arcoplast®
WALL AND CEILING SYSTEMS
Germfree

# the Science of seismic design

## purpose built : High risk containment environments

Volume III 2025

11:55am 25th March

# Arcoplast Seismic Design





## Introduction : Arcoplast Seismic Control Systems

Arcoplast Seismic's primary barrier designs undergo a process of rigorous scrutiny based on three fundamental aspects of compliance for high level risk seismic containment facilities :

1/ Biocontainment Standards
2/ Physical, Mechanical, Structural Integrity
3/ Seismic Building Codes

These factors are carefully evaluated in combination to ensure the highest level of performance, safety and compliance. Only after meeting all of these rigorous criteria are the designs approved by site engineers, ensuring they align with specifications tailored to the unique construction of each building and in accordance with jurisdictional regulations. This process guarantees that the Arcoplast Seismic Design is fully optimized for high-level containment in a purpose-built facility.

There are multiple Arcoplast Seismic systems : Arcoplast Spline, Control and Expansion Joints, Control Strips, and various systems within the TR35 suspended ceiling system, each system is designed to address different conditions and requirements.

As an example : The Arcoplast seismic control joint and the two seismic control strip systems are designed to reduce the transfer of seismic movement and ground vibrations to the upper structure connected to the ceiling of the primary barrier, while maintaining an air, gas, watertight seal, thus maintaining the working integrity of the high containment environment.

The Arcoplast Dry Build System consists of ready to install CBS ( Construction by Components ) and customized on-site installation practices. The advantage of on-site customization offers an element of flexibility when changes and modifications are needed, ensuring the system can be adapted to meet evolving requirements throughout the construction process.

# Arcoplast : The 3x fundamental systems

In a high containment facility all fundamental systems are in a congruent relationship with the facilities design, function and purpose. Vital to achieving the necessary compliance jurisdictions, three fundamental systems of compliancy are tested and scrutinized in combination before they are signed off individually :

All systems must function as a whole for any of them to work

## Design and test reports

### 1/ Arcoplast priamry barrier : **Physical and mechanical integrity**

Applied Technical Services - Report # ATS: X-210394 – FEA analysis to determine compliance with ICC-ES_AC156 and NZS 4219 (2009) under seismic loading for Arcoplast architectural nonstructural systems and components.

Simpson Gompertz & Heger (SGH) - Report # Project 231274 – Testing of Arcoplast top wall panel seismic control joint assembly subjected to mechanical loading in a vertical and lateral orientation specified by the building Structural Engineer of Record (Australia) and subjected to pressure decay test of the wall panel assembly in conformance with ASTM E2930-2013 “Standard Practice for Pressure Decay Leak Test Method” whilst in cyclic displacement.

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### 2/ Biocontainment : **Industry guidelines and standards**

Australia, New Zealand – Biosafety Standards and Guidelines AS/NZS 2243.3:2022

BMBL - Biosafety in Microbiology and Biomedical Laboratories Guidelines, 6th Edition

Canadian Biosafety Standard, Third Edition. Physical Containment Requirements 2022

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### 3/ Seismic design : **Compliance & guidelines**

ASCE (2022) - Minimum Design Loads and Associated Criteria for Buildings and other Structures ASCE/DEI 7-22

Federal Emergency Management Agency - FEMA

Guidelines for Performance-Based Seismic Design of Buildings FEMA P-58-6 / December 2018

International Code Council (ICC) – 2021 International Building Code (IBC) & International Existing Building Code (IEBC)

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**Note :** Wall and ceiling linings, doors, windows and furniture are considered non structural.

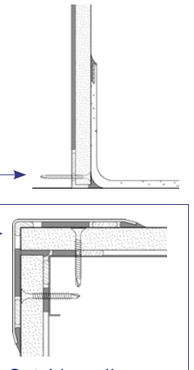


# Direct attach system : Arcoplast Seismic Dry Build

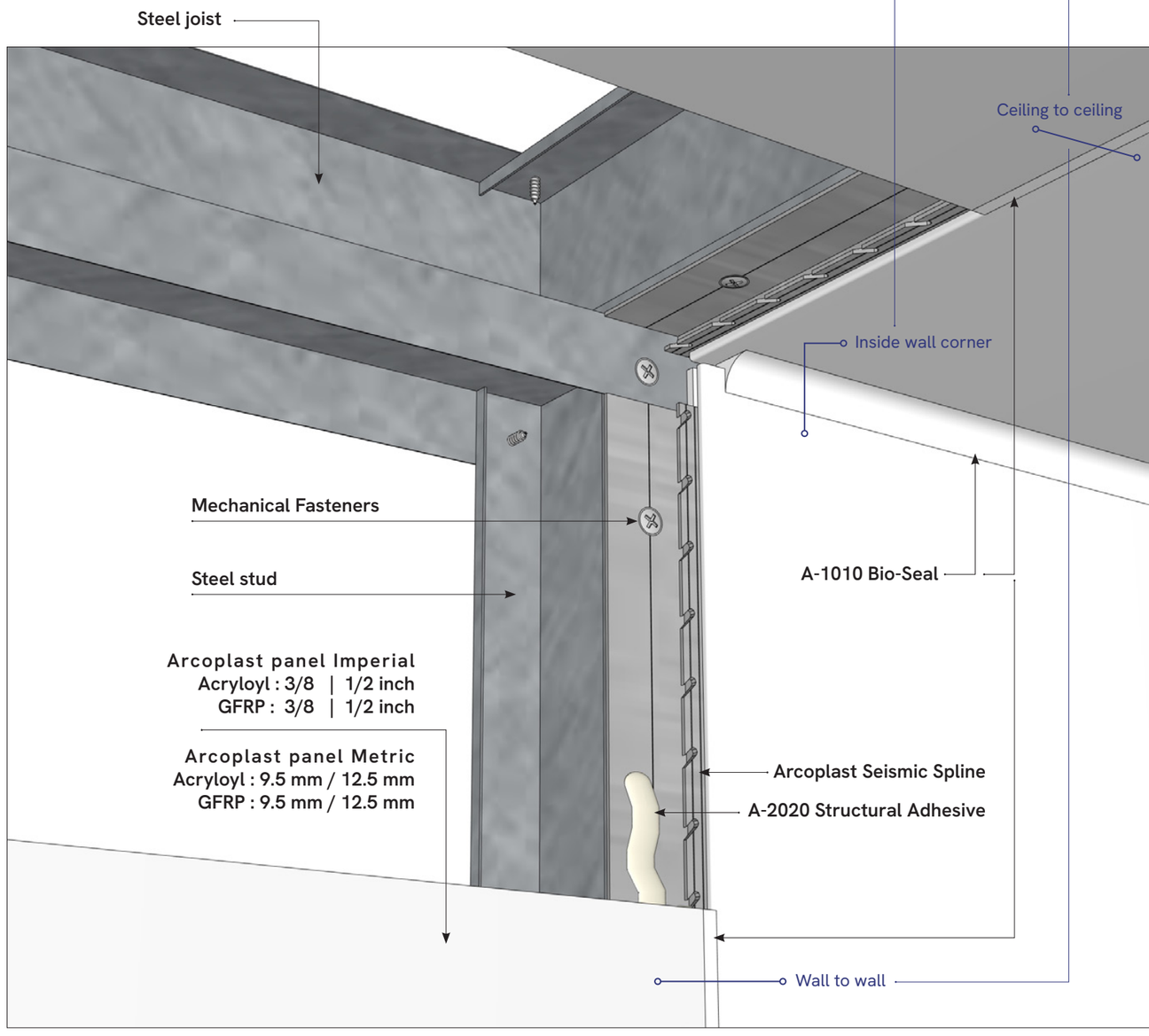
Interconnecting panel systems :

- Wall to Floor : Wall to floor panel terminations
- Panel to Panel : Walls and ceiling panel joints
- Wall to Wall : Inside or outside wall corner joints
- Wall to Ceiling : Wall to ceiling panel joints ( inside corners )

**note :** There are hundreds of variations of the Arcoplast direct attachment system



Outside wall corner




Applied Technical Services - Report # ATS: X-210394 – FEA Analysis to determine compliance with ICC-ES_AC156 and NZS 4219 (2009)

## Arcoplast Seismic Spline System : Primary Barriers rated BSL-3, BSL-4

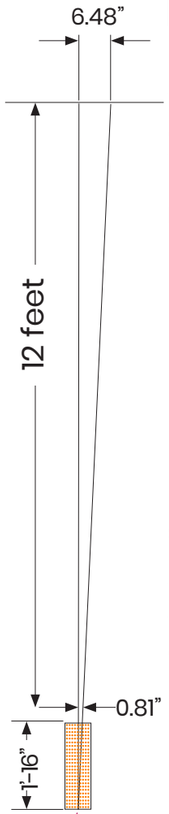
**Patent No : 10,087,637 B1**

The Arcoplast Seismic Spline System ( Rated seismic categories A, B, C, D, E, F ) features a unique zipper-teeth design that increases the surface area, allowing for maximum binding and adhesion of the A-2020 structural adhesive to the spline and primary barrier panel.

**Note :** Acryloyl, GFRMC, GFRP panels manufactured with a kerf are always installed with a seismic spline.

### Additional Testing for New Zealand and USA Conditions

| Country | Location | Report | Result |
|---|---|---|---|
| NZ | Arthurs/ Otira NZ | NZS 4219 (2009) | Pass |
| USA | California USA | ICC-ES_AC156 | Pass |




Testing was conducted to determine the seismic capability of the Arcoplast Seismic Spline System and the 9.5 mm GFRP primary barrier panel system. The GFRP panels were bonded, sealed and finished using : A-2020 Structural Adhesive and A-1010 BioSeal adhesive sealant finishing compound.

**Key Observations : NZS standards specify a relative displacement requirement for seismic shifts**

1. For a 12 ft wall section, the maximum calculated displacement was 6.48 inches, equivalent to a 2.6° rotation of the neutral axis.
2. For a 1 ft 6 inch section ( reduced model ), the 2.6° rotation corresponded to a displacement of 0.81 inches.

Tests were conducted by ATS on behalf of MPI New Zealand, focusing on seismic compliance in New Zealand’s seismic conditions.

### Conclusion

The Arcoplast seismic partition wall system demonstrated compliance with jurisdictional requirements for New Zealand **NZS 4219 (2009)** and USA **ICC-ES_AC156**. Key findings include : Satisfactory air-tightness under vertical and lateral seismic loads.

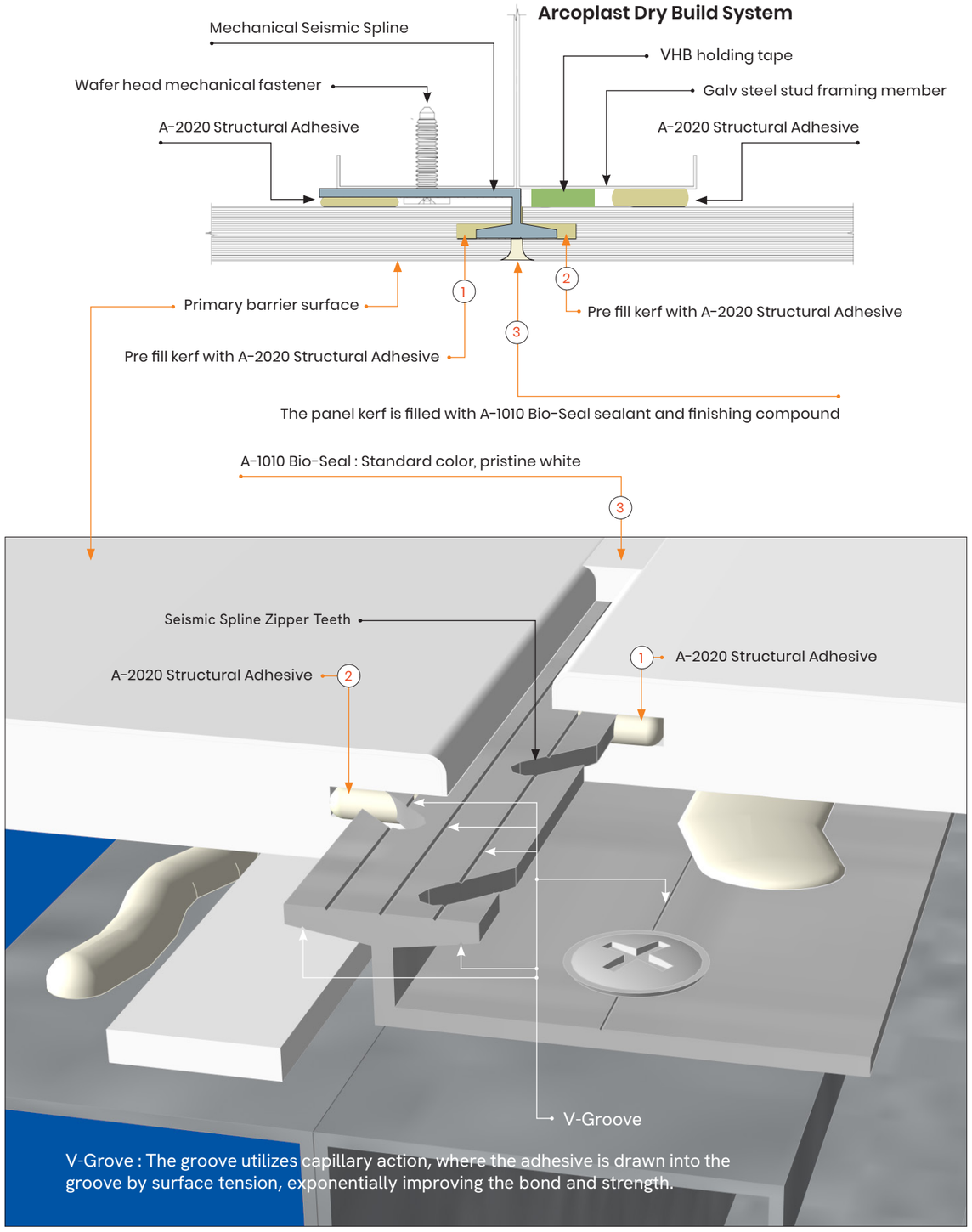
3. The ability to tolerate required lateral and vertical displacements with minimal structural distress.
4. Adhesive and sealant systems provided effective bonding and finishing for high containment applications.
5. These results confirm the system’s suitability for installation in BSL-3 & BSL-4 laboratories in seismic-prone regions.

