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LIV BUILDING PRODUCTS
TEST REPORT

SCOPE OF WORK
TESTING OF INVISIRAIL™ TO ASSESS RESISTANCE TO LIVE LOADS FOR EXTERIOR GUARDS AS PRESCRIBED IN THE 2018 IRC.

REPORT NUMBER
103287266TOR-001R1

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02/20/18

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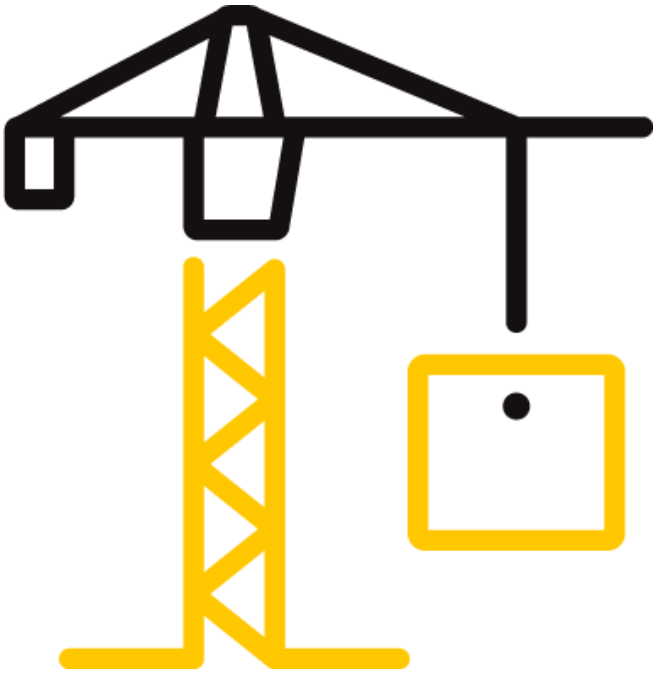

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TEST REPORT FOR LIV BUILDING PRODUCTS

Report No.: 103287266TOR-001R1
Date: 02/20/18

REPORT ISSUED TO

CUSTOMER FULL NAME
LIV Building Products
6050 Owen Road
Uxbridge, ON, L6P 1R1

SECTION 1

SCOPE

Intertek Building & Construction (B&C) was contracted by LIV Building Products (LIV) to perform testing of InvisiRial™ guard systems to assess resistance to the Live Loads prescribed in the 2018 International Residential Code, Sentence R301.5 d, f, h, and Table R301.5. Shot bag impact testing was additionally requested in accordance with ASTM E2353-16 Performance of Glazing in Permanent Railing Systems, Guards and Balustrades, section 13.3. The testing was performed during the period November 10, 2017 to February 9, 2018.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

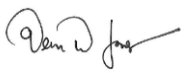
SECTION 2

SUMMARY OF TEST RESULTS

The SLX Invisirail™ and SS InvisiRail™ guard systems, with a maximum 70 in. long tempered glass glazing infill, as detailed in this report demonstrated resistance to the Live Loads prescribed in the 2018 International Residential Code, Sentence R301.5 d, f, h, and Table R301.5. Safety factors as outlined in this report were applied to the specified Live Loads.

The SLX Invisirail™ and SS InvisiRail™ guard systems, with a maximum 70 in. long tempered glass glazing infill, as detailed in this report resisted a shot bag impact of 100 lb swung from a height of 48 in.

For INTERTEK B&C:

COMPLETED BY:	Vern Jones	**REVIEWED BY:**	Joe DeRose, P. Eng.
TITLE:	Technician	**TITLE:**	Project Engineer
SIGNATURE:		**SIGNATURE:**	
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SECTION 3
EQUIPMENT

Calibration of test equipment was performed by Intertek B&C in accordance with ISO 17025 requirements.

Table 1 – Equipment		
Instrument/Equipment	**Asset #**	**Calibration Due Date**
Powerfist 24 in. stroke hydraulic ram	n/a	n/a
Electric Hydraulic Pump	n/a	n/a
Load Cell with Display	280-01-0774	Jan 15, 2019
600 mm Scale	280-01-1234	Feb 13, 2018
Mitutoyo Digital Indicator	280-01-0585	Mar 28, 2018

SECTION 4
TEST PROCEDURE

The IRC specified Live Loads are summarized in Table 2 below:

Table 2 – 2015 IRC Minimum Specified Loads	
Load Applied at any Point and Any direction at the Maximum Height of the Guard	**Horizontal Load Applied Elements Within the Guard, Including Solid Panels and Pickets**
Concentrated load of 200 lbf (0.89 kN)	Concentrated load of 50 lbf (0.224 kN) applied at any point on infill elements

The applicable test loads to be applied are based on the specified loads in Table 2 increased by a safety factor of 4 for loads applied to the glass glazing in accordance with 2018 IRC R301.4 note h, and a safety factor of 2.5 applied to the metal top rail and post.

The deflections of the guard system components under the specified and factored loads were measured and are detailed in this report.

Vertical Concentrated Load -Continuous Top Rail

A downward concentrated load of 2.22 kN (500 lbf) was applied to the stainless steel top rail by means of a loading system comprised of a calibrated load cell/single ram/pump system and a 100 mm by 100 mm platen. After release of the load, the system was evaluated for failure, evidence of disengagement of any component, and visible cracks in any component.

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Horizontal Concentrated Load - Continuous Top Rail

A concentrated horizontal load of 2.22 kN (500 lbf) was applied to the stainless steel top rail at the midspan, and separately centered over the post, by means of the loading system comprised of a calibrated load cell/single ram/pump system and a 100 mm by 100 mm platen. After release of the load, the system was evaluated for failure, evidence of disengagement of any component, and visible cracks in any component.

