

BRE Test Report

Operation and strength testing of Smart Architectural Aluminium SmartWall double swing, single leaf door to the requirements of BS6375-2:2009

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1 Introduction

At the request of Mark Walford, Technical Department, Smart Architectural Aluminium, Arnolds Way, Yatton, Bristol, North Somerset, BS49 4QN, BRE issued quotation number 136553 on 03 October 2014 covering the testing of the door to BS 6375-2:2009¹. The quotation was accepted on 07 October 2014 by Smart Architectural Aluminium.

This report details the results of operation and strength tests performed in accordance with the test methods defined in *BS 6375-2:2009 – Performance of windows and doors – Part 2: Classification for operation and strength characteristics and guidance on selection and specification*, on a SmartWall, double swing, single leaf door manufactured by Smart Architectural Aluminium.

The tests to methods in standards specified in BS 6375-2:2009 measure the operating forces, the strength and the resistance to repeated opening and closing of the specimen door. Classification of the results is based on standards referred to in BS 6375-2:2009.

Repeated opening and closing tests (clause 6.5 of BS 6375-2:2009) were carried out by Exova WarringtonFire, (UKAS accredited testing laboratory No.0621) finishing on 29 May 2015. At Exova WarringtonFire tests were coordinated by Christopher Bryan, under Job No. WIL349089 and reported on in document WIL349089² 29 May 2015.

Testing at BRE was conducted by Malcolm Pound on 17 November 2014 against job number 299802 under the BRE Terms and Conditions for Testing.



2 Test programme

The operation and strength tests were carried out to the requirements of standards specified in BS 6375-2:2009 for testing applicable to double swing doors.

BS 6375-2:2009 specifies performance requirements for doors and windows as manufactured, in glazed and fully furnished condition including hardware. It is applicable to most types of doors and windows. Before each test the specimen was opened and closed and the lock operated 5 times. Tests commenced after at least one week had elapsed since the manufacture of the specimen to allow weather strips to bed in and any sealants to fully cure. Storage and testing of the specimen were carried out in a non-destructive environment within the ranges of 10°C to 30°C and 25% to 75% relative humidity.

After the strength tests and before and after the repeated opening and closing tests the operating forces (as in clause 6.2) were re-measured to determine if the test specimen continued to function normally and meet the requirements for operating forces.

The resistance to repeated opening and closing test – Clause 6.5, was carried out by Exova WarringtonFire, (UKAS accredited testing laboratory No.0621).

The door has a single, double swing leaf. The tests listed below were applied to the specimen.

Clause 6.2 Operating forces

Tests as specified in BS EN 12046-2:2000 Operating forces – Test method – Part 2: Doors³. The test determines the force required when engaging or releasing the hardware of a door and when commencing the movement of a door leaf in both opening and closing directions.

When tested as above the performance achieved by the door shall not exceed the values specified in BS EN 12217: 2003⁴ Class 1 for external doors. Key operation ≤ 5 Nm or 20 N (Newtons), movement of door leaf ≤ 75 N.

Clause 6.3.1 Mechanical strength - Vertical load

Tests as specified in BS EN 947: 1999 Hinged or pivoted doors – Determination of the resistance to vertical load⁵. With a door leaf opened to $90^\circ \pm 5^\circ$ a vertical load acting downward of 800 N was applied for 5 minutes to the lock side top corner of the leaf. The diagonal (top lock corner to bottom hinge corner) and the location of the bottom lock corner were measured before and after application of the vertical load. After removal of the test load and examination of the specimen the operating forces were re-measured (see Clause 6.2).

When tested as above the performance achieved by the door shall be classified according to BS EN 1192: Doors – Classification of strength requirements⁶. The classification achieved shall be suitable for the required UK Category of duty. 800 N is Class 3 Heavy duty.



Clause 6.3.2 Mechanical strength - Resistance to static torsion

Tests as specified in BS EN 948: 1999 Hinged or pivoted doors – Determination of the resistance to static torsion⁷. With a door leaf opened to $90^{\circ} \pm 5^{\circ}$ the top lock side corner fixed in position. A load of 300 N was applied to the bottom free corner for 5 minutes. Deflections of the bottom free corner were measured before, during and after application of the load. After removal of the test load and examination of the specimen the operating forces were re-measured (see Clause 6.2).