This enables the finished primary barrier to mitigate up to an equivalent 2.6° rotation of the neutral axis in a seismic event while maintaining a high containment integrity.



## 3 x Critical seals : Arcoplast Seismic Spline assembly

Applied Technical Services - Report # ATS: X-210394
Walls and ceilings panel to panel assembly

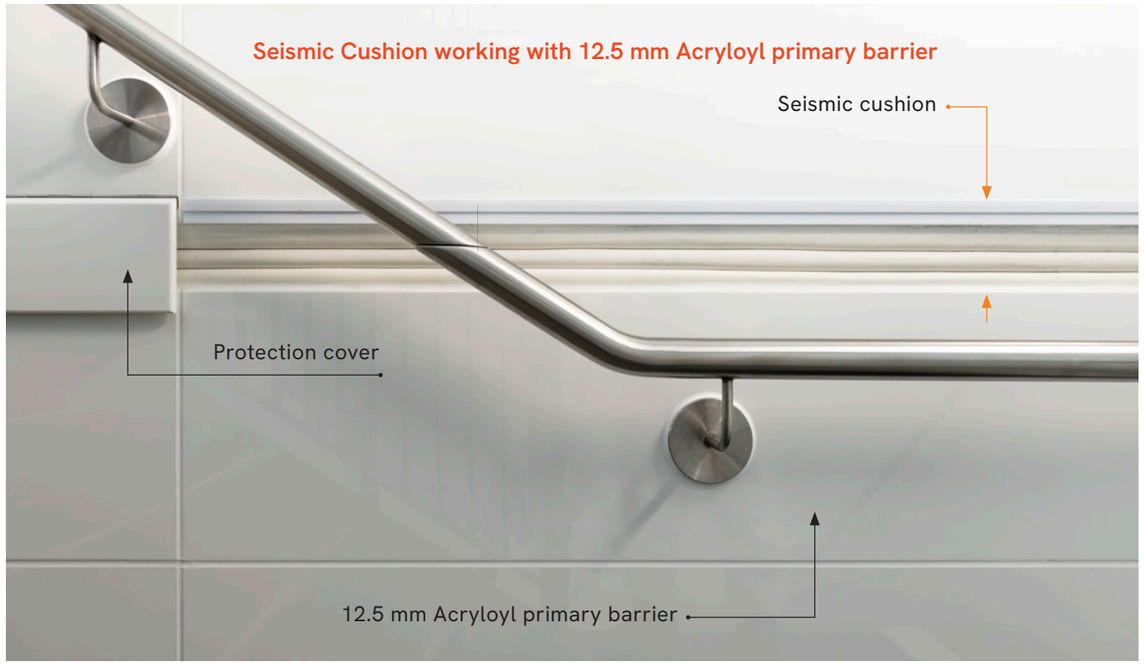



Aryloyl 12.5 mm panel and Arcoplast seismic spline assembly

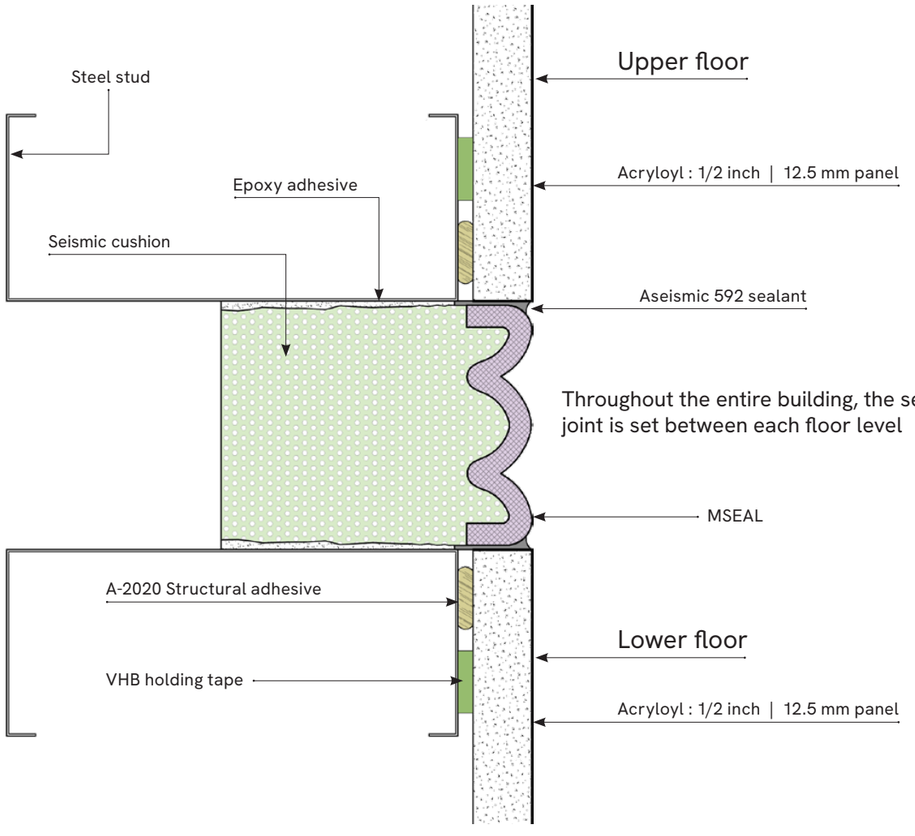
**Pleas note :** Also available in Acryloyl 9.5mm and GFRP 12.5mm and 9.5mm panels

# Arcoplast : Seismic Control Joint

Report : SGH 231274




Arcoplast seismic systems are compatible with a wide range of seismic arrays. In this image we observe the Arcoplast primary barrier installed into a building fitted with a triple bellows Seismic Cushion set between two floors meeting the engineer of record specifications.



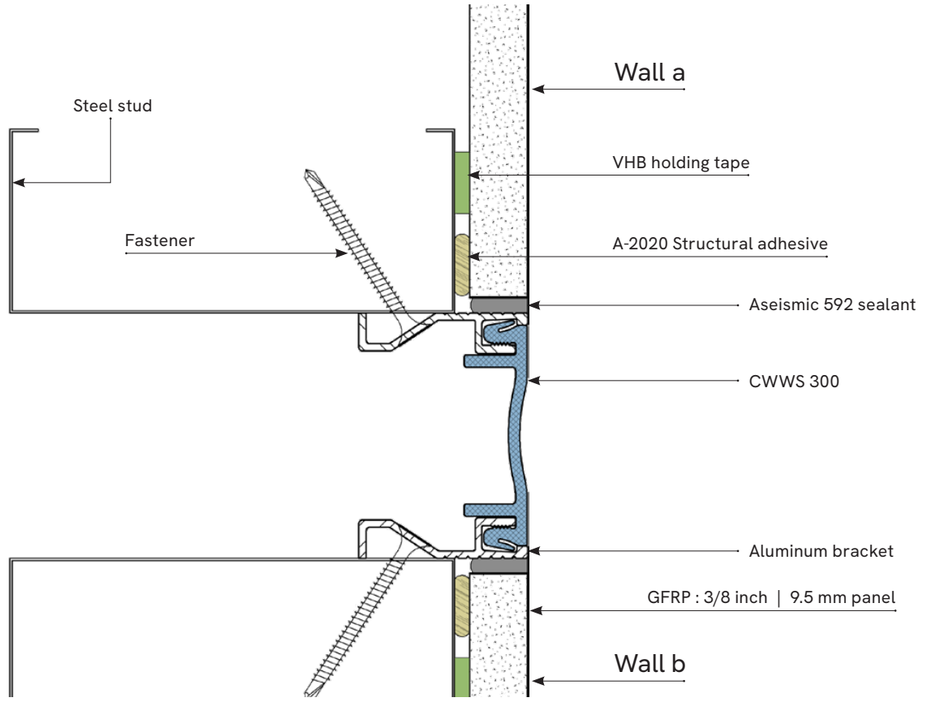



# Arcoplast : Expansion Control Joint

Report : TSS NC-ARC 10610A


GFRP 9.5 mm Primary Barrier : BSL-3 Facility | Cage wash room

**Arcoplast GFRP 9.5 mm primary barrier with a continuous wall ceiling expansion joint**



## Seismic Control Joints : Lab test reports

### Tests Reports : Seismic Control Joints and Expansion Control Joints

| Compliance | Test | Date | result |
|---|---|---|---|
| Report : IIA 21P-0611 | Leakage Rate | 02-25-2021 | ✓ |
| Report : SGH 231274 | Mechanical Loading - Pressure Decay Tests | 11-16-2023 | ✓ |
| Report : TSS NC-ARC 10610A | Pressure Decay Test | 11-2-2010 | ✓ |
| Report : ATS X-210394 | Structural Analysis | 02-14-2014 | ✓ |

### Arcoplast : Seismic Top Track Control Joint

Patent Pending

#### Technical Report : Arcoplast seismic partition wall system's for BSL-3, BSL-4 laboratories

All Arcoplast Seismic Control systems are designed for high level risk bio-containment environments. The Arcoplast Seismic Control Joint Top Track Assembly ( designed for partitions ) meets pressure decay tests and mechanical loading to the seismic requirements provided by the structural engineer of record, for specific projects. Additionally, it complies with specific seismic movement parameters as outlined in **SGH report***.

The aforementioned assembly minimizes leakage rates, ensuring the containment boundary achieves or exceeds the required standards, with a vertical movement capacity of ±10mm and horizontal movement capacity of ±5mm. This is achieved by the MSEAL Foam-Based DMS Sealant gasket. The MSEAL gasket's design allows it to accommodate joint movements through a bellows mechanism, enabling ±50% movement from its nominal size without inducing tensile stresses.

**Testing procedures**

The testing procedures were designed by SGH to meet the unique requirements of the project. Since no written standard exists for these tests, the following references were utilized as guidance :

**ASME AG-1 (2009) : Nuclear air and gas treatment**

Merrick White Paper ( October 2019 ) : Boundary Integrity Testing of CL3 ( BSL3 ) Biological Containment Laboratories.

*** Ref SGH lab report. Test pressure decay & leakage rates : Arcoplast seismic control joint assembly**

| Pressure range | Up to -500 Pa | | From -500 to -250 Pa | |
|---|---|---|---|---|
| Calculated rate | Pressure decay rate | Leakage rate | Pressure decay rate | Leakage rate |
| As received | 10.0 Pa/min | 0.061 L/min | 5.2 Pa/min | 0.032 L/min |
| After 25 Vertical load cycles to ± 10 mm | 9.6 Pa/min | 0.058 L/min | 6.1 Pa/min | 0.037L/min |
| After 25 lateral load cycles to ± 5 mm | 11.5 Pa/min | 0.067 L/min | 9.4 Pa/min | 0.057 L/min |

Tests conducted to evaluate the structural integrity and air-tightness of the wall system under vertical and lateral seismic loads.



**Vertical load test observations : Vertical motion tolerance: ±10 mm**

1. No changes in internal pressure were detected within the mockup.
2. No signs of structural distress were observed.

**Additional notes :**

Changes in internal pressure during loading were attributed to variations in the box volume, *that impacts the measured internal pressure*. These changes impacted pressure decay calculations during the load application phase. However, the post-loading pressure decay test indicated acceptable leakage rates and system behavior.

**Lateral load test observations : Lateral motion tolerance: ±5 mm**

3. No changes in internal pressure were detected during loading.
4. *Several localized tears were observed in the sealant at the MSEAL near the top plate connection on one side of the wall panel assembly.
5. Post-loading pressure decay tests showed a leakage rate of 0.067 L/min, which was within acceptable limits.

