SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a front opening wafer container portion with a door frame defining an open side and a door to latch to the door frame and close the open side, one of the door and door frame having a groove extending around a periphery of said one with a seal installed in said groove, the seal engageable with the other of the door and door frame for sealing the door to the container portion, the seal having a pedestal portion seated in the bottom of the groove, a core portion extending from the pedestal to a top of the seal, a plurality of opposing pairs of projections for engaging opposing sidewalls of the groove extending from the core portion, at least one pair sized to be larger than the groove at a position corresponding to the at least one pair of projections whereby the projections are angled upwardly and inhibit removal of the seal from the groove.

According to the second aspect of the present invention, there is provided a front opening wafer container for holding large diameter wafers of at least 300 mm, the wafer container comprising a container portion with an open front defined by a door frame, a door for sealing latching to the container portion in the door frame, the door having a groove for receiving a seal extending around a periphery of the door with a seal therein, the seal having at least five distinct and separate regions of contact with the door in the door seal.

According to the third aspect of the present invention, there is provided a sealable container for holding a plurality of wafers, the container comprising: a container portion having a top, a bottom, a left side, and a right side defining an interior space for receiving the wafers, the container portion having opposing shelves in the interior adjacent the left and right sides, the container portion having a kinematic coupling positioned at the bottom of the container portion, the container portion having an open side defined by a door frame, the door frame adjoining the top, the bottom, the left side and the right side and presenting a frame periphery with a corner sealing portion, the corner sealing portion comprising a forward facing planar surface and an inwardly facing surface extending rearwardly from the forward facing planar surface and defining a corner; a door receivable in the door frame to sealingly close the open side of the container portion, the door having an interior side and presenting a door periphery with a groove extending inwardly into the door adjacent the door periphery, the groove facing the interior of the container portion when the door is fitted in the door frame, wherein the groove is configured as a channel and is defined by a bottom seating surface, two opposing side surfaces, and an upper ledge portion with the upper ledge portion adjoining one of the two opposing sides at a corner; and an elastomeric seal disposed on the interior side of the door around and inward of the door

periphery, the seal sized to be retained in the groove, the elastomeric seal in cross section having a central core portion, the central core portion extending from the bottom of the seal to the top of the seal, the seal having a bottom pedestal portion positioned at the bottom of the central core portion, a pair of opposing tangs protruding laterally outwardly from the central core portion, the tangs sized with respect to the groove to be deflected upwardly when the seal is inserted into the groove whereby the tangs compressively grip the side walls and provide a resistive force opposing removal of the seal from the groove, a first and a second laterally protruding upper groove engaging projections, the first groove engaging projection engaging a side surface of the groove and the second groove engaging portion having a notch portion and engaging the opposing side surface of the groove and the upper ledge at said notch portion, the first groove engaging projection, the second groove engaging portion, and the central core positioned intermediate the first and second groove engaging portions being laterally compressed between the two opposing side surfaces of the groove, the seal further comprising a finger member extending obliquely and laterally from the central core portion and positioned above the upper ledge; wherein when the door is received in the door frame closing the open front of the container portion, the corner sealing portion engages the finger member extending obliquely to deflect said finger member downwardly and further engages the top of the seal at the core portion; wherein the groove is configured as a channel and is defined by a bottom seating surface, two opposing side surfaces, and an upper ledge portion with the upper ledge portion adjoining one of the two opposing sides at a corner.

According to a fourth aspect of the present invention, there is provided a seal for a wafer container, the seal configured as a loop and, in cross section, comprising a pedestal portion for seating in the bottom of a groove, a core portion extending from the pedestal portion, the core portion having an inward side and an outward side, a plurality of projections extending from the inward side, a plurality of projections extending from the outward side, the seal formed of an elastomeric material and all portions thereof being unitary.

According to a fifth aspect of the present invention, there is provided a seal for a wafer container, the seal configured as a loop with four segment portions jointed by four corner portions, and, in cross section, comprising a base portion for seating in the bottom of a groove, a core portion extending from the pedestal portion, the core portion having an inward side and an outward side, a plurality of projections extending from the inward side, a plurality of projections extending from the outward side, the seal formed of an elastomeric material and all portions thereof being unitary.

