R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

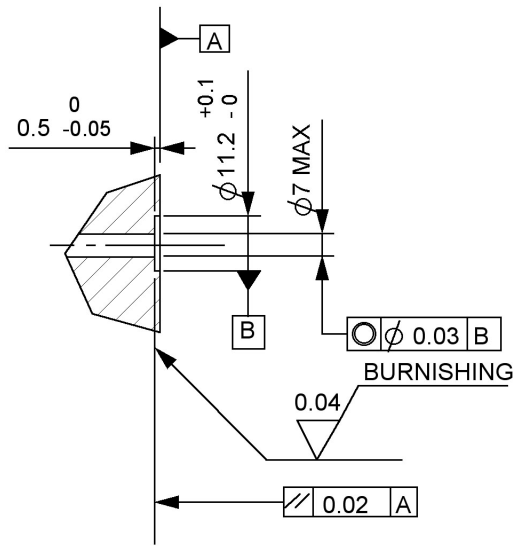

Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

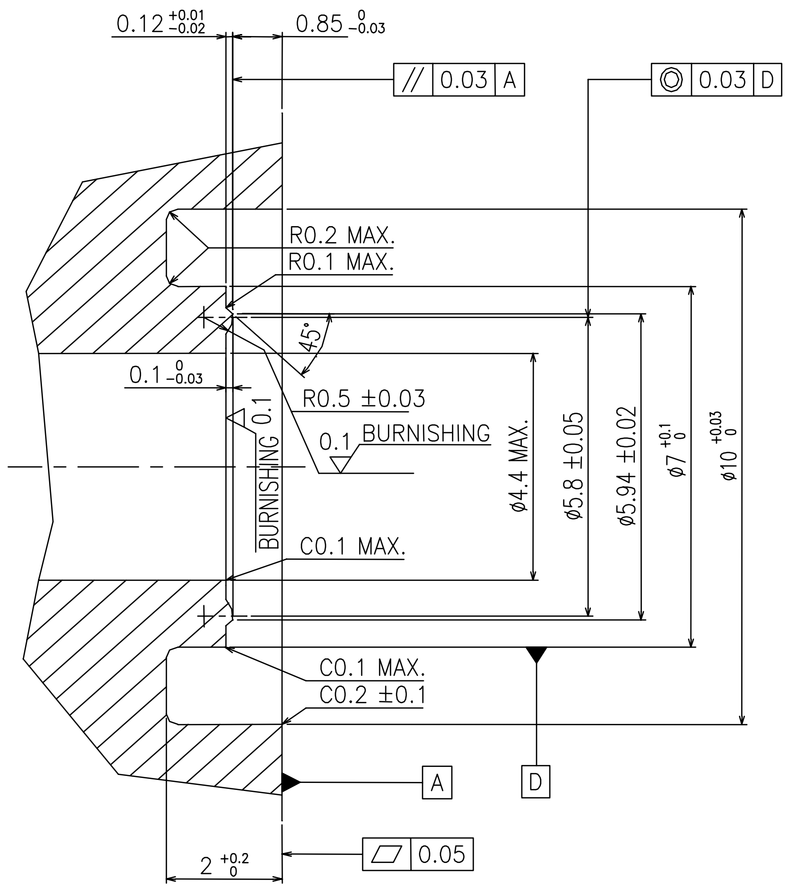

Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

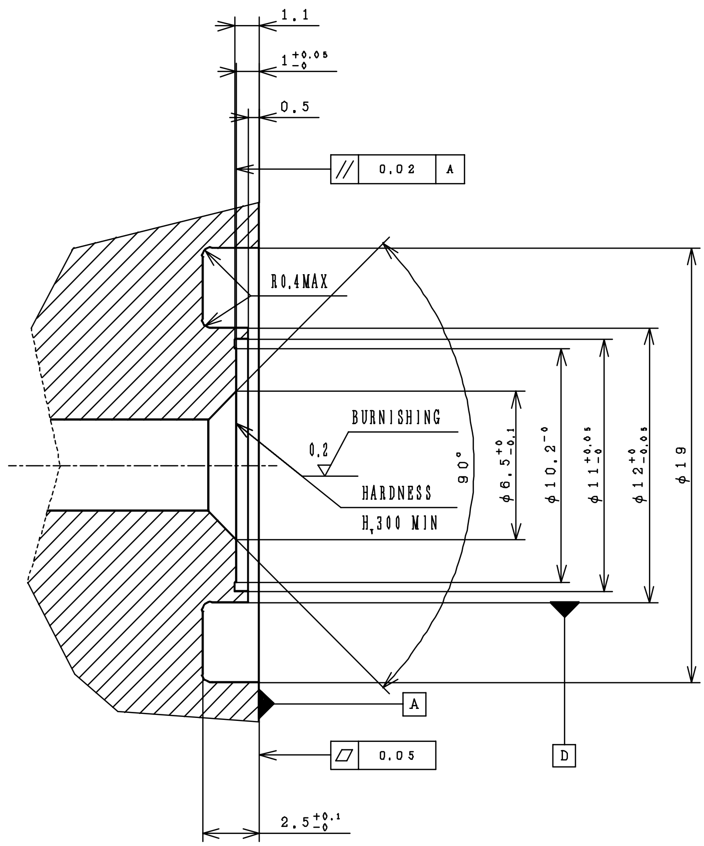

Figure R1-4
Design Example 4

NOTICE: 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 or equipment mentioned herein. These standards are subject to change without notice.

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SEMI F91-0304[E]

SPECIFICATION FOR DIMENSION OF COMPACT SIZE TWO PORT COMPONENTS (EXCEPT MFC/MFM) FOR 1.5 INCH TYPE TWO FASTENER CONFIGURATION SURFACE MOUNT GAS DISTRIBUTION SYSTEMS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the Japanese Gases & Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on November 20, 2003. Initially available at www.semi.org February 2004; to be published March 2004.

[E] This document was modified in May 2004 with committee approval to correct an error made at the pre-ballot stage. Changes were made to Figure R1-2.

1 Purpose

1.1 This standard establishes the properties and physical dimensions of two port components for 1.5 inch type surface mount gas distribution systems.

2 Scope

2.1 This document includes common requirements, layout, size, detailed specifications, and dimensions of the components.

2.2 This standard applies to all compact size two port two fastener components (except mass flow controllers and mass flow meters). The components (i.e. valves, pressure regulators, pressure transducers, filters and purifiers) are mounted on substrates with fasteners accessible from the top.

2.3 This standard only applies to components, which control flow of ≤ 50 slm nitrogen equivalent at 308 kPa (44.7 psia). This standard also only applies to components with operating pressures less than 3445 kPa (500 psia) at 20°C.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard only addresses the component; it does not address the seals, the sealing system, or the assembly process and does not guarantee the performance of the sealing system. The user should be aware that gas delivery system performance and sealing system performance are addressed elsewhere in the SEMI standards.

3.2 The user should be aware that alternative technologies are commercially available.

3.3 International, national, and local codes, regulations, and laws should be consulted to ensure that the equipment meets regulatory requirements in each location of use.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E49.9 — Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Extruded Shapes, Plate, and Investment Castings for Components Used in High Purity Semiconductor Manufacturing Applications

4.2 *ASME Standards*[1]

ASME Y14.5 — Dimensioning and Tolerancing

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Definitions*

5.1.1 *components for surface mount* — a gas distribution system component having inlets and outlets located on the bottom of the component with the attachment mechanism accessible from the top.

5.1.2 *Ra* — roughness average. The arithmetic average of the absolute values of the measure profile height deviations taken within the sampling length and measured from the graphical centerline.

5.1.3 *two fastener configuration* — the component has two fasteners per sealing point. The sealing point is located in the middle of the two fasteners.

1 American Society of Mechanical Engineers. Three Park Avenue, New York, NY 10016-5990, USA. Telephone: 800.843.2763 (U.S./Canada), 95.800.843.2763 (Mexico), 973.882.1167 (outside North America). Website: www.asme.org

6 Common Requirements

6.1 *Dimensional Requirements* — All components shall meet the requirements outlined in Figure 1. All geometric dimensioning and tolerancing complies with ASME Y14.5 and/or the applicable ISO standard.

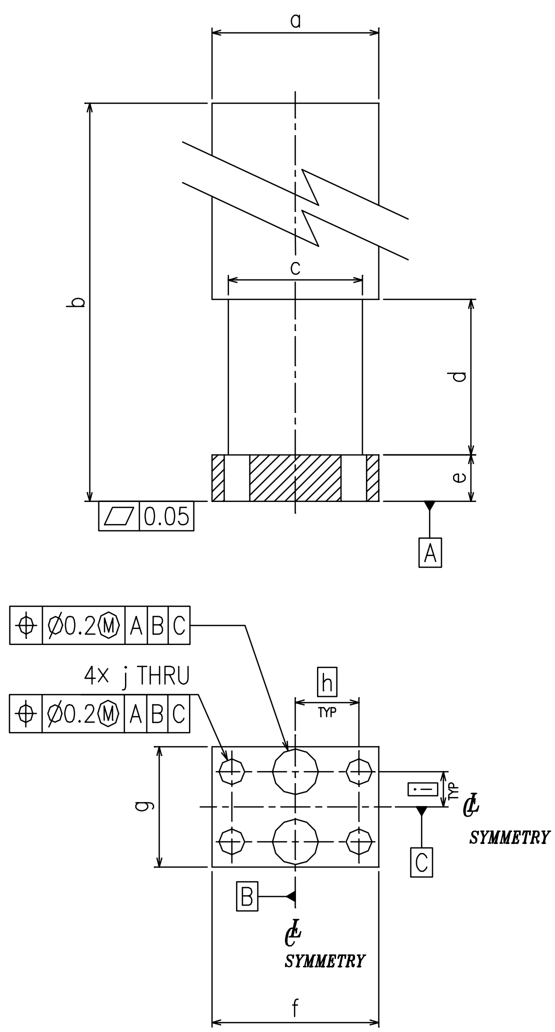
NOTE 1: All dimensions are in millimeters unless otherwise noted.

NOTE 2: The through hole of the sealing port will be elliptical if the through hole is drilled at an angle. In this case, the diameter shall apply to the major diameter of the ellipse.

6.2 *Material* — The material used to manufacture the base of the components shall comply to SEMI F20 with the exception that the sulfur content shall comply to SEMI E49.9.

NOTE 3: SEMI E49.9 was withdrawn. However, a ballot to combine E49.8 and E49.9 in one single standard was submitted for SEMICON West 2003.

6.3 *Burrs and Sharp Edges* — Unless specifically noted on the drawing, remove all burrs and sharp edges.



a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
ϕ26 MAX	180 MAX	ϕ23 MAX	22 MIN	8.0 ±0.2	38.15 ±1.15	26 ±0.2	15	6.5	ϕ5.6 ±0.1

UNIT: [mm]

Figure 1
Dimensional Requirements for All Components

6.4 *Handles and Displays* — Rotating handles and removable displays shall stay within the maximum envelope of the base of the component with the exception of toggle and/or lockout/tagout valves at the discretion of the system designer. They shall be movable or removable such that they do not interfere with the access of the mounting fasteners from above.

7 Related Documents

7.1 *ISO Standards*[2]

ISO 406 — Technical Drawings - Tolerancing of Linear and Angular Dimensions

ISO 1101 — Technical Drawings - Geometrical Tolerancing - Tolerancing of Form, Orientation, Location, and Run-Out - Generalities, Definitions, Symbols, and Indications on Drawings.

ISO 1660 — Technical Drawings - Dimensioning and Tolerancing of Profiles

ISO 2692 — Technical Drawings - Geometrical Tolerancing - Maximum Material Principle

ISO 6507 — Metallic Materials - Vickers Hardness Test

ISO 8015 — Technical Drawings - Fundamental Tolerancing Principles

2 ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Genevè 20, Switzerland. http://www.iso.ch

RELATED INFORMATION 1
EXAMPLES OF SEAL DESIGNS FOR 1.5 INCH TYPE SURFACE MOUNT COMPONENTS

NOTICE: This related information is not an official part of SEMI F91 and was derived from the work of the originating task force. This related information was approved for publication by full ballot procedures. Determination of the suitability of the material is solely the responsibility of the user.

R1-1 Design Example 1

R1-1.1 *Seal Design* — See Figure R1-1.

R1-1.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 170 Vickers. The hardness may be tested per ISO 6507.