**Additional Notes :**

The wall panel assembly's ability to *deform and accommodate ±5 mm deflection minimized significant volume changes, maintaining air-tightness.

* Relating to the sealant localized tears.

## Cleaning Decon : Chemical & Gas test reports

The neutral-cure Aseismic 592 silicone sealant is integrated into the system's primary barrier liner, ensuring a surface that is able to be maintained, cleaned and decontaminated using the following processes.

**Tests for decontamination chemical exposure : Acryloyl panels & Aseismic 592 silicon sealant**

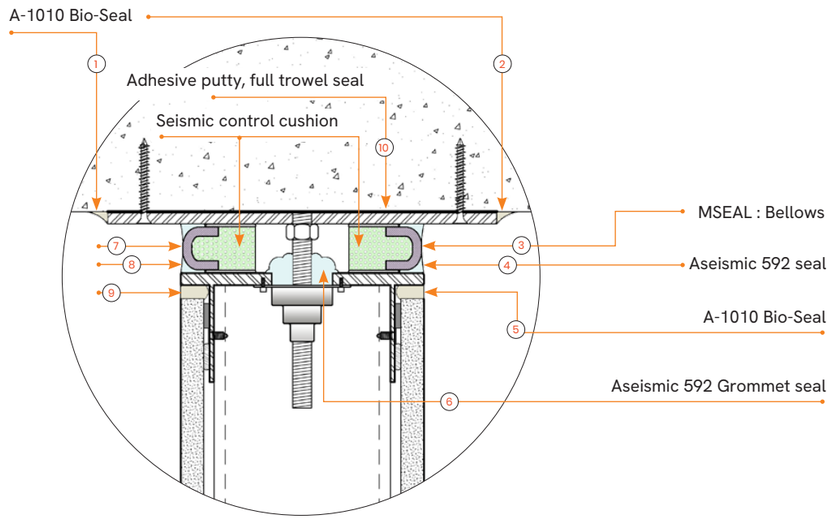
| Acryloyl Panel & Aseismic 592 | 1440 ppm-hrs | 24hrs Including neutralization cycle | Automated exposure cycle completed | 12hr exposure cycle |
|---|---|---|---|---|
| Decon Chlorine Dioxide | No damage | No damage | No damage | No damage |
| Formaldehyde exposure | No damage | No damage | No damage | No damage |
| 7% Hydrogen Peroxide ( Curis system test ) | No damage | No damage | No damage | No damage |
| 35% Hydrogen Peroxide ( VHP type ) | No damage | No damage | No damage | No damage |

Information and reports are taken from a series of engineer control laboratory tests :
For the full test reports please visit : www.arcoplast.com

## 10 x Critical seals : Arcoplast Top Track Control Joint ( Assembly )

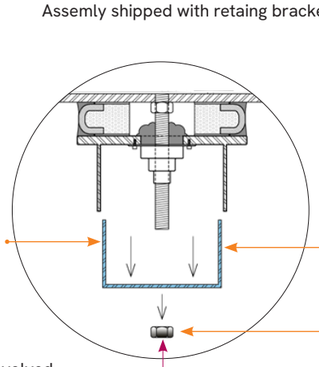
**Description :** The Seismic Wall Partition Top Track Control Joint Assembly is engineered and designed for under slab/ soffit concrete substrate construction in high-level risk seismic zones, for high-level risk containment facilities.

Please note : Arcoplast Seismic Control Joints & Control Strips are non-structural building components. Arcoplast products are to be installed by experienced certified trades people.




### Seismic Control Joint : Partition Top Track ( Assembly )

Seismic mechanism with grommet seal, and the support shaft bolt mechanism. The Partition Top Track ( Assembly ) is packaged and shipped with a retaining bracket.




### Seismic Top Track : Retaining Bracket

The retaining bracket is fitted to secure the pre-compressed MSEAL making for efficient handling, transportation and installation.

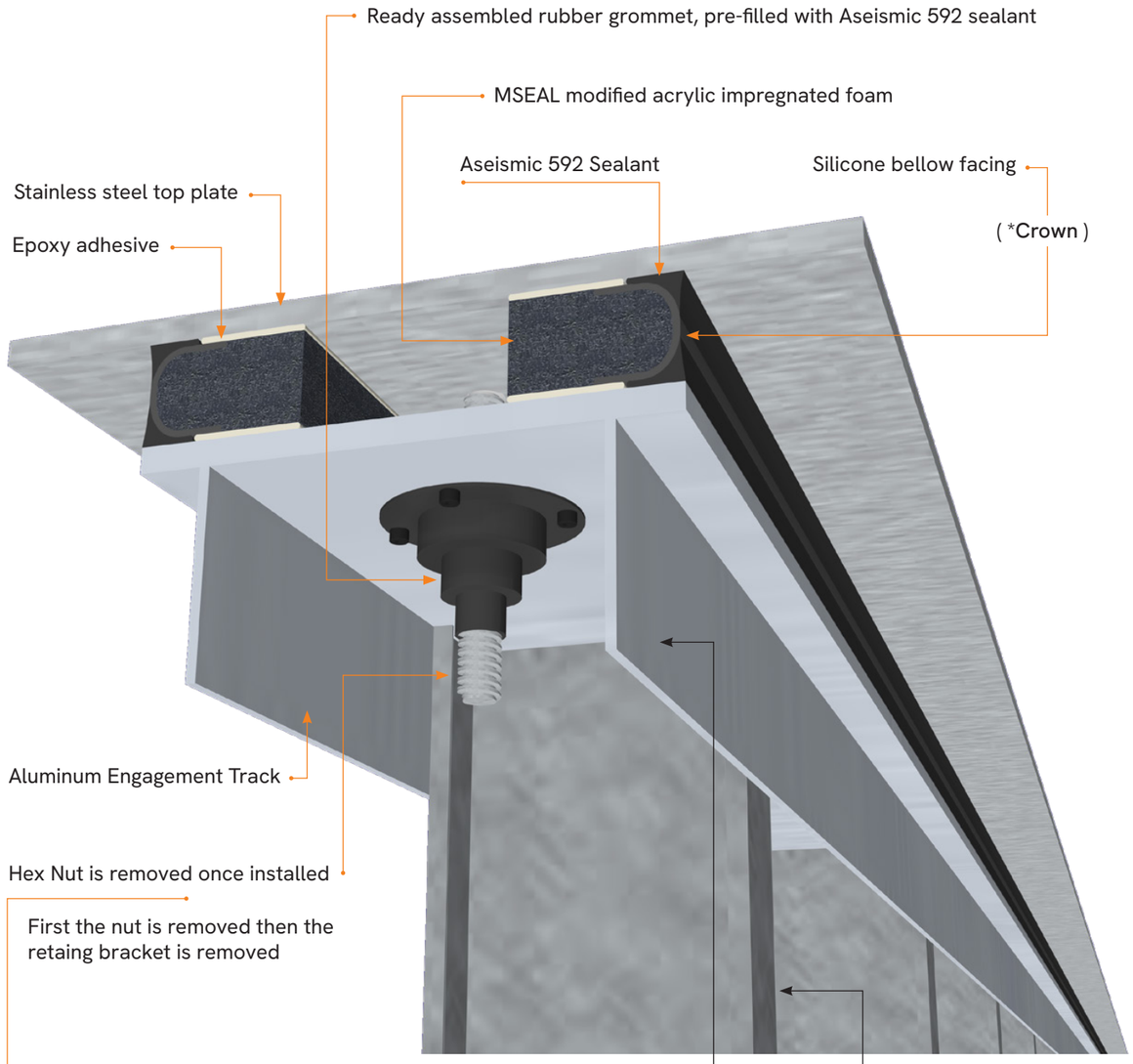
Before installing, please refer to the installation manual, as there are critical processes involved



## Seismic high containment cleanrooms : Constructed for partition/ dividing walls

The Seismic Control Joint Assembly is designed for partition/ dividing walls in a high level risk seismic zone. In a seismic episode the top track mechanism is designed to maintain the 3 critical functions :

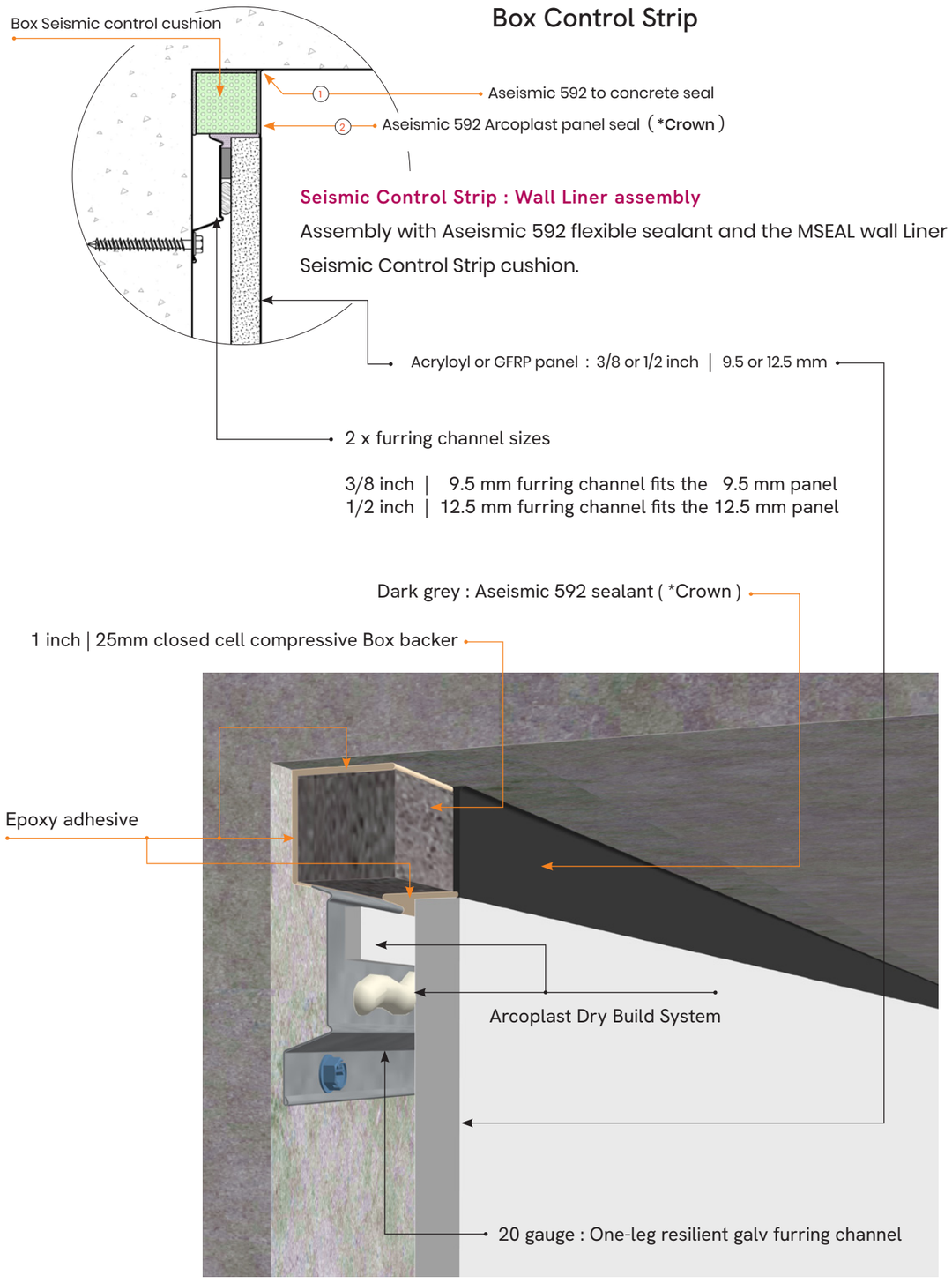
1/ Preserve physical and mechanical properties of the Arcoplast primary barrier
2/ Maintain biocontainment room integrity
3/ Seismic compliance : Absorb vertical, lateral, oblique drift movements




*Crown : In a full room configuration made up of partition and structural walls, the Top Track Control Joint and the Box Control Strip MSEALS form a continuous line around the top of the cleanroom called the "**Crown**".

## 2 x Critical primary barrier seals : Box Control Strip

**Desciption : The** Arcoplast Seismic Box Control Strip Assembly is designed for lining seismic cleanroom walls connected to partition walls constructed with the Arcoplast Seismic Top Track Control Joint.

