

APEX

TV ENCLOSURES

Prototype Design Pack

Model ATE-75 (75" TV Enclosure)

Design Version	v5.3.0 IP55
External Dimensions	1760 x 1120 x 160mm
Weight (empty)	~38 kg
Weather Rating	IP55 (dust protected + water jet resistant)
Design Feature	Integrated Bezel Ventilation
Thermal System	3x Delta AFB1412HH-A (165-195 CFM)

Confidential Manufacturing Document
For Eurotech Metal Industries LLC
January 2026

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Document Purpose: This design pack contains all specifications required to manufacture the ATE-75 prototype. The enclosure is designed for 75" commercial TVs operating in Gulf region outdoor environments (UAE, Saudi Arabia, Qatar).

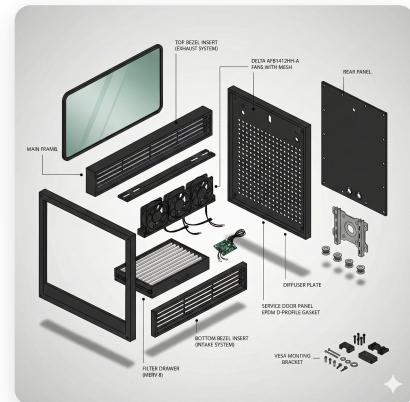
Product Renders (Reference Only)



External 3/4 View



Internal View (TV Mounting)



Exploded Assembly View

(Conceptual Renders - Guide Only)

1. Executive Summary

Product Overview

The ATE-75 is a premium weatherproof enclosure designed to protect standard 75" commercial TVs in extreme outdoor conditions. The v5.3.0 design features integrated bezel ventilation - a clean "picture frame" aesthetic with no protruding deflector.

Key Design Features

Integrated Bezel Ventilation

- 80mm top/bottom bezels with recessed slots
- Slots recessed 30-40mm behind face
- Clean flush front - NO deflector
- Bezel edges shield from water jets

Ducted Rear-Plenum Cooling

- 30mm rear air channel
- Perforated diffuser plate (8mm holes, 40% open)
- Direct cooling of TV heat sinks
- Bottom-to-top airflow path

High-Static Pressure Fans

- 3x Delta AFB1412HH-A (140mm)
- 4.8 mmH₂O static pressure
- 165-195 CFM total airflow
- PWM speed control (20-100%)

IP55 Weather Protection

- Dust protected (limited ingress)
- Low-pressure water jet resistant
- Continuous EPDM gasket seals
- 316 SS marine-grade hardware

Target Environment

Parameter	Specification
Operating Temperature	0C to 55C continuous
Humidity	Up to 95% RH non-condensing
Rain Exposure	Heavy/wind-driven rain
Sand/Dust	Sandstorm conditions (MERV 8 filtered)
Salt Fog	>500 hours (coastal UAE spec)

UV Exposure

5+ years stability

2. External Dimensions

ATE-75 Overall Dimensions

Dimension	Value	Notes
External Width	1760 mm	TV width + 2x 40mm side bezels
External Height	1120 mm	TV height + 2x 80mm top/bottom bezels
External Depth	160 mm	30mm plenum + TV + glass + bezel
Internal Cavity (W x H x D)	1680 x 960 x 125 mm	For TV placement
Glass Visible Area	1680 x 960 mm	Viewable screen area
Weight (empty)	~38 kg	Without TV installed
Weight (with TV)	~68 kg	With typical 75" TV (~30kg)

Bezel Dimensions

Component	Dimension	Purpose
Top Bezel Height	80 mm	Integrated exhaust slots + fan cavity
Bottom Bezel Height	80 mm	Integrated intake slots + filter drawer
Side Bezel Width	40 mm	Standard frame profile
Slot Recess Depth	30-40 mm	Distance slots are recessed behind face
Service Door	1650 x 80 mm	Bottom bezel service access

Rear Plenum Dimensions

Component	Dimension	Notes
Plenum Width	1650 mm	Spans TV back width
Plenum Height	900 mm	From intake to exhaust
Plenum Depth	30 mm	Air channel behind TV
Diffuser Plate	8mm holes, 40% open	Equalizes airflow distribution

Recess Installation Cavity (if wall-recessed)

Dimension	Value	Notes
Cavity Width	1820 mm	+30mm each side
Cavity Height	1160 mm	+20mm top, +20mm bottom
Cavity Depth	215 mm	+55mm behind enclosure
Top Gap Required	20 mm	Fitting tolerance only (front exhaust)

3. Design Philosophy - Integrated Bezel v5.3.0

Why Integrated Bezel Design?