When tested as above the performance achieved by the door shall be classified according to BS EN 1192: Doors – Classification of strength requirements. The classification achieved shall be suitable for the required UK Category of duty. 300 N is Class 3 Heavy duty.

Clause 6.3.3 Mechanical strength - Soft and heavy body impact

Tests as specified in BS EN 949:1999 Windows and curtain walling, doors, blinds and shutters – Determination of the resistance to soft and heavy body impact for doors⁸. The test determines the damage caused by striking the closed and locked door leaf with a soft and heavy body.

When tested as above the performance achieved by the door shall be as specified in BS EN 1192 Clauses 4 and 4.4:

Clause 4 – imposed stresses and accidental impacts on doors shall neither damage them nor impair their performance.

Clause 4.4 – the resultant residual deformation in flatness measured in accordance with BS EN 949 shall not exceed 2 mm.

The performance class achieved shall be suitable for the required UK category of duty. BS 6375-2:2009 Table 5, Class 1 Light duty, Class 2 Medium duty, Class 3 Heavy duty or Class 4 Severe duty.

Clause 6.3.4 Mechanical strength - Hard body impact

Tests as specified in BS EN 950:1999 Door leaves – Determination of the resistance to hard body impact⁹. The test determines the damage caused by striking the door leaf frame with a hard object. The test is used to determine the structural integrity of the construction and not the effect of such impacts upon appearance.

When tested as above the performance achieved by the door shall be as specified in BS EN 1192 Clauses 4 and 4.5:

Clause 4 – imposed stresses and accidental impacts on doors shall neither damage them nor impair their performance.

Clause 4.5 – when measured according to BS EN 950 the mean value of the diameters of indentations (caused by the hard body impact tests) shall not exceed 20 mm and the mean value of the depths of indentations caused shall not exceed 1.0 mm and the maximum value shall not exceed 1.5 mm.

The performance class achieved shall be suitable for the required UK category of duty. BS 6375-2:2009 Table 5, Class 1 Light duty, Class 2 Medium duty, Class 3 Heavy duty or Class 4 Severe duty.



Clause 6.4 Load bearing capacity of safety devices

The door specimen was not fitted with any hardware specified as a safety device.

Clause 6.5 Resistance to repeated opening and closing

Test as specified in BS EN 1191: 2000 Windows and doors – Resistance to repeated opening and closing – Test method¹⁰. The side hung opening leaf on the door was opened and closed at least 200,000 times using the locking hardware it is equipped with. The operating forces are measured before and after the repeated cycles of operation.

When tested as above the door shall remain functional in relation to its operating forces, i.e. the initial and final operating forces shall fall within the same classification. The specimen shall not suffer damage or deformation that would cause the door to be unfit for its purpose. 200,000 cycles equates to Class 3 Heavy duty in BS EN 12400:2002 Windows and pedestrian doors – Mechanical durability – requirements and classification¹¹.

The performance class achieved shall be suitable for the required UK category of duty. BS 6375-2:2009 Table 6, Classes 1, 2 and 3 Light duty, Classes 4 and 5 Medium duty, Class 6 Heavy duty and Classes 7 and 8 Severe duty.

The resistance to repeated opening and closing test was performed for BRE by Exova WarringtonFire (UKAS number 0621).



3 Test specimen

A SmartWall double swing door specimen, manufactured in October 2014, was submitted on 17 November 2014 for testing to the requirements of BS 6375-2:2009. The specimen was allocated the unique BRE reference number 299802.

The overall size of the door frame is 1200 mm wide x 2500 mm high.

The design and component details of the door tested are given in Section 5 Test results - work sheets, of this report. These details were based on the documentation provided and observations from the specimen. Drawings and photographs in the Annex of this report show cross sections of the frame members and details.