Horizontal Concentrated Load - Continuous Top Rail End Connection (Corner Condition)

For the testing of a corner condition a post, 1588mm glass in-fill panel and a return continuous top rail was added perpendicular to the guard assembly. The return section was restrained so as to create a fixed continuous top rail return. An outward concentrated horizontal load of 2.22 kN (500 lbf)) was applied to the continuous top rail adjacent to the corner by means of the loading system comprised of a calibrated load cell/single ram/pump system and a 100 mm by 100 mm platen. After release of the load, the system was evaluated for failure, evidence of disengagement of any component and visible cracks in any component.

Horizontal Concentrated Load - Post

A concentrated horizontal load of 2.22 kN (500 lbf) was applied to continuous the top rail at the post location by means of the loading system comprised of a calibrated load cell/single ram/pump system and a 100 mm by 100 mm platen. After release of the load, the system was evaluated for failure, evidence of disengagement of any component, and visible cracks in any component.

Horizontal Load on Infill

An outward concentrated horizontal test load of 0.89 kN (200 lbf) was applied to the center of the glass light by means of the loading system comprised of a calibrated load cell/single ram/pump system and a 100 mm by 100 mm platen. After release of the load, the system was evaluated for failure, evidence of disengagement of any component, and visible cracks in any component.

Shot Bag Impact on Infill

A test apparatus capable of supporting a 45.4 kg (100 lbs) and allowing unimpeded swinging was set up. A 45.4 kg (100 lbs) shot bag was suspended from the overhead support via a 1.83 m (6') cable and positioned to impact the geometric centre of the glass infill panel. The shot bag was pulled back and upwards through an arc shaped trajectory to the required test height and then released, impacting the centre of the glass infill panel. The test was performed at 540 J (400 ft·lbs).

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SECTION 5
TEST SPECIMEN DESCRIPTION

The SLX Invisirail™ guard system tested consisted of two aluminum end posts, an interior InvisPost aluminum post, a continuous stainless steel tube top rail, and two 10 mm tempered glass infill panels. For the corner condition test, the return guard section described in Section 4 was connected to the test guard at the SLX Invisirail™ end post.

When installed, the guard length, center-to-center of post, for the two sections measured 71 in. (1803 mm) and 73 (1854mm). As installed, the top of the top rail was 42.5 in. (1080 mm) up from the floor surface.

The SS InvisRail™ guard system as tested and detailed in Intertek report 102784150TOR-001a IRC dated September 6, 2017 consisted of two stainless steel InvisiPosts, a continuous stainless steel tube top rail, and one 10 mm tempered glass infill panels. For the corner condition test, a return guard section was connected to the test guard at the end post.

GUARD ASSEMBLY DESCRIPTION

The Invisirail™ guard system component descriptions and key dimensions are summarized in Table 3.

Table 3: Guard Assembly Description

Component	Part	Part /Drawing Number	Part Dimensions (mm)			Reported Material
			Length In. (mm)	Width in. (mm)	Thickness In. (mm)	
InvisiPost Aluminum Post, Surface Mount	Post welded to 4.75 in. (121mm) x 2.5 in. (64 mm) x 0.375 in. (9.5mm) surface mount base.	1511.2391	42.5 (1080)	2.83 (72) to 1.89 (48) taper	0.394 (10)	Aluminum
InvisiPost SS Post, Surface Mount	Post welded to 4.75 in. (121mm) x 2.5 in. (64 mm) x 0.375 in. (9.5mm) surface mount base.	1406.0793	42.5 (1080)	2.5 (64) to 1.50 (38) taper	0.315 (8)	Stainless Steel
ALX HD Aluminum Post (for SLX Invisirail™), Surface Mount	Post welded to 5.0 in. (127mm) x 5.0 in. (127mm) x 0.375 in. (9.5mm) surface mount base.	IN136608	44 (1118)	2.5 (64) x 2.5 (64)	0.150 (3.8)	Aluminum

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Table 3: Guard Assembly Description						
Component	**Part**	**Part /Drawing Number**	**Part Dimensions (mm)**			**Reported Material**
			Length In. (mm)	**Width in. (mm)**	**Thickness In. (mm)**	
Continuous Top Rail	Rail	-	152 (3861)	1.654 (42) OD	0.063 (1.6)	Stainless Steel
	Rail Corner Multi-Angle Fitting	1412.2463 (male section), 1412.3678 (female section	Per Appended Drawing(s)			Stainless Steel
	Inline - Rail to Post Bracket	1711.0736	Per Appended Drawing(s)			Stainless Steel
	Corner – Rail to Post Bracket	1711.0712	Per Appended Drawing(s)			Stainless Steel
Glass Light	10mm Tempered Glass	-	69.8 (1773) 67.9 (1588)	38.9 (987) 38.9 (987)	0.394 (10) 0.394 (10)	Tempered Glass
	Clamp s (4 per section) located 75 mm up from lower edge of glass, and 60 mm down from upper edge of glass on both sides.	-	64	45	6.3	Stainless Steel
	Glass Clip Sandwich Fasteners (2 each)	-	M6x1.0 Countersink 10mm screw type			Stainless Steel
	Glass Retaining Pin	-	20 by 8 OD			Stainless Steel
	Retaining Pin Bushing	-	8 by 12 OD			Nylon

SPECIMEN PREPARATION

The test guard assembly was assembled by the client. For testing of the guard assemblies, the post surface mount flanges were anchored to concrete and wood substrate as follows:

	Number of Fasteners	**Concrete Slab**	**6 x 6 SPF Wood Beam**
InvisiPost Aluminum Surface Mount	6	Cobra Tork concrete screw anchors (5/16 X 3 inch)	US Fasteners™ 2-22 106000 (3/8 x 6 in.)
InvisiPost SS Surface Mount	6		
ALX HD Aluminum Surface Mount (for SLX Invisirail™)	4		

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CONDITIONING

The guard specimens were tested in the laboratory under ambient conditions. No specific conditioning parameters were required before testing.