The v5.3.0 design eliminates the protruding exhaust deflector found in earlier versions. Instead, ventilation slots are integrated into wider 80mm bezels, recessed 30-40mm behind the front face. This creates:

- **Clean "Picture Frame" Aesthetic** - Flush front face with no protrusions
- **IP55 Protection** - Bezel edges naturally shield slots from water jets
- **Architectural Integration** - Easier to recess into walls
- **Improved Durability** - No deflector to damage or degrade

Airflow Path

Bottom-to-Top Flow:

Ambient air enters through recessed slots in bottom 80mm bezel → passes through gasketed MERV 8 filter drawer → enters rear plenum through perforated diffuser plate → flows through 30mm channel directly cooling TV heat sinks → 3x Delta 140mm fans pull air up → exits through recessed slots in top 80mm bezel

Thermal Performance

Parameter	Value	Status
Design Ambient	55C (Dubai summer)	Worst case
Solar Load	~250W absorbed	Direct sun exposure
TV Heat	~300W (75" LED)	Maximum operation
Total Heat Load	~550W	Must be removed
Airflow (3x Delta fans)	165-195 CFM	At system pressure
Thermal Rise	<15K above ambient	Air temp increase
Wall-Mount Margin	50-80%	Excellent
Recess Margin	10-30%	Adequate with 20mm gap

Acoustic Performance

PWM Level	Slot Velocity	Sound Level	Mode
20%	0.7 m/s	≤30 dBA	Idle (near silent)
40%	1.4 m/s	≤34 dBA	Quiet mode
60%	2.1 m/s	≤38 dBA	Normal cooling
100%	3.4 m/s	≤48 dBA	Emergency (audible)

Design Intent: Quiet operation most of the time (≤40% PWM). Fans only reach full speed during thermal emergencies. This is achieved through high-static pressure fans + large slot area ($A_{eff} \geq 0.035 \text{ m}^2$).

4. Technical Drawings

4.1 Side Cross-Section - Airflow Path

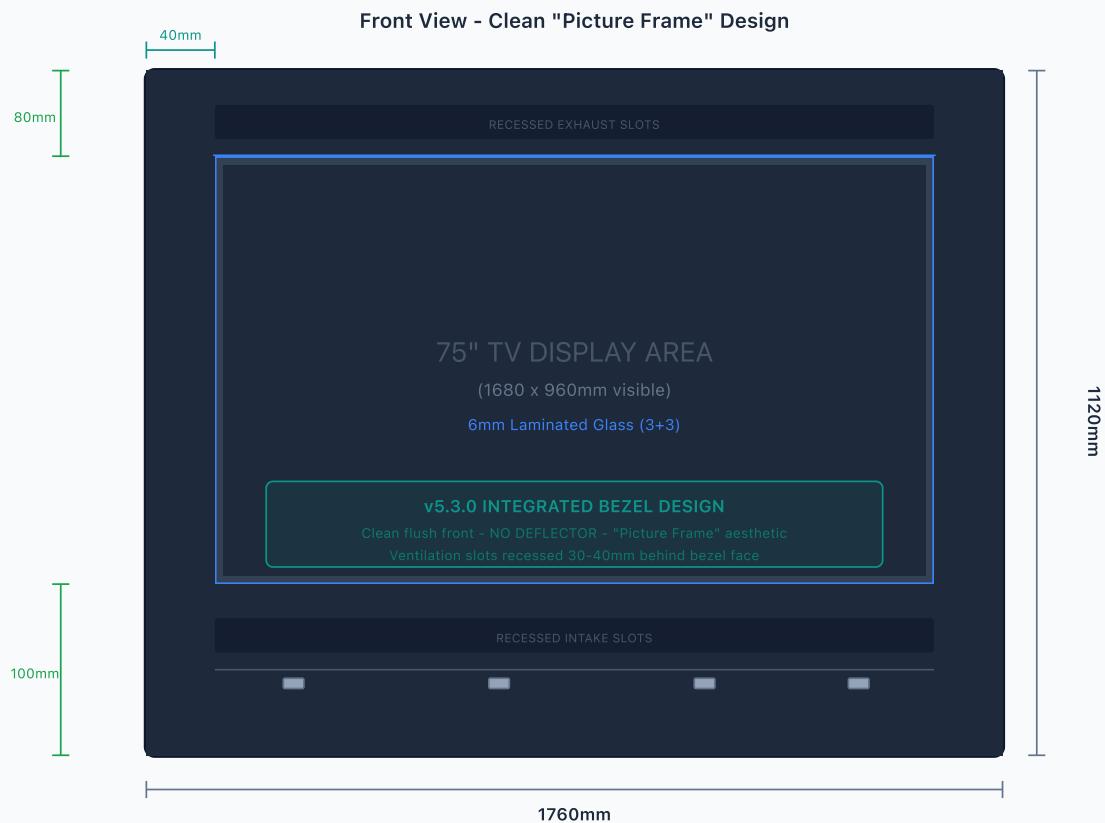
Figure 4.1: Side Cross-Section Showing Airflow (v5.3.0 IP55)

