

STEVE BARNES

Safety and Compliance Manager
Pentair Water Pool and Spa

APSP Technical Committee: Chairman
ASME A112.19.8 and APSP/IAPMO 16: Member
ASME A112.19.17 and APSP/IAPMO 17: Member

TOPICS


- Body entrapment science
- Evolution of ASME Body Block Test
- APSP Technical Committee evaluation of Body Block Element
- Foam & plywood vs. skin & bone
- Release force, 18 x 23 vs. 9 x 11.5

BODY SUCTION ENTRAPMENT

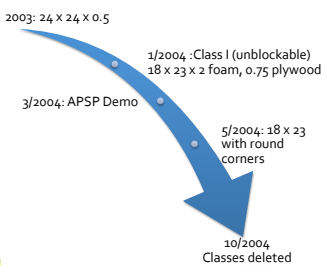
- The root cause:
 - Suction Outlet can be blocked/sealed
 - Suction strong enough to hold and trap
 - Structural failures result in victim getting stuck in sump, no peeling possible
- Solutions for cover/grate design:
 - Strength & integrity over useful life
 - Prevent the seal:
 - Unblockable
 - Complex geometry

ASME A112.19.8M – 1987

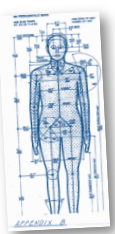
- Reaffirmed 1996
- "...maximum degree of safety from body and hair entrapment."
- Structural tests only
 - No UV aging test
 - No fastener test
 - No body block test
 - No "life" expectancy



BODY BLOCK TEST EVOLUTION

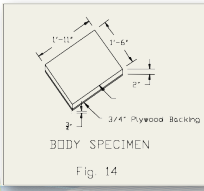



- 2003: 24 X 24 X 0.5
- 1/2004: Class I (unblockable) 18 x 23 x 2 foam, 0.75 plywood
- 3/2004: APSP Demo
- 5/2004: 18 x 23 with round corners
- 10/2004: Classes deleted

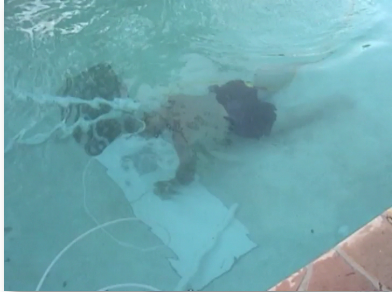


BODY BLOCK ELEMENT

- ASME A112.19.8 – Draft (Jan 2004)
 - Body block test: "Large Limited Velocity Covers"
- APSP Technical Committee – (Mar 2004)
 - Body block element demonstration

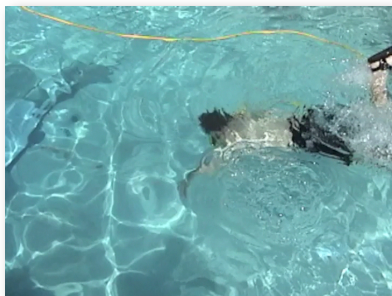
BODY BLOCK DEMONSTRATION



RELEASE FORCE

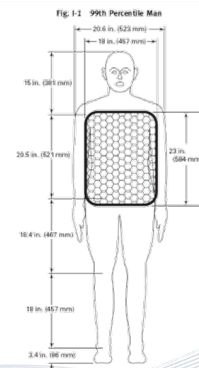
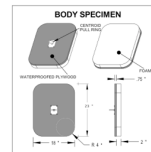
- 12 x 12 flat grate
- Skin sealed openings
- 20 in. Hg. sustained vacuum
 - 9.8 psi x 97.3 sq. in. open area
- **954 lbf.**
- **World Record Strength?**
- No! Skin peels, breaking seal