4 Test rigs and preparatory procedures

For tests performed at BRE the test specimen was conditioned for at least 4 hours within temperature and humidity ranges specified in the test standards of 10°C to 30°C and 25% to 75% RH respectively.

The test specimen was mounted in the BRE test rig for all of the tests except that for resistance to repeated opening and closing, BS 6375-2:2009 Clause 6.5 for doors. The BRE test rig consists of rigid steel sections and moveable steel columns adjusted to fit the specimen that is held in the rig by clamps around its edge.

For the resistance to repeated opening and closing test, the test rig is constructed and operates in a similar manner to the BRE test rig with the addition of apparatus to operate door leaves and hardware sequentially.



5 Test results – work sheets – Specimen 299802

Test team

Name	Company
M Pound	BRE

Witnesses

Name	Company
Anthony Perry	Technical Department - Smart Architectural Aluminium

Test laboratory conditions at start of test

Temperature (°C)	22
Relative humidity (%RH)	45
Barometric pressure (mb)	989

Details of test specimen 299802

One door specimen was submitted on 17 November 2014 for testing to the requirements of BS 6375-2:2009. This was allocated a unique BRE reference number 299802.

The design and component details of the door tested were as follows, based on documents provided by Smart Architectural Aluminium and observations from the test specimen. Drawings and photographs in the Annex of this report show cross sections of the frame members and details.

The specimen was kept in the test laboratory for at least 4 hours prior to testing.

**Table 1** General description

Manufacturer's name and address:	Technical Department, Smart Architectural Aluminium, Arnolds Way, Yatton, Bristol, North Somerset, BS49 4QN
Product designation (e.g. trade name/model):	SmartWall
Configuration:	Double swing, single side-hung leaf
Material:	Aluminium frame members
Overall dimensions:	1200 mm wide x 2500 mm high
Description of outer frame:	Aluminium with thermal breaks
Description of door leaf frame:	Aluminium with thermal breaks
Description of hardware:	Overhead closer, integral with the frame. Pivots top and bottom. Single key operated locking point
Description of glazing/infill:	28 mm double glazed unit
Description of seals/gaskets:	The door leaf had seals around the edges. Glazing seals were retained in aluminium frame members and the aluminium glazing beads.

Table 2 Outer frame details

Component description	Supplier	Part No./Codes
Outer frame	Smart Architectural Aluminium	Frame head and jambs, frame threshold
Outer frame jointing method:	Glued and cleated (jambs to head) Blocks and two screws (Jambs to threshold)	
Outer frame surface treatment:	Aluminium	

**Table 3** Door leaf frame details

Component description	Supplier	Part No./Code
Door leaf frame	Smart Architectural Aluminium	Stile and rail leaf framing
Sash jointing method:	Cleated and crimped	
sash surface treatment:	Aluminium	

Table 4 Hardware details

Hardware description	Supplier	Part No./Code	Fixings
Pivots			Supplied with hinges
Dead Lock	Adamsrite		
Cylinder & pull handle	Yale		

Table 5 Glazing/infill details

Component description	Supplier	Part No./Code
Insulating glazing unit 923 mm wide x 2230 mm high	Astra	-
Glazing beads – clip-in - aluminium	Smart Architectural Aluminium	
Glazing thickness and composition	28 mm overall. 6 mm thick toughened clear glass and 16 mm spacer	
Internally or externally glazed:	Glazed from one side	

Table 6 Seal details

Component description	Supplier	Part No./Code
Door frame weather seal	Smart Architectural Aluminium	
Glazing gasket external	Smart Architectural Aluminium	
Glazing gasket internal	Smart Architectural Aluminium	



Figure 1. SmartWall single leaf, double swing door installed in the test rig



Results of tests

The results of tests conducted to the relevant clauses from BS 6375-2:2009 on 17 November 2014 are given below.

Before conducting the tests the door and hardware were operated five times.

Clause 6.2 – Initial operating forces

The operating forces were measured in accordance with BS EN 12046-2.