R1-1.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.25 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-1.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

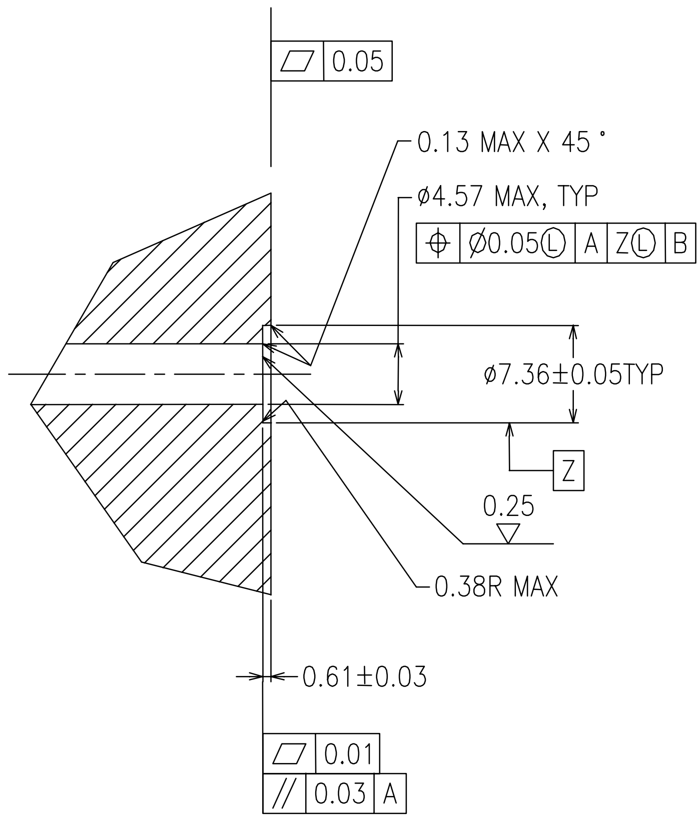


Figure R1-1
Design Example 1

R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

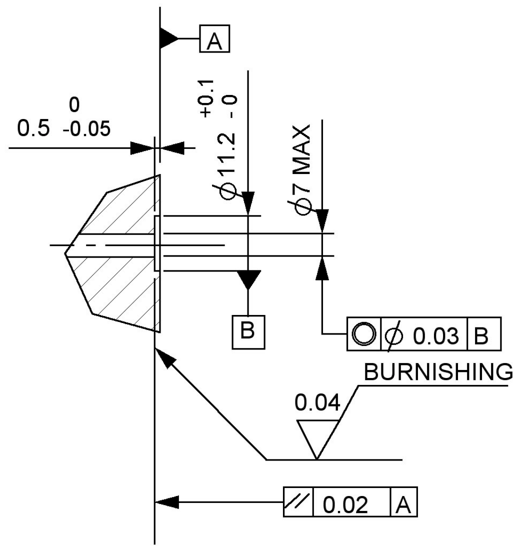


Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

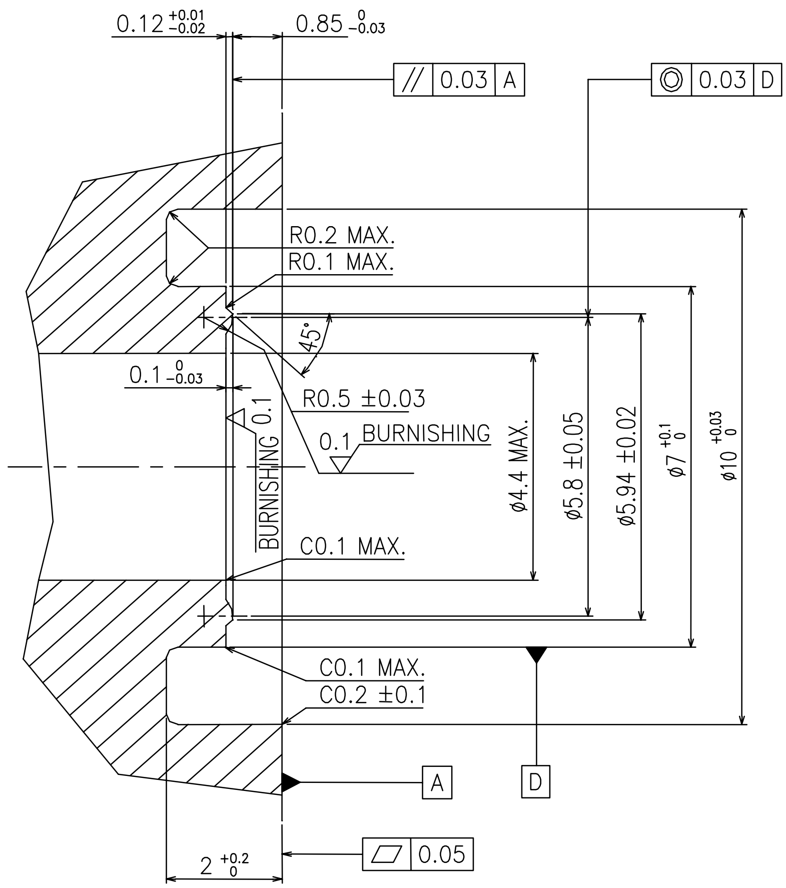


Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

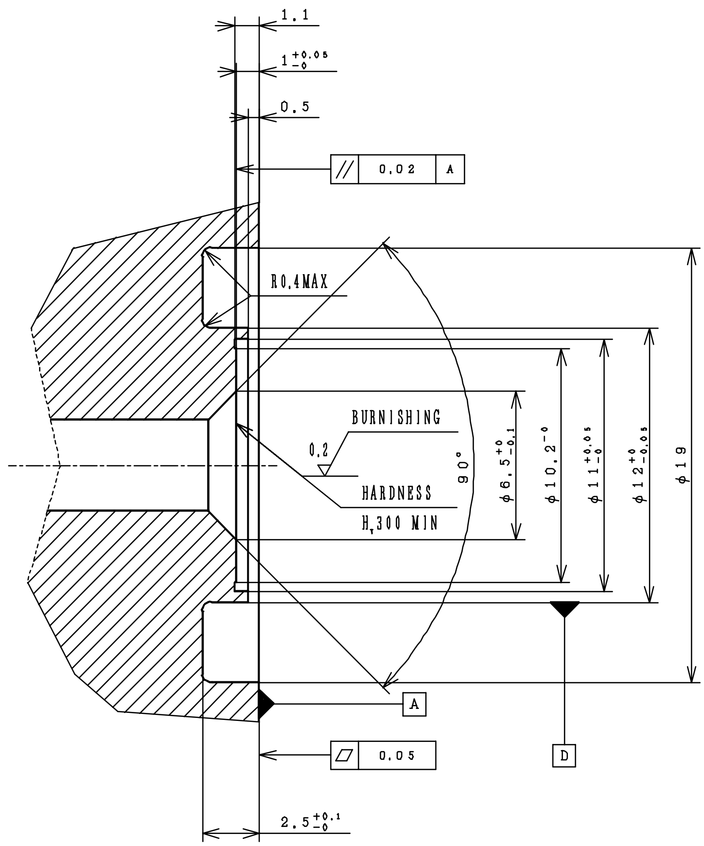


Figure R1-4
Design Example 4

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SEMI F92-0304E
SPECIFICATION FOR DIMENSION OF COMPACT SIZE THREE PORT COMPONENTS FOR 1.5 INCH TYPE TWO FASTENER CONFIGURATION SURFACE MOUNT GAS DISTRIBUTION SYSTEMS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the Japanese Gases & Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on November 20, 2003. Initially available at www.semi.org February 2004; to be published March 2004.

E This document was modified in May 2004 with committee approval to correct an error made at the pre-ballot stage. Changes were made to Figure R1-2.

1 Purpose

1.1 This standard establishes the properties and physical dimensions of two port components for 1.5 inch type surface mount gas distribution systems.

2 Scope

2.1 This document includes common requirements, layout, size, detailed specifications, and dimensions of the components.

2.2 This standard applies to all compact size three port two fastener components. The components (i.e. valves, pressure regulators, pressure transducers, filters and purifiers) are mounted on substrates with fasteners accessible from the top.

2.3 This standard only applies to components, which control flow of ≤ 50 slm nitrogen equivalent at 308 kPa (44.7 psia). This standard also only applies to components with operating pressures less than 3445 kPa (500 psia) at 20°C.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard only addresses the component; it does not address the seals, the sealing system, or the assembly process and does not guarantee the performance of the sealing system. The user should be aware that gas delivery system performance and sealing system performance are addressed elsewhere in the SEMI standards.

3.2 The user should be aware that alternative technologies are commercially available.

3.3 International, national, and local codes, regulations, and laws should be consulted to ensure that the equipment meets regulatory requirements in each location of use.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E49.9 — Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Extruded Shapes, Plate, and Investment Castings for Components Used in High Purity Semiconductor Manufacturing Applications

4.2 *ASME Standards*[1]

ASME Y14.5 — Dimensioning and Tolerancing

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Definitions*

5.1.1 *components for surface mount* — a gas distribution system component having inlets and outlets located on the bottom of the component with the attachment mechanism accessible from the top.

5.1.2 *Ra* — roughness average. The arithmetic average of the absolute values of the measure profile height deviations taken within the sampling length and measured from the graphical centerline.

5.1.3 *two fastener configuration* — the component has two fasteners per sealing point. The sealing point is located in the middle of the two fasteners.

1 American Society of Mechanical Engineers. Three Park Avenue, New York, NY 10016-5990, USA. Telephone: 800.843.2763 (U.S./Canada), 95.800.843.2763 (Mexico), 973.882.1167 (outside North America). Website: www.asme.org

6 Common Requirements

6.1 *Dimensional Requirements* — All components shall meet the requirements outlined in Figure 1. All geometric dimensioning and tolerancing complies with ASME Y14.5 and/or the applicable ISO standard.

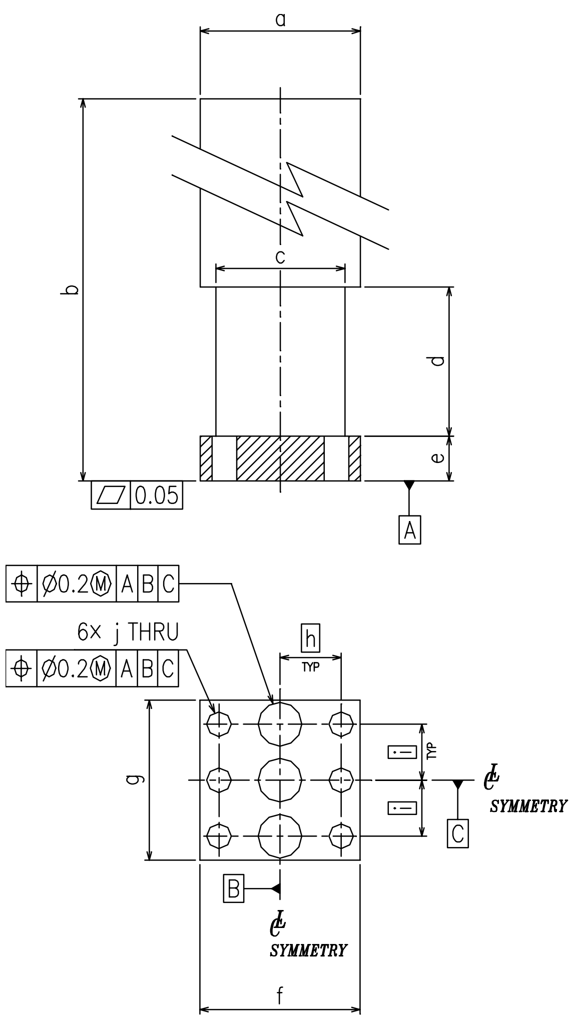
NOTE 1: All dimensions are in millimeters unless otherwise noted.

NOTE 2: The through hole of the sealing port will be elliptical if the through hole is drilled at an angle. In this case, the diameter shall apply to the major diameter of the ellipse.

6.2 *Material* — The material used to manufacture the base of the components shall comply to SEMI F20 with the exception that the sulfur content shall comply to SEMI E49.9.

NOTE 3: SEMI E49.9 was withdrawn. However, a ballot to combine E49.8 and E49.9 in one single standard was submitted for SEMICON West 2003.

6.3 *Burrs and Sharp Edges* — Unless specifically noted on the drawing, remove all burrs and sharp edges.



a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
ϕ38.4 MAX	180 MAX	ϕ34 MAX	22 MIN	8.0 ±0.2	38.15 ±1.15	38.15 ±1.15	15	13	ϕ5.6 ±0.1

UNIT: [mm]

Figure 1
Dimensional Requirements for All Components

6.4 *Handles and Displays* — Rotating handles and removable displays shall stay within the maximum envelope of the base of the component with the exception of toggle and/or lockout/tagout valves at the discretion of the system designer. They shall be movable or removable such that they do not interfere with the access of the mounting fasteners from above.

7 Related Documents

7.1 *ISO Standards*[2]

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2 ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Genevè 20, Switzerland. http://www.iso.ch

RELATED INFORMATION 1
EXAMPLES OF SEAL DESIGNS FOR 1.5 INCH TYPE SURFACE MOUNT COMPONENTS

NOTICE: This related information is not an official part of SEMI F92 and was derived from the work of the originating task force. This related information was approved for publication by full ballot procedures. Determination of the suitability of the material is solely the responsibility of the user.

R1-1 Design Example 1

R1-1.1 *Seal Design* — See Figure R1-1.

R1-1.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 170 Vickers. The hardness may be tested per ISO 6507.