TESTING OF SLX INVISIRAIL™

Load Type	IRC Specified Load	Applicable Safety Factor	Required/Applied Factored Load	Outward Load Deflection (mm)	Live Load Resistance
In-fill Load	0.224 kN (50 lbf)	4	0.89 kN (200 lbf)	22	Pass
Midspan Vertical Concentrated Load at Continuous Top Rail	0.89 kN (200 lbf)	2.5	2.22 kN (500 lbf)	28	Pass
Midspan Horizontal Concentrated Load at Continuous Top Rail	0.89 kN (200 lbf)	2.5	2.22 kN (500 lbf)	35	Pass
Adjacent to Post Concentrated Load at Continuous Top Rail	0.89 kN (200 lbf)	2.5	2.22 kN (500 lbf)	25	Pass
Top of Post Concentrated Load	0.89 kN (200 lbf)	2.5	2.22 kN (500 lbf)	25	Pass
Corner Condition Adjacent to Post Concentrated Load at Continuous Top Rail	0.89 kN (200 lbf)	2.5	2.22 kN (500 lbf)	6	Pass

No evidence of disengagement or visible cracks were observed in any component of the guard system

The SS InvisRail™ guard system was tested as detailed in Intertek report 102784150TOR-001a IRC dated September 6, 2017.

SHOT BAG IMPACT TESTING OF GUARD SYSTEMS

The 70 in. (1773mm) tempered glass infill panel secured to posts was tested at the 540 J (400 ft·lbs) impact level. The tempered glass panel was unbroken and the panel was retained. The bottom left glass clip fastener was loosened but did not disengage from the post.

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SECTION 6
CONCLUSION

Intertek has conducted testing for LIV Building Products on the SLX InvisiRail® guard system.

The SLX Invisirail™ and SS InvisiRail™ guard systems, with a maximum 70 in. long glass glazing infill, as detailed in this report demonstrated resistance to the Live Loads prescribed in the 2018 International Residential Code, Sentence R301.5 d, f, h, and Table R301.5. Safety factors as outlined in this report were applied to the specified Live Loads.

The SLX Invisirail™ and SS InvisiRail™ guard system, with a maximum 70 in. long glass glazing infill, as detailed in this report resisted a shot bag impact of 100 lb swung from a height of 48 in.

SECTION 7
DRAWINGS

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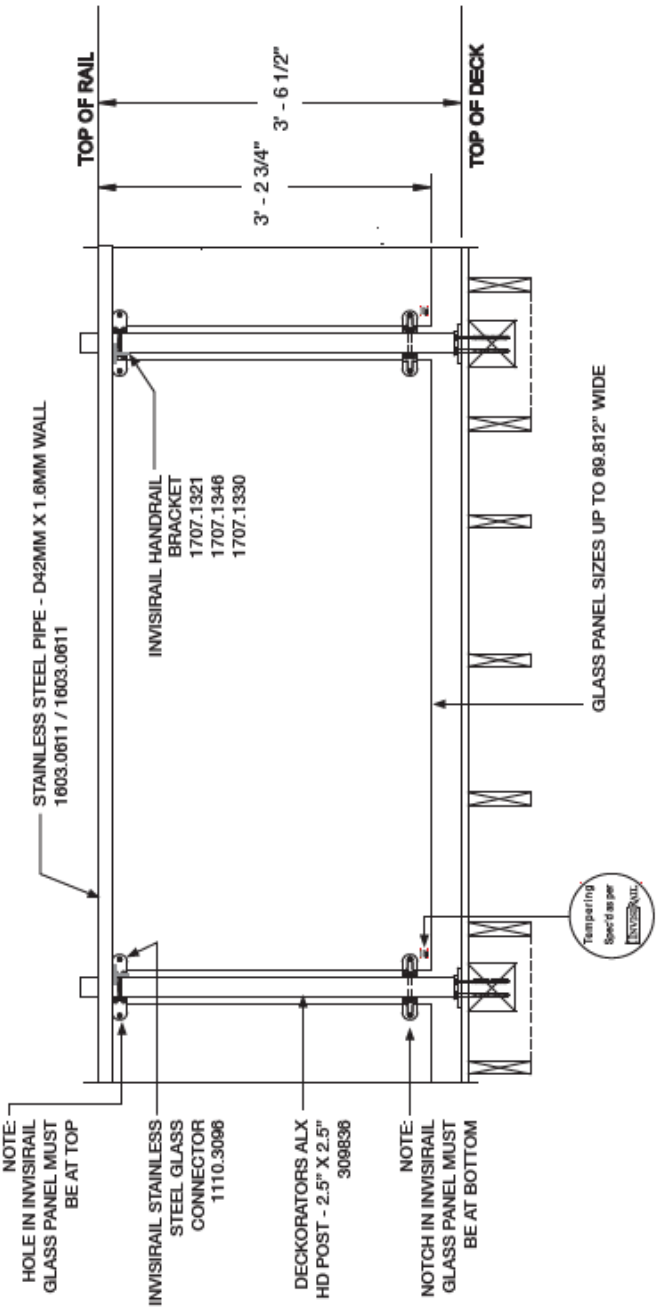

