Understanding and Compliance

of the

Virginia Graeme Baker Pool & Spa Safety Act

Sponsored by the U.S. Consumer Product Safety Commission

Presented By:

Rick English, Certified Building Professional, CPOI

www.poolinspections.com

English Pool Consulting

Inspections, Forensics, Design, Supervision

1445 Twenty Eighth Street
San Diego, CA 92102

VGB TRAINING.COM
Complete Training Source for Pool & Spa Professionals

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Please Silence Cell Phones

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Here's what you'll learn today

- Why do we have the Act?
- What are the hazards (and their causes)?
- What's required for compliance?
- What are the two most common compliance mistakes?
- How can you verify compliance?
- What are the "alternate" compliance methods?
- How can you "audit" an existing installation?
- Where can you go for more information?

How it works

- Congress wrote pool and spa “Rules”
- Requires CPSC to enforce “Rules”
- Does not require state or local enforcement
- Does not prevent state and local authorities from enforcing VGB, or imposing additional regulations
- Preempts state and local authority on minimum drain cover requirements, and the need to update single drain public pools and spas

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Why do We have the Act?

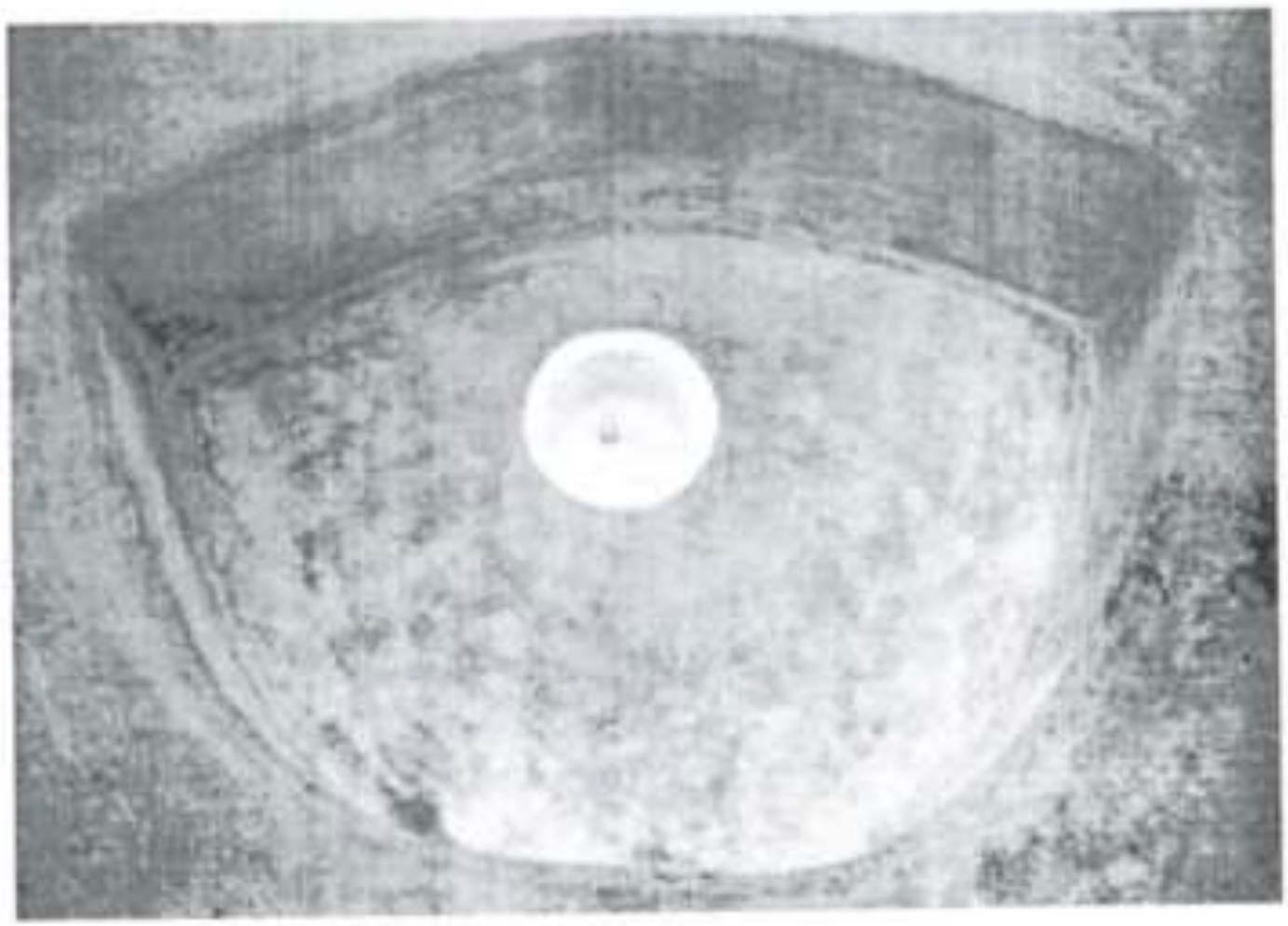

Photo f: View of bottom of spa with plastic grate missing from intake area.

Whitfield, Troy W.; Lansing, Joseph W.

CPSC FORM 182 (12/96) Approved for use through 07/31/2003 OMB NO. 30410029

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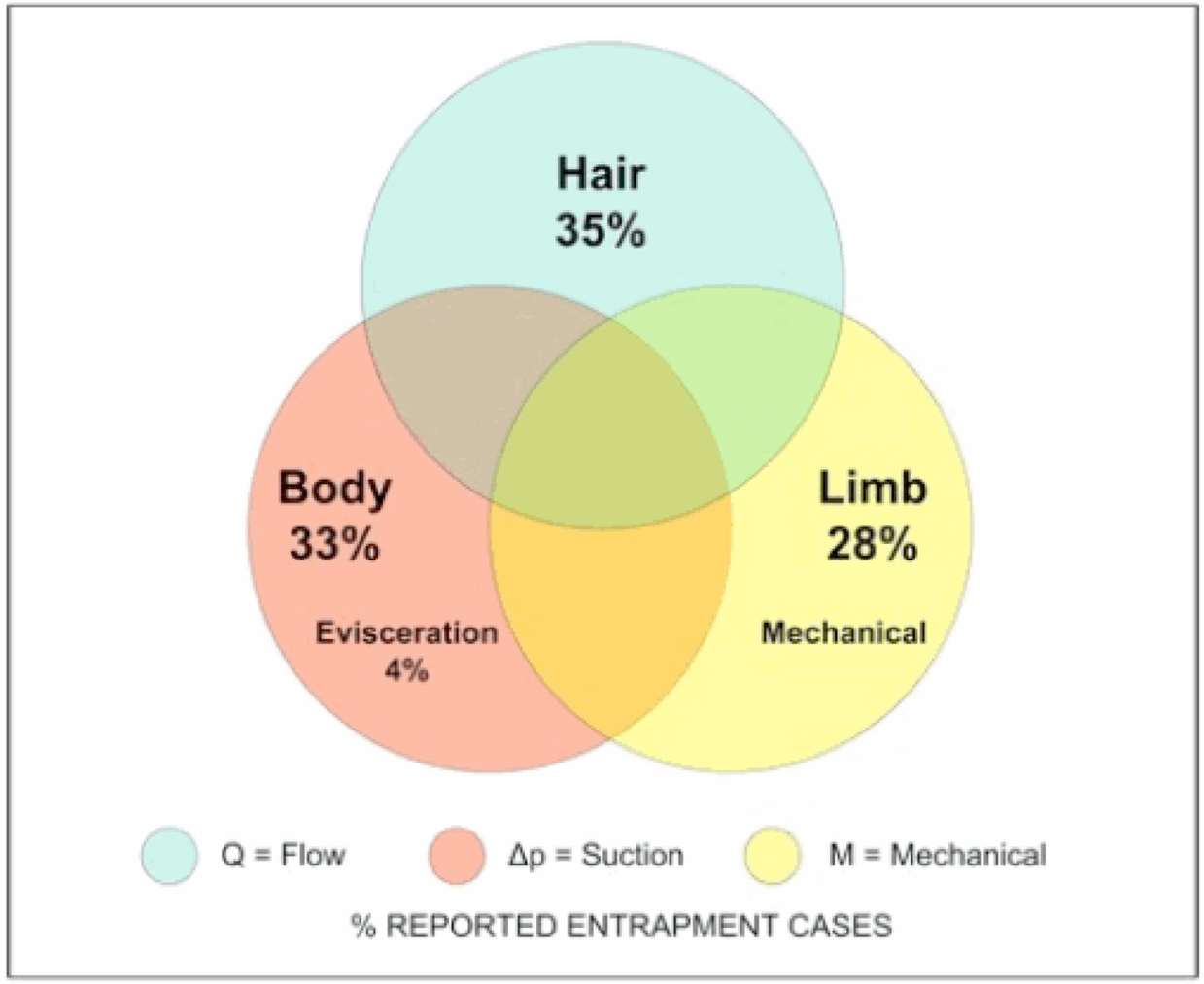
Three Root Causes of Entrapment

- **Flow**
  - **Hair Entrapment**
- **Suction**
  - **Body Entrapment**
  - **Evisceration**
- **Mechanical**
  - **Limb Entrapment**
  - **Finger**



APSP Technical Committee Research

February **1985** through August **2002**
155 data files ~ 141 with sufficient information to categorize
52% Residential / 48% Public

Three Root Causes of Entrapment

- Data Available from the CPSC is collected from several sources:
  - NEISS – National Electronic Injury Surveillance System
  - INDP – A Review of In Depth Investigations
  - IPII – Injury and Potential Injury Incidence File
  - DTHS – Death Certificate File

155 data files ~ 141 with sufficient information to categorize
52% Residential / 48% Public

Entrapment by Type

Cause	Injured	Fatalities	Total
Hair	9	3	12
Limb	26	4	30
Body	30	3	33
Evisceration	1	1	2
Mechanical	12	1	13
Total	78	12	90

1999 through 2009

94 entrapments;

79 injuries (38 Residential / 21 Public / 10 unknown); 1 unclear

12 fatalities (7 residential / 4 Public)

3 No Injury reports

Entrapment by Type

- 50% occurred in pools / 33% in spas / 17% in whirlpool tubs
- 58% Residential / 42% Public
- 75% of victims were under the age of 15

Information from the CPSP 5/24/10

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Entrapment by Hazard

Hazard	Injured	Fatalities	Total
Broken outlet cover	1	3	4
Outlet cover missing	16	4	20
Cover removed/ disengaged	5	0	5
Caught on Outlet cover	10	2	12
Trapped by Suction	27	3	30
Unknown	20	0	20
Total	79	12	91

42% trapped by suction

41% broken, missing, removed or disengaged outlet cover

17% caught on outlet cover

Flow – Suction – Mechanical

- Water Flowing = Hair Entrapment
- Suction doesn't need to be excessive
- The PROBLEM:
  - Hair gets knotted behind cover
  - Wrong cover flow rating for system flow
  - Shutting off pumps ineffective
- Most don't know this is a problem!
- What is the flow rate of your pools?