R1-1.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.25 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-1.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

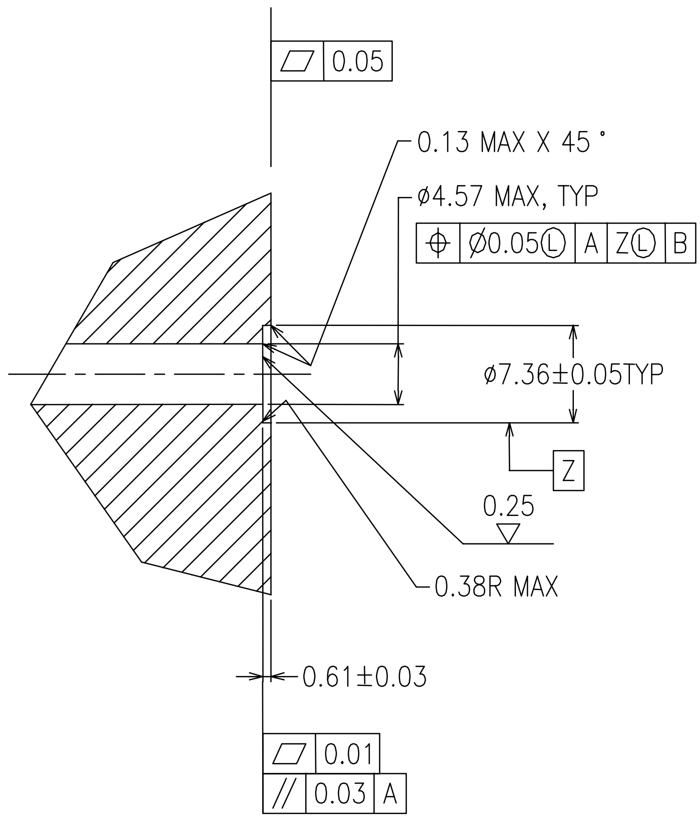

Figure R1-1
Design Example 1

R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

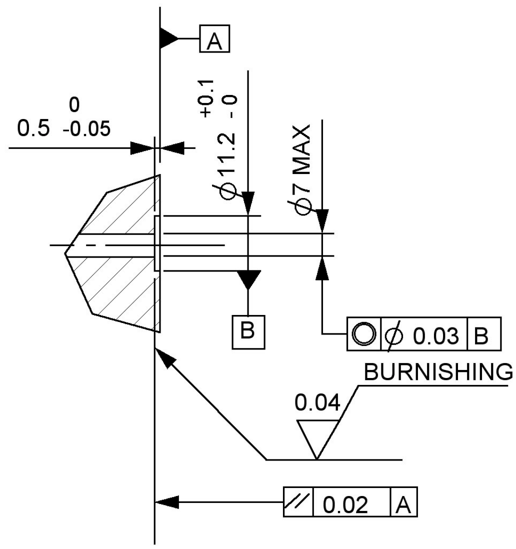

Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

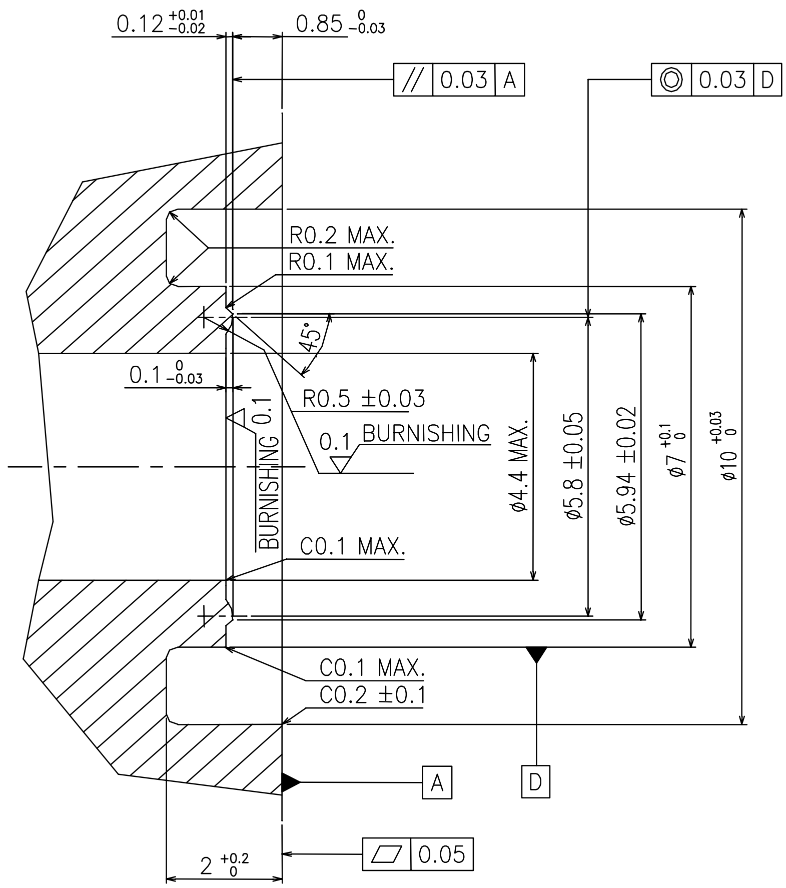

Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

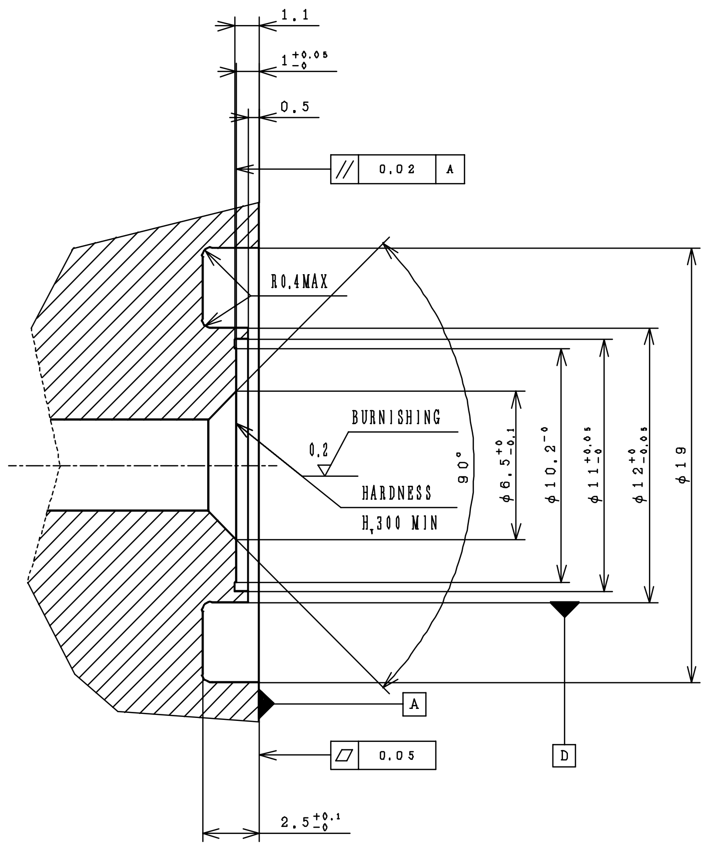

Figure R1-4
Design Example 4

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SEMI F93-0304[E]
SPECIFICATION FOR DIMENSION OF ONE PORT COMPONENTS FOR 1.5 INCH TYPE FOUR FASTENER CONFIGURATION SURFACE MOUNT GAS DISTRIBUTION SYSTEMS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the Japanese Gases & Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on November 20, 2003. Initially available at www.semi.org February 2004; to be published March 2004.

[E] This document was modified in May 2004 with committee approval to correct an error made at the pre-ballot stage. Changes were made to Figure R1-2.

1 Purpose

1.1 This standard establishes the properties and physical dimensions of one port components for 1.5 inch type surface mount gas distribution systems.

2 Scope

2.1 This document includes common requirements, layout, size, detailed specifications, and dimensions of the components.

2.2 This standard applies to all one port four fastner components. The components are mounted on substrates with fasteners accessible from the top.

2.3 This standard only applies to components, which control flow of ≤ 50 slm nitrogen equivalent at 308 kPa (44.7 psia). This standard also only applies to components with operating pressures less than 3445 kPa (500 psia) at 20°C.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard only addresses the component; it does not address the seals, the sealing system, or the assembly process and does not guarantee the performance of the sealing system. The user should be aware that gas delivery system performance and sealing system performance are addressed elsewhere in the SEMI standards.

3.2 The user should be aware that alternative technologies are commercially available.

3.3 International, national, and local codes, regulations, and laws should be consulted to ensure that the equipment meets regulatory requirements in each location of use.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E49.9 — Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Extruded Shapes, Plate, and Investment Castings for Components Used in High Purity Semiconductor Manufacturing Applications

4.2 *ASME Standards*[1]

ASME Y14.5 — Dimensioning and Tolerancing

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Definitions*

5.1.1 *components for surface mount* — a gas distribution system component having inlets and outlets located on the bottom of the component with the attachment mechanism accessible from the top.

5.1.2 *four fastener configuration* — the component has four fasteners located on an interface, independent of number of sealing point.

5.1.3 *Ra* — roughness average. The arithmetic average of the absolute values of the measure profile height deviations taken within the sampling length and measured from the graphical centerline.

6 Common Requirements

6.1 *Dimensional Requirements* — All components shall meet the requirements outlined in Figure 1. All

1 American Society of Mechanical Engineers. Three Park Avenue, New York, NY 10016-5990, USA. Telephone: 800.843.2763 (U.S./Canada), 95.800.843.2763 (Mexico), 973.882.1167 (outside North America). Website: www.asme.org

geometric dimensioning and tolerancing complies with ASME Y14.5 and/or the applicable ISO standard.

NOTE 1: All dimensions are in millimeters unless otherwise noted.

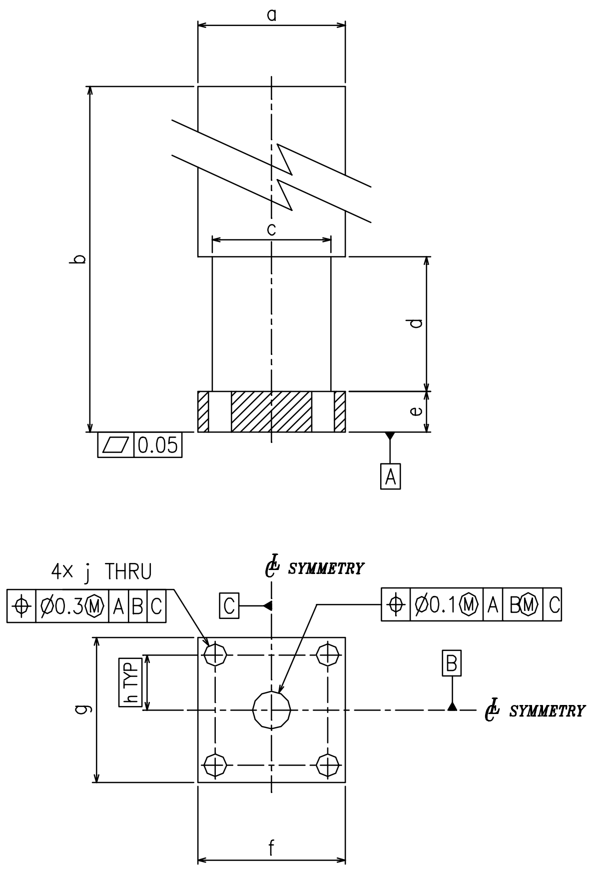
NOTE 2: The through hole of the sealing port will be elliptical if the through hole is drilled at an angle. In this case, the diameter shall apply to the major diameter of the ellipse.

6.2 *Material* — The material used to manufacture the base of the components shall comply to SEMI F20 with the exception that the sulfur content shall comply to SEMI E49.9.

NOTE 3: SEMI E49.9 was withdrawn. However, a ballot to combine E49.8 and E49.9 in one single standard was submitted for SEMICON West 2003.

6.3 *Burrs and Sharp Edges* — Unless specifically noted on the drawing, remove all burrs and sharp edges.

6.4 *Displays* —Removable displays shall stay within the maximum envelope of the base of the component. They shall be movable or removable such that they do not interfere with the access of the mounting fasteners from above.



a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*
ϕ38.4 MAX	180 MAX	ϕ34 MAX	22 MIN	8.0 ± 0.2	38.15 ±1.15	38.15 ±1.15	15.1	ϕ5.6 ± 0.1

UNIT: [mm]

Figure 1
Dimensional Requirements for All Components

7 Related Documents

7.1 *ISO Standards*[2]

ISO 406 — Technical Drawings - Tolerancing of Linear and Angular Dimensions

ISO 1101 — Technical Drawings - Geometrical Tolerancing - Tolerancing of Form, Orientation, Location, and Run-Out - Generalities, Definitions, Symbols, and Indications on Drawings.

ISO 1660 — Technical Drawings - Dimensioning and Tolerancing of Profiles

ISO 2692 — Technical Drawings - Geometrical Tolerancing - Maximum Material Principle

ISO 6507 — Metallic Materials - Vickers Hardness Test

ISO 8015 — Technical Drawings - Fundamental Tolerancing Principles

2 ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Genevè 20, Switzerland. http://www.iso.ch

RELATED INFORMATION 1
EXAMPLES OF SEAL DESIGNS FOR 1.5 INCH TYPE SURFACE MOUNT COMPONENTS

NOTICE: This related information is not an official part of SEMI F93 and was derived from the work of the originating task force. This related information was approved for publication by full ballot procedures. Determination of the suitability of the material is solely the responsibility of the user.