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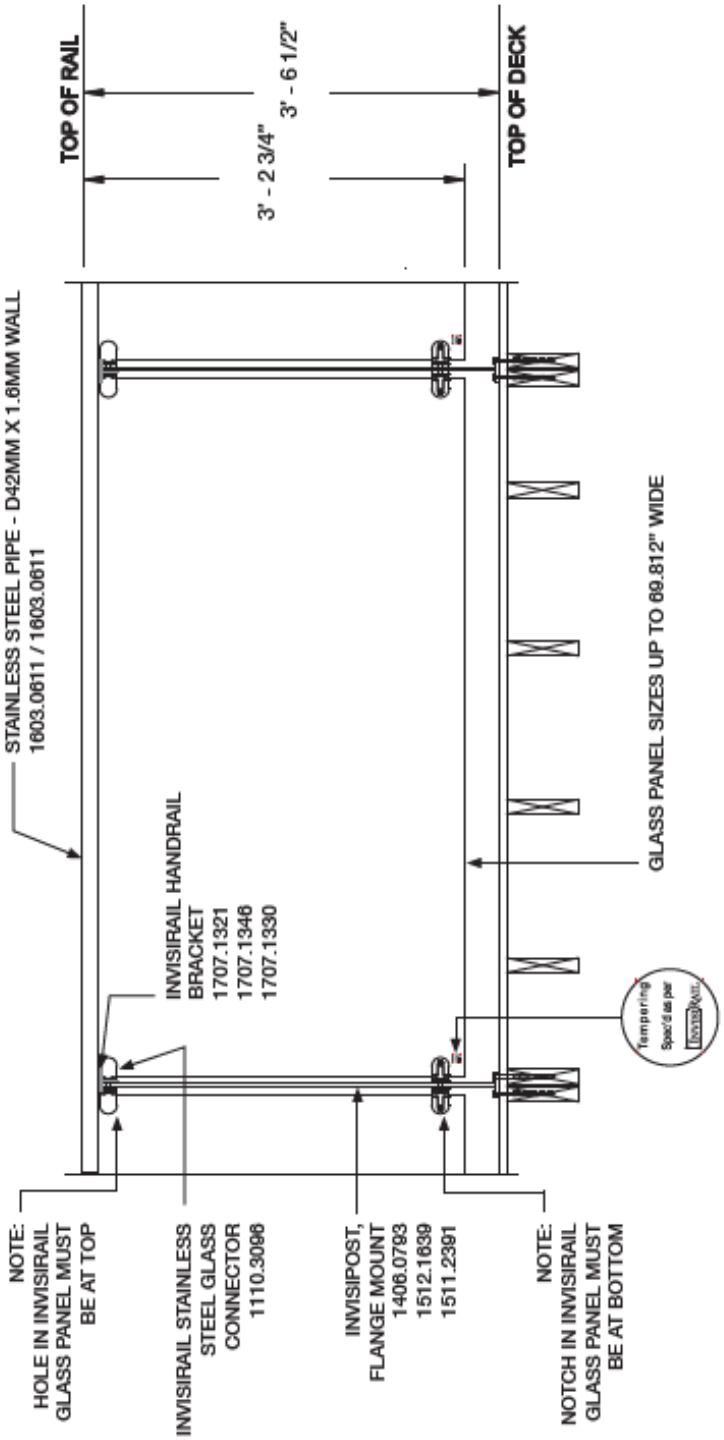