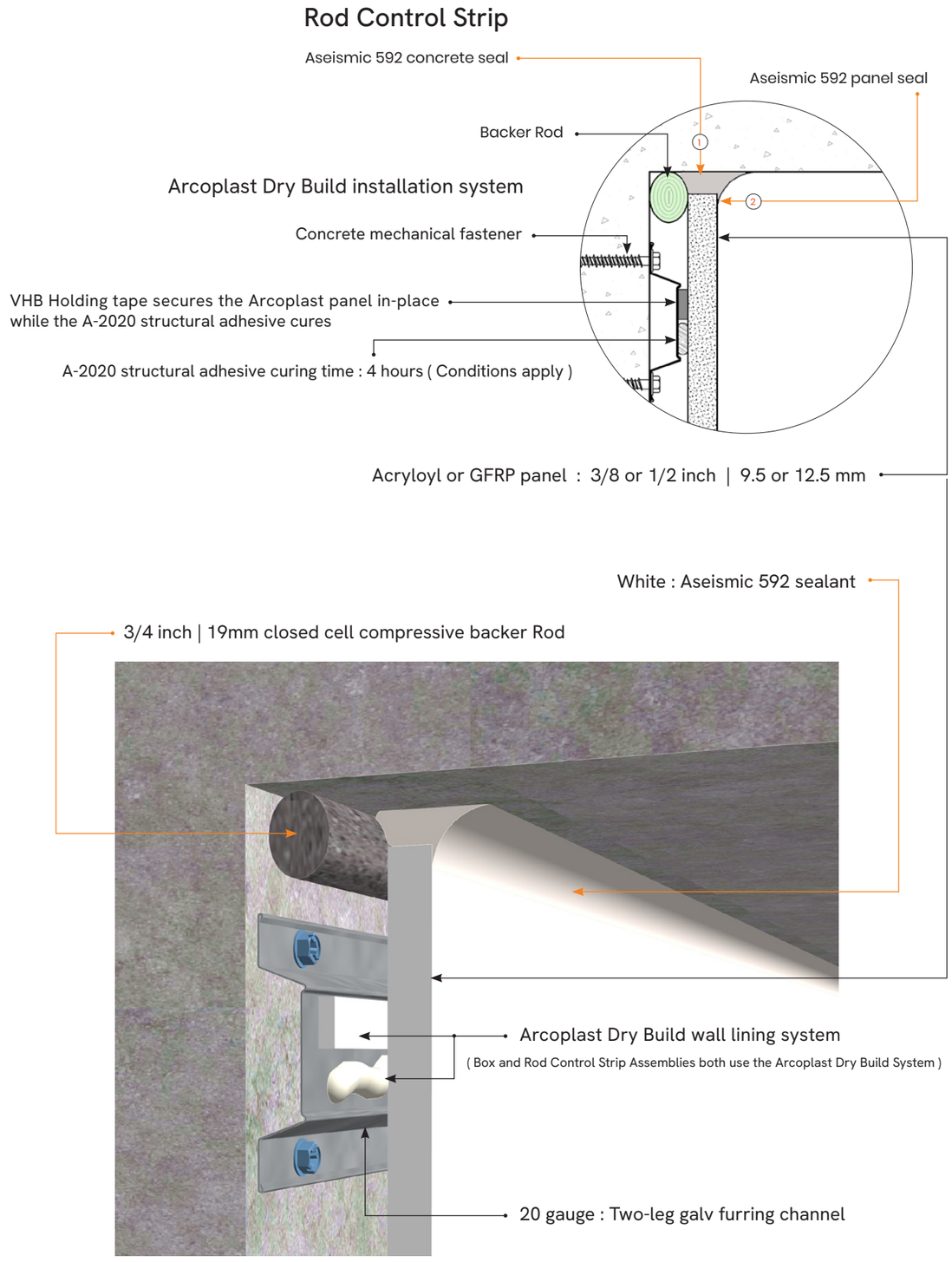



Please note shop drawings colors are used to represent different components and are not indicative of the true colors.



## 2 x Critical primary barrier seals : Rod Control Strip

**Description : The** Arcoplast Seismic Rod Control Strip Assembly is installed when lining structural walls. The Rod control strip is quick, efficient and cost effective to install.



# Seismic

SCOPE : TR35 pultruded fiberglass suspended ceiling grid system

Seismic compliance and specifications are unique to every country, state and region, based on national, regional and local building codes. It is beyond the scope of this document to present more than working examples, laboratory test data and reference material, as every build from design to construction has a regime of unique requirements specific to a buildings purpose and location.

**C635-04 :** Standard specification for the manufacture, performance, and testing of metal suspension systems for acoustical tile and lay-in panel ceilings.

Arcoplast commissioned an independent laboratory to carry out a series of tests using the C635-04 test model, as there are currently no seismic tests specific to Pultruded Fiberglass Suspended Ceiling Grid Systems. Arcoplast does not sight the test as the C635-04 test, as it is specific to metal T inverted grid systems. However the test laboratory simulated the C635-04 test model to establish a working comparison between the TR35 pultruded fiberglass suspended ceiling grid system and metal suspended ceiling systems.

The tests analyzed each of the TR35 components, testing for strength and working performance in seismic and non seismic zones, ascertaining side by side data based on the simulated C635-04 test model.

The ASTM Designation : C 635 – 04 document / page 1

*1.2 Some suspension systems incorporate locking assembly details that enhance performance by providing some continuity or load transfer capability between adjacent sections of the ceiling grid. The test methods included in this specification do not provide the means for making a complete evaluation of continuous beam systems, nor for assessing the continuity contribution to overall system performance. However, the test methods can be used for evaluating primary structural members in conjunction with secondary members that Interlock, as well as with those of non-Interlocking type.*

**ASTM E580 :** Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings. This standard governs the manufacturing and performance requirements for a lay-in suspended ceiling grid.

Arcoplast complies to the ASTM E580 protocols and build methods for : Seismic zones A, B, C.

**Useful References and information**

For all USA and International Seismic Building Code Compliance it is essential to consult government departments and agencies that have jurisdiction. In the USA local jurisdiction has the final say for all code requirements.

ASTM E580 : Standard practice for installation of ceiling suspension systems for acoustical tile and lay-in panels in areas subject to earthquake ground motions

ASCE 7 Adopts : ASTM E580 for most of its seismic requirements for suspended ceilings

IBC Adopts : SCE 7 for nearly all seismic requirements

State Building Code : Local jurisdiction. City, County, Township, or State agencies such as (OSHPD)

Keel Manufacturing - ICC-ES Evaluation Report ESR-1722 - May 2016





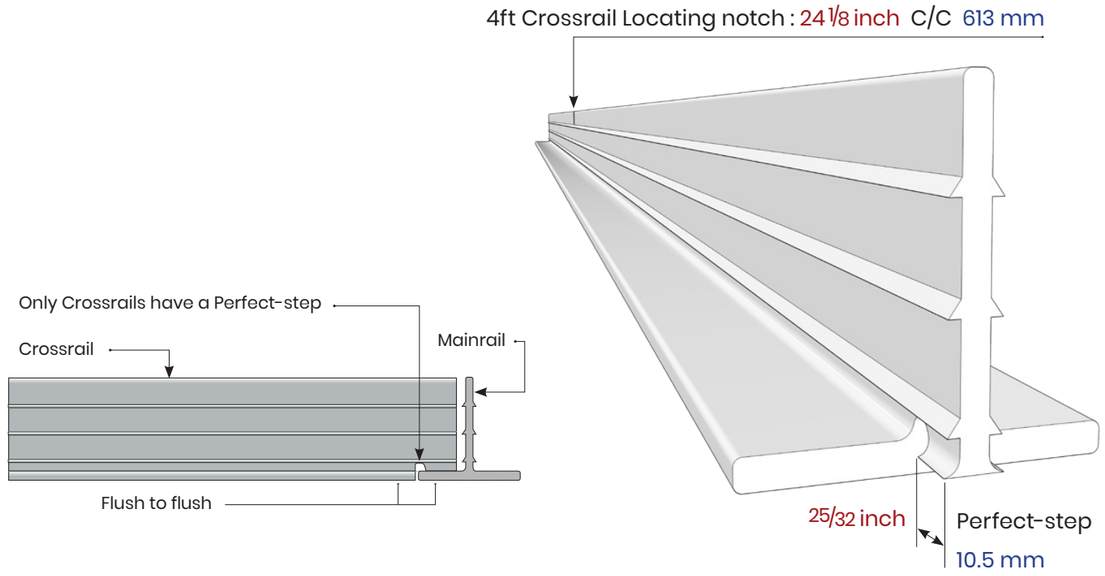


# Perfect step or Seismic Step

Please Note : Arcoplast TR35 utilizes a perfect step for Cat A, B and the seismic step for Cat C, D, E, F

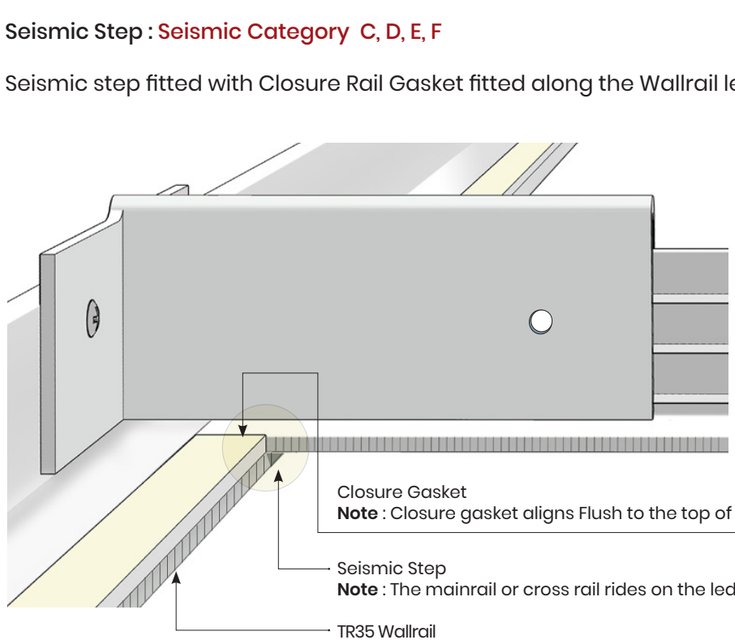
**Perfect Step :** Seismic Catagory A, B

To ensure rails and panels are flush and seat correctly, Crossrails are manufactured with what is called a Perfect-step.




**Seismic Step :** Seismic Category C, D, E, F

Seismic step fitted with Closure Rail Gasket fitted along the Wallrail ledge



# Mainrails & Hangers

**TR35** **Mechanical physical properties**

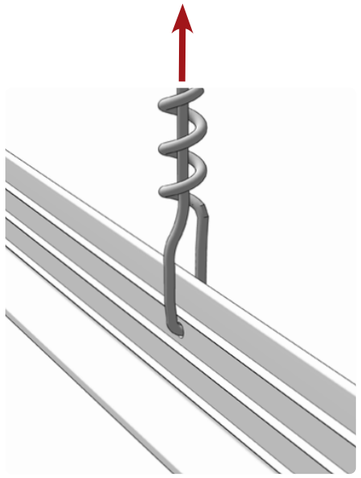
Subject **TR35 Mainrail :** Hanger wire galvanized no 12 gauge**

Test **90° degree pull out test :** Holes located 0.580 inch | 14.73 mm down

Method **ASTM D953-10 :** Modified samples tested in finished form

Failure mode **TR35 Mainrail**

| Descriptions | Measurements are averages | |
|---|---|---|
| Mainrail | Imperial | Metric |
| Thickness | 0.095 inch | 2.413 mm |
| Bearing hole diameter | 0.150 inch | 3.81 mm |
| Load at bearing strength 4% strain | 19 lbf | 8.69 Kg |
| Maximum load | 436 lbf | 197.77 Kg |
| Bearing strength | 1366 psi | 9418 Pa |
| Ultimate bearing strength | 30600 psi | 2.1098 Pa |



**TR35** **Mechanical physical properties**

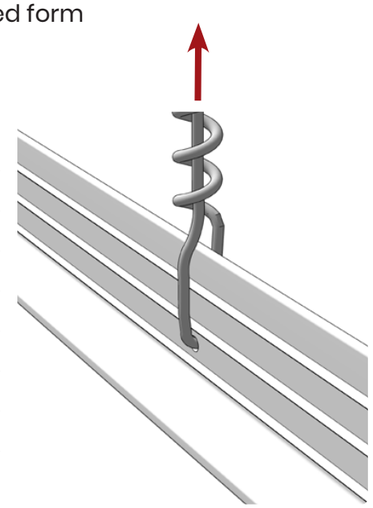
Subject **TR35 Mainrail :** Hanger wire galvanized no 12 gauge**

Test **90° degree pull out test.** Holes located 0.900 inch | 22.86 mm down

Method **ASTM D953-10 :** Modified samples tested in finished form

Failure mode **TR35 Mainrail**

| Descriptions | Measurements are averages | |
|---|---|---|
| Mainrail | Imperial | Metric |
| Thickness | 0.095 inch | 2.413 mm |
| Bearing hole diameter | 0.150 inch | 3.81 mm |
| Load at bearing strength 4% strain | 21 lbf | 9.52 Kg |
| Maximum load | 575 lbf | 260.81 Kg |
| Bearing strength | 1480 psi | 1.0204 Pa |
| Ultimate bearing strength | 40200 psi | 2.77169 Pa |