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Flow - Suction - Mechanical

- Water Flow Blocked = Injury or Death
- Suction strong enough to hold and trap stomach, back, back and arms, upper leg
- The PROBLEM:
- Suction outlet that can be sealed, with or without cover

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Flow – Suction – Mechanical

Evisceration (Disembowelment)

- Near instantaneous - ¼ second @ 60 GPM
- Injury at the speed of flowing water

The PROBLEM

Single outlet with missing or broken cover and buttock seal (wading pools)

Flow – Suction – Mechanical

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Flow – Suction – Mechanical

Open pipe = Injury or Death

- Openings large enough for hand or foot
- Limb goes in, can't be pulled out
- Pumps shut–off

Small hole = finger entrapment

- ½ inch hole in thin drain cover
- Entraps like sticking ring on finger

The PROBLEM:

- Broken or Missing drain covers
- Drain covers not Certified

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Flow - Suction -Mechanical

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CPSC Recommended...

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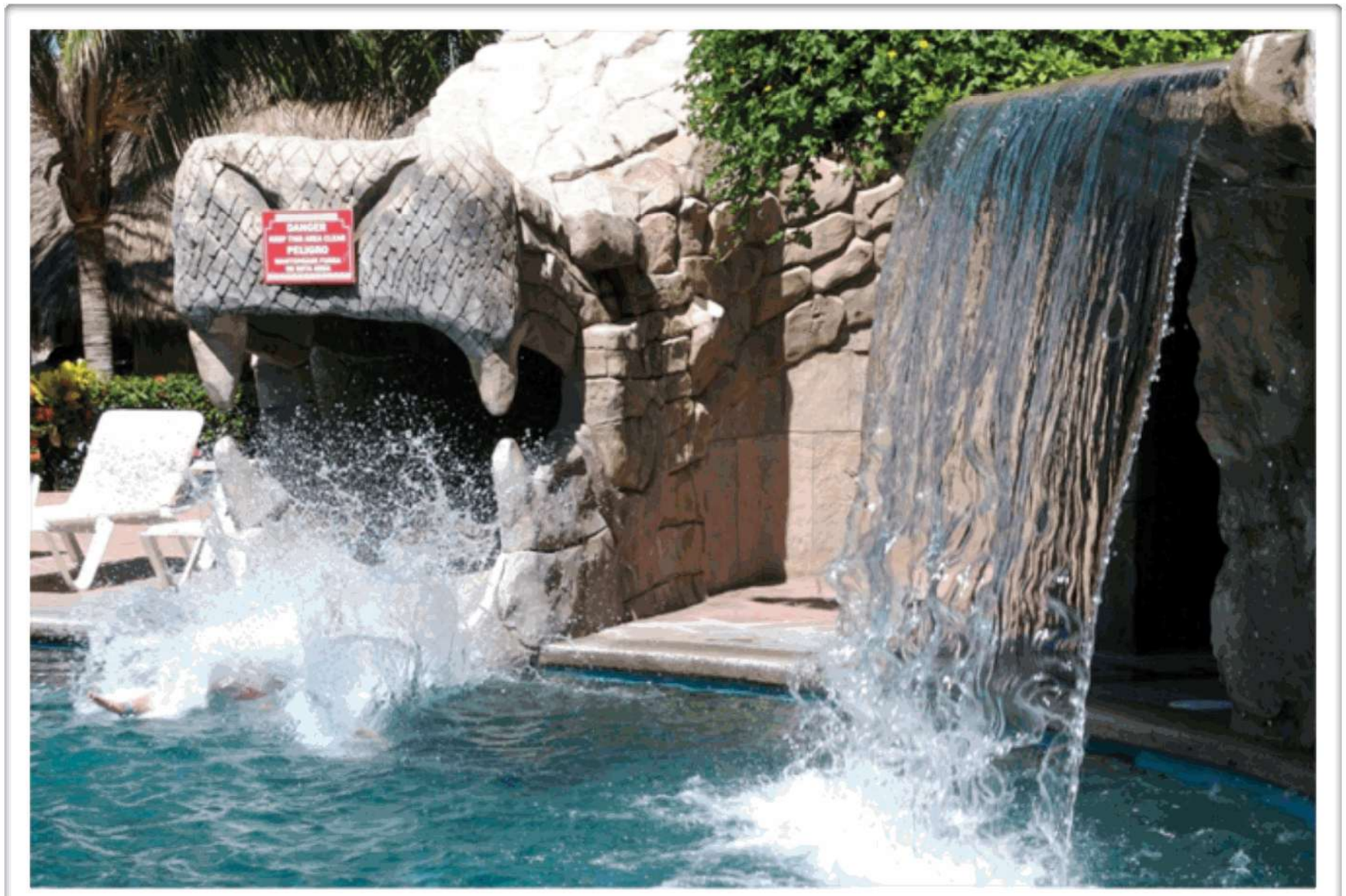

CPSC Recommended...

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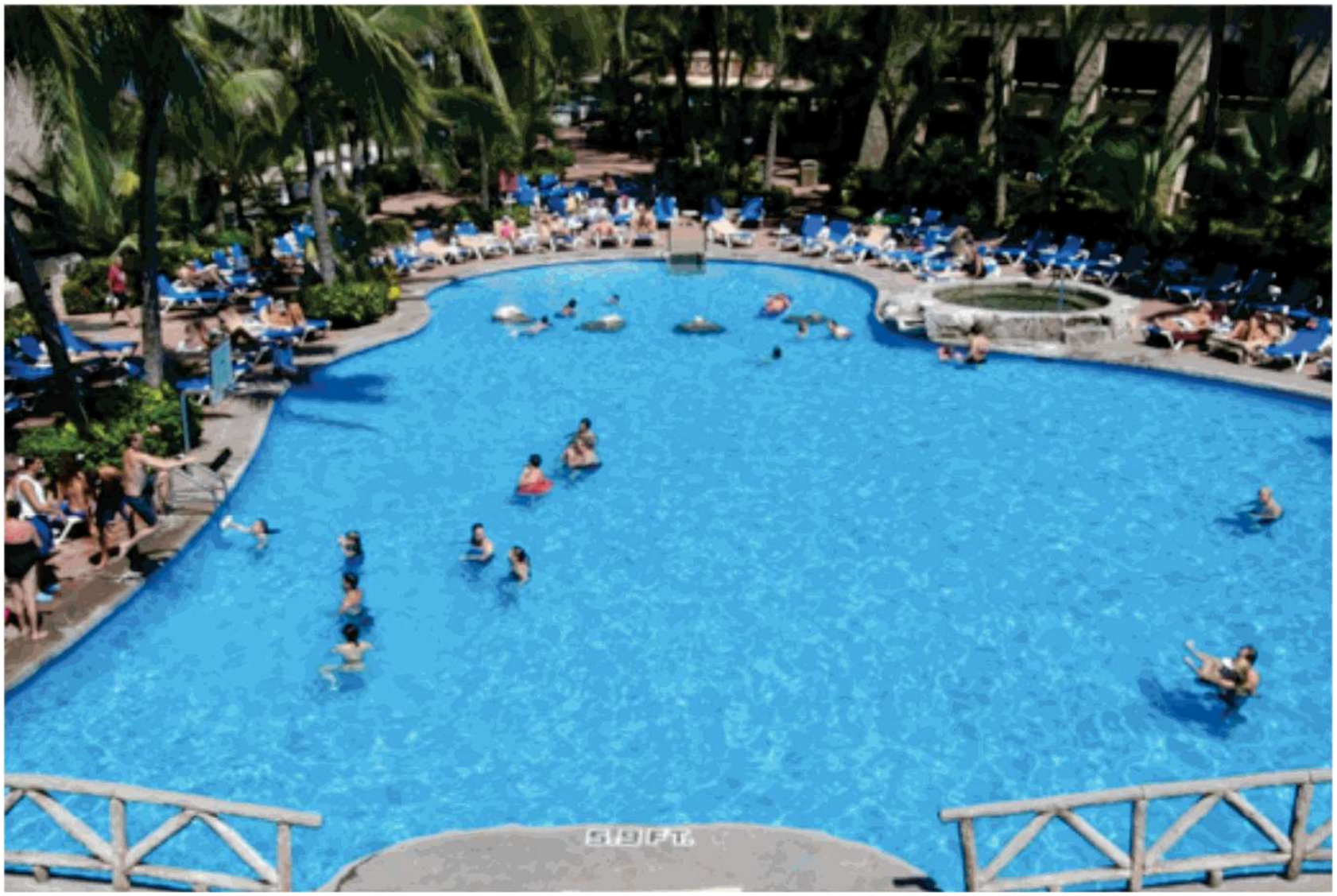
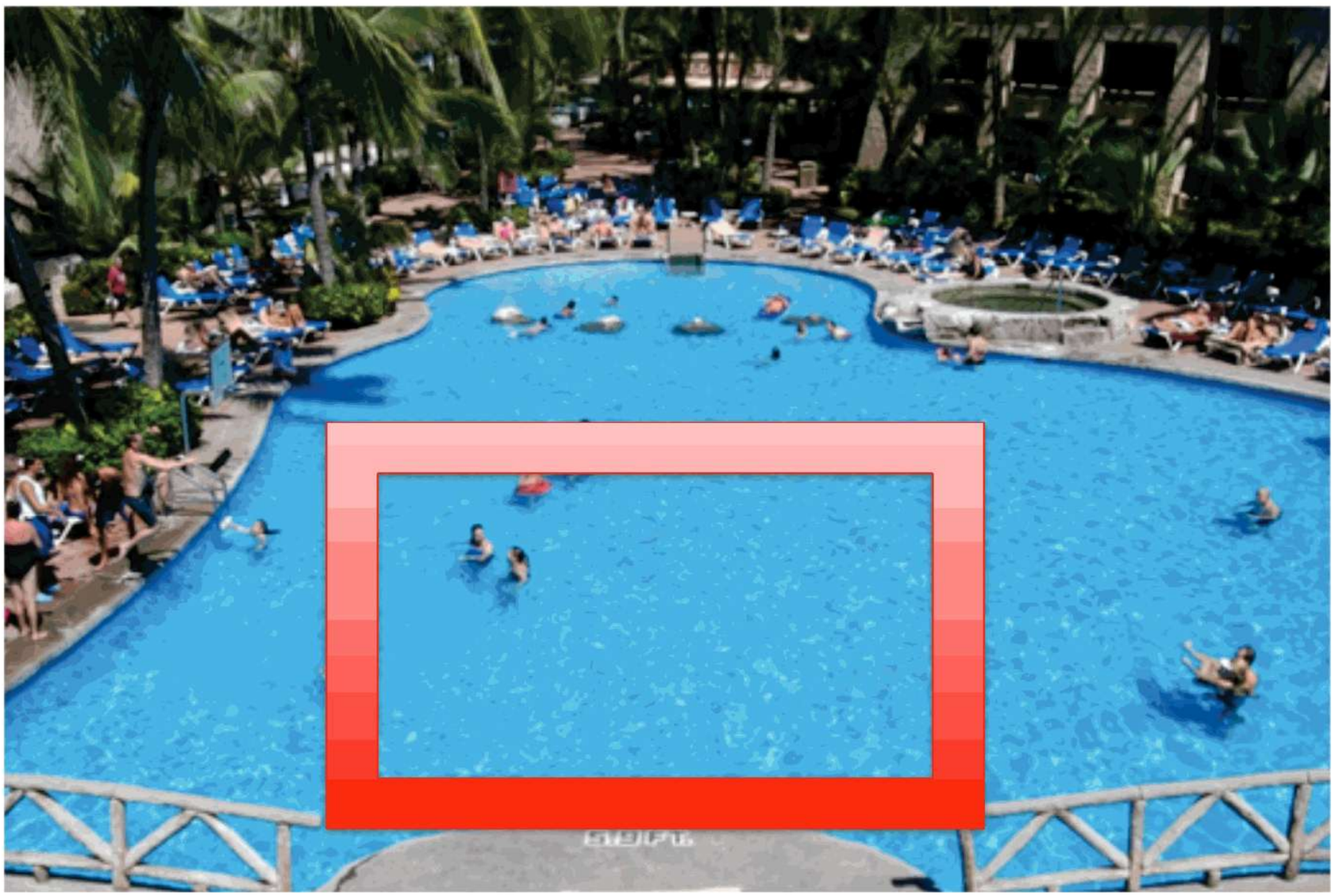
Why?