Side View - 160mm Depth with Integrated Bezel Ventilation



4.2 Front View - External Appearance

Figure 4.2: Front View - 1760 x 1120mm (v5.3.0)



5. Mechanical Construction

5.1 Materials

Component	Material	Thickness	Finish
Main Shell	Aluminum 5052-H32	2.0 mm	Powder coat RAL 9005 (black)
Service Door Frame	Aluminum 5052-H32	2.0 mm	Powder coat to match
Front Glass	Laminated (3+3mm)	6.0 mm	AR + anti-fog hydrophilic
Rear Panel	Aluminum 5052-H32	2.0 mm	30mm standoff (forms plenum)
Top Bezel	Aluminum 5052-H32	2.0 mm	80mm with recessed slots + fans
Bottom Bezel	Aluminum 5052-H32	2.0 mm	80mm with intake + filter drawer
Diffuser Plate	Aluminum 5052-H32	1.5 mm	8mm holes, 40% open area
VESA Mount Plate	Steel	6.0 mm	Through-bolted reinforcement
Gaskets	EPDM closed-cell	10x15 mm	Higher durometer, IP55 grade
All Fasteners	Stainless 316	M4/M5/M6	Marine grade

5.2 Fabrication Requirements

- CNC laser cut + CNC press brake
- TIG welding where required (full penetration)
- Integrated stiffening ribs (no oil-canning)
- All edges deburred, no sharp edges
- Corner radius: 3mm minimum external

- Weld finish: Ground flush on visible surfaces

5.3 Door & Access System

Hinged Front Frame

- 3x concealed 3-knuckle hinges (316 SS)
- 110 minimum opening angle
- Top-hinged with gas strut support
- Tool-free TV access

Gas Struts (x2)

- Force: Sized to hold at 90°
- Material: 316 Stainless steel
- Soft-close damping action
- 250mm stroke length

Compression Latches (x4)

- Over-center draw latch design
- Material: 316 Stainless steel
- Adjustable keeper for seal
- 200N holding force each

5.4 Internal TV Mounting (Vertical Rail System)

Component	Specification
Vertical Rails (x2)	800mm aluminum, M6 holes every 25mm, 3mm steel
Rail Spacing	Adjustable 400-600mm to match TV VESA width
TV Brackets (x2)	L-shaped, connects TV VESA to rails
Height Adjustment	Full range via slotted rail holes
VESA Compatibility	200x200 to 600x400mm
Load Rating	75kg (3x safety factor)

5.5 External Wall Mount (Rear Panel)

Component	Specification
Rear VESA Plate	6mm steel, 400x400 and 600x400mm holes
Hardware	M8 threaded inserts

