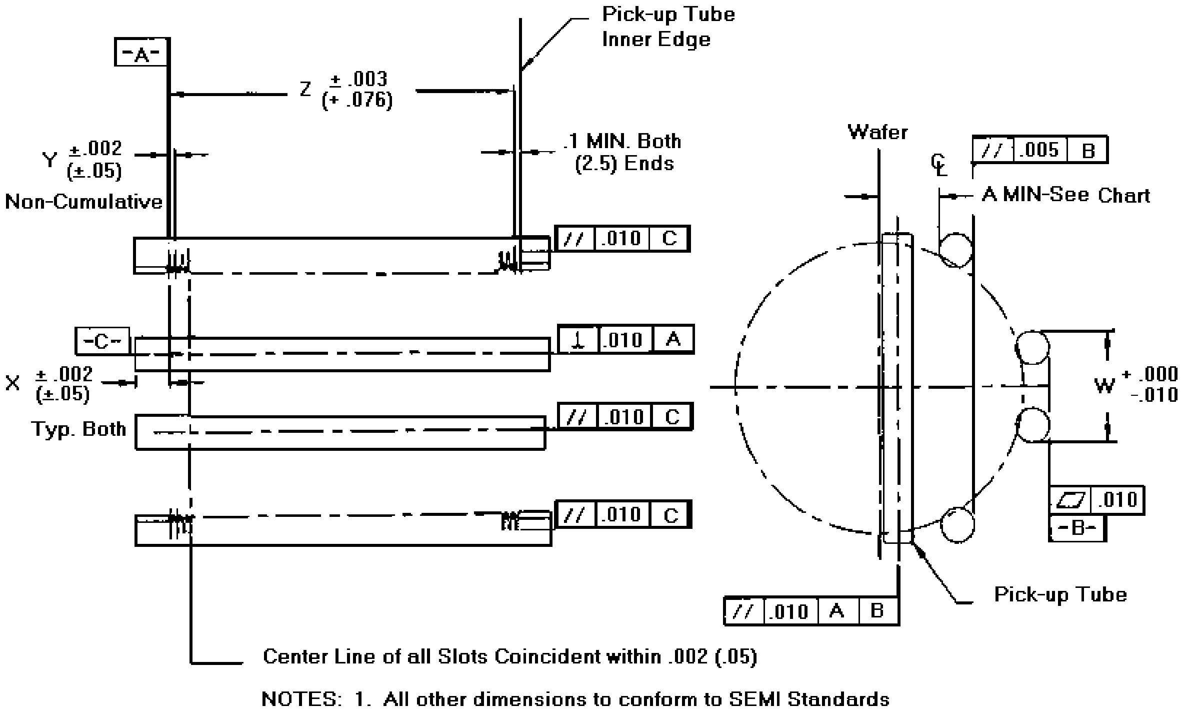

Figure A1-1
Style 1: Non-Contiguous

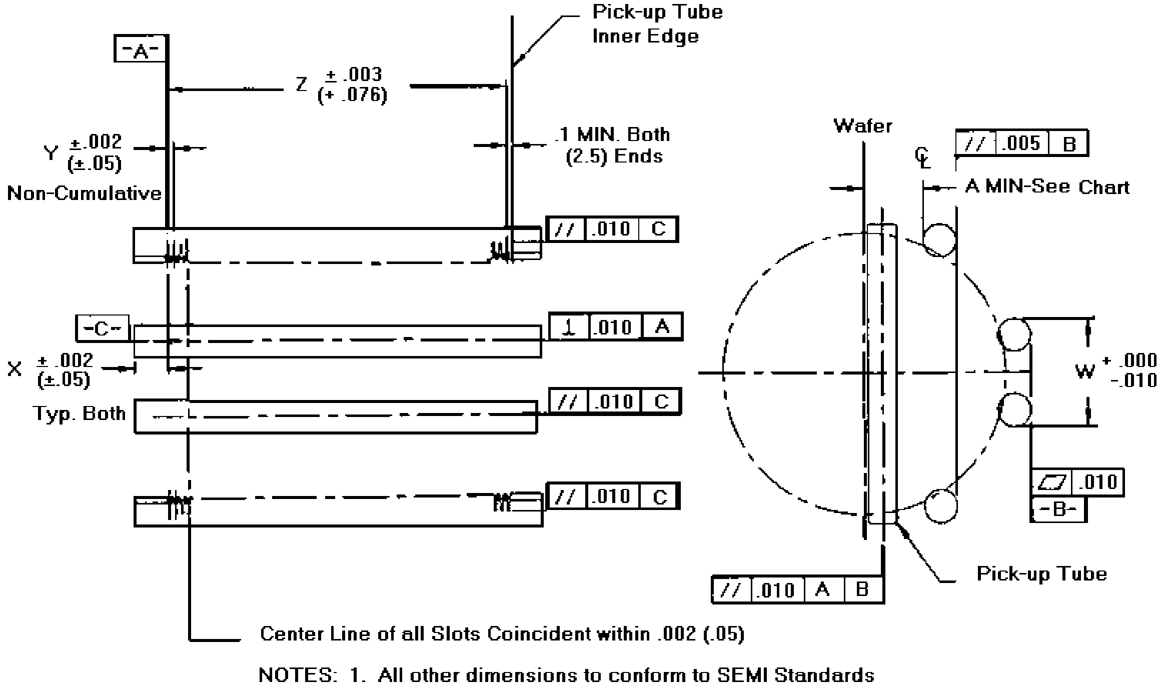

Figure A1-2
Style 2: Contiguous

NOTICE: These standards do not purport to address safety issues, if any, associated with their use. It is the responsibility of the user of these standards to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer' s instructions, product labels, product data sheets, and other relevant literature respecting any materials mentioned herein. These standards are subject to change without notice.

The user' s attention is called to the possibility that compliance with this standard may require use of copyrighted material or of an invention covered by patent rights. By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI E2.2-93 (Withdrawn 1103)
STANDARD FOR 200 mm QUARTZ AND HIGH TEMPERATURE WAFER CARRIERS

This standard was technically reapproved by the Physical Interfaces & Carriers Committee and is the direct responsibility of the North American Physical Interfaces & Carriers Committee. Current edition approved by the North American Regional Standards Committee in October 1998. Initially available at www.semi.org February 1999; to be published February 1999. Originally published in 1988; previous published revision in 1996.

NOTICE: This document was balloted and approved for withdrawal in 2003.

NOTE: Terms and Dimensions used in this specification are defined in SEMI E2.

	Description	*Style 1 — Non-Contiguous (Figure 1)*	*Style 2 — Contiguous (Figure 2)*
Symbol			
A	Wafer Height	105.6 mm REF (4.14 in. REF)	105.6 mm REF (4.14 in. REF)
