

## TEST METHODOLOGY –

Grab Bars are fastened to varied wall sections utilizing an embodiment of the WingIt Fastening Technology. The TEST METHOD consists of a Hydraulic Lift and a Hydraulic Scale. Hydraulics are utilized because of the minimal travel requirements to achieve desired weight loads, the high level of control over specific load settings, and the relative accuracy (deviation <2%).

The wall samples range in height from 32” to 48” and from 32” to 96” in width.

The FRAMING consisted of 2x3 or 2x4 studs - wood or 25-gauge steel. The stud span ranged from 16” to 48” on center. Tests were run with no center stud support. Assembly of the frame was made with standard drywall screws.



The SUBSTRATE was attached to the Frame utilizing standard drywall screws – ranging from meeting specifications to installing less than 10% of the screws required under ASTM C840-99 and C954-98.

TESTED SUBSTRATES - Substrates range from new to more than 40 years old.

- \* 5/8” drywall – painted, wallpapered, and with stucco finish.
- \* 5/8” drywall with tub surrounds ranging from 0.060” to 0.250” thick.
- \* 5/8” drywall with tile, marble, and other commercially available stone substrates.
- \* 5/8” drywall with panels - including fiberglass, faux marble, acrylic, and plastics.
- \* ½” drywall – painted, wallpapered, and with stucco finish.
- \* ½” drywall with tub surrounds ranging form 0.060” to 0.250” thick.
- \* ½” drywall with tile, marble, and other commercially available stone substrates.
- \* ½” drywall with panels - including fiberglass, faux marble, acrylic, and plastics.
- \* Masonry type boards.
- \* Plaster and lathe.
- \* Multiple layers of drywall.
- \* Hollow masonry block.
- \* Substrates that have been previously wet – *tested dry*.

**TESTING** – Two types of test methods are utilized to test Grab Bars and Handrails.

- 1) Standardized testing in accordance with ASTM F446-85. Loads are applied to the center 3 ½” section of grab bars and handrails of all lengths. An initial load of 50 pounds is applied to allow the Test Coupon to “settle”. Instrumentation capable of detecting 0.001” intervals is then attached to the outer most point of the Grab Bar or Handrail to measure deflection. Singular directional loads are applied for a minimum of 5 minute intervals - at 250 pounds (1,112 Newtons), then 300 pounds (1,335 Newtons), and then 404 pounds (1800 Newtons). Test Coupons are either disassembled or brought to failure, then they are examined to determine force distribution efficiencies.
  
- 2) Patent pending test procedures that subject Grab Bars, Handrails, and Bath Accessories to *Vector and Vibratory Forces*. These test procedures were developed by Pinnacle Innovations® to measure the “Stability of Environment” created by fastening systems. ASTM F446-85 only requires that the load is exerted in a “downward” direction with fluent incremental load increases. Pinnacle Innovations® developed the testing technology based on the fastening requirements of aerospace applications. The testing incorporates multi-vector forces transferred to the object through a specified or random pattern. High weights in low cycle patterns are vector force tests. High cycle, random patterns are vibratory test. The objective was to develop testing that mimics real life use – multi directional forces of varying intensity. This test method also accounts for the immense *Initial Moment Forces* created upon instantaneous loading – similar to an individual needing instantaneous support for their entire body weight.

REPRESENTATIVE SAMPLING FROM TESTING CONDUCTED AT SOUTH RIVER and EAST BRUNSWICK, NEW JERSEY

**Humidity / Temp** –Relative Humidity measured at exterior wall surface and inner wall surface. Temp is room temperature.

**WingIt Embodiment** – Type of WingIt - standard or reverse / generation.

**Bar Length** – The length of the grab bar utilized in the test. All grab bars used in testing exceed ASTM F-462 and comprise import and domestic manufacture.

**Tube Length** – WingIt Fastening System Spacer Tube Length.

**Wing Tip Material** – Rubberized footpad material measured in “A” scale Durometer / shape.

**Wing Tip Diameter** – Actuated Diameter/Installed Diameter of Wing Tips. “TYP” is the standard of 2.45” to 2.65”

**Tape** – Active Yes or No – The 3M® VHB Closed Cell Waterproof Tape was activated (tape liner removed) or not.

**Installed Force** – The force used to tighten the WingIts. “TYP” is 125-165 inch pounds exerted during installation.

**Cycle Load Testing** – Indicates testing done prior to achieving “Set Load”. (TEST TYPE) APPLIED LOAD are shown in this summary. (1) XXX indicates Standard Load in accordance with ASTM F446-85. (2) XXX indicates applied Vector Loads. (2A) XXX indicates Vibratory Loads.