R1-1 Design Example 1

R1-1.1 *Seal Design* — See Figure R1-1.

R1-1.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 170 Vickers. The hardness may be tested per ISO 6507.

R1-1.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.25 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-1.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

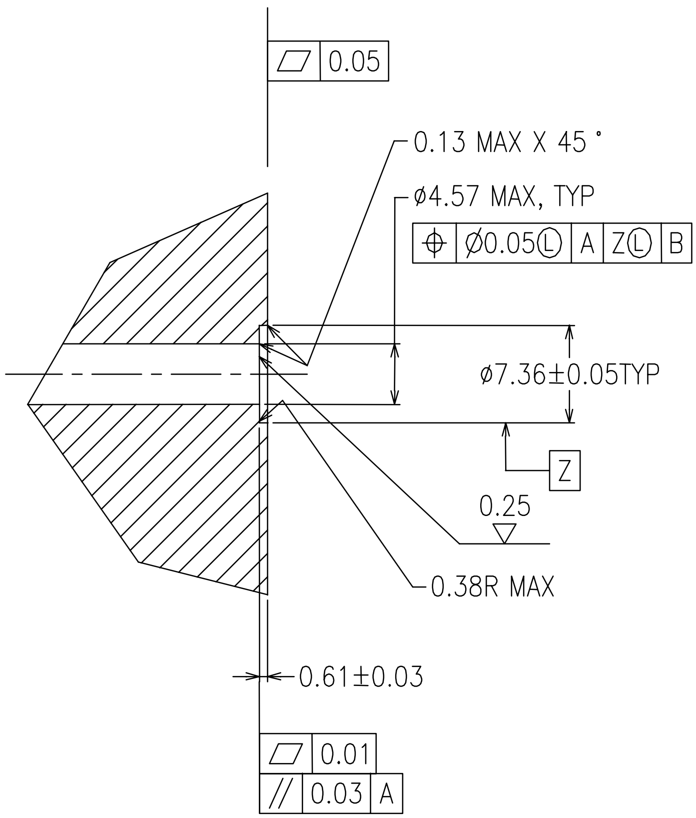


Figure R1-1
Design Example 1

R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

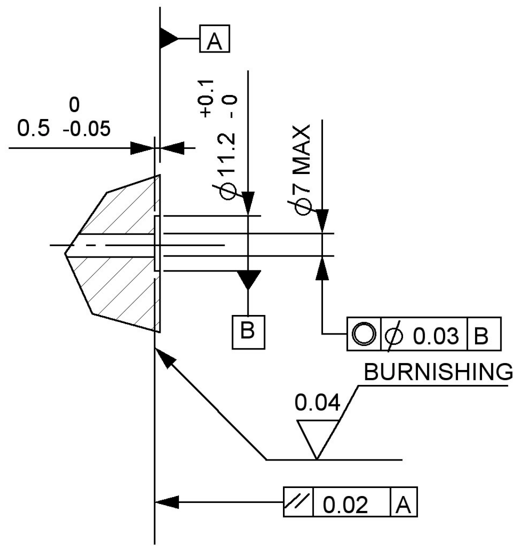


Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

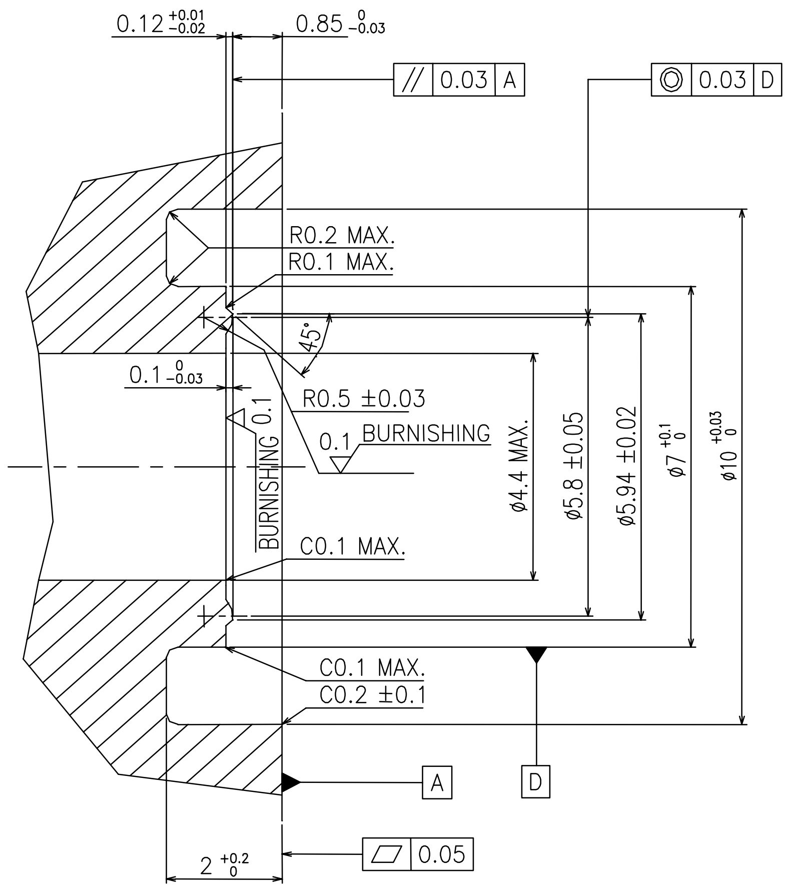


Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

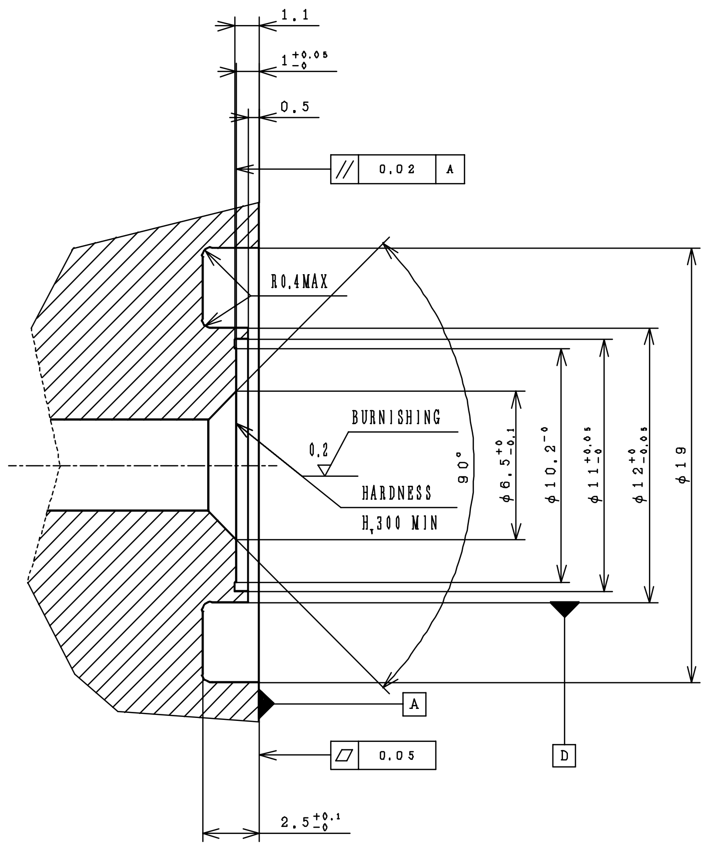


Figure R1-4
Design Example 4

NOTICE: 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 or equipment mentioned herein. These standards are subject to change without notice.

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SEMI F94-0304[E]
SPECIFICATION FOR DIMENSION OF TWO PORT COMPONENTS (EXCEPT MFC/MFM) FOR 1.5 INCH FOUR FASTENER CONFIGURATION TYPE SURFACE MOUNT GAS DISTRIBUTION SYSTEMS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the Japanese Gases & Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on November 20, 2003. Initially available at www.semi.org February 2004; to be published March 2004.

[E] This document was modified in May 2004 with committee approval to correct an error made at the pre-ballot stage. Changes were made to Figure R1-2.

1 Purpose

1.1 This standard establishes the properties and physical of two port components for 1.5 inch type surface mount gas distribution systems.

2 Scope

2.1 This document includes common requirements, layout, size, detailed specifications, and dimensions of the components.

2.2 This standard applies to all two port four fastener components (except mass flow controllers and mass flow meters). The components (i.e. valves, pressure regulators, pressure transducers, filters and purifiers) are mounted on substrates with fasteners accessible from the top.

2.3 This standard only applies to components, which control flow of ≤ 50 slm nitrogen equivalent at 308 kPa (44.7 psia). This standard also only applies to components with operating pressures less than 3445 kPa (500 psia) at 20°C.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard only addresses the component; it does not address the seals, the sealing system, or the assembly process and does not guarantee the performance of the sealing system. The user should be aware that gas delivery system performance and sealing system performance are addressed elsewhere in the SEMI standards.

3.2 The user should be aware that alternative technologies are commercially available.

3.3 International, national, and local codes, regulations, and laws should be consulted to ensure that the equipment meets regulatory requirements in each location of use.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E49.9 — Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Extruded Shapes, Plate, and Investment Castings for Components Used in High Purity Semiconductor Manufacturing Applications

4.2 *ASME Standards*[1]

ASME Y14.5 — Dimensioning and Tolerancing

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Definitions*

5.1.1 *components for surface mount* — a gas distribution system component having inlets and outlets located on the bottom of the component with the attachment mechanism accessible from the top.

5.1.2 *four fastener configuration* — the component has four fasteners located on an interface, independent of number of sealing point.

5.1.3 *Ra* — roughness average. The arithmetic average of the absolute values of the measure profile height deviations taken within the sampling length and measured from the graphical centerline.

1 American Society of Mechanical Engineers. Three Park Avenue, New York, NY 10016-5990, USA. Telephone: 800.843.2763 (U.S./Canada), 95.800.843.2763 (Mexico), 973.882.1167 (outside North America). Website: www.asme.org

6 Common Requirements

6.1 *Dimensional Requirements* — All components shall meet the requirements outlined in Figure 1. All geometric dimensioning and tolerancing complies with ASME Y14.5 and/or the applicable ISO standard.

NOTE 1: All dimensions are in millimeters unless otherwise noted.

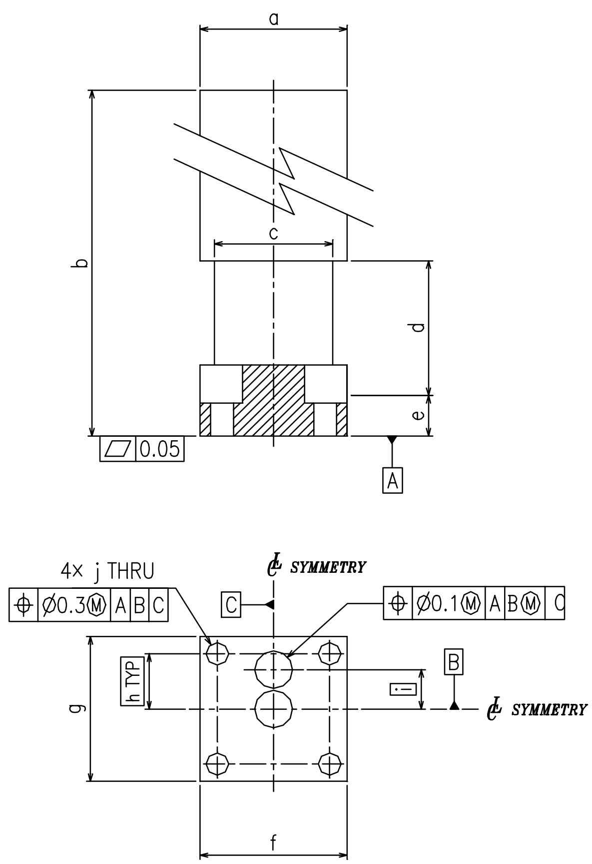
NOTE 2: The through hole of the sealing port will be elliptical if the through hole is drilled at an angle. In this case, the diameter shall apply to the major diameter of the ellipse.

6.2 *Material* — The material used to manufacture the base of the components shall comply to SEMI F20 with the exception that the sulfur content shall comply to SEMI E49.9.

NOTE 3: SEMI E49.9 was withdrawn. However, a ballot to combine E49.8 and E49.9 in one single standard was submitted for SEMICON West 2003.

6.3 *Burrs and Sharp Edges* — Unless specifically noted on the drawing, remove all burrs and sharp edges.

6.4 *Handles and Displays* — Rotating handles and removable displays shall stay within the maximum envelope of the base of the component with the exception of toggle and/or lockout/tagout valves at the discretion of the system designer. They shall be movable or removable such that they do not interfere with the access of the mounting fasteners from above.



a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
ϕ38.4 MAX	180 MAX	ϕ34 MAX	22 MIN	8.0 ± 0.2	38.15 ±1.15	38.15 ±1.15	15.1	7.75	ϕ5.6 ± 0.1

UNIT: [mm]

Figure 1
Dimensional Requirements for All Components

7 Related Documents

7.1 *ISO Standards*[2]

ISO 406 — Technical Drawings - Tolerancing of Linear and Angular Dimensions

ISO 1101 — Technical Drawings - Geometrical Tolerancing - Tolerancing of Form, Orientation, Location, and Run-Out - Generalities, Definitions, Symbols, and Indications on Drawings.