B	Base Width	66.040 mm ± 0.508 mm (2.600 in. ± 0.020 in.)	66.040 mm ± 0.508 mm (2.600 in. ± 0.020 in.)
D	Lift Access Height	17.8 mm (0.70 in.)	17.8 mm (0.70 in.)
E	Lift Access Spacing	178.562 mm ± 0.760 mm (7.030 in. ± 0.030 in.)	154.940 mm ± 0.760 mm (6.100 in. ± 0.030 in.)
F	Lift Access Opening	6.0 mm (0.236 in.) min.	same
J	Pocket Size (DIA)	202 mm ± 0.500 mm (7.953 in. ± 0.020 in.)	202 mm ± 0.500 mm (7.953 in. ± 0.020 in.)
K	Base Side to Wafer Centerline	33.02 mm ± 0.254 mm (1.300 in. ± 0.010 in.)	1/2 B ± 0.254 mm (1.300 in. ± 0.010 in.)
L	Carrier Region	150° max.	125° max.
P	Separation — Wafer to Wafer	≥ 10% H	≥ 10% H
25 Capacity			
C	Base Length	C = 195.15 mm ± 0.076 mm (7.683 in. ± 0.003 in.)	157.750 mm ± 0.076 mm (6.250 in. ± 0.003 in.)
G	Base End to 1st Slot	G = 21.374 mm ± 0.076 mm (0.8415 ± 0.003 in.)	3.175 mm ± 0.076 mm (0.125 in. ± 0.003 in.)
H	Slot Spacing (non-accumulative)	6.350 mm ± 0.076 mm (0.250 in. ± 0.003 in.)	6.350 mm ± 0.076 mm (0.250 in. ± 0.003 in.)
I	End Slot to End Slot	152.400 mm ± + 0.076 mm (6.000 in. ± 0.003 in.)	152.400 mm ± + 0.076 mm (6.000 in. ± 0.003 in.)
50 Capacity			
C	Base Length	195.148 mm ± 0.076 mm (7.683 in. ± 0.003 in.)	158.750 mm ± 0.076 mm (6.260 in. ± 0.003 in.)
G	Base End to 1st Slot	19.787 mm ± 0.076 mm (0.779 in. ± 0.003 in.)	3.175 mm ± 0.076 mm (0.125 in. ± 0.003 in.)
H	Slot Spacing (non-accumulative)	3.18 mm ± 0.08 mm (0.125 in. ± 0.003 in.)	3.18 mm ± 0.08 mm (0.125 in. ± 0.003 in.)
I	End Slot to End Slot	155.575 mm ± 0.076 mm (6.125 in. ± 0.003 in.)	155.575 mm ± 0.076 mm (6.125 in. ± 0.003 in.)