Bracket Type	Full-motion dual-arm (customer supplied)
Load Rating	75kg minimum capacity

6. Thermal Management System

6.1 Fan Specifications

Parameter	Specification
Model	Delta AFB1412HH-A
Quantity	3 units (in top bezel cavity)
Size	140mm x 140mm x 25mm
Voltage	12V DC
Max Airflow	~83 CFM each (~250 CFM total)
Static Pressure	4.8 mmH2O
System Airflow	165-195 CFM (after system losses)
Control	4-wire PWM (20-100%)
Noise	≤34 dBA @ 40% PWM (quiet mode)

Why Delta AFB1412HH-A? This fan was selected for its HIGH STATIC PRESSURE (4.8 mmH2O). The system has significant pressure drops: MERV 8 filter + diffuser plate + rear plenum + recessed slots. Consumer fans like Noctua (2.56 mmH2O) cannot overcome this. The Delta fan maintains airflow even when the filter loads with dust.

6.2 Ventilation Slot Design

Parameter	Top Bezel (Exhaust)	Bottom Bezel (Intake)
Slot Configuration	12x horizontal slots, 3mm gap	12x horizontal slots, 3mm gap
Slot Width	1600mm	1600mm
Gross Area	0.058 m ²	0.058 m ²

Effective Area (A_eff)	$\geq 0.035 \text{ m}^2$	$\geq 0.035 \text{ m}^2$
Recess Depth	30-40mm behind face	30-40mm behind face
Protection	316 SS insect mesh	316 SS insect mesh

6.3 Filter System

Component	Specification
Filter Type	MERV 8 pleated polyester
Housing	Gasketed slide-out drawer
Gasket	EPDM frame seal (IP55)
Access	Tool-free, pull-tab drawer
Spare Included	Yes (1 extra filter)

6.4 PWM Control Parameters

Temperature	PWM Level	Mode
<30C internal	20%	Idle (near silent)
30C	20% (ramp start)	Ramp begins
35C	50%	Normal cooling
45C	100%	Full speed
50C	100% + warning LED	Alarm state
55C for 60s	100% + buzzer	Critical - signal shutdown

6.5 Mandatory Noise Mitigation

NO SUBSTITUTIONS: These specifications are mandatory for acoustic performance.

Requirement	Specification

Vibration Isolation	Silicone grommets, Shore A 40-60, NO metal-to-metal
Slot Design	12x 3mm slots, $A_{eff} \geq 0.035\ m^2$ (not reducible)
Panel Resonance	$\geq 2.0\text{mm}$ aluminum, stiffening ribs where span $>400\text{mm}$
PWM Control	20% baseline, smooth ramp, no on/off thermostat

7. Electrical System

7.1 Power Distribution

Component	Specification
Power Inlet	IEC C14 with fuse holder, 10A
Fuse	5x20mm glass, 3A slow-blow (spare included)
Surge Protection	275V MOV varistor (line-neutral, line-earth)
Terminal Block	DIN rail, 3-position (L, N, E), 10A
DC Power Supply	Mean Well LRS-35-12, 12V 3A, 85-264VAC input
Accessory Outlet	UK 3-pin (Type G), 13A, panel mount

7.2 Control Board

Feature	Specification
Type	MCU-based PWM fan controller
PWM Outputs	4 channels (3 used for fans)
Temperature Inputs	2x DS18B20 digital (internal), 1x NTC (exhaust)
Indicators	Power LED, Alarm LED
Alarm Output	12V piezo buzzer (85dB)
Failsafe	100% fans if sensor fails

7.3 Wiring Requirements

Circuit	Wire Spec	Notes

Mains	3G1.0mm ² , 105C rated	Black, ~2m per unit
DC Fan	4-wire PWM, 22AWG shielded	~1m per fan
Sensors	3-wire, 24AWG	1-Wire protocol
Earth Bonding	10mm tinned copper braid	Panel to frame

7.4 Cable Entry

Component	Specification
Cable Glands	M20, IP68, 316 SS body
Quantity	3 (power, HDMI, spare)
Cable Range	6-12mm diameter
Breather Vent	M12 ePTFE membrane (pressure equalization)