ISO 1660 — Technical Drawings - Dimensioning and Tolerancing of Profiles

ISO 2692 — Technical Drawings - Geometrical Tolerancing - Maximum Material Principle

ISO 6507 — Metallic Materials - Vickers Hardness Test

ISO 8015 — Technical Drawings - Fundamental Tolerancing Principles

2 ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Genevè 20, Switzerland. http://www.iso.ch

RELATED INFORMATION 1
EXAMPLES OF SEAL DESIGNS FOR 1.5 INCH TYPE SURFACE MOUNT COMPONENTS

NOTICE: This related information is not an official part of SEMI F94 and was derived from the work of the originating task force. This related information was approved for publication by full ballot procedures. Determination of the suitability of the material is solely the responsibility of the user.

R1-1 Design Example 1

R1-1.1 *Seal Design* — See Figure R1-1.

R1-1.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 170 Vickers. The hardness may be tested per ISO 6507.

R1-1.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.25 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-1.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

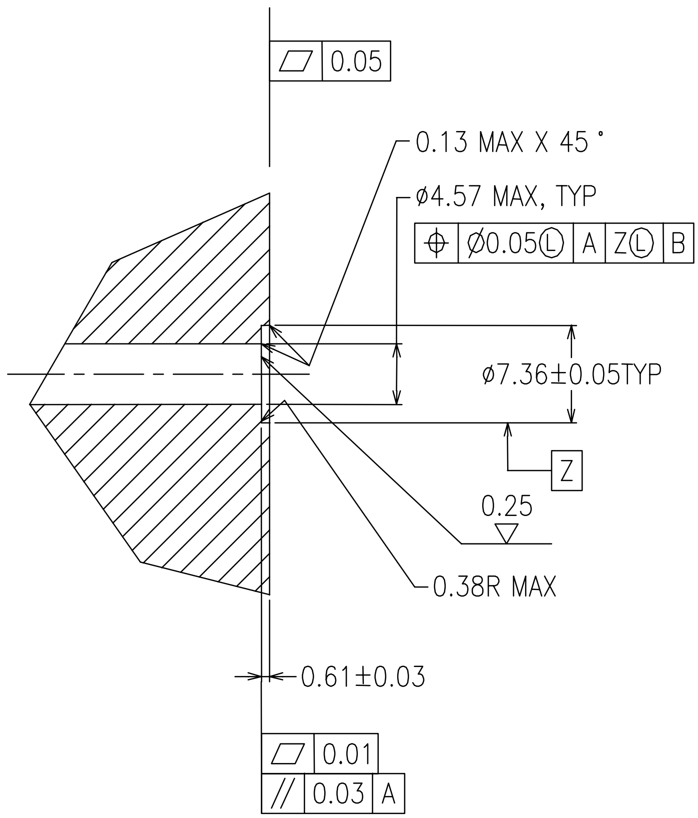


Figure R1-1
Design Example 1

R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

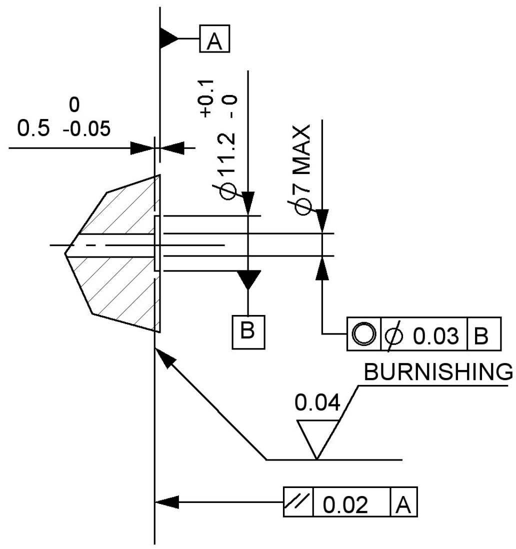


Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

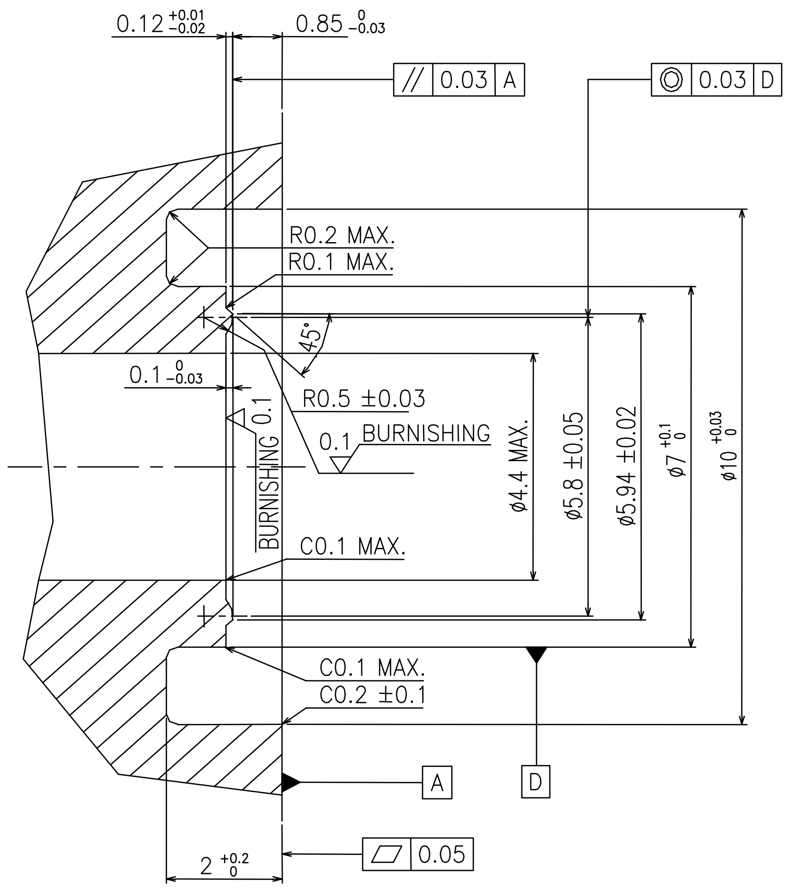


Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

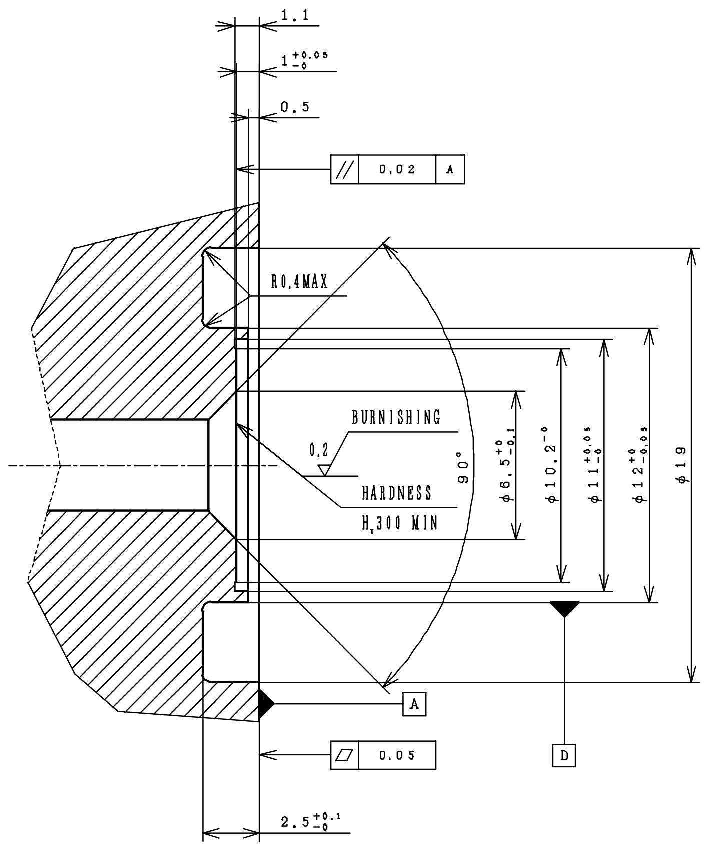


Figure R1-4
Design Example 4

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SEMI F95-0304^{E}
SPECIFICATION FOR DIMENSION OF THREE PORT COMPONENTS FOR 1.5 INCH FOUR FASTENER CONFIGURATION TYPE SURFACE MOUNT GAS DISTRIBUTION SYSTEMS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the Japanese Gases & Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on November 20, 2003. Initially available at www.semi.org February 2004; to be published March 2004.

E This document was modified in May 2004 with committee approval to correct an error made at the pre-ballot stage. Changes were made to Figure R1-2.

1 Purpose

1.1 This standard establishes the properties and physical of two port components for 1.5 inch type surface mount gas distribution systems.

2 Scope

2.1 This document includes common requirements, layout, size, detailed specifications, and dimensions of the components.

2.2 This standard applies to all three port four fastener components. The components (i.e. valves, pressure regulators, pressure transducers, filters and purifiers) are mounted on substrates with fasteners accessible from the top.

2.3 This standard only applies to components, which control flow of ≤ 50 slm nitrogen equivalent at 308 kPa (44.7 psia). This standard also only applies to components with operating pressures less than 3445 kPa (500 psia) at 20°C.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard only addresses the component; it does not address the seals, the sealing system, or the assembly process and does not guarantee the performance of the sealing system. The user should be aware that gas delivery system performance and sealing system performance are addressed elsewhere in the SEMI standards.

3.2 The user should be aware that alternative technologies are commercially available.

3.3 International, national, and local codes, regulations, and laws should be consulted to ensure that the equipment meets regulatory requirements in each location of use.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E49.9 — Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Extruded Shapes, Plate, and Investment Castings for Components Used in High Purity Semiconductor Manufacturing Applications

4.2 *ASME Standards*[1]

ASME Y14.5 — Dimensioning and Tolerancing

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Definitions*

5.1.1 *components for surface mount* — a gas distribution system component having inlets and outlets located on the bottom of the component with the attachment mechanism accessible from the top.

5.1.2 *four fastener configuration* — the component has four fasteners located on an interface, independent of number of sealing point.

5.1.3 *Ra* — roughness average. The arithmetic average of the absolute values of the measure profile height deviations taken within the sampling length and measured from the graphical centerline.

1 American Society of Mechanical Engineers. Three Park Avenue, New York, NY 10016-5990, USA. Telephone: 800.843.2763 (U.S./Canada), 95.800.843.2763 (Mexico), 973.882.1167 (outside North America). Website: www.asme.org

6 Common Requirements

6.1 *Dimensional Requirements* — All components shall meet the requirements outlined in Figure 1. All geometric dimensioning and tolerancing complies with ASME Y14.5 and/or the applicable ISO standard.

NOTE 1: All dimensions are in millimeters unless otherwise noted.

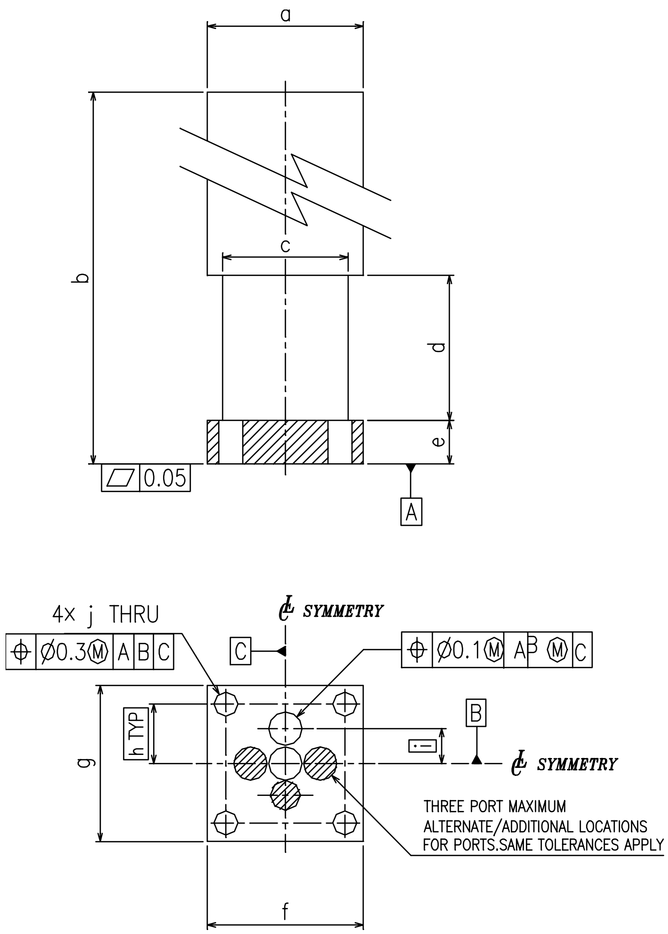
NOTE 2: The through hole of the sealing port will be elliptical if the through hole is drilled at an angle. In this case, the diameter shall apply to the major diameter of the ellipse.