CPSC Recommended...

Why?



CPSC Recommended

"CPSC s *nd not just MI* *ools and spas, po* *uild new pools w* *ws and/or skimme*

Photo Courtesy of USA Swimming

This is one of five alternatives offered by the CPSC

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What is Covered by the ACT?

<u>Mandatory</u> Requirements for Entrapment Avoidance.

Public Pool Drain Covers & Grate
Public Pool Drain Systems
Safety Drain Covers (Residential & Commercial)

Voluntary Grant Program for States (Residential)
Barriers
Suction Entrapment Avoidance

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Drain Covers

- VGB requires compliance

Professional
(See ASME 112.19.8-2007
Sections 2.3.7.7 and 3.1.1)

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Compliant Drain Covers

- ✓Finger & Limb Entrapment Test
- ✓Body Entrapment Test
- ✓Shear Load & Pull Load Tests
- ✓UV Weathering before structural test
- ✓Fastener Test
- ✓Full Head of Hair Test
- ✓Pony Tail Test
- ✓No Size Limit

Compliant Drain Covers

- Field Fabricated Outlets:

  "**Certification Report**" by Professional Engineer

  (See ASME A112.19.8-2007 Mandatory Appendix II)

  - ✓Maximum system flow rate
  - ✓UV tested and usable lifetime documentation
  - ✓Sump specification
  - ✓Body entrapment calculations
  - ✓Structural analysis
  - ✓Finger test

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Compliant Drain Covers

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Drain cover rating must be higher than maximum system flow rate

- Choose new drain cover based on 100% flow through drain system
  - No skimmers or overflow systems operating
- Each cover requires a flow rating equal to or greater than the maximum system flow
  - Unless there are three or more drain covers piped together without valves
- Assume one cover is blocked.
  - See ASME A112.19.8-2007 Section 7.2.1(a) (4)

Drain cover flow rating must be higher than maximum system flow

- Example
- Maximum System Flow = **140 GPM**
- VGB 2008 Drain Cover = Rated at 100 GPM
- Dual-Drain System
  - 100 + 100 = 200 GPM System?
  - **NO** - 100 + 100 = 100 GPM System!
- Three-drain System
  - 100 + 100 + 100 = 200 GPM System!
  - 200 > 140 GPM

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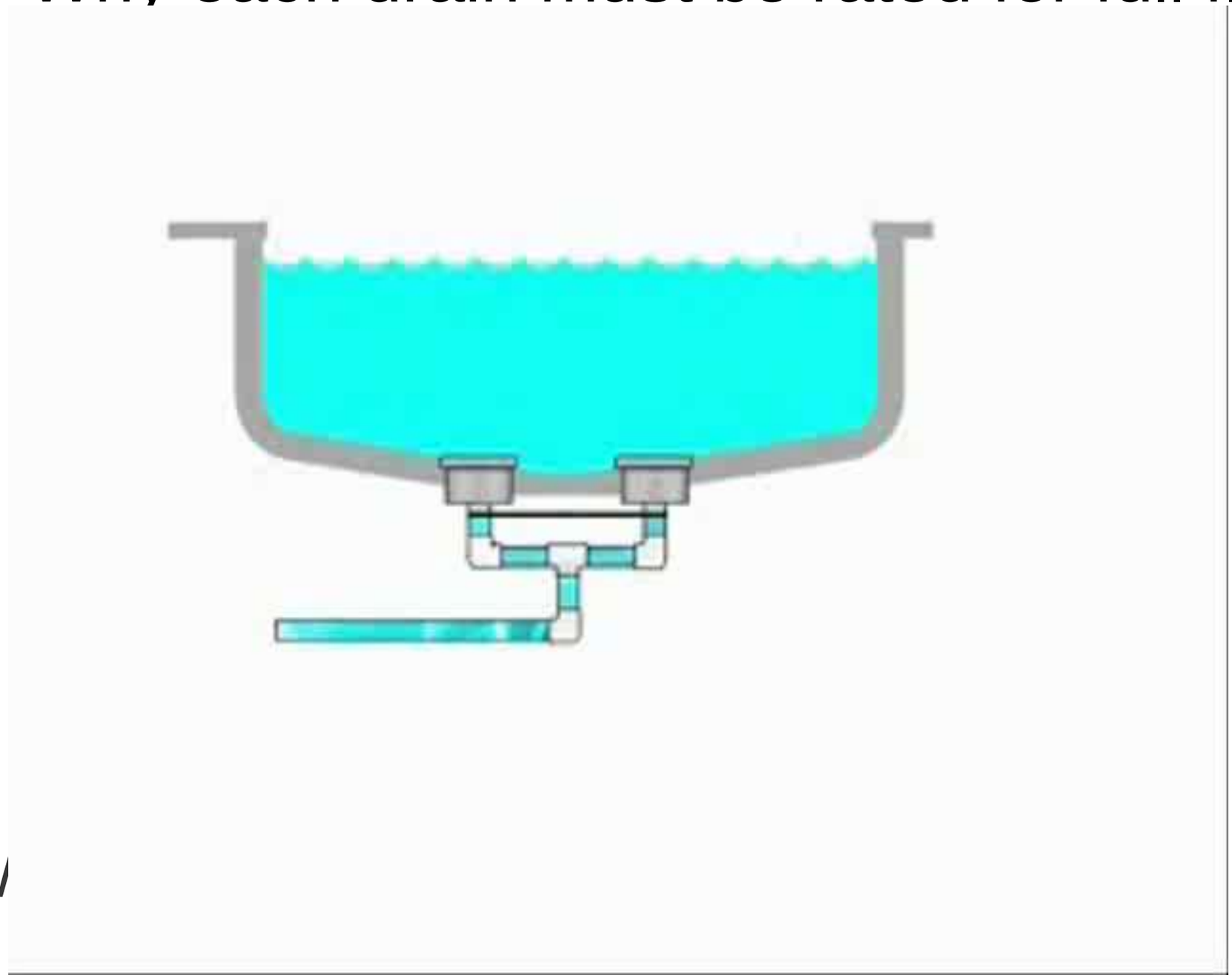
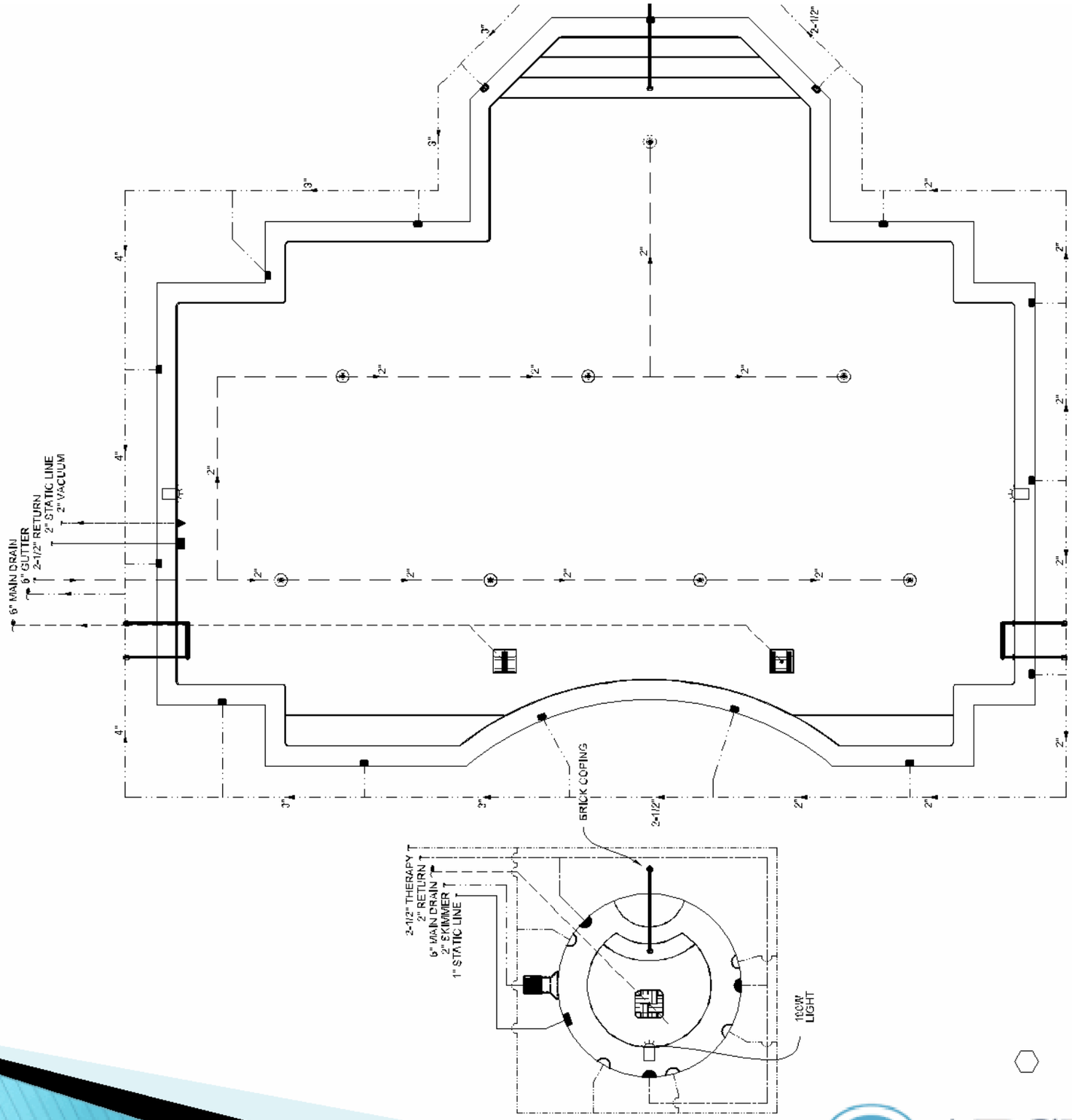
Dual Drain System