** **International Building Code :** 2012 Seismic Design Category C : 12 gauge vertical hanger wire minimal requirement : 0.0808 inch | 2.052 mm





## Hanger wires & bracket

**TR35** **Mechanical physical properties**

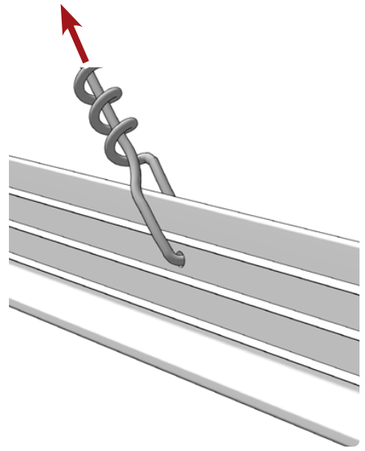
Subject **TR35 Mainrail :** Hanger wire galvanized no 12 gauge**

Test **45° degree pull out test :** Holes located 0.580 inch | 14.73 mm down

Method **ASTM D953-10 :** Modified samples tested in finished form

Failure mode **TR35 Mainrail**

| Descriptions | Measurements are averages | |
|---|---|---|
| Mainrail | Imperial | Metric |
| Thickness | 0.095 inch | 2.413 mm |
| Bearing hole diameter | 0.150 inch | 3.81 mm |
| Load at bearing strength 4% strain | 31 lbf | 14.1 Kg |
| Maximum load | 391 lbf | 177.35 Kg |
| Bearing strength | 2180 psi | 1.503 Pa |
| Ultimate bearing strength | 27400 psi | 1.8892 Pa |



**TR35** **LTGH Bracket mechanical properties**

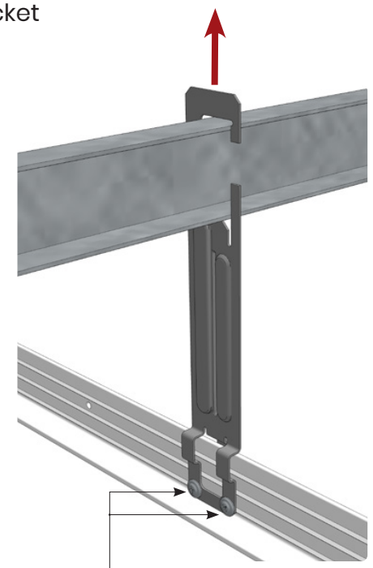
Subject **Mainrail :** TR-7400 Bracket assembly

Test **Holding strength test** completed on TR-7400 Bracket

Method **ASTM D638-14**

Failure mode **TR35 Mainrail flange fracture**

| Descriptions | | Measurements are averages | |
|---|---|---|---|
| TR-7400 Bracket | | Imperial | Metric |
| Max load | 1 x UTWH screw | 466.4 lbf | 211.55 Kgf |
| Peak load | 1 x UTWH screw | 380.48 lbf | 172.58 Kgf |
| Max load | 2 x UTWH screw | 573.90 lbf | 260.05 Kgf |
| Peak load | 2 x UTWH screw | 557.88 lbf | 253.05 Kgf |
| Ultimate Static load limit | | 100.00 lb | 45.35 Kg |



2x UTWH Self drilling screw #8

# Seismic test results

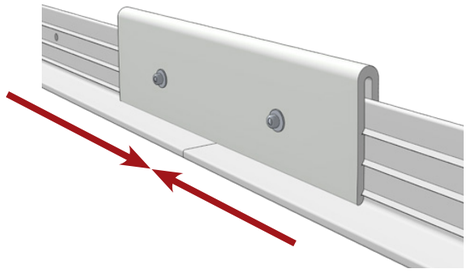
**TR35** **Mechanical physical properties**

Subject **Splice clamp :** Extruded grade K type 2 virgin PVC, UL 94 V-O certified

Method **ASTM D695-15 :** Modified samples tested in finished frame

Test **Compressive test**

Failure mode **Material yield**



| Specimen | Load at yield | | Compressive extension at yield | |
|---|---|---|---|---|
| **Average** | 3644 lbf | 1652.89 Kg | 0.054 inch | 1.3716 mm |

**TR35** **mechanical physical properties**

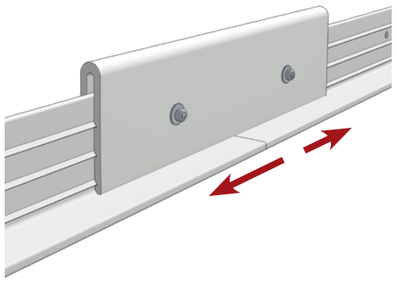
Subject **Splice clamp :** Extruded grade K type 2 virgin PVC, UL 94 V-O certified

Test **Pull apart test**

Method **ASTM D953-10 :** Modified samples tested in finished frame

Failure mode **PVC at rivet**

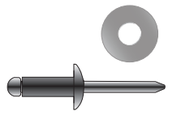
| Description | Measurements are averages | |
|---|---|---|
| Specimen number | Imperial | Metric |
| Thickness | 0.095 inch | 2.413 mm |
| Bearing hole diameter | 0.150 inch | 3.81 mm |
| Load at bearing strength 4% strain | 37 lbf | 16.78 Kg |
| Maximum load | 646 lbf | 293.02 Kg |
| Bearing strength | 2580 psi | 1.7788 Pa |
| Ultimate bearing strength | 42600 psi | 2.9371 Pa |

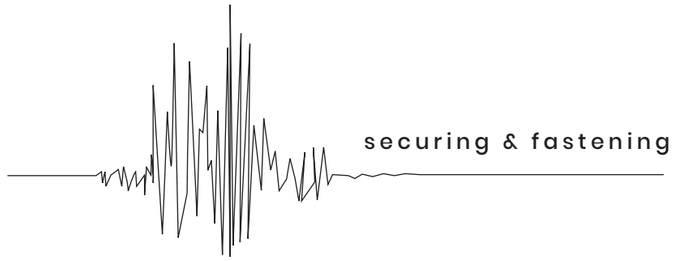


International Building Code : IBC 2012 Seismic Design Category C : Minimal seismic strength requirement, Main and Cross Rail connection 60 lbf (270 N )









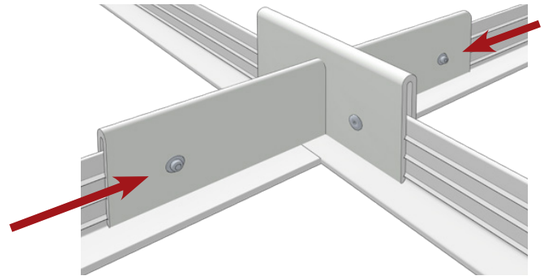
**TR35** **Mechanical physical properties**

Subject **Inter & Overlock clamps :** Extruded grade K type 2 virgin PVC, UL 94 V-O certified

Method **ASTM D695-15 :** Modified samples tested in finished frame

Test **Compressive test**

Failure mode **Material yield**



| Specimen | Load at yield | | Compressive extension at yield | |
|---|---|---|---|---|
| **Average** | 1460 lbf | 662.24 Kg | 0.043 inch | 1.0922 mm |

**TR35** **Mechanical physical properties**

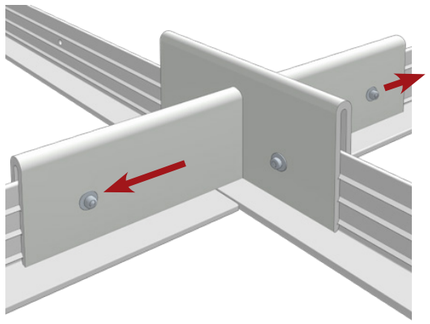
Subject **Inter & Overlock clamps :** Extruded grade K type 2 virgin PVC, UL 94 V-O certified

Test **Pull apart test**

Method **ASTM D953-10 :** Modified samples tested in finished form

Failure mode **PVC at intersection**

| Description | Measurements are averages | |
|---|---|---|
| Specimen number | Imperial | Metric |
| Thickness | 0.095 inch | 2.413 mm |
| Bearing hole diameter | 0.150 inch | 3.81 mm |
| Load at bearing strength 4% strain | 20 lbf | 9.071 Kg |
| Maximum load | 575 lbf | 260.9 Kg |
| Bearing strength | 1500 psi | 1.0342 Pa |
| Ultimate bearing strength | 40200 psi | 2.7716 Pa |



International Building Code : IBC 2012 Seismic Design Category C : Minimal seismic strength requirement, Main and Cross Rail connection 60 lbf (270 N )

# Seismic Category C, D, E, F

## Heavy Duty : Seismic Categories C & D, E, F

Seismic Cat C, D, E, F and the TR35 Heavy Duty Grid is made up of the same components, assembled differently. Most notably is the use of lockrivets, used to lock Rails and clamps into the grid so to strengthen and secure the grid.

Another aspect of interest is, the TR35 grid is assembled to allow for movement in the event of an earthquake. There are different arrays where the Main and Cross Rails are able to move. This is made possible by what is called the Seismic Step, fitted with a Closure gasket, working in conjunction with the working design of the clamps and junction assemblies.

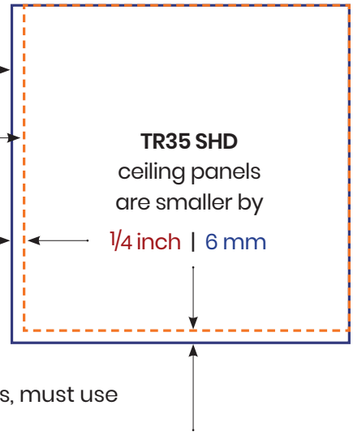
Lockrivets : It is important to note the lockrivet encroaches into the Panel or MEP Bay by 1/8 inch | 3mm. For this reason the SHD panel system is used for Seismic Category C, D, E, F, and Heavy Duty grids, as the SHD panel system is slightly smaller than the standard panel sizes. Note : All SHD ceiling panels, length and width are smaller by a factor of 1/4 inch | 6mm, the panel thickness remains the same.

**Standard** ceiling panel : Width 23¾" x Length 23¾"

**TR35 SHD** ceiling panel : Width 23½" x Length 23½"

All TR35 SHD ceiling panels are smaller by : 1/4 inch | 6 mm

Page 40-41 : Full range of SHD ceiling panel dimensions




**Conclusion :** Lockriveted TR35 Grids fitted with Acryloyl or i-Panels, must use the TR35 SHD ceiling panel system.

**SHD : Seismic Category C, D, E, F Heavy Duty** ceiling panel system.
Ceiling panels reduced in size by : 1/4 inch | 6 mm.

**Lockrivets :** Rivet with a back washer. Stainless steel, Aluminum and Zinc plated steel.

**Lockrivet clearance :** Allow a factor of 1/8 inch | 3 mm.

**Lockrail**
Main or Cross Rail lockriveted to the grid to increase strength and prevent slip movement.

**Sliprail**
Main and Cross Rails capable of slip movement in a seismic episode.

**Slip Lockrail**
One end of a Cross or Main Rail is lockriveted to a clamp, preventing any slip movement, the opposite end of the Rail is clamped but not lockriveted, facilitating the Rail to slip.

**Slip movement**
The controlled movement of Main and Cross Rails in a seismic event. Slip movement up to 3/4 inch | 19 mm.





# Seismic Cross Junctions

## Heavy Duty : Seismic A, B

All Clamps are lockriveted.
No Seismic-Step
No Closure gasket.
Standard gaskets and caulking
Uses the SHD ceiling panel system

## Heavy Duty : Seismic C, D, E, F

Configured as Seismic C, D, E, F

## Heavy Duty : Seismic Categories C, D, E, F

Cross Junctions are assembled the same way as the Seismic Cat A, B, Standard TR35 Grid assembly; except the Cross Junctions are lockriveted together to maintain the integrity of the grid assembly in the event of an earthquake.

The strength of the lockrivets under laboratory conditions were extensively tested, returning impressive results, note pages 28-31.

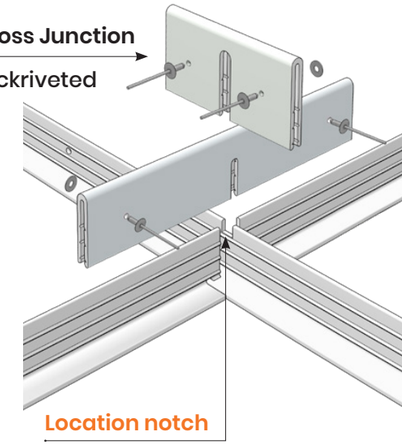
Mainrails, Crossrails and Wallrails are all compliant to Seismic Category C, D, E, F and are assembled the same way as the standard TR35 Grid, but with the use of lockrivets in various arrays.

The Cross Junction, the Offset Junction and the Modified Offset Junction are assembled in the same way but are all Lockriveted. The drilling of rivet holes is done on-site. Arcoplast supply the Lockrivets with separate washers.