~~The~~Embodiments of the present invention addresses the need of the industry for a better performing and longer lasting seal structure for a wafer container by providing an elastomeric seal that has enhanced sealing capabilities with respect separating the interior and exterior of the container, enhanced retention of the seal in the groove characteristics, and enhanced sealing of the groove by the seal to preclude leakage through the seal-groove engagement and to minimize or eliminate water from entering the groove during washing.

In accordance with an embodiment the invention, a wafer container includes a container portion with a door frame defining an opening for insertion and removal of wafers in an axial direction and a door insertable into, in an axial direction, and fittable within, the door frame to close the open front and seal the container portion. In an embodiment of the invention, a continuous elastomeric seal extends around the door inward of the periphery. The seal is positioned in a retaining groove extending in an axial direction proximate the perimeter of the door.

A feature and advantage of embodiments of the invention is that a plurality of lateral projections extend from each side, the inner side and the outer side, of a central core portion for engaging the opposing sides of the groove, the inward side and the outward side. It is understood that the features described and claimed herein are typically referencing the features such as they appear in the cross sectional views, it is apparent that the features extend continuously around the continuous seal. For example, a thin projection from a core portion that extends all the way around seal may be described and claimed as a "finger" referencing its appearance on the cross sectional views. The core with the projections, as compared to a singular body portion with no projections, is easily inserted into the groove as the lateral projections, a pedestal and the tangs, may readily deflect and compress to reduce the effective width of the seal during insertion and then resist removal of the seal, particularly by the tangs which may be slightly upwardly angled. Removal requires the tangs to compress and then invert to a slightly downward angle for removal which requires more force than the insertion force. Moreover, the first and second projections provide lateral sealing to preclude or minimize water from entering the groove during washing. This allows washing of the door without removal of the seal providing an advantage over conventional, particularly radially installed seals.

Alternatively, the frame can be dimensioned such that when the door is seated, the bridging portion of the elastomeric seal is compressed interstitially between the sealing surface of the door and the sealing surface of the door frame.

A feature and advantage of embodiments of the invention is ease of installation and removal. The install is a simple press fit "axial" install and does not involve deforming the gasket as is necessary in a "radial" install.

A feature and advantage of embodiments of the invention is that the non-symmetrical design provides a fail-safe installation as there is only one way that the seal will fit the groove.

A feature and advantage of embodiments of the invention is that enhanced sealing is provided without excessive closing pressures. A C-shaped portion is at the top of the seal and provides effective sealing with minimal compressive force. The upper leg of the C sealingly engaging the door frame and the lower leg engaged with a shoulder of a wall defining the seal groove.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a wafer container in accord with the invention.

Figure 2 is a perspective view of the door of the wafer container of Fig. 1 showing the inside facing surface of the door and the seal.

Figure 3 is a cross sectional view of the installation of a seal in accord with the invention.

Figure 4 is a cross sectional view of the install as commenced in Fig. 3 with the seal seated in the seal retaining groove.

Figure 5 is a cross sectional detail view of the seal on the door and the door frame before insertion and seating of the door in the door frame.

Figure 6 is a cross sectional detail view of the door and door frame of Fig. 5 in a fully seated position corresponding to the door latched onto the container portion.

CLAIMS

1. A ~~substrate container having a~~ front opening wafer container portion with a door frame defining an open side and a door to latch to the door frame and close the open side, one of the door and door frame having a groove extending around a periphery of said one with a seal installed in said groove, the seal engageable with the other of the door and door frame for sealing the door to the container portion, the seal having a pedestal portion seated in the bottom of the groove, a core portion extending from the pedestal to a top of the seal, a plurality of opposing pairs of projections for engaging opposing sidewalls of the groove extending from the core portion, at least one pair sized to be larger than the groove at a position corresponding to the at least one pair of projections whereby the projections are angled upwardly and inhibit removal of the seal from the groove.