Why each drain must be rated for full flow



V

Engineered Equipment Layout



Things Change in the field

Total Dynamic Head is the sum of all the resistances in the system.

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Things Change in the Field

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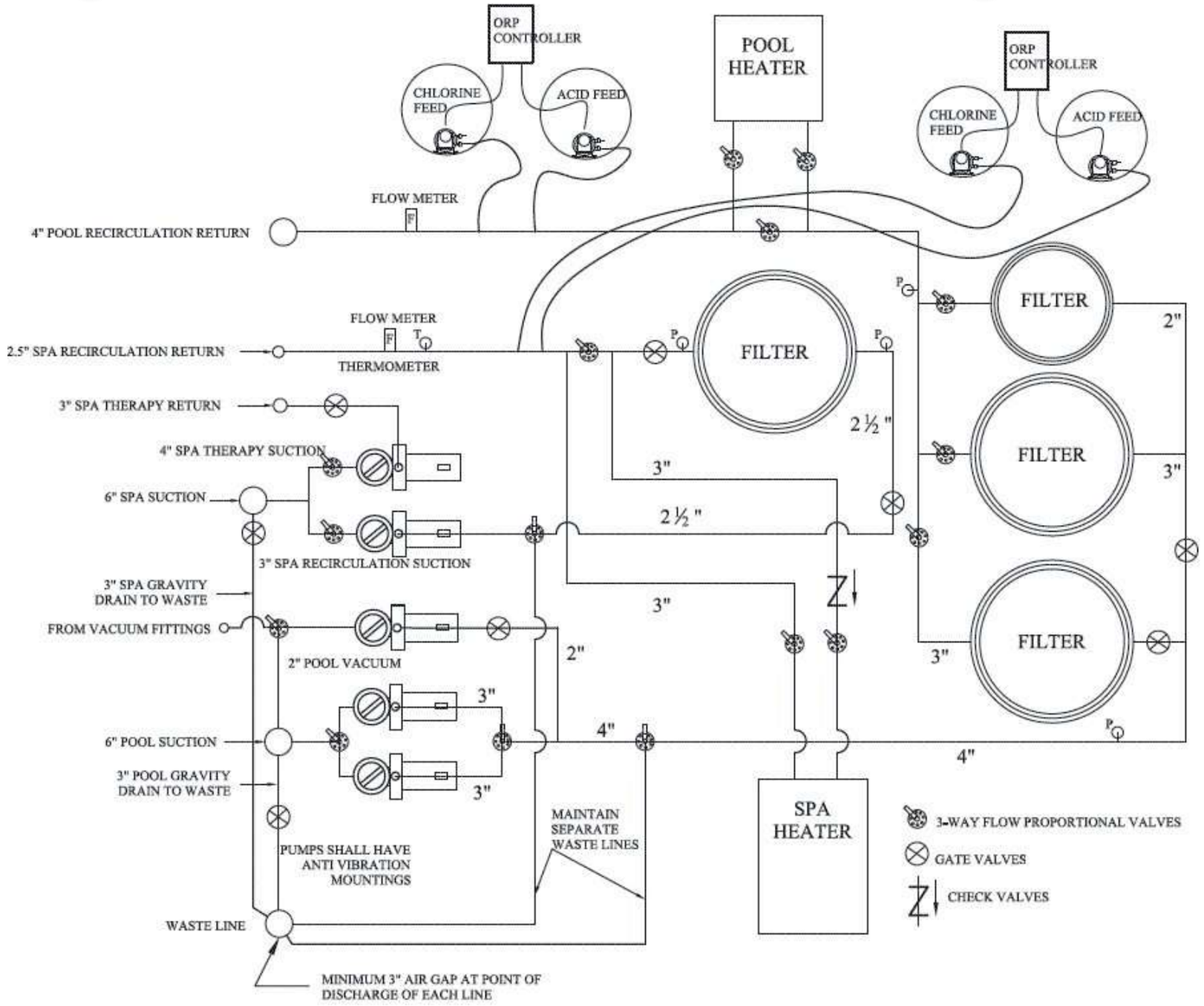
Engineered Plumbing Design



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Things Change in the Field

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If you know TDH, you can determine the flow

Calculations must include the resistances in the equipment, piping, fittings, valves and other all other system components

The problem here is that what we call "calculations" are really estimations of system resistance and they are ALWAYS higher than actual resistance!

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Basic Pool Hydraulics – 101

1. Determine pool volume in gallons
2. Calculate desired flow rate based on turnover time – usually 6 hours
3. Determine resistance of pipes & fittings (TDH)
4. Select a pump based on
   - ❑ Desired Flow Rate
   - ❑ TDH
   - ❑ Pump Head Curve (from lab tests)

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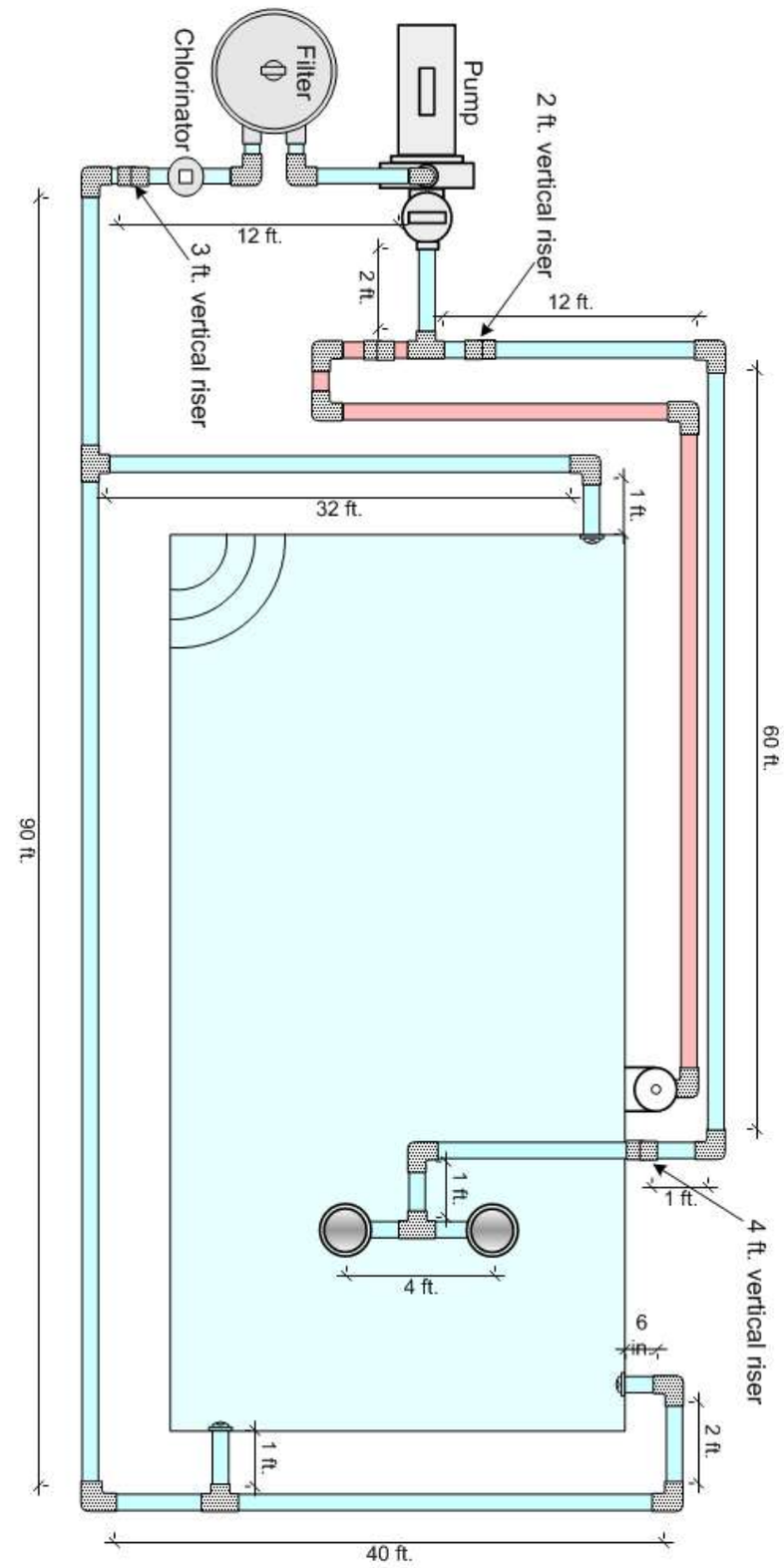
Example – 25,000 gallon pool