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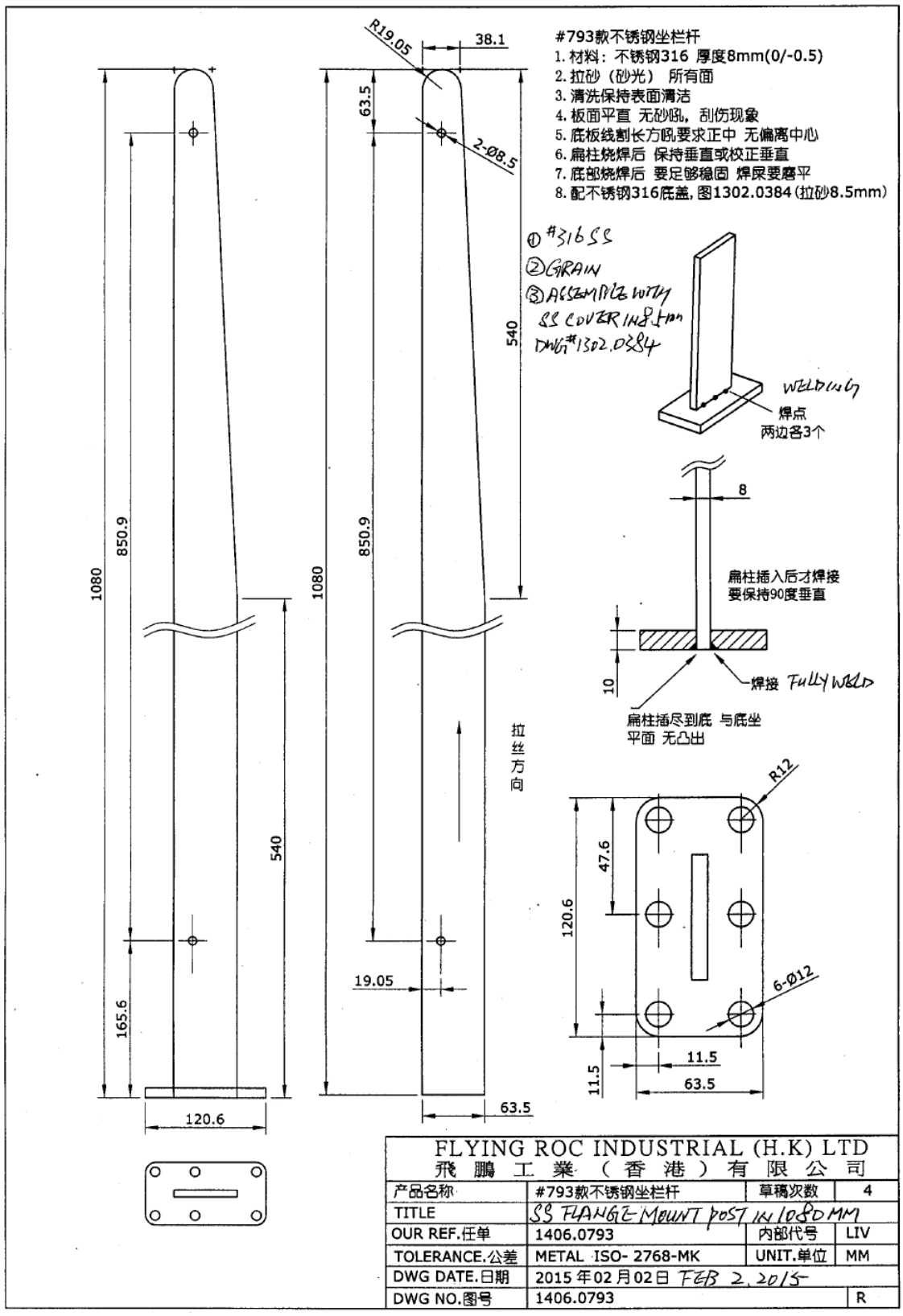

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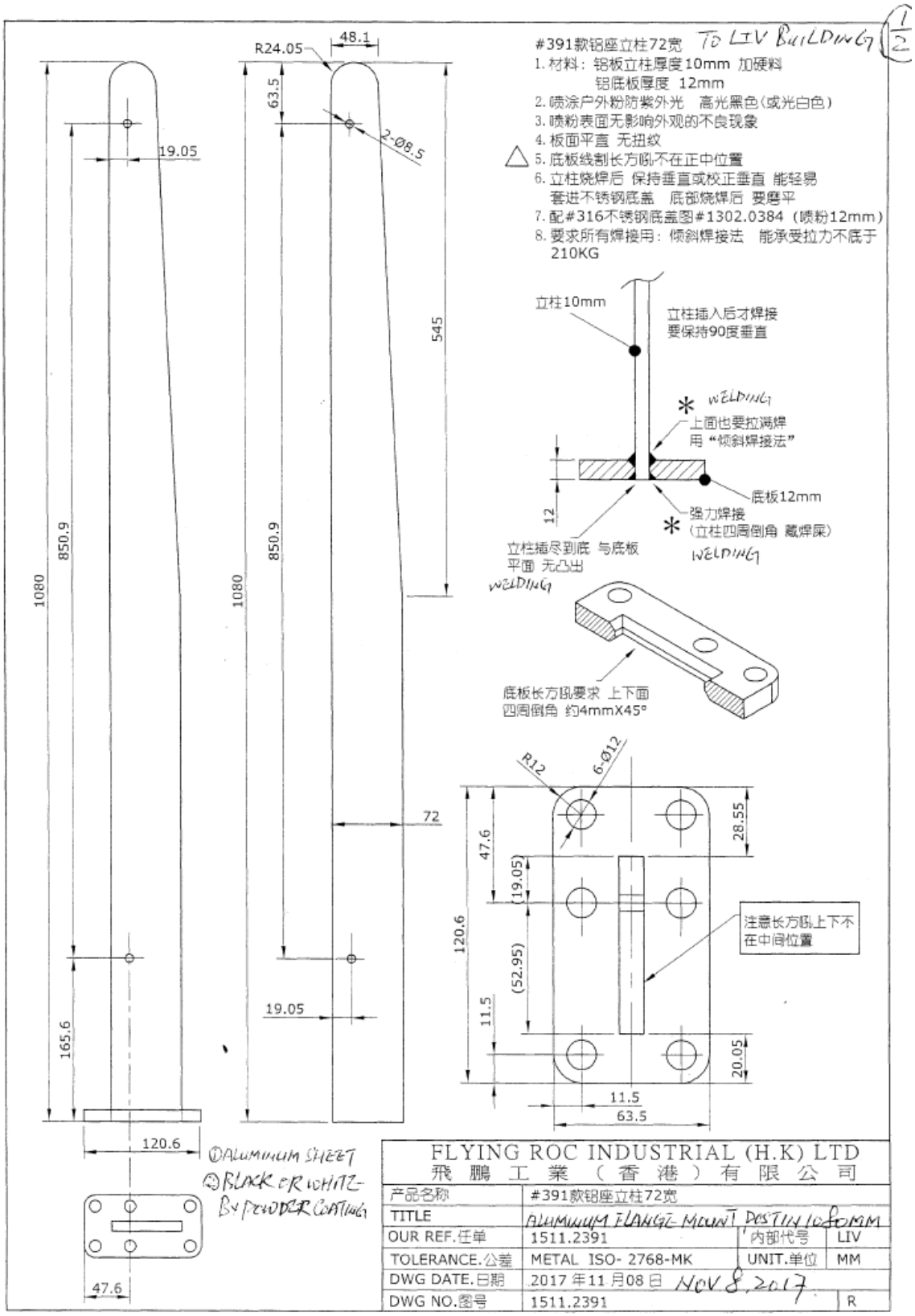