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test*	ü	ü	ü	ü
Torque to lock key	<0.1	<0.1	<0.1	<0.1
Torque to unlock key	0.35	0.30	0.30	0.32
Force to commence motion	56.0	56.0	56.5	56.2
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm



Clause 6.3.1 Mechanical strength – resistance to vertical load

The resistance to vertical load test was conducted in accordance with BS EN 947:1999.

The diagonal of the door leaf prior to conducting the test.	2520 mm
Vertical load applied	800 N
Maximum deformation under load.	0.97 mm
Residual deformation 3 minutes after removal of the load.	0.52 mm
The diagonal of the door leaf after conducting the test.	2520 mm
Class achieved	Class 3

After Clause 6.3.1 repeat Clause 6.2 - Operating forces

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test*	ü	ü	ü	ü
Torque to lock key	0.2	0.2	0.2	0.2
Torque to unlock key	0.35	0.35	0.35	0.35
Force to commence motion	56.5	56.5	56.5	56.5
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm



Clause 6.3.2 Mechanical strength – resistance to static torsion

The resistance to static torsion test was conducted in accordance with BS EN 948:1999.

Load applied	300 N
Maximum deformation under load.	51.49 mm
Residual deformation 3 minutes after removal of the load.	0.23 mm
Class achieved	Class 3

After Clause 6.3.2 repeat Clause 6.2 - Operating forces

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test*	ü	ü	ü	ü
Torque to lock key	0.1	0.1	0.1	0.1
Torque to unlock key	0.1	0.1	0.1	0.1
Force to commence motion	56.5	56.5	56.5	56.5
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm



Clause 6.3.3 - Resistance to soft and heavy body impact

The resistance to soft and heavy body impact test was conducted in accordance with BS EN 949:1999.

The maximum deviation in flatness prior to conducting the test was 0 mm

Impacts in the direction of opening (i.e. three impacts to the indoor face of the leaf). Symmetrical construction so one face only tested.

Door leaf	Impacts and energy	Residual deformation in flatness after impacts	Observations
Single leaf	1 at 120 J	-	No visual damage to door leaf or hardware
Single leaf	1 at 120 J	-	No visual damage to door leaf or hardware
Single leaf	1 at 120 J	0.8 mm	No visual damage to door leaf or hardware

The door set achieved	Class 3
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After Clause 6.3.3 repeat Clause 6.2 - Operating forces

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test	ü	ü	ü	ü
Torque to lock key	>0.1	>0.1	>0.1	>0.1
Torque to unlock key	0.2	0.2	0.2	0.2
Force to commence motion	56.1	56.1	56.1	56.1
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm



Clause 6.3.4 - Resistance to hard body impact

The resistance to hard body impact test was conducted in accordance with BS EN 950:1999. Pattern 4 on the aiming template was chosen for the impacts as this included various points on the aluminium door stiles and rails. Only the indoor face of the leaf was impacted as the construction of the non-glazed areas were identical on both faces.

The door leaf was not removed from the door frame for this test for health and safety reasons. However, the door leaf was laid horizontally and was supported by timbers laid underneath the long edges of the door leaf.

Impacts were applied starting at the bottom lock side corner and working upwards and around. The depths of any indentations left on the face of the door leaf following the impacts were measured as follows:

Impacts at 5J	Depth of indentation (mm)	Diameter of deflected area (mm)
1	0.3	10.0
2	1.0	15.0
3	0.8	14.0
4	0.9	14.0
5	0.8	14.0
6	1.0	14.0
7	0.5	15.0
8	1.2	16.0
9	0.7	12.0
10	0.2	12.0
11	1.0	14.0
12	1.1	14.0
13	1.2	16.0
14	1.1	16.0
15	1.0	14.0

The impactor did not damage the door to the extent that it passed through the door leaf or cause any component to fail. The mean value of the diameter of the indentations was 14.0 mm. The mean value of the depth of the indentations was 0.85 mm. The maximum indentation depth was 1.2 mm.