1. First determine flow rate in gallons per minute
2. Six hour turnover required
3. 360 minutes
   - $25000 gallons \div 360 minutes = 69.4\ GPM$
4. Round to 70 GPM



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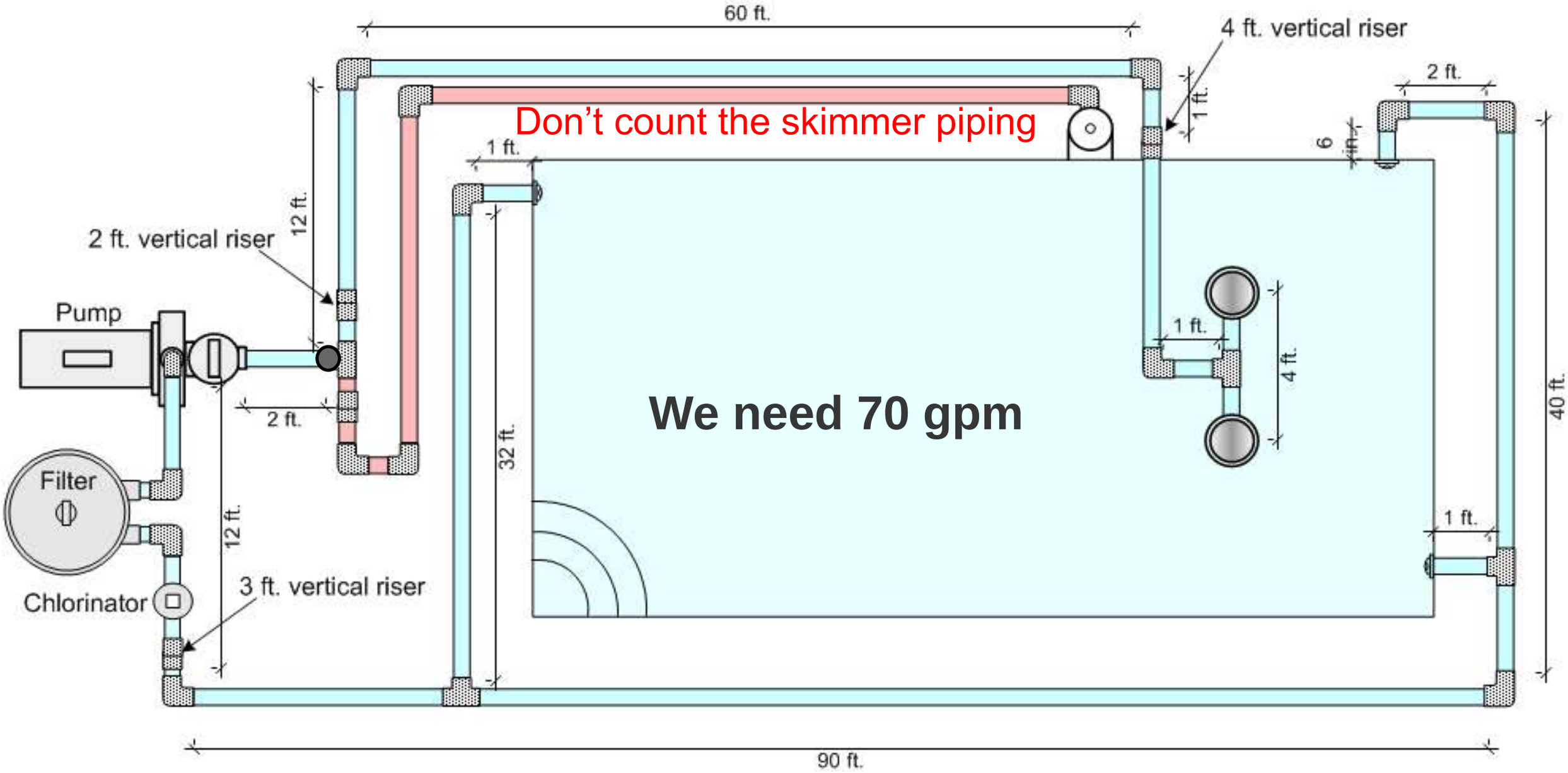
Here's how TDH is estimated



Measure the pipe, count the fittings, valves, equipment, return & drain fittings

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Friction Loss – Water

Flow Velocity & Friction Loss — Schedule 40 Pipe

Gallons/Minute	½ in. Velocity Ft./Second	½ in. Friction Loss Ft. Water/100 Ft.	½ in. Friction Loss PSI/100 Ft.	¾ in. Velocity Ft./Second	¾ in. Friction Loss Ft. Water/100 Ft.	¾ in. Friction Loss PSI/100 Ft.	1 in. Velocity Ft./Second	1 in. Friction Loss Ft. Water/100 Ft.	1 in. Friction Loss PSI/100 Ft.	1¼ in. Velocity Ft./Second	1¼ in. Friction Loss Ft. Water/100 Ft.	1¼ in. Friction Loss PSI/100 Ft.	1½ in. Velocity Ft./Second	1½ in. Friction Loss Ft. Water/100 Ft.	1½ in. Friction Loss PSI/100 Ft.	2 in. Velocity Ft./Second	2 in. Friction Loss Ft. Water/100 Ft.	2 in. Friction Loss PSI/100 Ft.	2½ in. Velocity Ft./Second	2½ in. Friction Loss Ft. Water/100 Ft.	2½ in. Friction Loss PSI/100 Ft.	3 in. Velocity Ft./Second	3 in. Friction Loss Ft. Water/100 Ft.	3 in. Friction Loss PSI/100 Ft.
1	1.13	2.08	0.90	0.63	0.51	0.22																		
2	2.26	4.16	1.80	1.26	1.02	0.44	0.77	0.55	0.24	0.44	0.14	0.06	0.33	0.07	0.03									
5	5.64	23.44	10.15	3.16	5.73	2.48	1.93	1.72	0.75	1.11	0.44	0.19	0.81	0.22	0.09	0.49	[illegible]	0.029	0.30	0.038	0.016	0.22	0.015	0.007
7	7.90	43.06	18.64	4.43	10.52	4.56	2.72	3.17	1.37	1.55	0.81	0.35	1.13	0.38	0.17	0.69	0.11	0.048	0.49	0.051	0.023	0.31	0.021	0.009
10	11.28	82.02	35.51	6.32	20.04	8.68	3.86	6.02	2.61	2.21	1.55	0.67	1.62	0.72	0.31	0.98	0.21	0.091	0.68	0.09	0.039	0.44	0.03	0.013
15	4 in.			9.48	42.46	18.39	5.79	12.77	5.53	3.31	3.28	1.42	2.42	1.53	0.66	1.46	0.45	0.19	1.03	0.19	0.082	0.66	0.07	0.030
20	0.51	0.03	0.013	12.65	72.34	31.32	7.72	21.75	9.42	4.42	5.59	2.42	3.23	2.61	1.13	1.95	0.76	0.33	1.37	0.32	0.14	0.88	0.11	0.048
25	0.64	0.04	0.017	5 in.			9.65	32.88	14.22	5.52	8.45	3.66	4.04	3.95	1.71	2.44	1.15	0.50	1.71	0.49	0.21	1.10	0.17	0.074
30	0.77	0.06	0.026	0.49	0.02	0.009	11.58	46.08	19.95	6.63	11.85	5.13	4.85	5.53	2.39	2.93	1.62	0.70	2.05	0.68	0.29	1.33	0.23	0.10
35	0.89	0.08	0.035	0.57	0.03	0.013				7.73	15.76	6.82	5.66	7.36	3.19	3.41	2.15	0.93	2.39	0.91	0.39	1.55	0.31	0.13
40	1.02	0.11	0.048	0.65	0.03	0.013				8.84	20.18	8.74	6.47	9.43	4.08	3.90	2.75	1.19	2.73	1.16	0.50	1.77	0.40	0.17
45	1.15	0.13	0.056	0.73	0.04	0.017	6 in.			9.94	25.10	10.87	7.27	11.73	5.08	4.39	3.43	1.49	3.08	1.44	0.62	1.99	0.50	0.22
50	1.28	0.16	0.069	0.81	0.05	0.022	0.56	0.02	0.009	11.05	30.51	13.21	8.08	14.25	6.17	4.88	4.16	1.80	3.42	1.75	0.76	2.21	0.60	0.26
60	1.53	0.22	0.095	0.97	0.07	0.030	0.67	0.03	0.013				9.70	19.98	8.65	5.85	[illegible]	2.53	4.10	2.46	1.07	2.65	0.85	0.37
70	1.79	0.30	0.13	1.14	0.10	0.043	0.79	0.04	0.017							6.83	7.76	3.36	4.79	3.27	1.42	3.09	1.13	0.49
75	1.92	0.34	0.15	1.22	0.11	0.048	0.84	0.05	0.022							7.32	[illegible]	3.82	5.13	3.71	1.61	3.31	1.28	0.55
80	2.05	0.38	0.16	1.30	0.13	0.056	0.90	0.05	0.022							7.80	9.94	4.30	5.47	4.19	1.81	3.53	1.44	0.62
90	2.30	0.47	0.20	1.46	0.16	0.069	1.01	0.06	0.026	8 in.						8.78	12.37	5.36	6.15	5.21	2.26	3.98	1.80	0.78
100	2.56	0.58	0.25	1.62	0.19	0.082	1.12	0.08	0.035	0.65	0.03	0.012				9.75	15.03	6.51	6.84	6.33	2.74	4.42	2.18	0.94
125	3.20	0.88	0.38	2.03	0.29	0.125	1.41	0.12	0.052	0.81	0.035	0.015							8.55	9.58	4.15	5.52	3.31	1.43
150	3.84	1.22	0.53	2.44	0.40	0.17	1.69	0.16	0.069	0.97	0.04	0.017							10.26	13.41	5.81	6.63	4.63	2.00
175	4.48	1.63	0.71	2.84	0.54	0.235	1.97	0.22	0.096	1.14	0.055	0.024	10 in.									7.73	6.16	2.67
200	5.11	2.08	0.90	3.25	0.69	0.30	2.25	0.28	0.12	1.30	0.07	0.030	0.82	0.027	0.012							8.83	7.88	3.41
250	6.40	3.15	1.36	4.06	1.05	0.45	2.81	0.43	0.19	1.63	0.11	0.048	1.03	0.035	0.015							11.04	11.93	5.17
300	7.67	4.41	1.91	4.87	1.46	0.63	3.37	0.60	0.26	1.94	0.16	0.069	1.23	0.05	0.022	12 in.								
350	8.95	5.87	2.55	5.69	1.95	0.85	3.94	0.79	0.34	2.27	0.21	0.091	1.44	0.065	0.028	1.01	0.027	0.012						
400	10.23	7.52	3.26	6.50	2.49	1.08	4.49	1.01	0.44	2.59	0.27	0.12	1.64	0.09	0.039	1.16	0.04	0.017						
450				7.31	3.09	1.34	5.06	1.26	0.55	2.92	0.33	0.14	1.85	0.11	0.048	1.30	0.05	0.022						
500				8.12	3.76	1.63	5.62	1.53	0.66	3.24	0.40	0.17	2.05	0.13	0.056	1.45	0.06	0.026						
750										4.86	0.85	0.37	3.08	0.28	0.12	2.17	0.12	0.052						
1000										6.48	1.45	0.63	4.11	0.48	0.21	2.89	0.20	0.087						
[illegible]													5.14	0.73	0.32	3.62	0.31	0.13						
													6.16	1.01	0.44	4.34	0.43	0.19						
																5.78	0.73	0.32						
																7.23	1.11	0.49						