6.2 *Material* — The material used to manufacture the base of the components shall comply to SEMI F20 with the exception that the sulfur content shall comply to SEMI E49.9.

NOTE 3: SEMI E49.9 was withdrawn. However, a ballot to combine E49.8 and E49.9 in one single standard was submitted for SEMICON West 2003.

6.3 *Burrs and Sharp Edges* — Unless specifically noted on the drawing, remove all burrs and sharp edges.

6.4 *Handles and Displays* — Rotating handles and removable displays shall stay within the maximum envelope of the base of the component with the exception of toggle and/or lockout/tagout valves at the discretion of the system designer. They shall be movable or removable such that they do not interfere with the access of the mounting fasteners from above.



a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
ϕ38.4 MAX	180 MAX	ϕ34 MAX	22 MIN	8.0 ± 0.2	38.15 ±1.15	38.15 ±1.15	15.1	7.75	ϕ5.6 ± 0.1

UNIT: [mm]

Figure 1
Dimensional Requirements for All Components

7 Related Documents

7.1 *ISO Standards*[2]

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2 ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Genevè 20, Switzerland. http://www.iso.ch

RELATED INFORMATION 1
EXAMPLES OF SEAL DESIGNS FOR 1.5 INCH TYPE SURFACE MOUNT COMPONENTS

NOTICE: This related information is not an official part of SEMI F95 and was derived from the work of the originating task force. This related information was approved for publication by full ballot procedures. Determination of the suitability of the material is solely the responsibility of the user.

R1-1 Design Example 1

R1-1.1 *Seal Design* — See Figure R1-1.

R1-1.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 170 Vickers. The hardness may be tested per ISO 6507.

R1-1.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.25 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-1.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

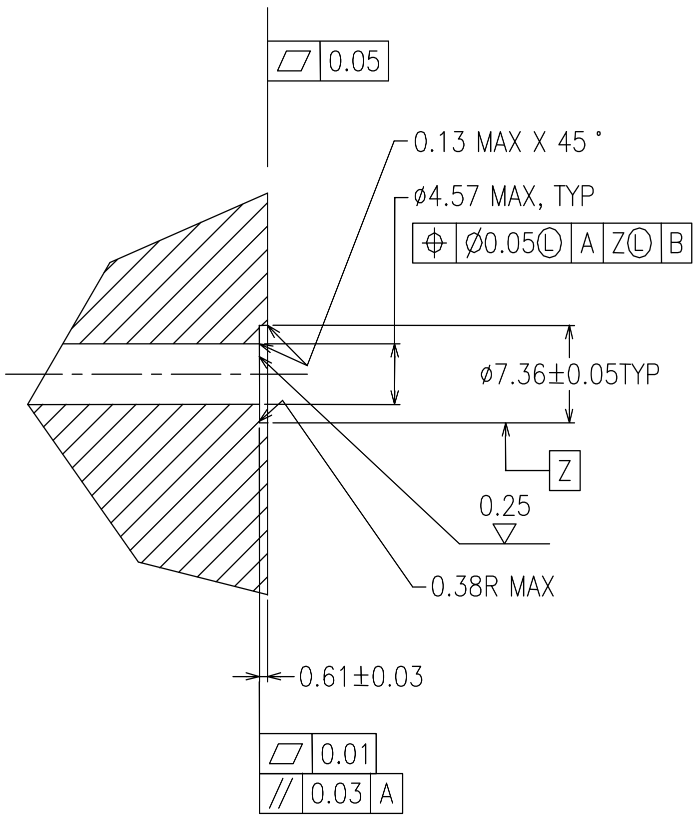

Figure R1-1
Design Example 1

R1-2 Design Example 2

R1-2.1 *Seal Design* — See Figure R1-2.

R1-2.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-2.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.04 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-2.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

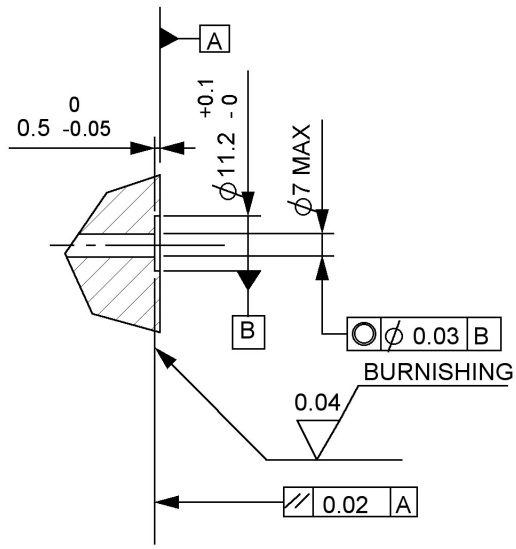

Figure R1-2
Design Example 2

R1-3 Design Example 3

R1-3.1 *Seal Design* — See Figure R1-3.

R1-3.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-3.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.1 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-3.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

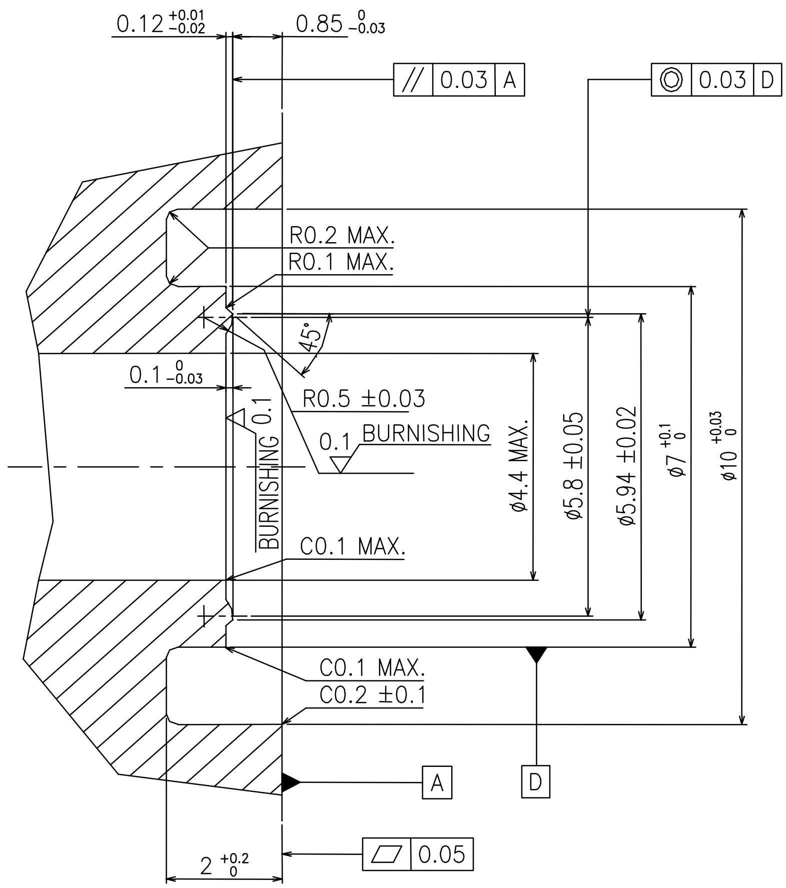

Figure R1-3
Design Example 3

R1-4 Design Example 4

R1-4.1 *Seal Design* — See Figure R1-4.

R1-4.2 *Surface Hardness* — The sealing surface (the bottom of the counterbore) has a minimum hardness of 300 Vickers. The hardness may be tested per ISO 6507.

R1-4.3 *Surface Roughness* — The sealing surface (the bottom of the counterbore) has a surface roughness of 0.2 micrometers Ra max. The surface roughness may be tested per SEMI F37-0299.

R1-4.4 *Surface Scratches* — The sealing surface (the bottom of the counterbore) is without any lateral scratches which are visible to non-magnified normal vision.

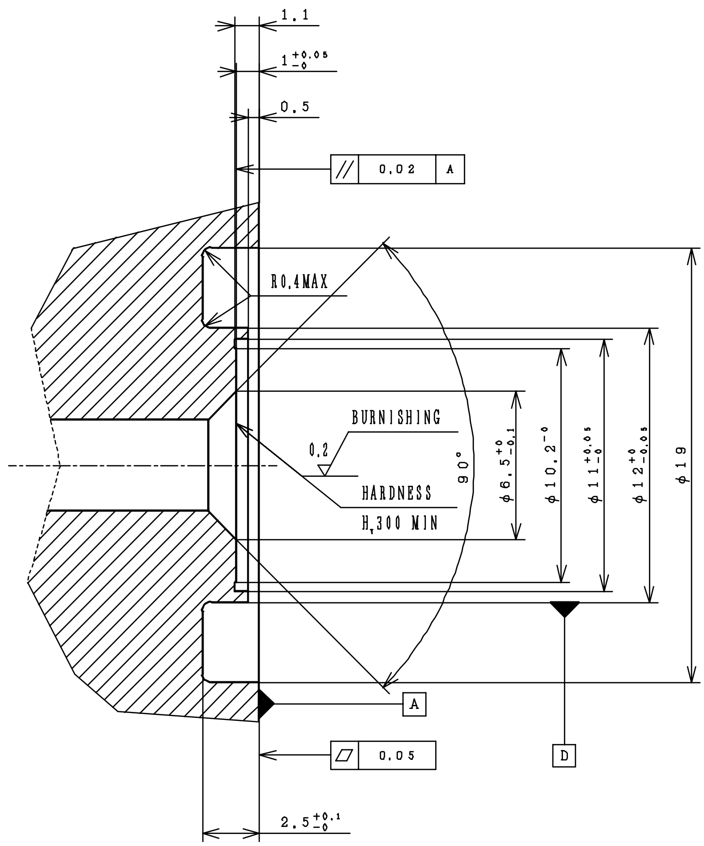

Figure R1-4
Design Example 4

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SEMI F96-0704
SPECIFICATION FOR PORT CONFIGURATION OF CANISTERS TO CONTAIN LIQUID CVD PRECURSORS

This specification was technically approved by the Global Gases Committee and is the direct responsibility of the North American Gases Committee. Current edition approved by the North American Regional Standards Committee on April 22, 2004. Initially available at www.semi.org June 2004; to be published July 2004.

1 Purpose

1.1 This document specifies the type, size and spacing of connectors to be used on metal (e.g. stainless steel) canisters for liquid chemical precursors, solutions and solvents.

2 Scope

2.1 This document applies to metal (e.g. stainless steel) canisters to be used for "liquid precursors" (see definition) including solutions of precursors in solvents. It also applies to containers for solvents used for in situ cleaning of delivery system.

2.2 The liquid connection ports (inlet and outlet) are included, as are pneumatic connections to valves.

2.3 Parameters such as overall canister dimensions are expected to be specified by other standards.

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

3 Referenced Standards

3.1 *SEMI Standard*

SEMI F66 — Specification for Port Marking and Symbol of Stainless Steel Vessels for Liquid Chemicals

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

4.1.1 *canister* — a metal (usually stainless steel) container in which a liquid precursor is supplied. Canisters are also known as "ampoules", "shuttle drums", " tanks", etc.

4.1.2 *liquid precursor* — a liquid precursor is a chemical supplied as a liquid and used in Chemical Vapor Deposition (CVD). Many liquid precursors are toxic, reactive and air-sensitive.

5 Ports

5.1 A canister has a gas inlet port and a liquid outlet port. The outlet port is equipped with a dip-tube, marked according to SEMI F66. Note that a canister may be used as a bubbler, by using the dip-tube port as the gas inlet. In this standard however, liquid delivery is assumed and the dip-tube port will be referred to as the "outlet".

5.2 Canisters up to 100 liters in volume:

5.2.1 The ports will be located with the dip tube at the 3 o'clock position and the gas inlet at the 9 o'clock position, as illustrated in Figure 1.

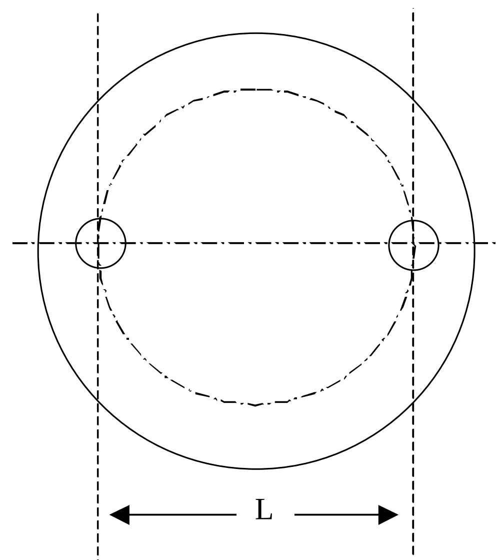

Figure 1
Port Configuration

5.2.2 Both ports shall be fitted with ¼" O.D. face-seal connectors.

5.2.3 The port separation (L in the Figure) shall be 76 mm or 146 mm, + /- 4 mm, the value to be chosen according to the diameter of the canister.