The door set achieved	Class 3
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Clause 6.5 Resistance to repeated opening and closing

The resistance to repeated opening and closing test was conducted for BRE at a separate test laboratory. The test results are given here:

Before Clause 6.5 repeat Clause 6.2 - Operating forces

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test*	ü	ü	ü	ü
Torque to lock key	<0.3	<0.3	<0.3	<0.3
Torque to unlock key	<0.3	<0.3	<0.3	<0.3
Force to commence motion	52.3	52.3	52.3	52.3
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm

Test: Repeated opening and closing	Results
200,000 cycles of operation in each direction	Pass. Class 6. The door continued to operate normally after 200,000 cycles of operation

After Clause 6.11 repeat Clause 6.3 - Operating forces

Tests	Results			
	1 st test	2 nd test	3 rd test	Average
Dynamic closing test*	ü	ü	ü	ü
Torque to lock key	<0.3	<0.3	<0.3	<0.3
Torque to unlock key	<0.3	<0.3	<0.3	<0.3
Force to commence motion	40.8	40.8	40.8	40.8
Class achieved	Class 1			

*ü = single leaf closed to a central position (leaf swings equally in both directions) by action of self-closure device, no latch fitted.

Forces measured in Newtons N. Torques measured in Newton metres Nm



6 Summary

The operation and strength of a specimen of Smart wall, single leaf, glazed, double swing door, met the performance requirements specified in BS 6375-2:2009 as given below:

Summary of results for tests carried out:

Characteristic	Test method	Requirement	Results
Operating forces	BS EN 12046-2	BS EN 12217 Class 1 external doorsets	Met Class 1*
Resistance to vertical loading	BS EN 947	BS EN 1192 Class 3 800 N	Met Class 3
Resistance to static torsion	BS EN 948	BS EN 1192 Class 3 300 N	Met Class 3
Soft and heavy body impact	BS EN 949	BS EN 1192 Class 3 120 J x 3 impacts	Met Class 3
Hard body impact	BS EN 950	BS EN 1192 Class 3. 5 J impacts	Met Class 3
Resistance to repeated opening and closing	BS EN 1191:2000	BS EN 12400:2002 200,000 cycles	Met Class 6 (Heavy duty)

*Met Class 1 throughout the testing and after the final test at BRE

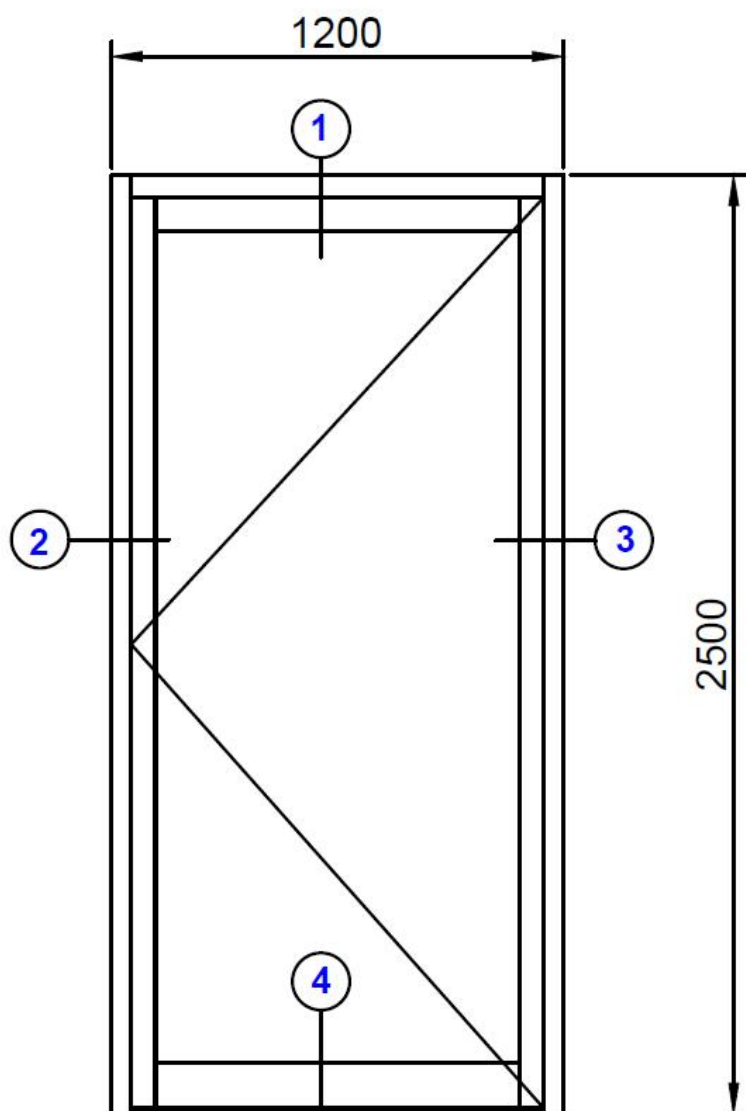
Class 3 is Heavy/severe duty – high frequency of use without care, where there is a good chance of accident occurring or of misuse.