Cycles per hour is noted where appropriate.

**Load/Time** - Indicates the tested load (set load, other load testing may have occurred prior to achieving set load) and the duration @ set load.

**Deflection** – Deflection of the grab bar at set load. Initial loads of 50 – 100 # are exerted to “settle” the sample and bar’s deflection is accounted for. Deflection is the actual movement created in the grab bar and WingIts.

**Failure** – Some samples are, after all other testing is completed, brought to failure to gauge load ratings and map out the load transferences in the substrate (wall). Loads applied to create failure are recorded. Note: This measurement can only be analyzed in conjunction with prior cycle tests on the coupon.

**Water Test** – Water filtration is measured on samples having gone through the physical test cycles by placing sample wall on the horizontal and placing a square, acrylic 6"x6" frame in a bed of silicon around the WingIt and adding 3" of water for a duration of no less than 24 hours.

**Tested Substrate** – ½” Drywall screwed to 25 gauge steel studs 16" on center. Ceramic tile, 4" x 4", contractor grade, attached to the wall in accordance with ANSI A108.4 using standard adhesive and grout. Source - Home Depot. Cure times – mastic 24 hours, non-sanded grout – 24 Hours. Open wall coupon – 09/98

Humidity / Temp	WingIt Embodiment	Bar Length	Tube Length	Wing Tip Material	Wing Tip Diameter	Tape	Installed Force	CYCLE LOAD TESTING Refer to notes -	Load / Time	Deflection	Failure Load	Water Test
87% - 76	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(2) 300# x 12 cycles	250 # / 24 hrs	0.022" / 0.170"	N/A	Pass
87% - 76	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	N	Std	(1) 404#	250 # / 24 hrs	0.020" / 0.150"	702	N/A
87% - 76	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	N	Std	(1) 404#	250 # / 24 hrs	0.028" / 0.178"	688	N/A
87% - 76	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(1) 404#	250 # / 24 hrs	0.018" / 0.160"	752	N/A
87% - 76	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(1) 404#	250 # / 24 hrs	0.022" / 0.186"	736	N/A

WingIt Innovations **CONFIDENTIAL DOCUMENT** *Test Data Summary*

**Tested Substrate** – 5/8” Drywall screwed to 25 gauge steel studs 24" on center. Ceramic tile, 4" x 4", contractor grade, attached to the wall in accordance with ANSI A108.4 using standard adhesive and grout. Source - Home Depot. Cure times – mastic 24 hours, non-sanded grout – more than 24 Hours. Open wall coupon – 08/98

Humidity / Temp	WingIt Embodiment	Bar Length	Tube Length	Wing Tip Material	Wing Tip Diameter	Tape	Installed Force	CYCLE LOAD TESTING Refer to notes -	Load / Time	Deflection	Failure Load	Water Test
99% - 65	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(3) 50# x 150 cycles	404 # / 20 min	0.029" / 0.146"	N/A	Pass
99% - 65	Std – 5 <sup>th</sup>	36"	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 20 min	0.026" / 0.090"	N/A	N/A
99% - 65	Std – 5 <sup>th</sup>	36"	0.625	85 - Std	STD	N	Std	(1) 404#	404 # / 20 min	0.032" / 0.112"	960	N/A
99% - 65	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	N	Std	(1) 404#	404 # / 20 min	0.038" / 0.128"	945	N/A
99% - 65	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(2) 250# x 20 cycles	404 # / 60 min	0.029" / 0.186"	N/A	N/A

**Tested Substrate** – 5/8” Drywall screwed to 25 gauge steel studs 16" on center. Acrylic tub surround @ 0.087” thickness set on the drywall. Open wall coupon – 11/98

Humidity / Temp	WingIt Embodiment	Bar Length	Tube Length	Wing Tip Material	Wing Tip Diameter	Tape	Installed Force	CYCLE LOAD TESTING Refer to notes -	Load / Time	Deflection	Failure Load	Water Test
47% - 32	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	N	Std	(1) 404#	300# / 30 min	0.046" / 0.189"	N/A	Pass
47% - 32	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	N	Std	(1) 404#	300# / 30 min	0.032" / 0.186"	642	N/A
47% - 32	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(1) 404#	300# / 30 min	0.058" / 0.192"	608	N/A
47% - 32	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(2) 300# x 10 cycles	300# / 30 min	0.038" / 0.229"	572	N/A
47% - 32	Std – 5 <sup>th</sup>	18"	0.625	85 - Std	STD	Y	Std	(3) 100# x 50 cycles	300# / 30 min	0.050" / 0.238"	586	N/A