5.3 For canisters greater than 100 liters in volume, the outlet port shall be in the center, the port separation 152 + /- 4 mm, and the port connections ½" O.D. face-seal.

5.4 The connector shall be male on the gas inlet port and female on the dip tube port.

5.5 The height difference between the tops of the ports will be no more than 0.5 mm.

5.6 Additional ports may be provided so long as they do not interfere with the above specifications.

NOTE 1: The user of this standard should evaluate the consequences of connecting a given precursor to a point intended for other precursors. The nature of the precursor itself and of the other precursors expected to be in use at the same location should be taken into account. Consider packaging precursors with a non-standard connector on the canister outlet if necessary to avoid a dangerous situation.

6 Valves

6.1 The inlet and outlet port are each provided with a valve but the details of those valves are not specified here. If pneumatic valves are provided, the pneumatic connection shall be a 1/8" quick-connect type.

SEMI F97-0305
SPECIFICATION FOR FACILITY PACKAGE INTEGRATION, MONITORING AND CONTROL

This specification was technically approved by the Global Facilities Committee and is the direct responsibility of the European Global Facilities Committee. Current edition approved by the European Regional Standards Committee on November 10, 2004. Initially available at www.semi.org January 2005; to be published March 2005.

1 Purpose

1.1 The purpose of this specification is to provide the requirements for the architecture, functionality and interfaces for Facility Monitoring and Control Systems and the various Facility Package Units to enable a standardized and integrated communication between them. This specification is appended with related information to provide application examples.

1.2 *Background and Motivation*

1.2.1 Today, the suppliers of Facility Package Units (e.g., chemicals, power supply, gases, HVAC) are often using individual communication concepts. This leads to high efforts to specify the communication structures between Facility Package Units (FPU) and the Facility Monitoring and Control Systems (FMCS), to evaluate the quoted solutions and to eventually integrate these units. These individual, not standardized concepts today are not reusable, bear risks in execution and lead to high maintenance costs.

1.2.2 This specification is a first step to standardize the communication between facility and monitoring components. Therefore, it focuses in its scope to a small set of requirements which are common to all FPUs. As this communication concept is adopted by the various FPU suppliers and their customers, more specific standards describing particular FPUs and their services may evolve.

1.3 Who and what is addressed by this standard.

1.3.1 A standardization of the communication concept between FMCS and FPUs will support Facility Package Unit manufacturers, general contractors, system integrators, purchasers, and control system manufacturers. It will lead to substantially reduced costs, more reliable execution times, and optimized maintenance concepts.

2 Scope

2.1 This standard specifies the requirements for the architecture, common services, data, and its semantic meaning to integrate the FPUs into the FMCS. For this purpose, a basic set of common services (operations) between the FMCS and the FPUs are specified to exchange FPU status information and data. In addition, the state models for FPUs are described.

2.2 *Out of scope for this standard are:*

- Services of FMCS provided to interface to Manufacturing Execution Systems or Enterprise Resource Planning Systems,
- Specification of functionality of particular FMCS functions (graphical user interface (GUI), data archives, reporting archives, alarm handling, etc.), and
- The specification of the interface between FPU control level and FPU field level.

2.3 *Applicability* — This standard applies to the field of facility management and is targeted for FPU suppliers and FMCS suppliers for systems integration, engineering and commissioning as well as the operation of such systems by the purchasers.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard focuses on the semantic definition of data exchanged between FMCS and FPUs. It is not intended to specify the protocols to be used for data being exchanged.

3.2 The standard does not focus on any specific hardware or software products to be used.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E6 — Guide for Semiconductor Equipment Installation Documentation

SEMI E30 — Generic Model for Communications and Control of Manufacturing Equipment (GEM)

SEMI E54 — Sensor Actuator Network Standards Series

4.2 *Other Standards*

4.2.1 OPC — *Data Access Automation Interface Standard, Version 2.0, OPC Foundation 1998, available from* http://www.opcfoundation.com/

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *CPU* — Central Processing Unit

5.1.2 *ERP* — Enterprise Resource Planning

5.1.3 *FMCS* — Facility Monitoring and Control System

5.1.4 *FPU* — Facility Package Unit

5.1.5 *GUI* — Graphical User Interface

5.1.6 *HVAC* — Heating Ventilation and Air Conditioning

5.1.7 *I/0* — Input/Output Device

5.1.8 *IT System* — Information System

5.1.9 *MES* — Manufacturing Execution System

5.1.10 *OLE* — Object Linking and Embedding

5.1.11 *OP-Mode* — Operating Mode

5.1.12 *OPC* — OLE for Process Control[1]

5.1.13 *PLC* — Programmable Logic Controller

5.1.14 *UPW* — Ultra Pure Water

5.2 *Definitions*

5.2.1 *alarm&event history* — functionality inside a FMCS to store alarms and events in a persistent storage (e.g. a database). Focus is to later retrieve alarms and events for investigation purposes.

5.2.2 *Client/Server-System* — a system consisting of two different sub systems: a server system which provides services and client systems which access these services.

5.2.3 *communication interface* — interface of an IT system to communicate with other IT systems. Usually the communication takes place via a network.

1 For OPC and OPC Foundation see OPC Foundation (http://www.opcfoundation.com/).

5.2.4 *data cache* — unit within an IT system or FMCS being responsible for buffering data usually with the focus of performance optimization.

5.2.5 *facility monitoring and control system (FMCS)* — IT System consisting of software and hardware components that are used to monitor and control all FPUs as described in §2 . Typically a FMCS is implemented using a PC based architecture. A FMCS in general consists of the following sub components:

- Software modules to monitor and control the FPU,
- Software module to cover alarm&event history,
- Report archive to store reports persistently,
- Data archive to store monitored data persistently,
- Human interface to provide access for human users to FMCS functionality, and
- Communication infrastructure to connect to the different FPUs and to external systems (e.g. Manufacturing Execution System, Enterprise Resource Planning System).

5.2.6 *facility system* — describes an overall architecture in the context of facility monitoring and control. A Facility System typically consists of 4 layers as described in §2.

5.2.7 *FPU Control Level* — describes a unit to monitor and/or control a certain piece of facility infrastructure. A FPU owns a well defined interface that enables external IT systems to monitor (and control) activities running on the specific FPU.

5.2.8 *FPU Field Level* — describes a unit of a FPU, such as sensors, actuators, aggregates or even an own subcontrol level to control a certain piece of facility infrastructure in order to support all the necessary functions of the FPU at the control level.

5.2.9 *integration* — covers the interconnection of FMCS and FPUs by Engineering and Commissioning with respect to communication. It does not cover the Engineering and Commissioning of the FPUs themselves.

5.2.10 *network* — general term for a bus technology which includes field bus technology or local area networks.

5.2.11 *programmable logic controller (PLC)* — a system consisting of software and hardware usually to fulfill monitor and control tasks. Typically a PLC comprises the following components:

- *rack* — accommodates the modules and connects them to each other;
- *power supply* — provides the internal supply voltages;
- *central processing unit (CPU)* — stores and processes the user program;
- *signal modules* — adapt the signals from the system to the internal signal level or control actuators via digital and analog signals;
- *function modules* — execute complex or time-critical processes independently of the CPU; and
- *communication processors* — interface the programmable controllers to each other or to other devices via a network.

5.2.11.1 A PLC may consist of several racks which are linked to one another via bus cables or may all be self contained.

5.2.12 *Tag* — is a unique identifier within a FMCS to access information in a FPU. Assigned to each unique Tag is the data necessary to select the access to a particular FPU on the Network and to access the particular information within that FPU.

6 Overview

6.1.1 A facility system within this standard is described by four levels (see Figure 1).

- ERP/MES Level: consists of systems within the Enterprise Resource Planning and Manufacturing Execution System,

- FMCS Level: consists of the FMCS,
- FPU Control Level: consists of the FPU that are monitored and controlled by the FMCS, and
- FPU Field Level: consists of the hardware components to monitor and control the FPUs. A subcontrol level within the level of the FPU may or may not be present depending on the complexity of the functions to be performed.

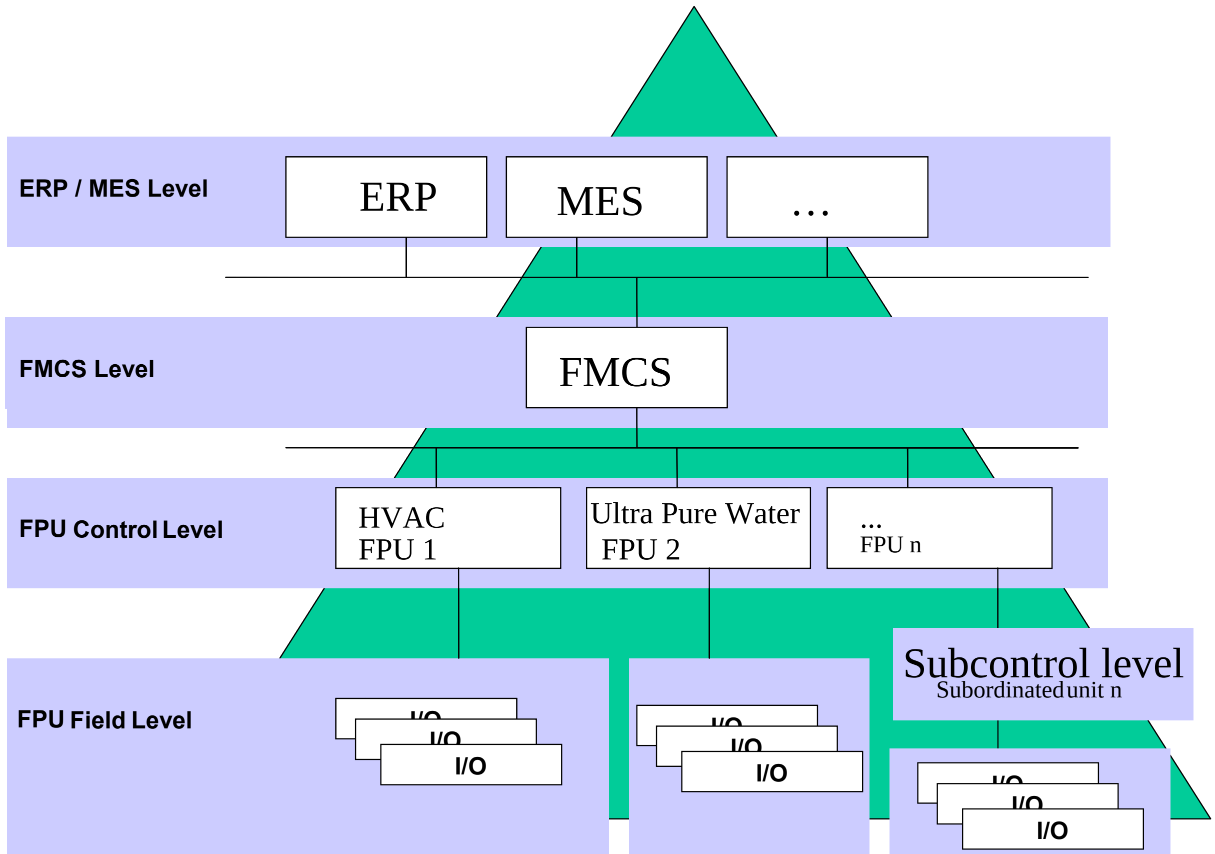

Figure 1
Facility System

6.1.2 Figure 2 depicts typical examples of Facility Package Units.

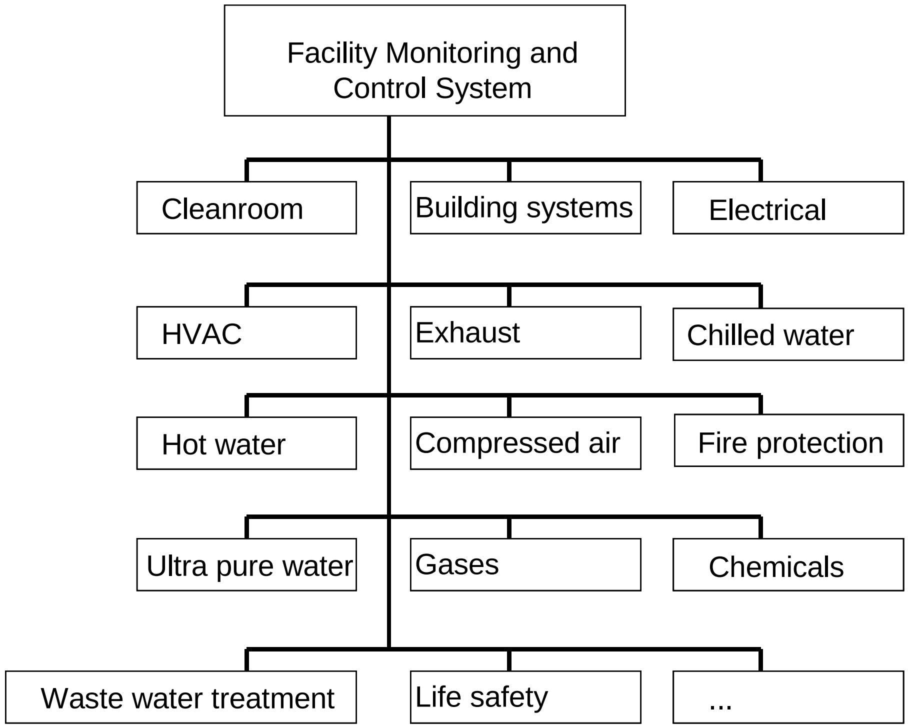

Figure 2
Typical Examples of Facility Package Units

6.1.2.1 Description of Figure 2.

- *Building systems* — facility installation concerning the building, e.g. lighting.
- *Chemicals* — facility installation for the supply of chemicals, e.g. for process tools.
- *Chilled water system* — facility installation for the supply of cold water, e.g. for air condition or process tools.
- *Cleanroom* — production area with clean conditions and specifications concerning air condition.
- *Compressed air* — facility installation for the supply of compressed air.
- *Electrical* — facility installation for the electrical power supply.
- *Exhaust* — facility installation for the disposal of gases and contaminated air.
- *Fire protection* — facility installation for fire protection, e.g. for fire and smoke detection.
- *Gases* — facility installation for the supply of bulk or special gases, e.g. for process tools.
- *Hot water* — facility installation for the supply of hot water, e.g. for radiators, air condition or process tools.
- *HVAC* — facility installation for heating, ventilation and air conditioning.
- *Life safety* — facility installation for life safety and security, e.g. for detection of leakages of gases.
- *Ultra pure water* — facility installation for the supply of ultra pure water, e.g. for process tools.
- *Waste water treatment* — facility installation for the treatment of waste water.