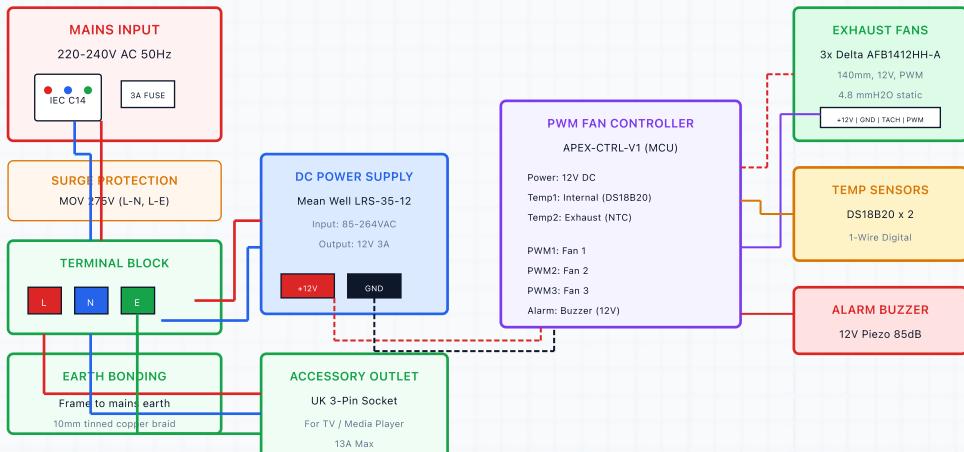
7.5 Wiring Diagram

Safety Warning: All electrical work must be performed by qualified personnel. Ensure mains power is disconnected before any wiring work. Unit must be properly earthed.

System Schematic

Figure 7.5: Complete Electrical System Schematic

APEX ATE-75 ELECTRICAL SCHEMATIC



WIRING LEGEND & WIRE SCHEDULE

— Live (L) - Brown - 1.0mm ²	- - - +12V DC - Red - 22AWG	— Sensor 1-Wire - Orange - 24AWG	Cable Entry: 3x M20 IP68 glands (316 SS)
— Neutral (N) - Blue - 1.0mm ²	- - - DC Ground - Black - 22AWG	— AC Wiring: H05VV-F 3G1.0mm ² (105C rated)	2x M12 breather vents
— Earth (E) - Grn/Yel - 1.0mm ²	— PWM Signal - Purple - 22AWG	— Fan Cable: 4-wire PWM shielded	
		All connections: Ferrule crimps or screw terminals	Drawing: APEX-WD-001-R2 Date: Jan 2026

Wire Schedule Summary

Circuit	From	To	Wire	Color
AC Mains (220-240V)				
Live	IEC Inlet	Fuse → Terminal Block	1.0mm ²	Brown
Neutral	IEC Inlet	Terminal Block	1.0mm ²	Blue

Earth	IEC Inlet	Terminal Block → Frame	1.0mm2	Green/Yellow
Live	Terminal Block	DC PSU + Accessory	1.0mm2	Brown
Neutral	Terminal Block	DC PSU + Accessory	1.0mm2	Blue
DC Power (12V)				
+12V	DC PSU	Controller VIN+	22AWG	Red
GND	DC PSU	Controller GND	22AWG	Black
Fans (4-wire PWM)				
Fan 1-3	Controller	Delta 140mm fans	22AWG x4	+12V/GND/Tach/PWM
Sensors				
Temp 1-2	Controller	DS18B20 probes	24AWG x3	1-Wire
Exhaust	Controller	NTC thermistor	24AWG x2	Signal
Alarm				
Buzzer	Controller	Piezo 85dB	22AWG x2	+12V/Signal

Important Notes:

- All AC wiring must use H05VV-F rated to 105C minimum
- Earth bonding braid: 10mm tinned copper between Terminal E and frame bonding point
- All fan cables routed away from heat sources
- Ferrule crimps required on all stranded wire terminations