2. A front opening wafer container comprising a container portion and a door, one of the container portion and the door having a radially installed seal with a plurality of opposing lateral projections that deflect from a normal position in a direction away from an install direction when the seal is installed in a groove, the lateral projections resisting removal of the seal after the seal is seated in the groove.

3. The front opening wafer container of claim 1 or 2 wherein the opposing projections are configured to require compression and an inversion to a deflection in a direction toward the install direction in order to remove the seal from the groove.

4. The front opening wafer container of any of the above claims wherein the seal has a pedestal portion that seats in the bottom of the groove and the groove has side wall surfaces that are tapered toward said bottom.

5. The front opening wafer container of claim 1 or 2 wherein the seal is in the door and has a C-shaped portion that engages the door frame.

6. A front opening wafer container for holding large diameter wafers of at least 300 mm, the wafer container comprising a container portion with an open front defined by a door frame, a door for sealing latching to the container portion in the door frame, the door having a groove for receiving a seal extending around a periphery of the door with a seal therein, the seal having at least five distinct and separate regions of contact with the door in the door seal.

an elastomeric seal disposed on the interior side of the door around and inward of the door periphery, the seal sized to be retained in the groove, the elastomeric seal in cross section having a central core portion, the central core portion extending from the bottom of the seal to the top of the seal, the seal having a bottom pedestal portion positioned at the bottom of the central core portion, a pair of opposing tangs protruding laterally outwardly from the central core portion, the tangs sized with respect to the groove to be deflected upwardly when the seal is inserted into the groove whereby the tangs compressively grip the side walls and provide a resistive force opposing removal of the seal from the groove, a first and a second laterally protruding upper groove engaging projections, the first groove engaging projection engaging a side surface of the groove and the second groove engaging portion having a notch portion and engaging the opposing side surface of the groove and the upper ledge at said notch portion, the first groove engaging projection, the second groove engaging portion, and the central core positioned intermediate the first and second groove engaging portions being laterally compressed between the two opposing side surfaces of the groove, the seal further comprising a finger member extending obliquely and laterally from the central core portion and positioned above the upper ledge;

wherein when the door is received in the door frame closing the open front of the container portion, the corner sealing portion engages the finger member extending obliquely to deflect said finger member downwardly and further engages the top of the seal at the core portion.

wherein the groove is configured as a channel and is defined by a bottom seating surface, two opposing side surfaces, and an upper ledge portion with the upper ledge portion adjoining one of the two opposing sides at a corner.

13. A method of installing a seal in a groove in a door for a large diameter wafer container, the method comprising, inserting the seal with lateral tangs that deflect in a direction away from the insertion direction and that engage sidewall defining the groove thereby releasably locking the seal in the groove.

14. A seal for a wafer container, the seal configured as a loop and, in cross section, comprising a pedestal portion for seating in the bottom of a groove, a core portion ~~extend from the core~~ extending from the pedestal portion, the core portion having an inward side and an outward side, a plurality of projections extending from the inward side, a plurality of projections

extending from the outward side, the seal formed of an elastomeric material and all portions thereof being unitary.

15. The seal of claim 14 wherein two projections extending from the outward side comprise a C-shaped portion with an upper leg for sealingly engaging a door frame.

16. The seal of claim 14, wherein the inward side of the core has three inwardly extending projections, including the pedestal portion.

17. The seal of claim 14, wherein the inward side of the core has four inwardly extending projections, including the pedestal portion.

18. The seal of any one of claims 14 through 17 wherein the outward side of the core has three projections including the pedestal.

19. The seal of claim 18 wherein the projection most distal from the pedestal portion comprises a finger.

20. The seal of claim 14 wherein the pedestal portion is configured as one of a post and two opposing finger portion.

21. A seal for a wafer container, the seal configured as a loop with four segment portions jointed by four corner portions, and, in cross section, comprising a base portion for seating in the bottom of a groove, a core portion ~~extend from the core~~ extending from the pedestal portion, the core portion having an inward side and an outward side, a plurality of projections extending from the inward side, a plurality of projections extending from the outward side, the seal formed of an elastomeric material and all portions thereof being unitary.