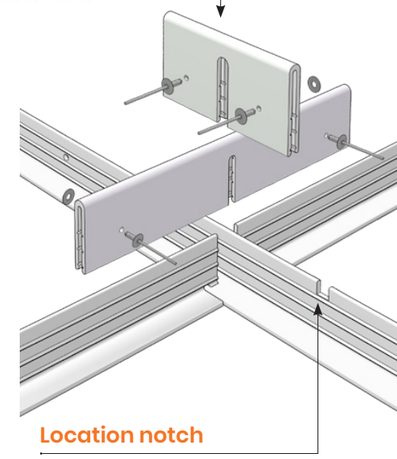
Note : This document does not go into the intricacies of complicated systems of hanger wires, trapezes and other mechanisms for supporting the grid from the building's numerous structures.

If you have any question regarding the assembly of the TR35 suspended ceiling grid system or you require more information please contact the Arcoplast technical team.

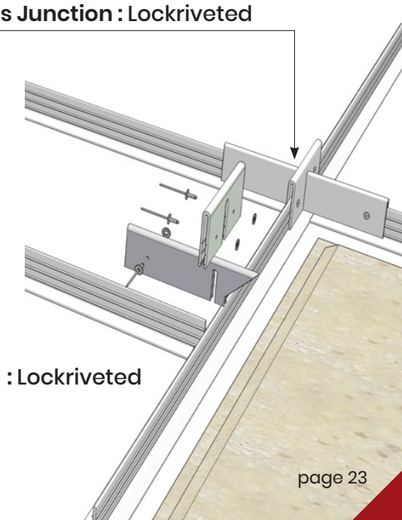
**Cross Junction**
Lockriveted




**Offset Junction**
Lockriveted

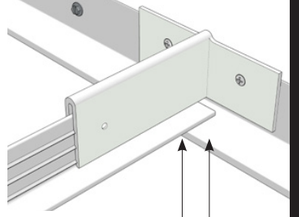



**Cross Junction :** Lockriveted



**Offset modified Junction :** Lockriveted

# Seismic T-Junctions




**Note :** The Closure gasket is not shown

## Seismic Categories C, D, E, F

Seismic step : Main and Cross Rails ride on the ledge of the Wallrail allowing for a seismic movement of up to 3/4 inch | 19 mm.

Seismic Cat C, D, E, F : In this seismic category, Splice clamps are never used for Rails terminating into Wallrails, only T-Clamps are configured for Main and Cross Rails terminating into Wallrails.

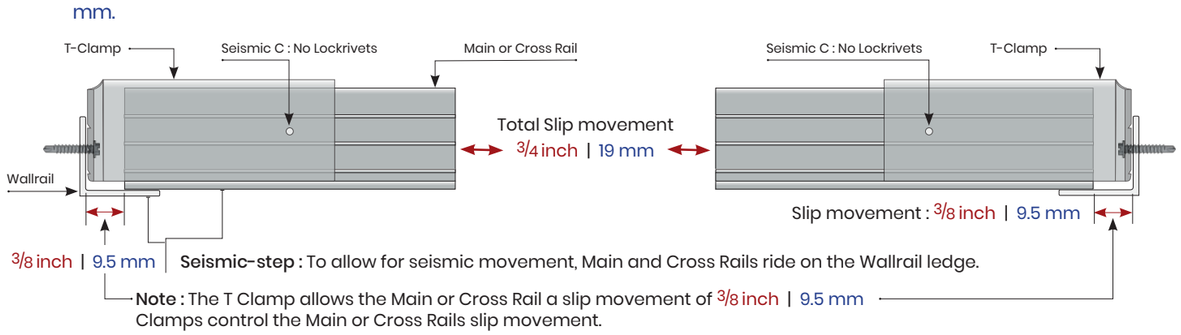
## T-T Junction : Seismic-step : Seismic Category : C

**Seismic T-T Junctions :** Combination : T-Clamp opposite T-Clamp

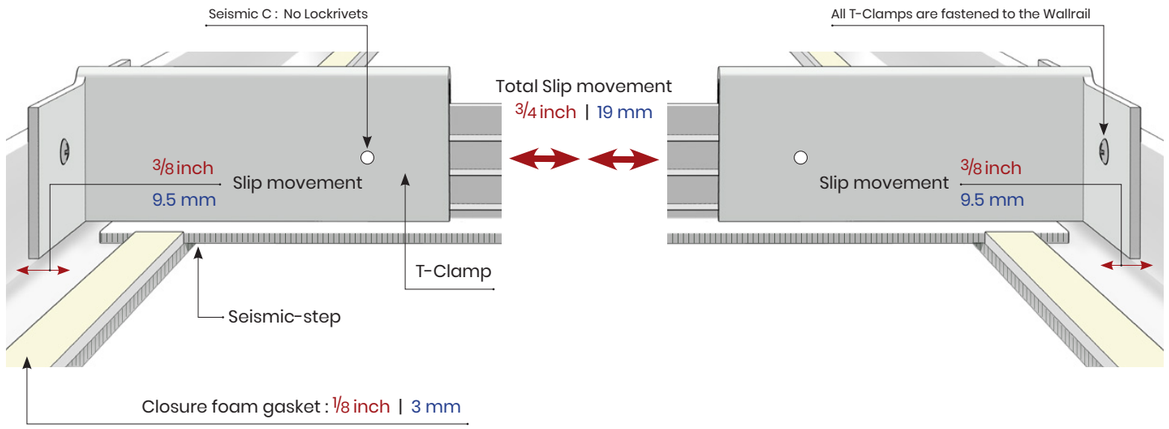
**T-Clamp T-Clamp termination**

The Seismic-step is necessary for seismic movement Category : C

Category C. Every Main or Cross Rail terminating into a Wallrail must facilitate a slip movement of 3/8 inch | 9.5 mm.




Category : C
Main and Cross Rails are not lockriveted.



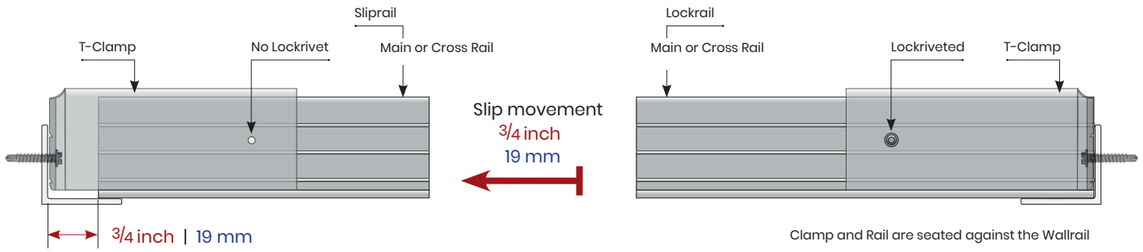





## T-T Junctions : Seismic-step : Seismic Categories D, E, F

**T-Clamp termination using a Seismic-step, Sliprail opposite Lockrail.**
One end of the Main or Cross Rail is not lockriveted to the T-Clamp to allow for seismic slip movement of 3/4 inch | 19 mm. The opposite end is lockriveted to the T Clamp, to prevent any slip movement.

**Note :** All T-Clamps are fixed to the Wallrail.

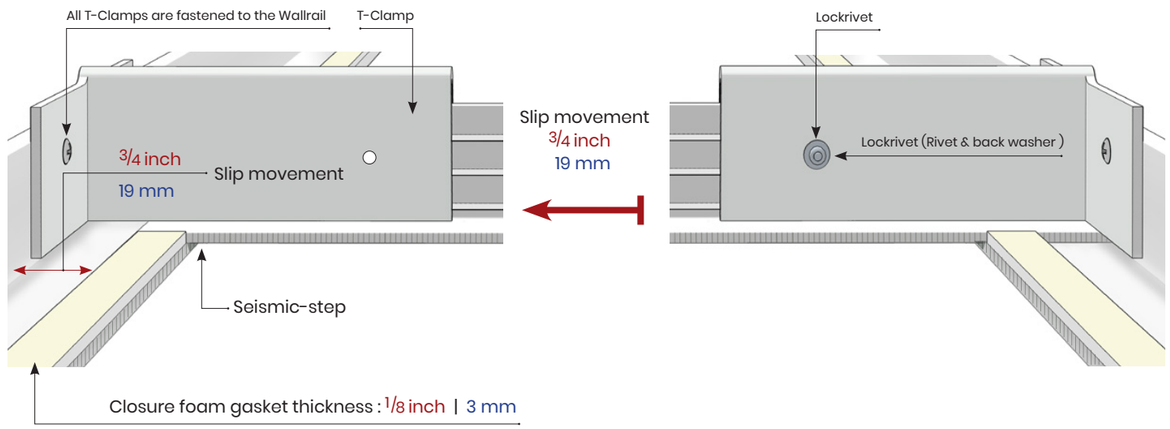



Category D, E, F : Stipulate in a four sided room the ceiling grid must be fixed to two adjacent walls, and each opposing wall must allow for seismic movement of no less than 3/4 inch | 19 mm.

**Note :** The design of the T Clamp and Splice clamp facilitates the linear slip movement of the Rails, and restricts any non-linear movement.

**Sliprail :** Describes if a Main or Cross Rail is able to slip in the event of an earth quake.
**Lockrail :** Rail is locked into position and has no slip movement.

Areas exceeding 2500 Sqft | 232 Sq meters
T-T Junction : Configured so only one end of the Mainrail run is lockriveted. Mainrails spliced together must use Splice Seismic separation junctions.



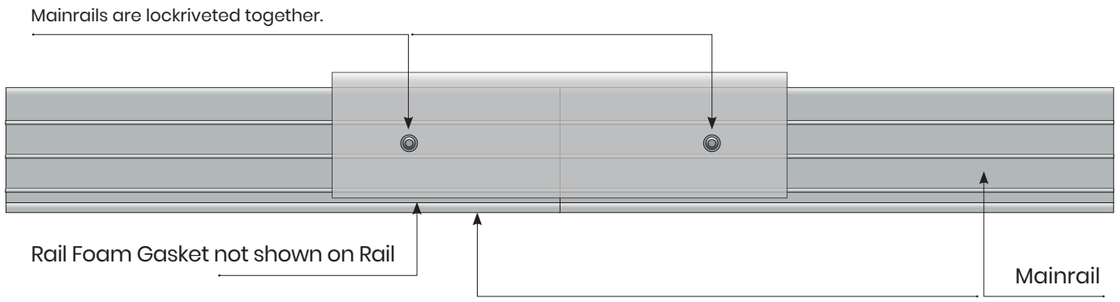
# Seismic Splice Junction

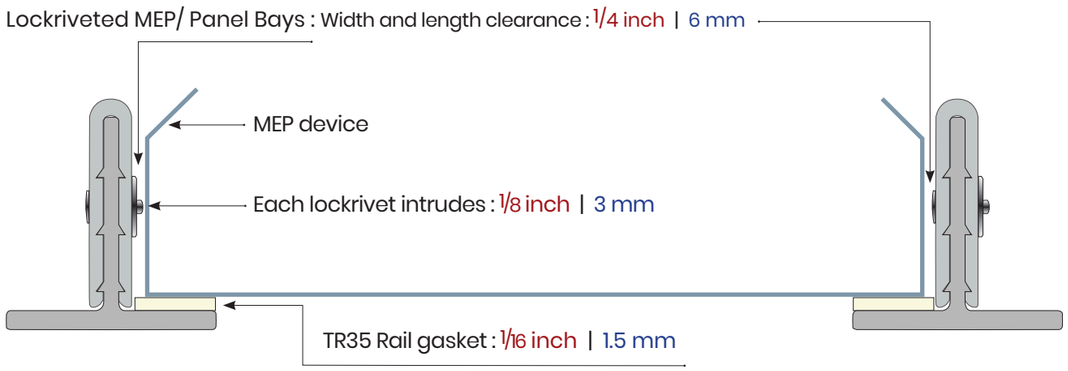
## Seismic Splice Junction : Seismic Categories C & D, E, F

**Seismic-step :** The TR35 grid is assembled with the Main & Cross rails seated on the ledge of the Wallrail to allow for seismic movement in categories C & D, E, F. The TR35 Wallrail ledge is 1½ inches wide, providing ample space for a seismic movement of 3/8 - 3/4 inch | 9.5 mm - 19 mm.

There are two arrays for Seismic Splice Junctions.
Splice clamp : Both intersecting Mainrails lockriveted together.
Splice clamp with Sliprail cover : One Mainrail is lockrivet with a sliprail cover to conceal the slip movement of the second Mainrail that is not lockriveted and facilitates a slip movement up to : 3/4 inch | 19 mm.

2x Lockrivets : Cat C
2x Lockrivets : Cat D, E, F areas smaller than 2500 sq.ft | 232 Sq meters




Lockriveted MEP Bays have a smaller housing area due to the lockrivets encroaching into the bay. When selecting an MEP device for a lockriveted MEP Bay, allow : 1/4 inch | 6 mm for both width & length.