Friction loss through fittings

Equivalent length of straight pipe in feet

Pipe Size	1”	1.5”	2”	2.5”	3”	4”	5”	6”	8”
90º elbow	2.5	4.0	5.7	6.9	7.9	11.4	14.5	16.7	21.0
45º elbow	1.4	2.1	2.6	3.1	4.0	5.1	7.0	8.0	10.6
Tee through	1.7	2.7	4.0	4.9	6.1	7.9	9.7	12.3	14.0
Tee branch	6.0	8.4	12.0	14.7	16.4	22.0	26.2	32.7	49.0
Swing Check Valve	11.2	15.2	19.1	22.0	27.0	38.0			

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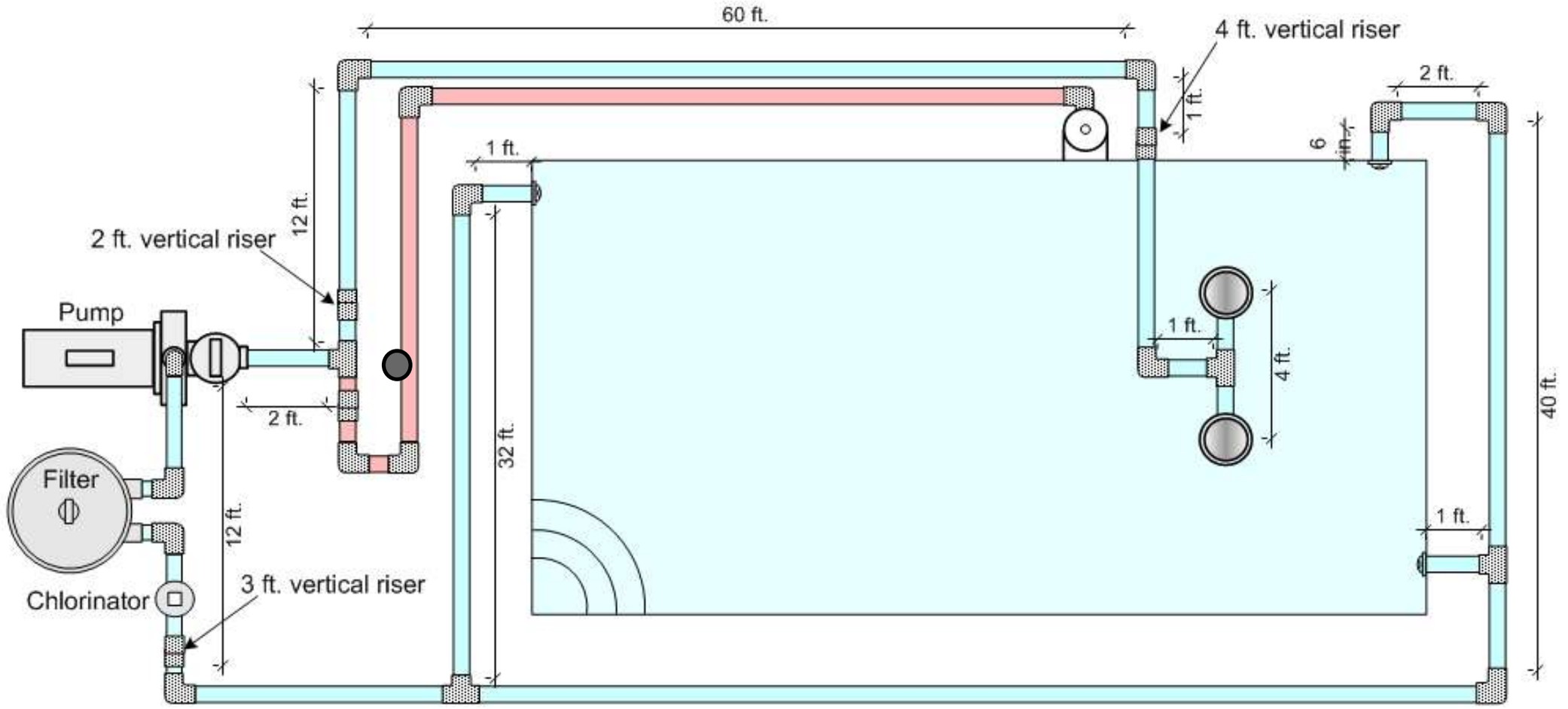
Friction Loss – Return Fittings

	½ in.		¾ in.		1 in.	
GPM	**Velocity in FPS**	**Loss in feet hd.**	**Velocity in FPS**	**Loss in feet hd.**	**Velocity in FPS**	**Loss in feet hd.**
5	8.2	1.0	3.6	.2		
10	16.3	4.2	7.3	.8		
15	24.5	9.3	10.9	1.9	6.1	.6
20			14.5	3.3	8.2	1.0
25			18.2	5.1	10.2	1.6
30			21.8	7.4	12.3	2.3
35					14.3	3.2
40					16.3	4.2
50					20.4	6.5



SUCTION SIDE

2" pipe	104 ft.	
2" 90's	9 ea. @ 5.7 ft. ea.	51 ft.
2" Tee's	2 ea. @ 12 ft.	24 ft.
3 way valve	1 ea. @ 12 ft.	12 ft.
Drains	2 ea. @ 2 ft.	4 ft.
Total equivalent feet of 2 in. pipe		**195 ft.**

1.95 x 7.76 ft. of head per 100 ft. @ 70 gpm = 15.3

RETURN SIDE

2" pipe	182 ft.	
2" 90's	10 ea. @ 5.7 ft. ea.	57 ft.
2" Tee's	2 ea. @ 4 ft.	8 ft.
Total equivalent feet of 2 in. pipe		**247 ft.**