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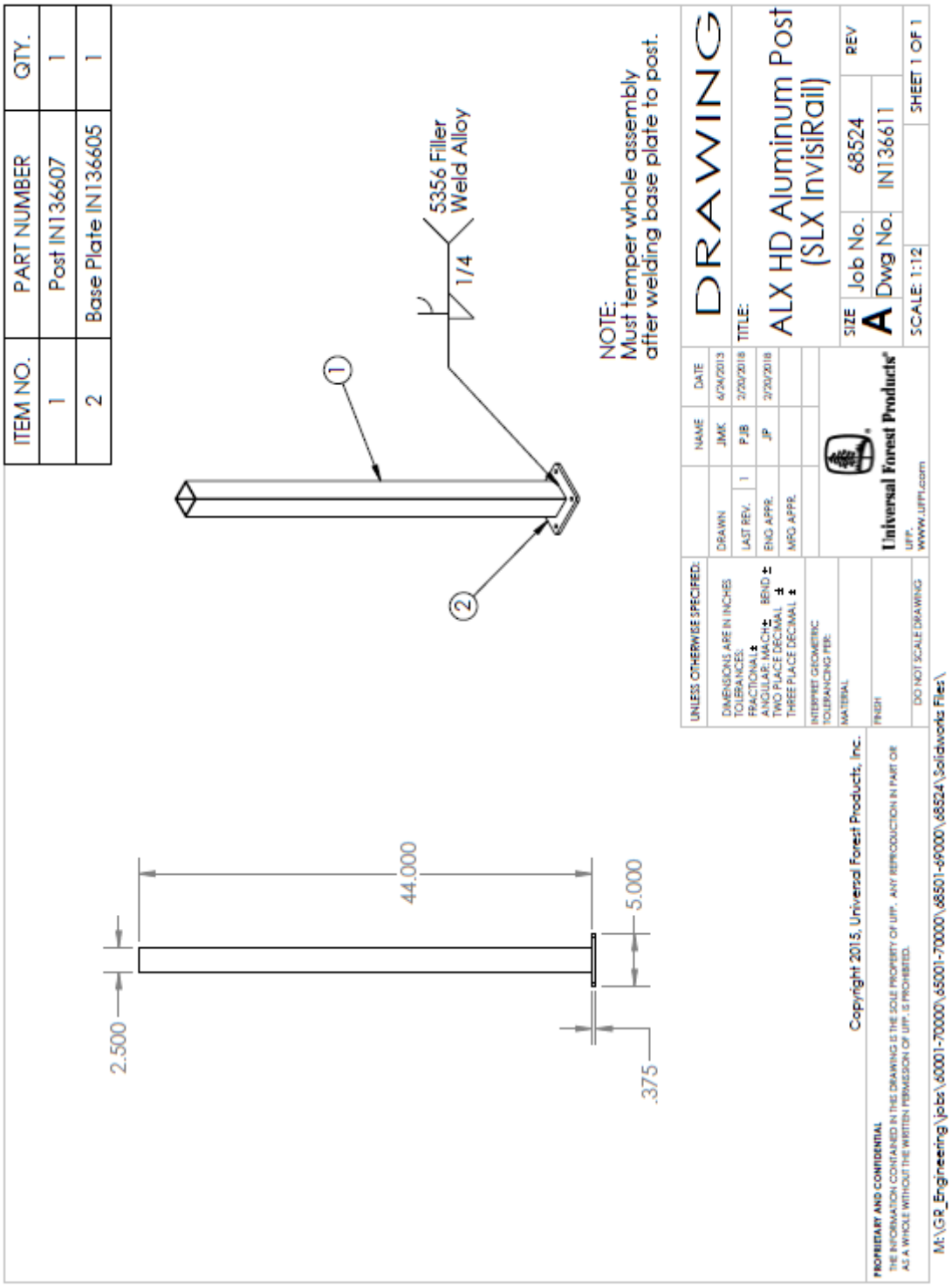