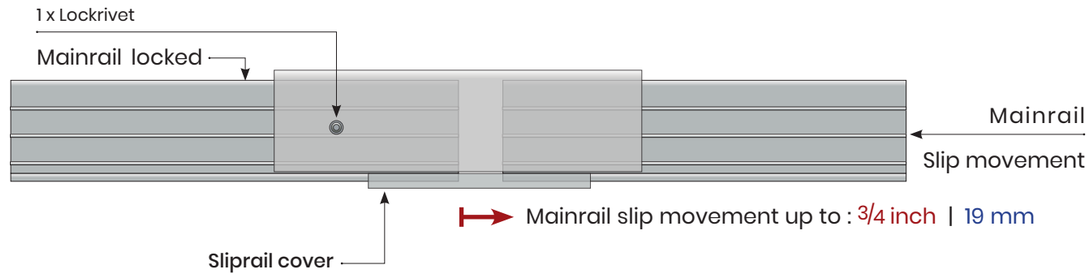
Lockriveted Panel Bays use the SHD panel system, SHD panels are slightly smaller by 1/4 inch | 6 mm

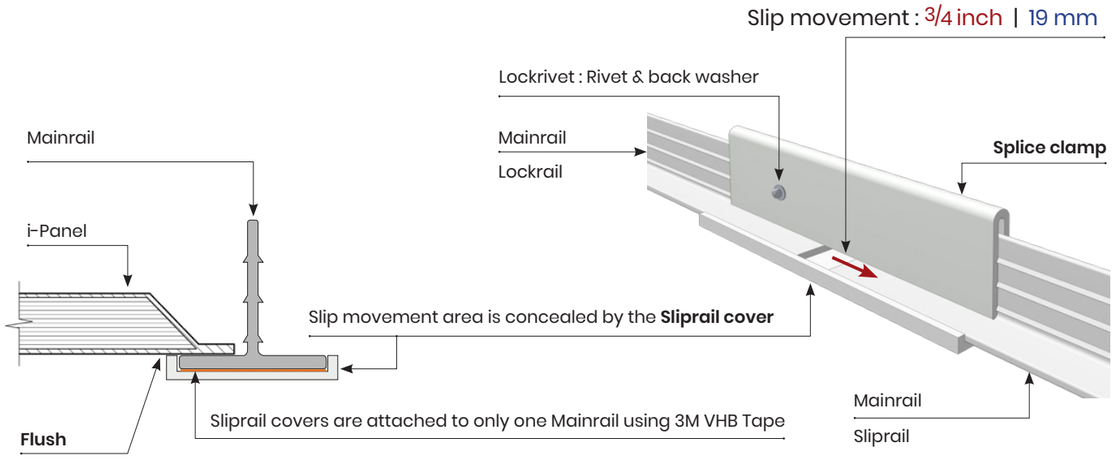




## Splice Seismic Separation Junction : Seismic Categories D, E, F

**ASCE / SEI 7 Section 13.5.6.2.2.d :** Seismic design Category D, E, F
Splice seismic separation junctions are required for areas exceeding 2500 sq.ft | 232 Sq meters




**Sliprail cover :** Sliprail covers align flush to the Mainrail and ceiling panel

**Splice seismic separation junction :** The junction is made up of 2 Mainrails, the first Mainrail is lockriveted to the Splice clamp, the second mainrail facilitates a slip movement of up to 3/4 inch | 19 mm.

**Slip movement :** The teeth of the Main and Cross Rail are designed to slip back and forward inside jaws of the clamp. This is how the Splice and T-Clamp controls the Main and Cross Rail's linear slip movement.

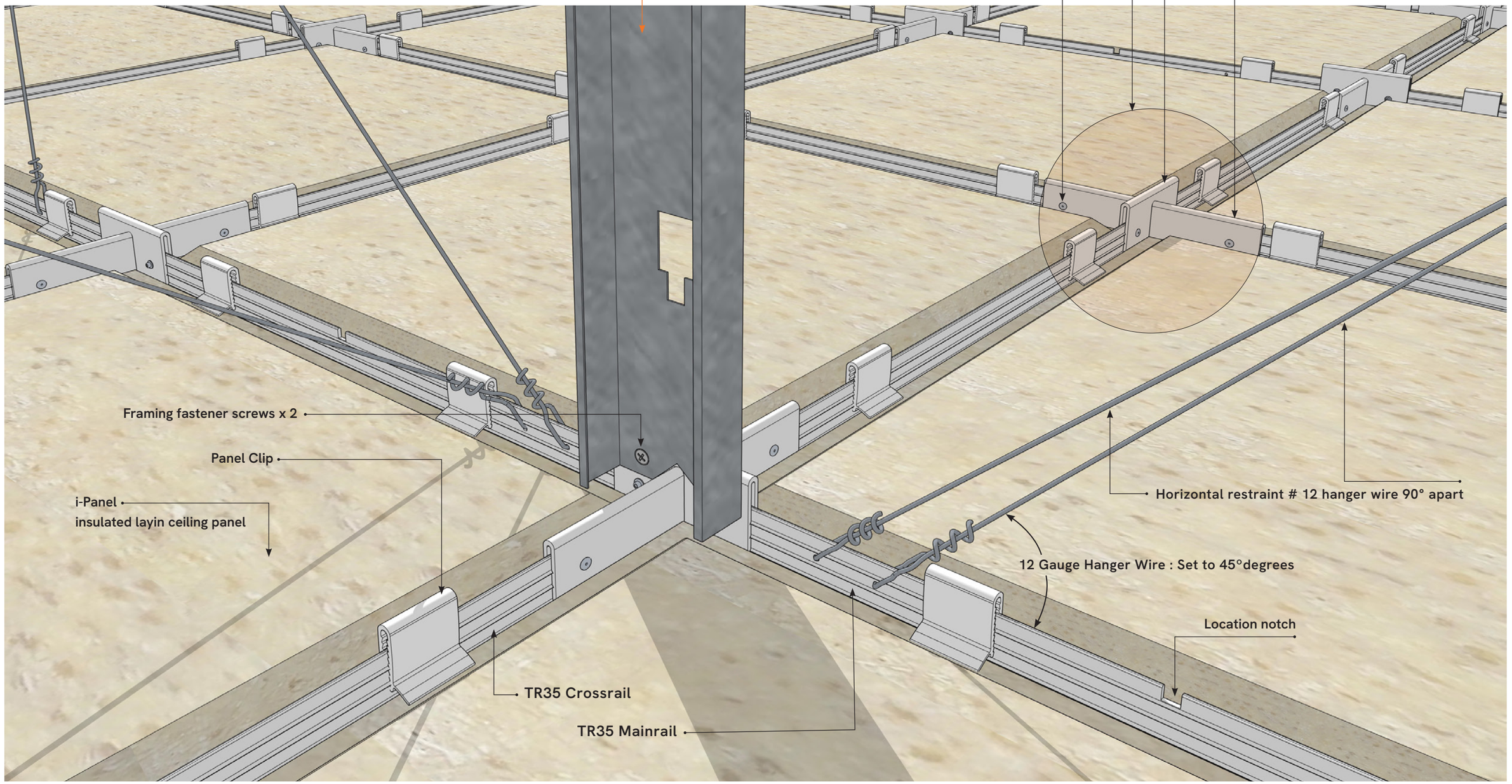
# Seismic compression post

Seismic Catagories : D, E, F

## Compression Post

**Steel stud Copression Post attached to overhead structure**

There are at least three variations on this seismic bracing system

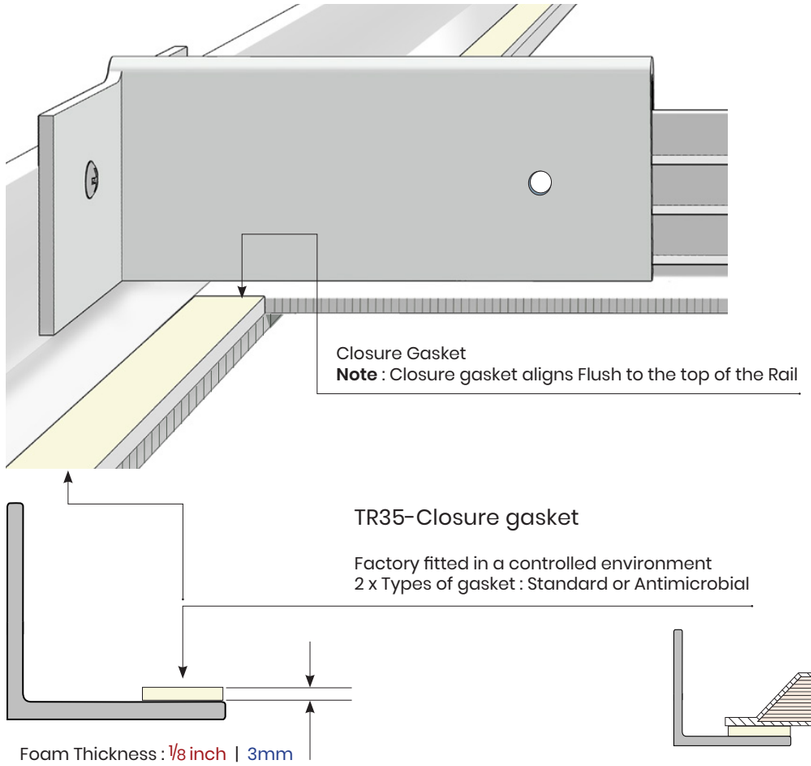



TR35 Grid with i-Panels, featuring Arcoplast Seismic compression post system

# Closure gasket

Closure & Rail gasket : Fitted along the Wallrail

Seismic Category C, D, E, F




**Note :** Cat C, D, E, F require a Closure gasket.

The closure gasket encloses the grid.
The ceiling panel is seated on the Main or Cross Rail and the Wallrail Closure gasket.
Panel Clips ensure the ceiling panel is seated correctly.

There are two types of Closure gasket .
1/ Closure gasket : Fitted only on the Wallrail ledge.
2/ Closure & Rail gasket : Fitted along the Wallrail with a separate Main and Cross Rail gasket.

| | |
|---|---|
| 1/ Closure gasket | 1/8 inch \| 3 mm ( Foam thickness ) |
| 2/ Closure & Rail gasket | 3/16 inch \| 4.5 mm ( Foam thickness ) |
| Main / Cross Rail foam gasket | 1/16 inch \| 1.5 mm ( Foam thickness ) |

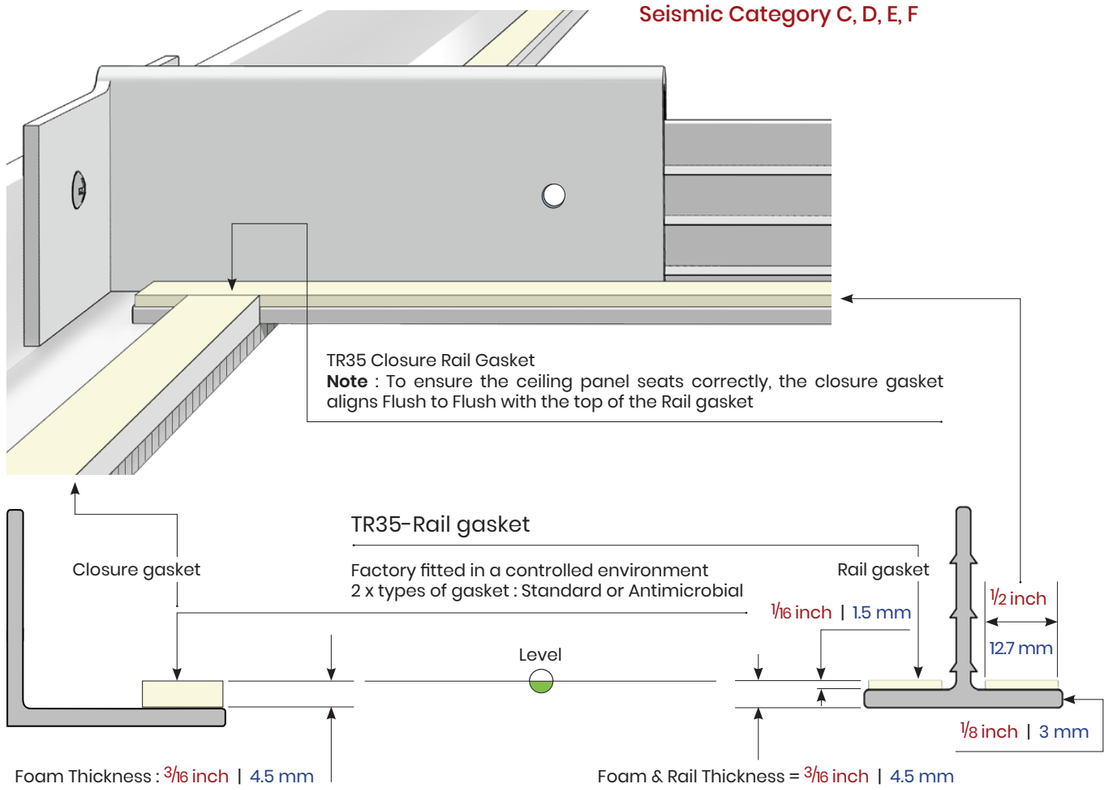




# Closure & Rail gasket

Closure & Rail gasket : Fitted along the Wallrail with a separate Main and Cross Rail gasket

Seismic Category C, D, E, F

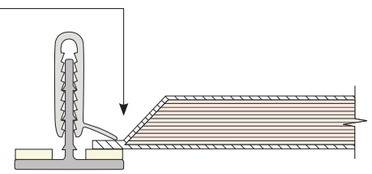



Closure & Rail gaskets are made of the same foam as the standard TR35 Foam Gasket.
TR35 Rail gasket : 1/16 inch | 1.5 mm is not as thick as the standard TR35 Foam Gasket.