BODY BLOCK DEMONSTRATION



REFINEMENT

- ASME A112.19.8 Draft (May 2004)
 - Body block test: *“Rounded corners”*

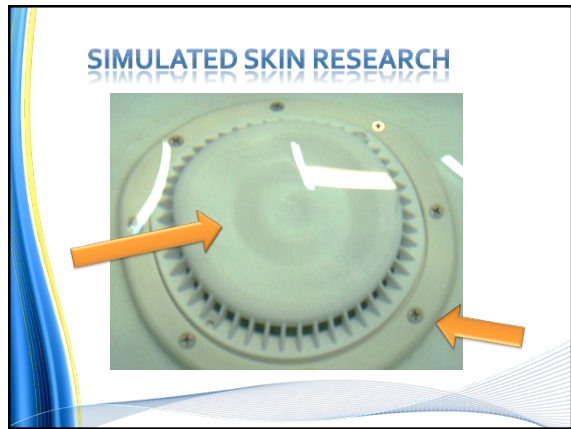


CHICAGO MEETING: 2004

- ASME A112.19.8 Draft (Oct 2004)
 - Classes removed
 - Class 3: *“Dual-Outlets”*
 - Removed *“Dual-Outlet”* body block testing
 - *“Unblockable”* body block test applied to all fittings
 - Classes did not include: *“Single (blockable) Outlet Systems”*

UNINTENDED CONSEQUENCES

- Blocking element conceived for *“unblockable”* flat grate certification
- Foam & plywood is not skin & bone
- Human bodies are rounded (shoulders, rib cage, hips, upper legs)
- Plywood and foam mimic suction cup
 - Rigid plywood forces foam against floor
- Skin pulls away from body
 - Foam can't

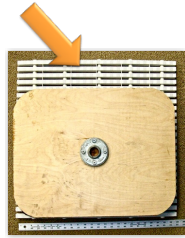


WHAT WE KNOW

- "Applicable" and "18 x 23" blocking elements shadow the drain cover
- Real skin, simulated skin, and foam blocking element seal openings
- When sealed, flow stops
 - Unlike hair test, where water continues to flow

FLOW RATING?

- Why flow "rating"
 - Conceived for "unblockable" flat grates
 - Unblockable flat grates have open area.
 - Release force proportional to flow = flow rating




UNINTENDED CONSEQUENCES

- Plywood and foam result in unrealistic and overly conservative "ratings"
 - Position of the blocking element **changes flow rating**
 - Speed of blocking element **changes flow rating**
 - Size of plywood **changes flow rating**

TEST ALIGNMENT

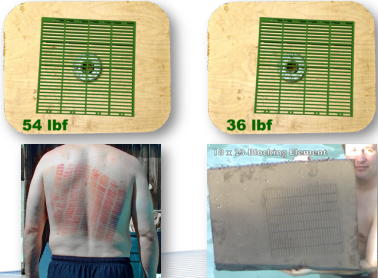
- Two-inch misalignment results* in a removal force reduction of 1.5 : 1
 - 2 inches = 50% test deviation
- 8 inch cover: 22.5 lbf vs. 15 lbf




(*Research conducted by George Pellington for ASTM 15.51 committee)

TEST ALIGNMENT

- 12 inch crate: 54 lbf vs. 36 lbf



HAND ALIGNMENT DIFFICULT



2" misalignment = 50% change in force

PLYWOOD PARACHUTE

- Why different lab results?
 - No pull speed specification
 - Faster pull speed = more force:



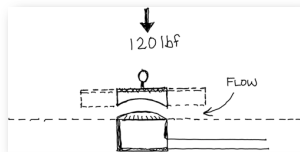
PLYWOOD PARACHUTE

- 18 x 23 requires 4 times more force than 9 x 11.5 at the same speed
 - Larger blocking element: **lower flow rating**



BERNOULLI'S PRINCIPLE

- Why different results?
 - 18 x 23 blocking element has 4 times more surface area than 9 x 11.5
 - 4 times larger Area = 4 times larger Force



BERNOULLI'S PRINCIPLE

- Why different results?
 - 18 x 23 blocking element has 4 times more surface area than 9 x 11.5
 - 4 times larger Area = 4 times larger Force



CONCLUSION

- Measured force (vacuum) does not equal release effort:
 - 954 lbs. measured force, yet bathers easily break the seal
- Body block flow rating NOT representative of swimmer safety
- Hair test rating IS representative of swimmer safety
- Current body block test "procedure" is NOT repeatable, test to test, much less lab to lab