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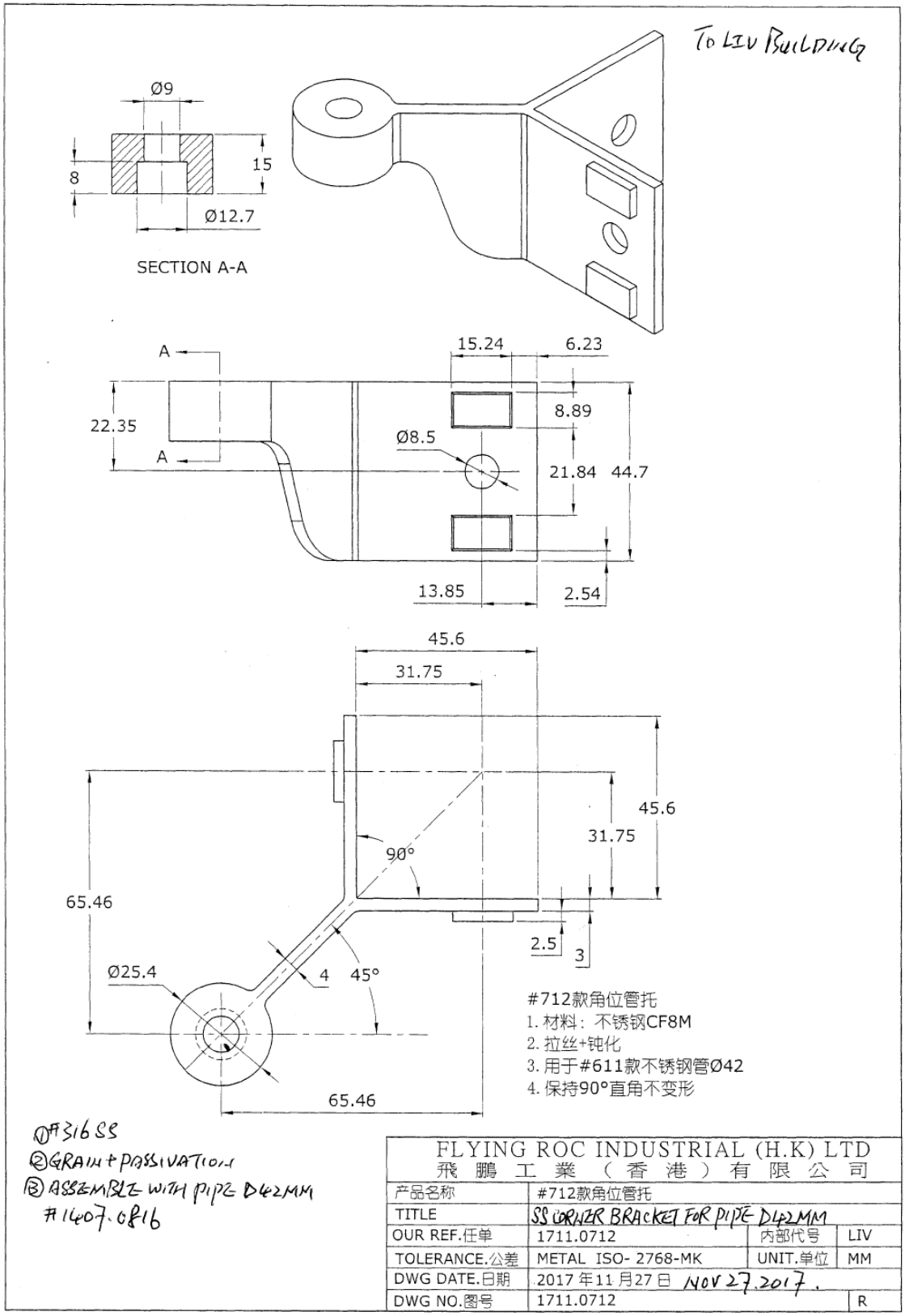

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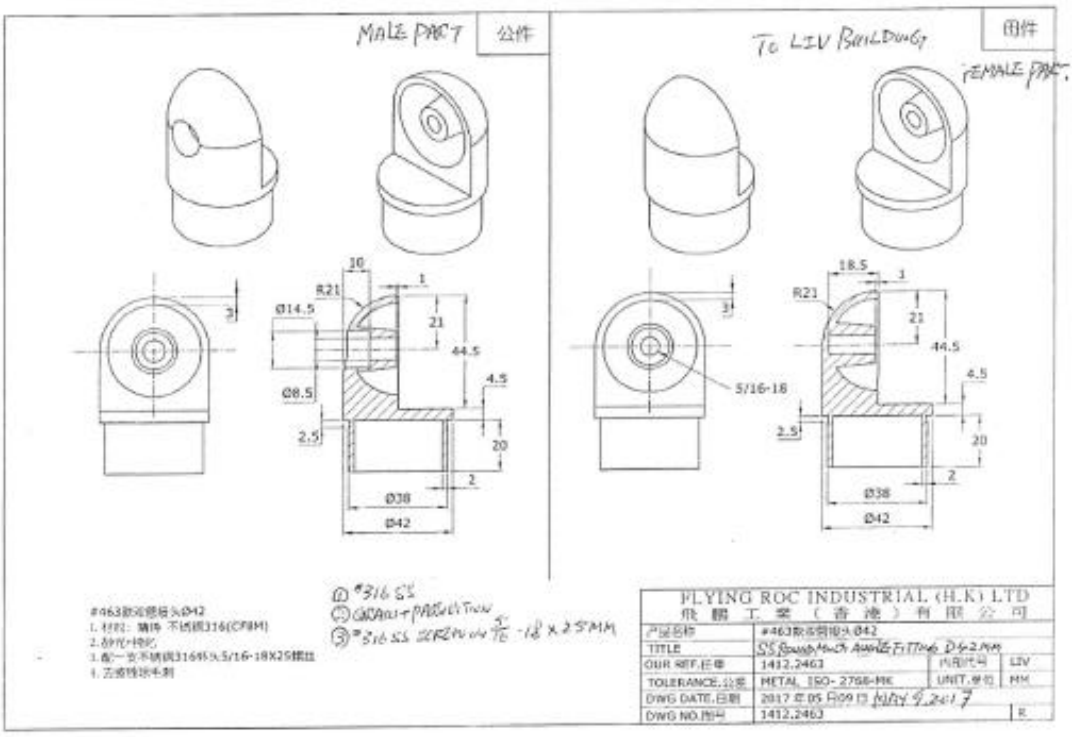