7 Ordering Information

7.1 When integrating FPUs into a FMCS, suppliers and purchasers have to agree on details on how the integration will be performed. This includes a number of items such as the information to be exchanged between FMCS and FPUs, the communication protocol to be used[2], or details of the available FPU subcontrol level. Other parties such as fab planners or system integrators may be involved in this information exchange. Related Information 2 provides a template for the ordering information and examples for its use.

8 Conventions

8.1 This standard follows the conventions for state model methodology and service definitions as defined by other SEMI standards supplemented by specific extensions. The conventions used in this standard are described in the following paragraphs.

8.2 *State Model Methodology*

8.2.1 This document uses the state model methodology as defined within SEMI E30 to describe the behavior of FPUs. A state model is comprised of the following elements:

- definitions of each state and sub state,
- a diagram of the states and the transition between states, and
- a state transition table.

8.2.2 The diagram of the state model uses the Harel State Chart notation[3].

8.3 *Notion of Alarm-Mode, Warning-Mode, Error-Mode* — Signifies the importance of the situation that occurred at the FPU to draw attention at the FMCS. Error-Mode is generally used to signify an error. This error may be persistent for some time until the error situation is corrected. Warning-Mode may be used to signal a higher awareness that is to be raised at the FMCS. Again, attention may be needed to correct the problem. Alarm-Mode signals the highest awareness required and may again need some attention for correction. The use of which mode is used when and where is intentionally left to the agreement between the purchaser and the supplier. It is recommended to use always the same philosophy for use of these three modes for the entire facility when possible.

8.4 *Transition Tables*

8.4.1 Transition Tables are provided in conjunction with the state diagrams to explicitly describe the nature of each state transition. A transition table contains columns for transition number, previous state, trigger, new state, actions and a remark. The trigger for the transition occurs while in the previous state. The actions include a combination of actions taken upon exit of the previous state and actions taken upon entry into the new state.

Number	*Previous State*	*Trigger*	*New State*	*Actions*	*Remark*

8.5 *Operation Representation*

8.5.1 Operations are used to describe interfaces between different resources (e.g. interfaces between FMCS and FPUs). An operation definition table defines the specific set of operations for a specific resource as shown in the following table:

Operation	*Description*

8.5.2 *Operation* — Defines the operation name. The operation name has to be unique for each given resource.

8.5.3 *Description* — Gives a short comprehensive description of the operation with regard to functionality.

2 As an example, OPC Data Access combined with the agreed communications protocol may be used for interconnecting FMCS and FPUs.

3 Harel, D., "Statecharts: A Visual Formalism for Complex Systems", Science of Computer Programming 8 (1987), p. 231-274

8.6 *Parameter Definitions*

8.6.1 When calling an operation, parameters can be passed and returned. Parameters to be passed and returned depend upon the operation that is called. By using a parameter definition table the parameters passed and returned by an operation are defined.

Parameter	*Description*	*Direction*	*Data Type*

8.6.2 *Parameter* — Within the parameter column the name of the specific parameter is given.

8.6.3 *Description* — Contains a description of a parameter.

8.6.4 *Direction* — Defines the direction:

- FMCS -> FPU: originated by FMCS and received by FPU
- FPU -> FMCS: originated by FPU and received by FMCS

8.6.5 *Data Type* — Defines the format of a parameter.

8.7 *Field Definitions*

8.7.1 A parameter can consist of different fields that define the contents of a parameter. A field definition table defines the format of the fields maintained within a specific parameter.

Field	*Bit*	*Meaning*	*Mandatory/optional*

8.7.2 *Field* — A parameter can consist of different fields representing the contents of a parameter. Within the field column the name of the specific field is given.

8.7.3 *Bit* — In case a field is stored within a bitwise-formatted parameter, the bit column defines the bit number or bit range where the field value is stored.

8.7.4 *Meaning* — Defines the meaning of the one or several field values.

8.7.5 *Mandatory/Optional* — Defines if setting the value of a field is either mandatory or optional.

9 Requirements

9.1 *Interconnection between FMCS and FPUs*

9.1.1 The interconnection between the FMCS and the FPUs may be made by any type of bus system specified by SEMI (e.g. SEMI E54 series) as well as industrial ethernet based networks. It is the purpose of this standard:

- to specify the semantics of the services that are exchanged between the FMCS and the FPUs, and
- to model the status information of the state machines that are maintained by the FPUs.

9.1.2 As introduced in §7, state models are used to represent the current state of a FPU. The FMCS may use this state information in order to display the state of all FPUs. In addition, the FMCS may decide based on the state of a FPU whether remote operations on a FPU are advisable or not.

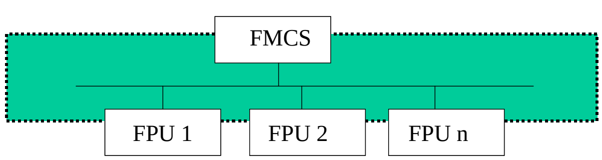

Figure 3
Interconnection Between FMCS and FPUs

9.2 *FPU Requirements*

9.2.1 The FPU shall be able to run without a FMCS and shall communicate a minimal amount of status information to FMCS via the network as described in the next section.

9.3 *FMCS Requirements*

9.3.1 The FMCS shall be able to support the interface to the FPU and to make the information of this interface available through the Data Cache of the FMCS. The FMCS shall be able to either monitor and/or control the FPU depending on the application.

9.4 *State Models of Facility Package Unit*

9.4.1 State Models are used to describe the status of the FPU. For the definition of the status models see §8. In the following all status values are specified together with their transitions.

9.4.2 *Watchdog-Toggle*

9.4.2.1 The Watchdog-toggle shall be used to signal that a FPU still is capable to perform its processing function and is able to notify this to the FMCS. As long as the toggle mechanism alternates between “on” and “off” the processing function of the FPU is assumed to be functional. The processing function is assumed to be a programmed function, e.g. for a PLC. The toggle mechanism shall be linked into the processing function of the FPU so that if the processing function stops, the toggle mechanism will stop as well. Watchdog-toggle represents a variable that toggles its value between “0” and “1” within a specified time window. The maximum required cycle time shall not exceed one minute. The Watchdog-toggle is used to realize a “life-beat monitoring function”.

9.4.2.2 The Watchdog-toggle is always required except

- in the case that the underlying communication system of the FPU and the FMCS already provides an integrated life-beat function, or
- the FPU is a very simple device which does not provide any processing function (e.g., a valve, electrical engine or heater).

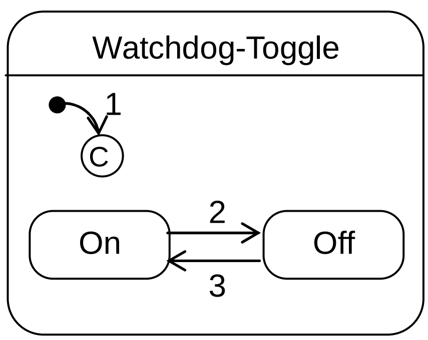

Figure 4
State Transition Diagram Watchdog-Toggle

Table 1 State Transition for Watchdog-Toggle

Number	*Previous State*	*Trigger*	*New State*	*Actions*	*Remark*
1	(no state)	Start up of FPU.	On or Off	Timer is set to expire for the next time period.	Dependent on Implementation.
2	On	Timer expired.	Off	Timer is set to expire for the next time period.	
3	Off	Timer expired.	On	Timer is set to expire for the next time period.	

9.4.3 *OP-Mode*

9.4.3.1 OP-Mode specifies the operation mode of the FPU. It can assume two values: Manual and Automatic. The behavior of the FPU with respect to the states Manual and Automatic is out of scope.

- **Manual**: FPU operates in manual mode.
- **Automatic**: FPU operates in automatic mode.

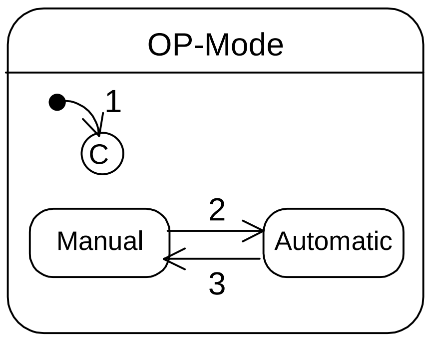

Figure 5
State Transition Diagram OP-Mode

Table 2 State Transition Table for OP-Mode

Number	*Previous State*	*Trigger*	*New State*	*Actions*	*Remark*
1	(no state)	Start up of FPU.	Manual or Automatic	None.	Dependent on type of FPU.
2	Manual	Trigger to switch to Automatic.	Automatic	FPU performs its automatic functions.	Trigger may be caused by: manual operator action or automatic trigger by a programmed logic.
3	Automatic	Trigger to switch to Manual.	Manual	FPU stops its automatic functions.	Trigger may be caused by: manual operator action or automatic trigger by a programmed logic.

9.4.4 *Control-Mode*

9.4.4.1 Control-Mode specifies the control mode of the FPU with respect to the FMCS. It may assume two values: Local and Remote. The behavior of the FPU with respect to the states Local and Remote is out of scope. It is dependent on the type of FPU. Control Mode is intended to be used by the FMCS to identify whether a remote operation of the FPU is enabled or disabled – by this the FMCS can allow or disallow operator actions on the FMCS with respect to that particular FPU. On the FPU this control mode may be used to enable or disable remote control of the FMCS.

- **Local**: FPU operates in local mode, i.e. it can be controlled locally.
- **Remote**: FPU operates in remote mode, i.e. it can be remotely controlled by the FMCS.

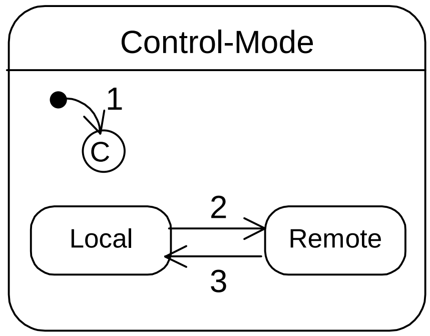

Figure 6
State Transition Diagram Control-Mode

Table 3 State Transition Table Control-Mode

Number	*Previous State*	*Trigger*	*New State*	*Actions*	*Remark*
1	(no state)	Start up of FPU.	Local or Remote	FPU disables remote control from FMCS.	Dependent on type of FPU.
2	Local	Trigger to switch to Remote.	Remote	FPU enables remote control from FMCS.	Trigger may be caused by: manual operator action or automatic trigger by a programmed logic.
3	Remote	Trigger to switch to Local.	Local	FPU disables remote control from FMCS.	Trigger may be caused by: manual operator action or automatic trigger by a programmed logic.

9.4.5 *Run-Mode*

9.4.5.1 Run-Mode specifies the different running states of the FPU. It assumes three main values: Down, in Stand-by or Run. The behavior of the FPU with respect to the states of Run-Mode is out of scope. It is dependent on the type of FPU. The Annex to this Standard (see Related Information 1) provides some examples of the use of Run-Mode. The Run-Mode provides general information of the FPU, whether it is Down, in Stand-by or in Run:

- **Down** (the FPU is in a fault situation or it may be switched into Down by a pre scheduled function; this is specified by an optional flag):
    - o flag set for **scheduled down**
    - o flag set for **unscheduled down**
- **Stand-by** (the FPU is ready to be switched into Run).
- **Run** (the FPU is running).

9.4.5.2 The FPU should assume optionally sub states when in Run or Stand-by. These sub states are:

- **Run**: sub state **Locked** (the FPU is locked to hold the Run state) or **Not_Locked** and
- **Stand-by**: sub state **Locked** (the FPU is locked to hold the Stand-by state) or **Not_Locked.**