**Tested Substrate** – 5/8” Drywall screwed to 25 gauge steel studs 16" on center. 12” X 12” X ¼” Marble, attached to the wall in accordance with ANSI A108.4 using standard adhesive and grout. Source - Home Depot. Cure times – mastic 24 hours, non-sanded grout – 24 Hours. Open wall coupon – 03/99

Humidity / Temp	WingIt Embodiment	Bar Length	Tube Length	Wing Tip Material	Wing Tip Diameter	Tape	Installed Force	CYCLE LOAD TESTING Refer to notes -	Load / Time	Deflection	Failure Load	Water Test
68% - 70	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(2) 300# x 10 cycles	250 # / 24 hrs	0.030" / 0.086"	N/A	Pass
68% - 70	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(3) 50# x 150 cycles	250 # / 24 hrs	0.030" / 0.090"	N/A	Pass
68% - 70	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(1) 404#	250 # / 24 hrs	0.028" / 0.092"	N/A	Pass
68% - 70	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(1) 404#	250 # / 24 hrs	0.018" / 0.080"	752	N/A
68% - 70	Std – 5 <sup>th</sup>	24"	0.625	85 - Std	STD	Y	Std	(1) 404#	250 # / 24 hrs	0.036" / 0.086"	736	N/A

WingIt Innovations **CONFIDENTIAL DOCUMENT** *Test Data Summary*

**Tested Substrate** – 5/8” Drywall screwed to 25 gauge steel studs 24” on center. Standard Interior Paint Applied on outside surface.

Water testing on painted drywall surfaces consists of a water spray directed at the WingIt Fastening System either under load, after loading, or both. The wall is maintained in a vertical direction throughout testing.

Open wall coupon – 06-98 thru 09-98

Humidity / Temp	WingIt Embodiment	Bar Length	Tube Length	Wing Tip Material	Wing Tip Diameter	Tape	Installed Force	CYCLE LOAD TESTING Refer to notes -	Load / Time	Deflection	Failure Load	Water Test
77% - 72	Std – 4 <sup>th</sup>	24”	0.625	85 - Std	STD	Y	Std	(3) 50# x 50 cycles	404 # / 10 min	0.080” / 0.238”	408	Pass
77% - 72	Std – 4 <sup>th</sup>	24”	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	0.085” / 0.210”	N/A	N/A
77% - 72	Std – 4 <sup>th</sup>	24”	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	0.050” / 0.178”	N/A	N/A
78% - 64	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(3) 50# x 50 cycles	404 # / 10 min	0.105” / 0.251”	412	N/A
78% - 64	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	0.080” / 0.220”	422	N/A
78% - 64	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	0.075” / 0.188”	N/A	N/A
47% - 79	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(2) 300# x 10 cycles	404 # / 10 min	0.075” / 0.222”	410	N/A
47% - 79	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(3) 50# x 50 cycles	404 # / 10 min	0.090” / 0.245”	416	N/A
47% - 79	Std – 5 <sup>th</sup>	18”	0.625	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	0.200” / 0.330”	422	N/A
90% - 76	Std – 5 <sup>th</sup>	24”	1.00”	85 - Std	STD	Y	Std	(3) 50# x 50 cycles	404 # / 10 min	.160” *	411	Pass
90% - 76	Std – 5 <sup>th</sup>	24”	1.00”	85 - Std	STD	N	Std	(1) 404#	404 # / 10 min	.120” *	N/A	N/A
90% - 76	Std – 5 <sup>th</sup>	18”	1.00”	85 - Std	STD	N	Std	(1) 404#	404 # / 10 min	.110” *	425	N/A
90% - 76	Std – 5 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	.110” *	N/A	N/A
90% - 76	Std – 5 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(2) 300# x 10 cycles	404 # / 10 min	.145” *	415	Pass
32% - 60	Std – 5 <sup>th</sup>	18”	1.00”	80 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	< ¼” *	N/A	N/A
32% - 60	Std – 5 <sup>th</sup>	18”	1.00”	80 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	< ¼” *	N/A	N/A
32% - 60	Std – 5 <sup>th</sup>	18”	1.00”	80 - Std	STD	N	Std	(1) 404#	404 # / 10 min	< ¼” *	N/A	N/A
87% - 71	Std – 4 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	N/A	425	Pass
87% - 71	Std – 4 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	N/A	N/A	N/A
87% - 71	Std – 4 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	N/A	N/A	N/A
87% - 71	Std – 4 <sup>th</sup>	18”	1.00”	85 - Std	STD	Y	Std	(1) 404#	404 # / 10 min	N/A	N/A	N/A

\* Indicates the an overall deflection measured - taken from the point of reaching highest initial load through testing process – coupon & bar deviations N/A.