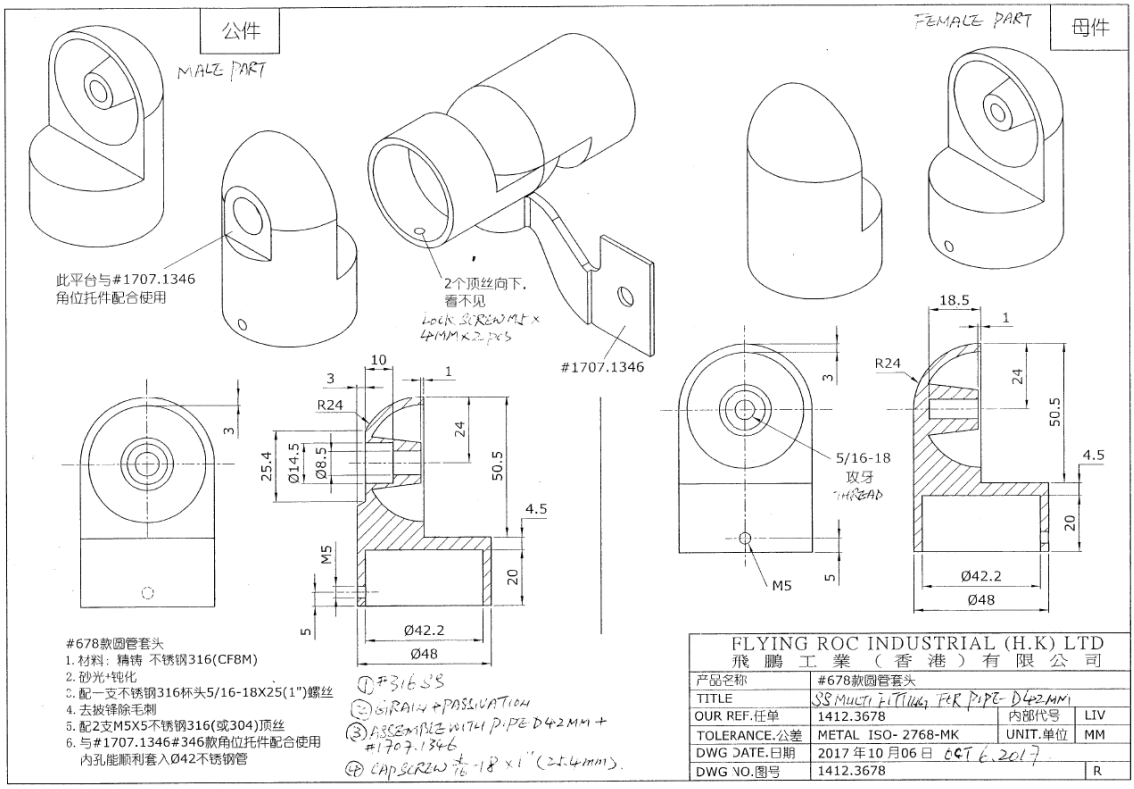

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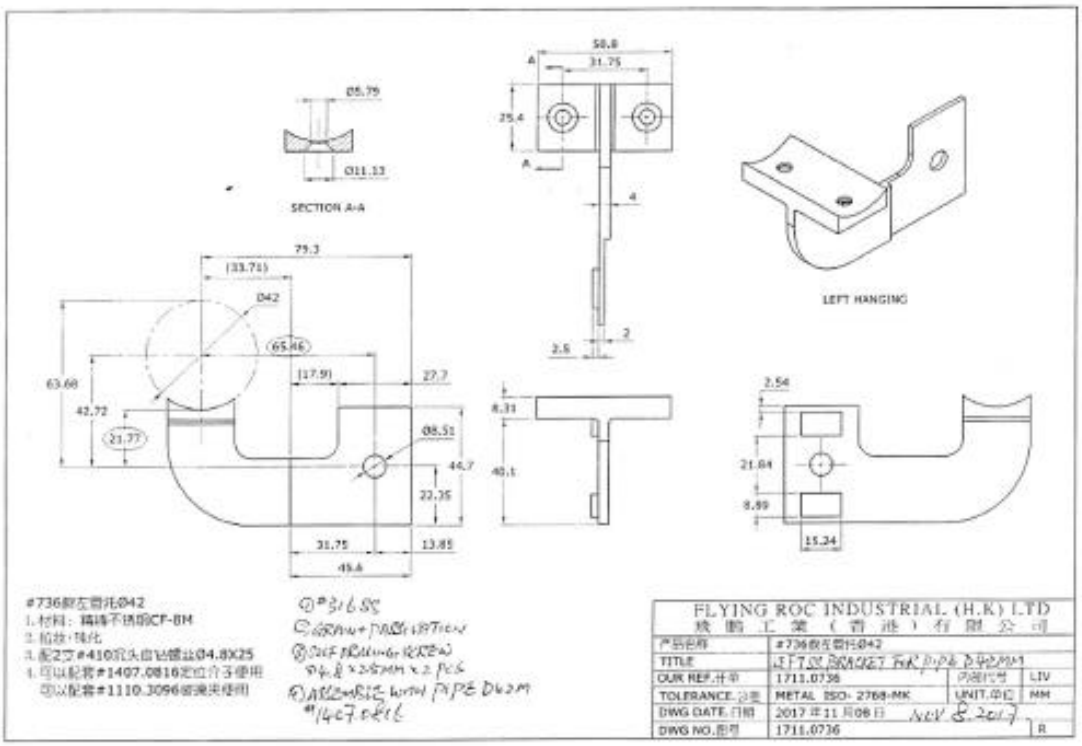

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SECTION 8
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	02/20/18	N/A	Original Report Issue – February 14, 2018
1	02/20/18	All	Added references to SS Invisirail