8. Sealing & IP55 Protection

8.1 IP55 Rating Explained

Digit	Rating	Meaning
First (5)	Dust Protected	Limited dust ingress, not harmful to operation
Second (5)	Water Jet Protected	Protected against low-pressure water jets from any direction (6.3mm nozzle, 12.5 L/min, 3m distance)

8.2 Gasket System

Location	Material	Profile	Compression
Main Door	EPDM closed-cell, higher durometer	12x15mm channel	20-30%
Glass Seal	Silicone U-channel	6mm glass fit	Continuous
Filter Drawer	EPDM frame seal	8x10mm	Compression latch
Cable Glands	IP68 rated	M16/M20	Compression fit
Service Door	EPDM closed-cell	10x12mm	4 latches + stops

8.3 IP55 Design Features

- Integrated Bezel Ventilation:** Slots recessed 30-40mm behind bezel face - bezel edges naturally shield from water jets
- No External Deflector:** Clean design eliminates potential leak paths
- Gasketed Filter Drawer:** EPDM seal maintains IP55 at intake
- 316 SS Insect Mesh:** Prevents ingress while maintaining airflow
- Continuous EPDM Gaskets:** No gaps, corners mitered and bonded
- Compression Latches:** Ensure consistent gasket compression

Ventilated Enclosure Note: While designed to IP55, this is an actively ventilated unit. Avoid direct high-pressure jets at intake/exhaust openings. Garden hose and rain exposure are fine.

9. Bill of Materials - ATE-75

Note: This BOM lists all components required for prototype fabrication. Quantities are for single unit production.

9.1 Enclosure Structure

#	Component	Specification	Qty
1.1	Main Frame Assembly	5052-H32 Aluminum, 2.0mm, CNC bent, powder coated	1
1.2	Back Panel	5052-H32 Aluminum, 2.0mm, with plenum standoffs	1
1.3	Front Bezel Frame	6063-T5 Aluminum extrusion, mitered corners	1
1.4	Top Bezel (80mm)	5052-H32 Aluminum, recessed slots, fan mounts	1
1.5	Bottom Bezel (80mm)	5052-H32 Aluminum, recessed slots, filter drawer	1
1.6	Diffuser Plate	1.5mm Aluminum, 8mm holes, 40% open	1
1.7	VESA Mount Plate (internal)	3.0mm Steel, universal adjustable	1
1.8	Vertical Mounting Rails	800mm, M6 holes @ 25mm spacing	2
1.9	TV Mounting Brackets	L-shaped adjustable	4
1.10	Rear VESA Plate	6mm steel, 400x400/600x400 pattern	1
1.11	Gas Struts	100N, 250mm stroke, 316 SS	2

9.2 Glass Assembly

#	Component	Specification	Qty
2.1	Laminated Glass Panel	3mm + PVB + 3mm low-iron, 1680 x 960mm	1
2.2	AR Coating	Anti-reflective, both sides, <1% reflectance	Applied
2.3	Anti-Fog Coating	Hydrophilic interior surface	Applied

9.3 Seals & Gaskets

#	Component	Specification	Qty
3.1	Main Door Gasket	EPDM channel, 12x15mm, higher durometer	5m
3.2	Glass Seal Gasket	Silicone U-channel, 6mm	5m
3.3	Filter Drawer Gasket	EPDM frame seal, 8x10mm	1.5m
3.4	Cable Glands IP68	M20, 316 SS, 6-12mm range	3
3.5	Breather Vent	M12 ePTFE membrane	2

9.4 Thermal System

#	Component	Specification	Qty
4.1	Exhaust Fan	Delta AFB1412HH-A, 140mm, PWM	3
4.2	Fan Grommets	Silicone anti-vibration, Shore A 40-60	12
4.3	Insect Mesh	316 SS, fine weave	As req
4.4	Filter Frame	ABS plastic, slide-out drawer	1
4.5	MERV 8 Filter Media	Pleated polyester, custom size	2

9.5 Control System

#	Component	Specification	Qty
5.1	PWM Controller Board	MCU-based, 4-channel PWM	1

5.2	Temperature Sensor	DS18B20 digital, waterproof	2
5.3	Exhaust Sensor	NTC 10K thermistor	1
5.4	Alarm Buzzer	12V piezo, 85dB	1