SEMI E2.3-93 (Withdrawn 1103)
STANDARD FOR 100 mm QUARTZ AND HIGH TEMPERATURE WAFER CARRIERS

This standard was technically reapproved by the Physical Interfaces & Carriers Committee and is the direct responsibility of the North American Physical Interfaces & Carriers Committee. Current edition approved by the North American Regional Standards Committee in October 1998. Initially available at www.semi.org February 1999; to be published February 1999. Originally published in 1993; previous published revision in 1996.

NOTICE: This document was balloted and approved for withdrawal in 2003.

NOTE: Terms and Dimensions used in this specification are defined in SEMI E2.

	Description	*Style 1 — Non-Contiguous (Figure 1)*	*Style 2 — Contiguous (Figure 2)*
Symbol			
A	Wafer Height	57.0 mm ± 0.5 mm (2.25 in. ± 0.020 in.)	57.0 mm ± 0.5 mm (2.25 in. ± 0.020 in.)
B	Base Width	39.1 mm ± 0.25 mm (1.54 in. ± 0.010 in.)	39.1 mm ± 0.25 mm (1.54 in. ± 00.010 in.)
D	Lift Access Height	17.8 mm (0.70 in.) min.	17.8 mm (0.70 in.) min.
E	Lift Access Spacing	134.5 ± 0.50 mm (5.296 in. ± 0.02 in.)	109.2 mm ± 0.5 mm (4.30 in. ± 0.02 in.)
F	Lift Access Opening	8 mm I.D. (3.15 in. I.D.) min.	8 mm I.D. (3.15 in. I.D.) min.
J	Pocket Size (DIA)	101.6 mm ± 0.5 mm (4.00 in. ± 0.020 in.)	101.6 mm ± 0.5 mm (4.00 in. ± 0.020 in.)
K	Base Side to Wafer Centerline	1/2 B ± 0.25 mm (0.01 in.)	1/2 B ± 0.25 mm (0.01 in.)
L	Carrier Region	150° max.	125° max.
P	Separation — Wafer to Wafer	≥ 10% H	≥ 10% H
25 Capacity			
C	Base Length	145.7 mm ± 0.076 mm (5.736 in. ± 0.003 in.)	119.00 ± 0.076 mm (4.688 in. ± 0.003 in.)
G	Base End to 1st Slot	15.7 mm ± 0.076 mm (0.618 in. ± 0.003 in.)	2.390 mm ± 0.076 mm (0.094 in. ± 0.003 in.)
H	Slot Spacing (non-accumulative)	4.76 mm ± 0.051 mm (0.1875 in. ± 0.002 in.)	4.76 mm ± 0.051 mm (0.1875 in. ± 0.002 in.)
I	End Slot to End Slot	114.3 mm ± 0.076 mm (4.500 in. ± 0.003 in.)	114.3 mm ± 0.076 mm (4.500 in. ± 0.003 in.)
50 Capacity			
C	Base Length	145.7 mm ± 0.076 mm (5.736 in. ± 0.003 in.)	121.46 mm ± 0.076 mm (4.782 in. ± 0.003 in.)
G	Base End to 1st Slot	14.50 mm ± 0.076 mm (0.571 in. ± 0.003 in.)	2.390 mm ± 0.076 mm (0.094 in. ± 0.003 in.)
H	Slot Spacing (non-accumulative)	2.381 mm ± 0.051 mm (0.09375 in. ± 0.002 in.)	2.381 mm ± 0.051 mm (0.09375 in. ± 0.002 in.)
I	End Slot to End Slot	116.69 ± 0.076 mm (4.594 in. ± 0.003 in.)	116.69 mm ± 0.076 mm (4.594 in. ± 0.003 in.)

NOTE 1: 25 capacity slot spacing is derived from SEMI E1.2.

NOTE 2: 50 capacity slot spacing is SEMI E1.2 divided by 2; to insure compatibility for wafer transfer between Plastic & High Temperature Carriers, the U.S. customary dimension is carried out to 5 decimals to eliminate accumulation in rounding error when multiplying times 49 spaces to achieve I.