**Note :** Cat C, D, E, F require a Closure gasket.

The closure gasket encloses the grid and allows for slip movement.
The ceiling panel rides on the Rail gasket, allowing the grid to move in an earthquake.
The grid slip movement is not impaired by the Closure or Rail gasket or the ceiling panel.
Panel Clips ensure the ceiling panel is seated correctly.

**Note :** The ceiling panel must not be attached with tape or sealants to the grid, as this will inhibit the slip movement of the grid.



An important difference between Seismic Category : A, B and Category C, D, E, F is the Seismic Step coupled with the Closure gaskets, working in conjunction with the internal structure of the grid assembly. It is these arrays that facilitate controlled movement, necessary in the event of a Category C, D, E, F seismic episode.

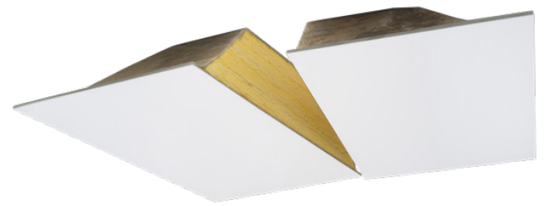
# Acryloyl / SHD Seismic Cat C, D, E, F / Heavy Duty

**Seismic / Heavy Duty ceiling panel, True dimensions**

| Profile | Imperial | | | Metric | | |
|---|---|---|---|---|---|---|
| Square edge | 0.25 inch | 23½ x 23½ inch | 2.0 Lb/Sq.ft | 6.3 mm | 597 x 597 mm | 9.70 Kg/SqM |
| Square edge | 0.375 inch | 23½ x 23½ inch | 3.5 Lb/Sq.ft | 9.5 mm | 597 x 597 mm | 17.09 Kg/SqM |
| Tegular edge | 0.375 inch | 23½ x 23½ inch | 3.0 Lb/Sq.ft | 9.5 mm | 597 x 597 mm | 14.60 Kg/SqM |
| **Profile** | **Imperial** | | | **Metric** | | |
| Square edge | 0.25 inch | 23½ x 35½ inch | 2.0 Lb/Sq.ft | 6.3 mm | 597 x 902 mm | 9.70 Kg/SqM |
| Square edge | 0.375 inch | 23½ x 35½ inch | 3.5 Lb/Sq.ft | 9.5 mm | 597 x 902 mm | 17.09 Kg/SqM |
| Tegular edge | 0.375 inch | 23½ x 35½ inch | 3.0 Lb/Sq.ft | 9.5 mm | 597 x 902 mm | 14.60 Kg/SqM |
| **Profile** | **Imperial** | | | **Metric** | | |
| Square edge | 0.25 inch | 23½ x 47½ inch | 2.0 Lb/Sq.ft | 6.3 mm | 596 x 1207 mm | 9.70 Kg/SqM |
| Square edge | 0.375 inch | 23½ x 47½ inch | 3.5 Lb/Sq.ft | 9.5 mm | 596 x 1207 mm | 17.09 Kg/SqM |
| Tegular edge | 0.375 inch | 23½ x 47½ inch | 3.0 Lb/Sq.ft | 9.5 mm | 596 x 1207 mm | 14.60 Kg/SqM |
| **Profile** | **Imperial** | | | **Metric** | | |
| Square edge | 0.25 inch | 11½ x 47½ inch | 2.0 Lb/Sq.ft | 6.3 mm | 292 x 1207 mm | 9.70 Kg/SqM |
| Square edge | 0.375 inch | 11½ x 47½ inch | 3.5 Lb/Sq.ft | 9.5 mm | 292 x 1207 mm | 17.09 Kg/SqM |
| Tegular edge | 0.375 inch | 11½ x 47½ inch | 3.0 Lb/Sq.ft | 9.5 mm | 292 x 1207 mm | 14.60 Kg/SqM |

**Conclusion :** TR35 Grids assembled using lockrivets, require the SHD ceiling panels that have a reduced length and width by : 1/4 inch | 6mm







# i-Panel /SHD Seismic Cat C, D, E, F / Heavy Duty

**Seismic / Heavy Duty ceiling panel, True dimensions**

Patent No: 6,068,907.

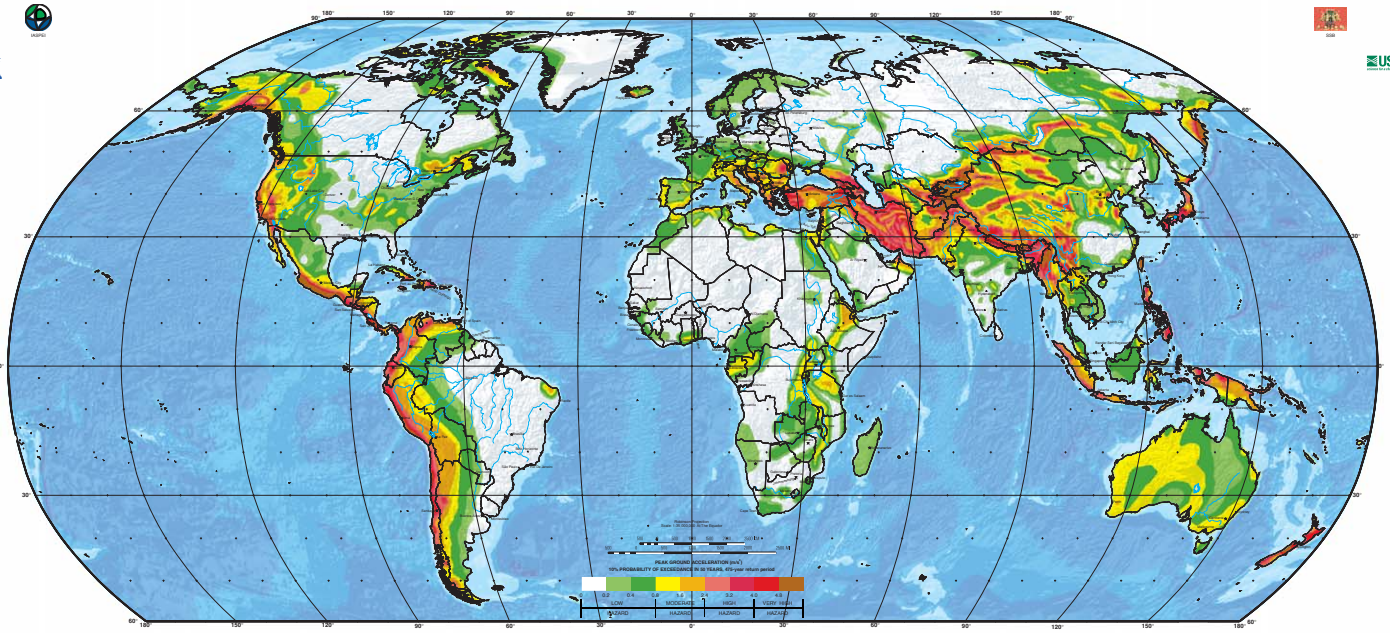
| Profile | R Value | Imperial | | | Metric | | |
|---|---|---|---|---|---|---|---|
| Tapper | R 2.368 | 5/8 inch | 47½ x 47½ inch | 1.15 Lb/Sq.ft | 15.9 mm | 1207 x 1207 mm | 5.61 Kg/SqM |
| Tapper | R 4.523 | 1⅛ inch | 47½ x 47½ inch | 1.25 Lb/Sq.ft | 28.6 mm | 1207 x 1207 mm | 6.09 Kg/SqM |
| Tapper | R 6.648 | 1⅝ inch | 47½ x 47½ inch | 1.35 Lb/Sq.ft | 41.3 mm | 1207 x 1207 mm | 6.58 Kg/SqM |
| Tapper | R 8.344 | 2⅛ inch | 47½ x 47½ inch | 1.45 Lb/Sq.ft | 53.9 mm | 1207 x 1207 mm | 7.07 Kg/SqM |
| **Profile** | **R Value** | **Imperial** | | | **Metric** | | |
| Tapper | R 2.368 | 5/8 inch | 23½ x 47½ inch | 1.15 Lb/Sq.ft | 15.9 mm | 597 x 1207 mm | 5.61 Kg/SqM |
| Tapper | R 4.523 | 1⅛ inch | 23½ x 47½ inch | 1.25 Lb/Sq.ft | 28.6 mm | 597 x 1207 mm | 6.09 Kg/SqM |
| Tapper | R 6.648 | 1⅝ inch | 23½ x 47½ inch | 1.35 Lb/Sq.ft | 41.3 mm | 597 x 1207 mm | 6.58 Kg/SqM |
| Tapper | R 8.344 | 2⅛ inch | 23½ x 47½ inch | 1.45 Lb/Sq.ft | 53.9 mm | 597 x 1207 mm | 7.07 Kg/SqM |
| **Profile** | **R Value** | **Imperial** | | | **Metric** | | |
| Tapper | R 2.368 | 5/8 inch | 11½ x 47½ inch | 1.15 Lb/Sq.ft | 15.9 mm | 292 x 1207 mm | 5.61 Kg/SqM |
| Tapper | R 4.523 | 1⅛ inch | 11½ x 47½ inch | 1.25 Lb/Sq.ft | 28.6 mm | 292 x 1207 mm | 6.09 Kg/SqM |
| Tapper | R 6.648 | 1⅝ inch | 11½ x 47½ inch | 1.35 Lb/Sq.ft | 41.3 mm | 292 x 1207 mm | 6.58 Kg/SqM |
| Tapper | R 8.344 | 2⅛ inch | 11½ x 47½ inch | 1.45 Lb/Sq.ft | 53.9 mm | 292 x 1207 mm | 7.07 Kg/SqM |
| **Profile** | **R Value** | **Imperial** | | | **Metric** | | |
| Tapper | R 2.368 | 5/8 inch | 23½ x 23½ inch | 1.15 Lb/Sq.ft | 15.9 mm | 597 x 597 mm | 5.61 Kg/SqM |
| Tapper | R 4.523 | 1⅛ inch | 23½ x 23½ inch | 1.25 Lb/Sq.ft | 28.6 mm | 597 x 597 mm | 6.09 Kg/SqM |
| Tapper | R 6.648 | 1⅝ inch | 23½ x 23½ inch | 1.35 Lb/Sq.ft | 41.3 mm | 597 x 597 mm | 6.58 Kg/SqM |
| Tapper | R 8.344 | 2⅛ inch | 23½ x 23½ inch | 1.45 Lb/Sq.ft | 53.9 mm | 597 x 597 mm | 7.07 Kg/SqM |
| **Profile** | **R Value** | **Imperial** | | | **Metric** | | |
| Tapper | R 2.368 | 5/8 inch | 23½ x 35½ inch | 1.15 Lb/Sq.ft | 15.9 mm | 597 x 902 mm | 5.61 Kg/SqM |
| Tapper | R 4.523 | 1⅛ inch | 23½ x 35½ inch | 1.25 Lb/Sq.ft | 28.6 mm | 597 x 902 mm | 6.09 Kg/SqM |
| Tapper | R 6.648 | 1⅝ inch | 23½ x 35½ inch | 1.35 Lb/Sq.ft | 41.3 mm | 597 x 902 mm | 6.58 Kg/SqM |
| Tapper | R 8.344 | 2⅛ inch | 23½ x 35½ inch | 1.45 Lb/Sq.ft | 53.9 mm | 597 x 902 mm | 7.07 Kg/SqM |

**Conclusion :** TR35 Grids assembled using lockrivets, require the SHD Ceiling Panel System that has a reduced length and width by : 1/4 inch | 6mm

# GLOBAL SEISMIC HAZARD MAP

Produced by the Global Seismic Hazard Assessment Program (GSHAP),
a demonstration project of the UN/International Decade of Natural Disaster Reduction, conducted by the International Lithosphere Program.

Global map assembled by D. Giardini, G. Grünthal, K. Shedlock, and P. Zhang
1999




GSHAP : Geological Seismic map presented with kind permission.

There are over 50 countries with unique seismic regulations. It is recommend that these standards be investigated on a country by country basis to comply with building codes. The assumption that US / California and New Zealand are amongst the “worst-case entire world” is not unreasonable. Reference the world map by GSHAP.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