9.6 Electrical

#	Component	Specification	Qty
6.1	IEC Power Inlet	C14 with fuse holder, 10A	1
6.2	Fuse	5x20mm, 3A slow-blow	2
6.3	MOV Varistor	275V surge protection	2
6.4	Terminal Block	DIN rail, 3-position, 10A	1
6.5	DC Power Supply	Mean Well LRS-35-12, 12V 3A	1
6.6	Accessory Outlet	UK 3-pin, 13A panel mount	1

9.7 Hardware & Fasteners (316 SS)

#	Component	Specification	Qty
7.1	Frame Screws	M4 x 10mm pan head, A4-316	40
7.2	Back Panel Screws	M5 x 12mm cap head, A4-316	12
7.3	VESA Screws	M6 x 15mm with washers, A4-316	8
7.4	Concealed Hinges	3-knuckle, 316 SS, 110	3
7.5	Compression Latches	Over-center draw latch, 316 SS	4
7.6	Threaded Inserts	M4/M6 press-fit for aluminum	30
7.7	Nylon Washers	M4/M5 isolation (dissimilar metals)	50

10. Quality Standards & Testing

10.1 Material Certifications Required

- Aluminum 5052-H32: Mill certificate with alloy composition
- 316 Stainless Steel: Material test report (fasteners, hinges, latches)
- Powder Coating: Salt spray test certification (>1500 hours)
- EPDM Gaskets: Shore hardness + UV stability certification
- Glass: Lamination certificate + AR coating performance data

10.2 Dimensional Tolerances

Feature	Tolerance
External Dimensions	±2.0mm
Internal Cavity	±1.5mm
Gasket Groove	±0.5mm
Hole Positions	±0.5mm
Flatness (panels)	<2mm/meter
Corner Radius	3mm ±0.5mm

10.3 Assembly QC Checks

- All fasteners torqued to specification
- Gasket compression uniform (visual + feeler gauge)
- Door opens/closes smoothly, latches engage
- Glass seated without gaps
- Fans spin freely, no rattle
- Filter drawer slides smoothly
- All electrical connections verified

10.4 IP55 Test Procedure

Test	Method	Duration	Pass Criteria

Dust	Talcum powder chamber	8 hours	No harmful deposits on electronics
Water Jet	6.3mm nozzle, 12.5 L/min, 3m	3 min/side	No water ingress to electronics

10.5 Thermal Test Procedure

Condition	Setup	Duration	Pass Criteria
Ambient 55C	Climate chamber	4 hours	Internal <70C, fans <100%
PWM Ramp	Heat from 25C to 50C	Continuous	Smooth speed increase
Filter Loaded	50% blocked filter	2 hours @ 45C	Adequate cooling maintained

11. Prototype Validation Requirements

11.1 Prototype Deliverables

- 1x Complete ATE-75 enclosure assembly
- Complete wiring harness installed
- PWM controller programmed and tested
- All accessories (IR extender, cleaning kit, spare filter)
- Installation manual draft

11.2 Validation Test Checklist

Test	Method	Pass/Fail
Dimensional Check	Measure all critical dimensions	
Gasket Compression	Feeler gauge at 8 points	
Door Operation	50 open/close cycles	
Latch Engagement	Pull test (50N hold)	
Fan Spin Test	All 3 fans, free rotation	
PWM Control	20% to 100% ramp	
Temperature Sensors	Read at known temps	
Alarm Function	Trigger at 50C	
Filter Drawer	Insert/remove 10 cycles	
Glass Fit	Visual inspection	
TV Mount	75kg load test	
IP55 Water Test	Garden hose, 3m, 3 min/side	
Thermal Soak	4 hours @ 45C ambient	
Acoustic Check	dBA at 1m, 40% PWM	

11.3 Documentation Required

- Inspection report with all measurements
- Photo documentation (all sides, interior, details)
- Test results (thermal, IP55, acoustic)
- Material certificates
- Any deviations from specification

Acceptance Criteria: Prototype must pass ALL validation tests before production approval. Minor deviations require written approval. Any IP55 or thermal failures require redesign before production.

Apex TV Enclosures

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