Smart Wall Single Door.

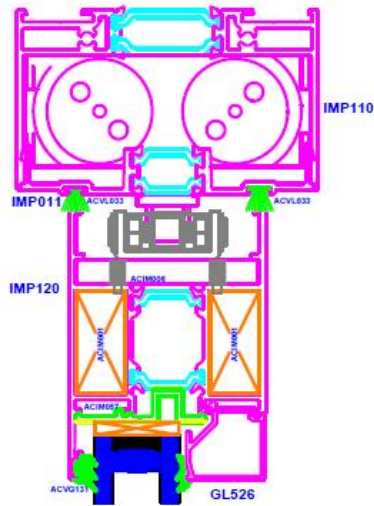
Adams Rite Sentinel Six Lock.

Adams Rite OHCC.

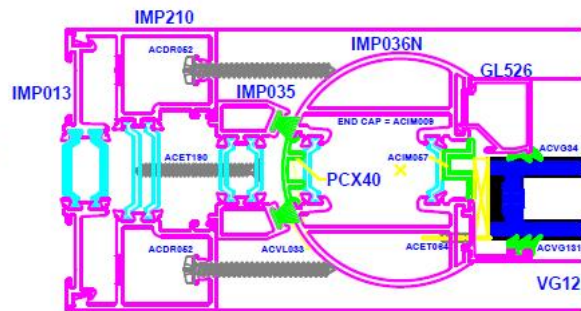




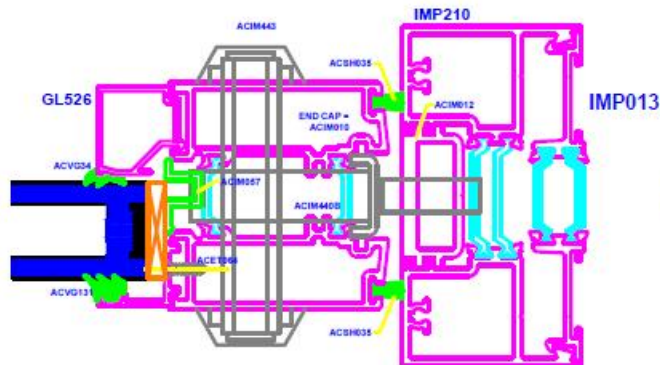
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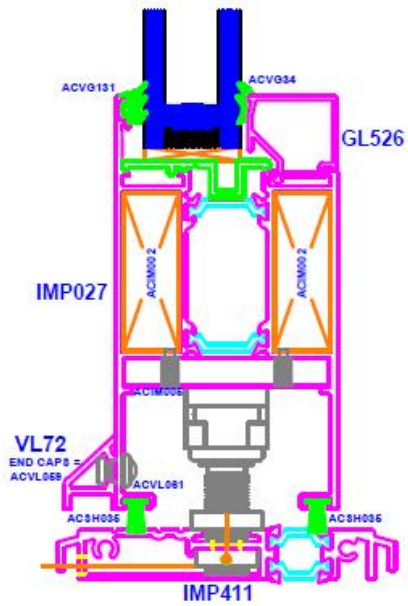


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