2.47 x 7.76 ft. of head per 100 ft. @ 70 gpm = 19.2

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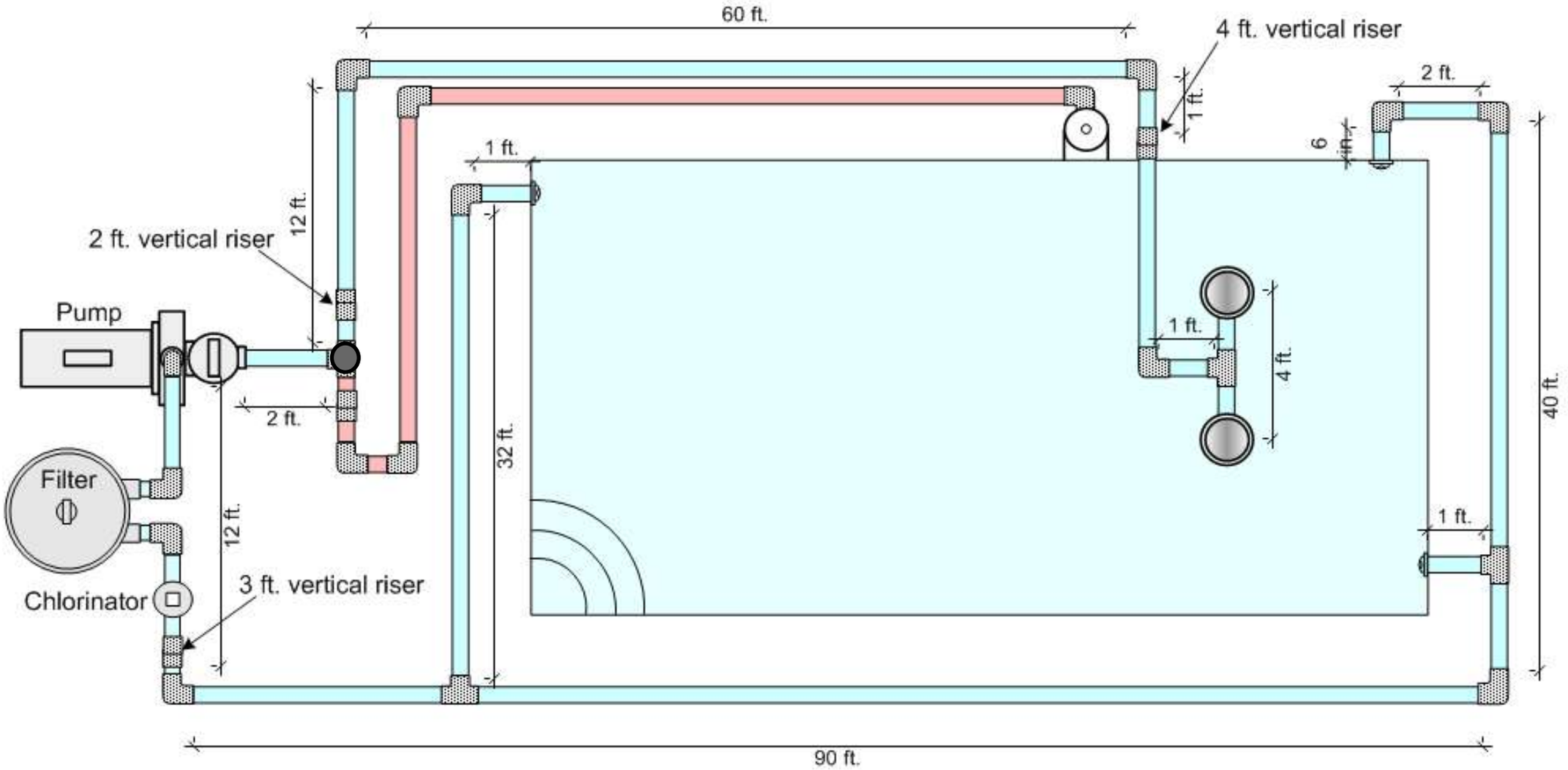

Suction side loss	15.3
Return side loss	19.2
Filter loss	12.0
Chlorinator loss	2.0
Return fitting loss	1.6

Total *Calculated* Loss =50.1 (TDH)

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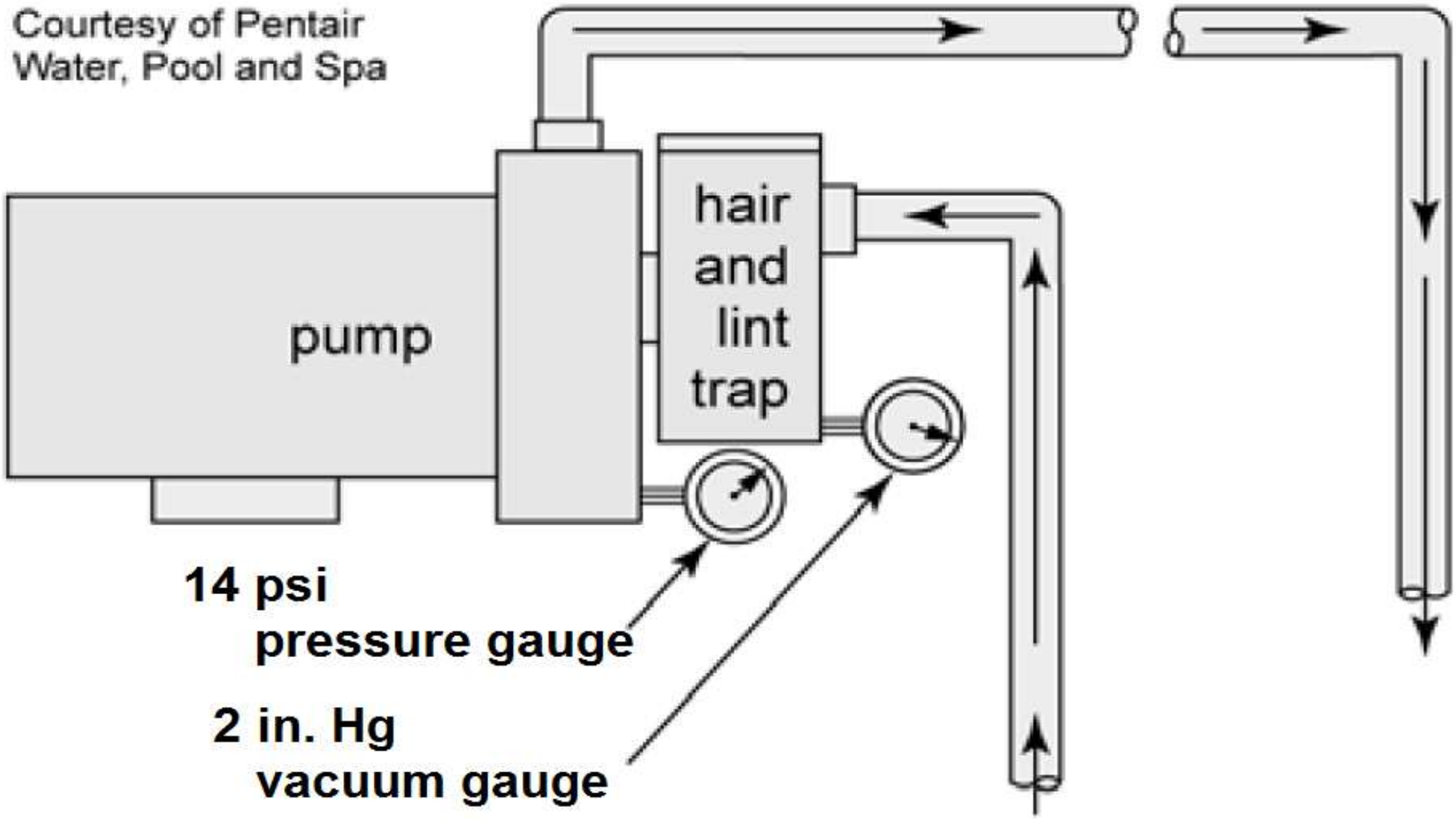
Resistance (TDH)
Calculated vs. Measured



Pressure Head = 14 psi x 2.31 = 32.34 feet
Suction Head = 2 in-Hg x 1.13 = 2.26 feet

Total = 34.6 feet

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Let’s do some math

The same pool measured with pressure and vacuum gauges:

14 lbs. pressure
2 inches vacuum

Then:

14 x 2.31 = 32.34 feet of head on the pressure side
2 x 1.13 = 2.26 feet of head on the suction side

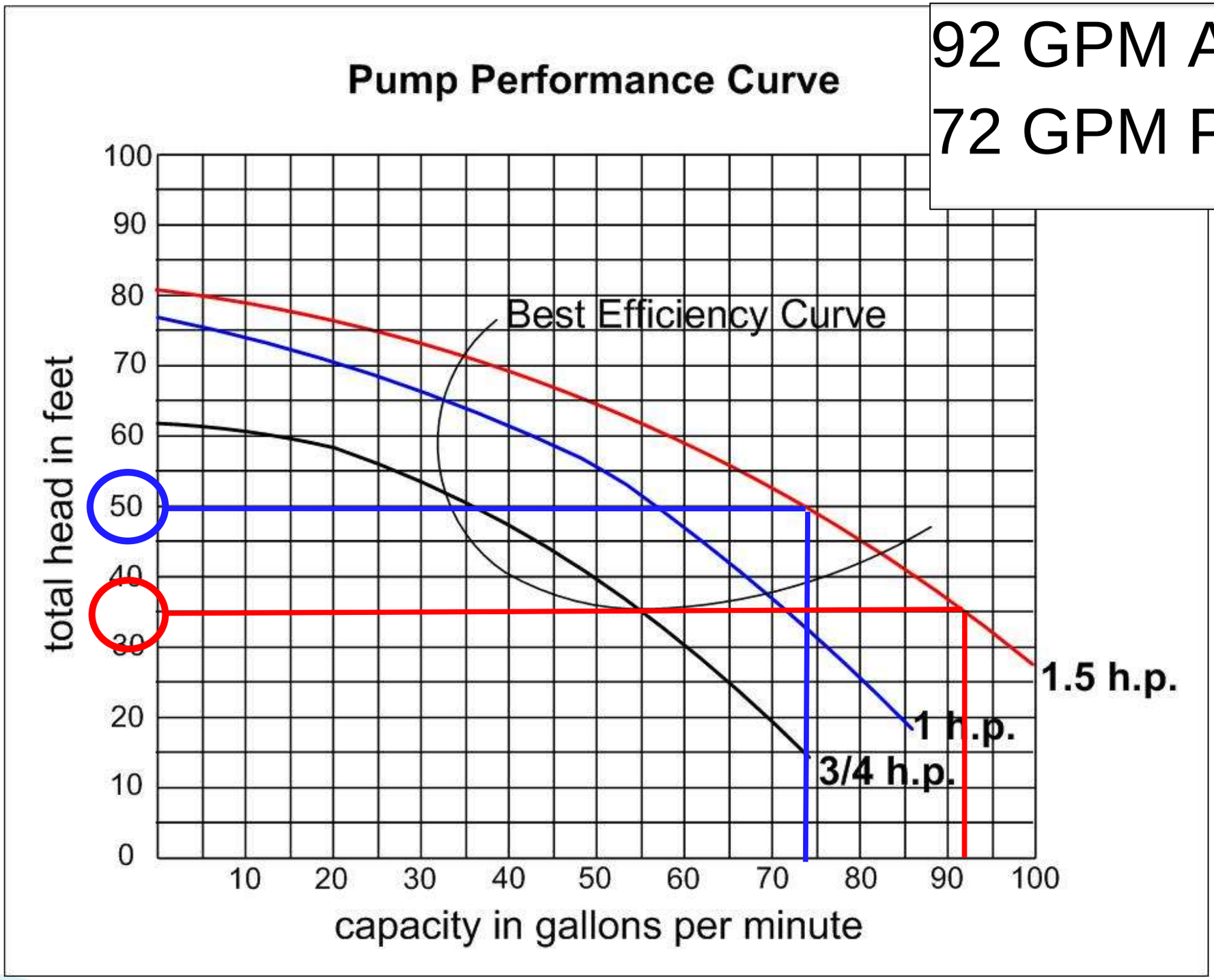
So:

32.34 plus 2.26 = 34.6 (Round to 35)
35 ft. is the total dynamic head in the system

Calculated TDH & Measured TDH

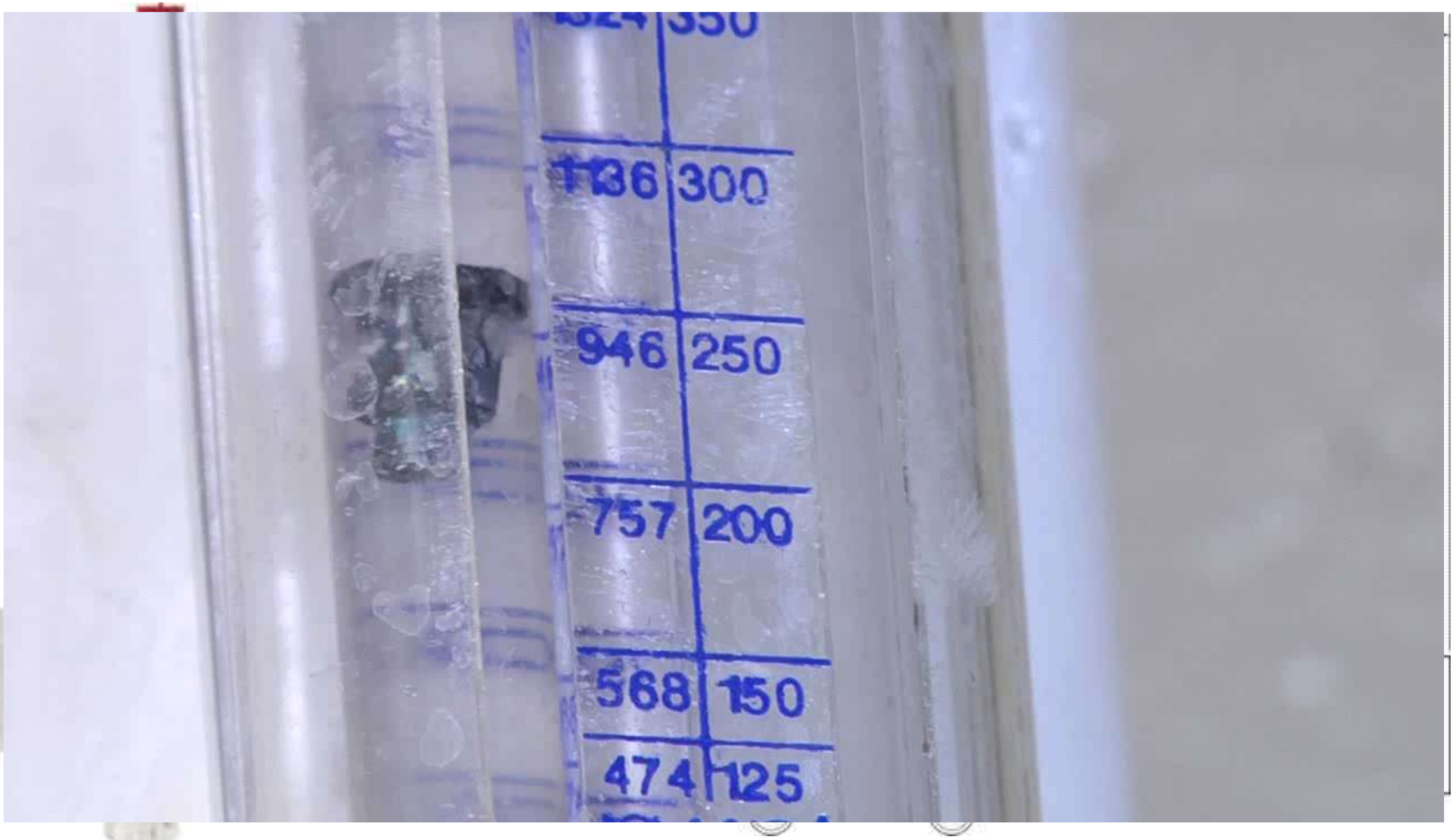
92 GPM Actual

72 GPM Predicted



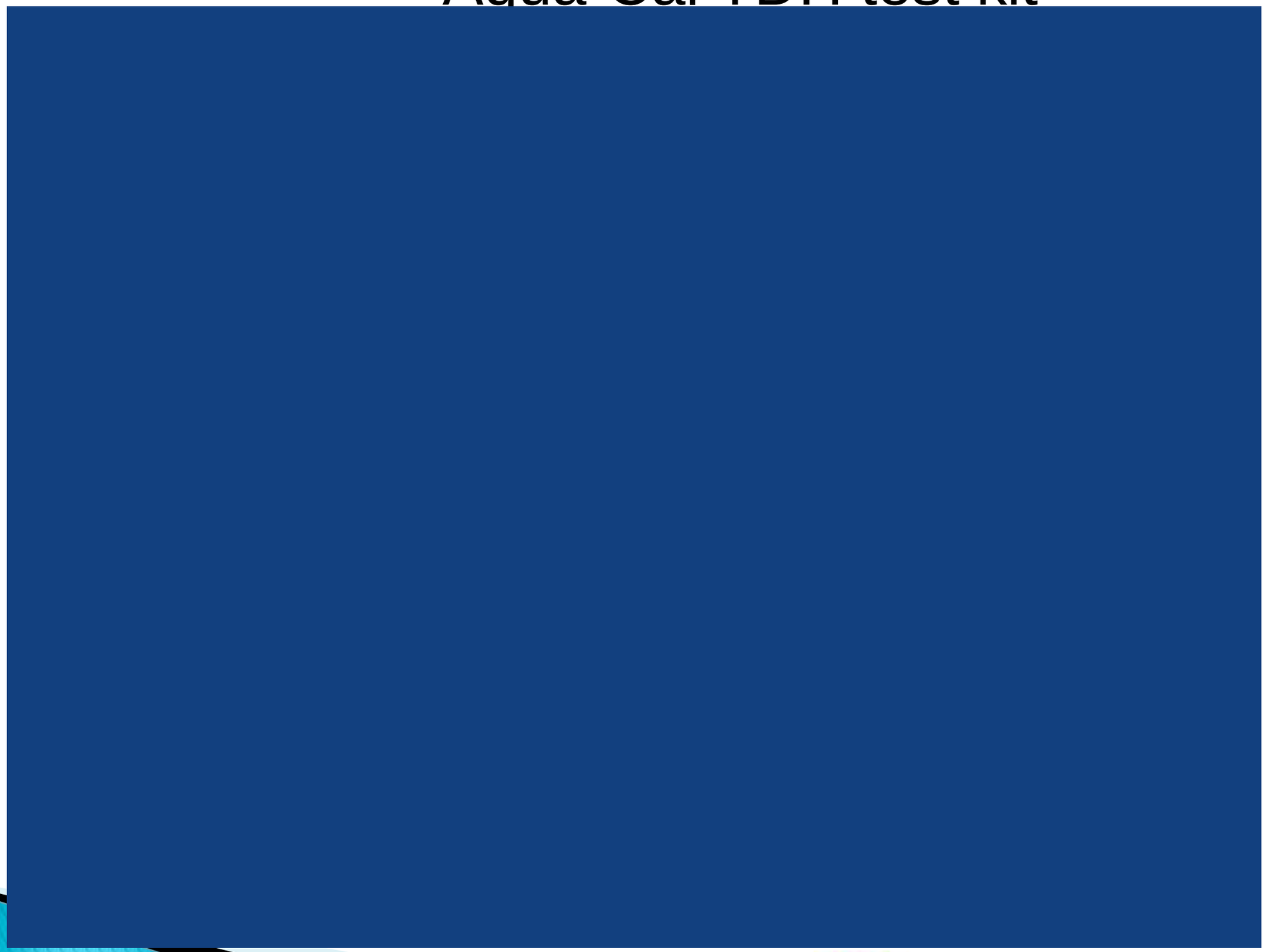
To know TDH, you have to measure

Flow Meters must be installed properly



Measuring TDH

Aqua-Cal TDH test kit



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Drain Safety Test Kit

Now you can you prove that your pool and spa upgrades are *really* in compliance with the Virginia Graeme Baker (VGB) Pool and Spa Safety Act. The Drain Safety Test Kit enables you to quickly and accurately determine the hydraulic characteristics of pools and inground spas required by the VGB Act using TDH and pump curves.

20-300

$595 **$495 member price***

**Item is drop-shipped from manufacturer.*
Price does not include a $10 shipping and handling charge.

The Drain Safety Test Kit is designed, manufactured, and distributed by AquaCal, not APSP. The APSP makes no warranties. All claims concerning the kit should be directed to AquaCal at 2737 24th St. North, St. Petersburg, FL 33713.

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Measuring TDH

- Now you can go to a pump curve with an accurate measurement of TDH and determine the actual system flow!

- Select the correct pump.

- Select the cover(s) with a flow rating equal to or higher than the system flow.

Measuring TDH

Measurement is the only accurate, reliable way to determine Total Dynamic Head.

And it works on both new & existing pools.

Public Pools and Spas

Virginia Graeme Baker Pool & Spa Act

- Requires VBG 2008 Certified Suction Outlets (Covers, fastening system, sump and correct flow rating for the pumps)

- Requires “system update” for single drain configurations, and multiple drain systems less than three-feet center-to-center, or separate planes (non compliant systems)

Non Compliant Drain “Update” Alternatives

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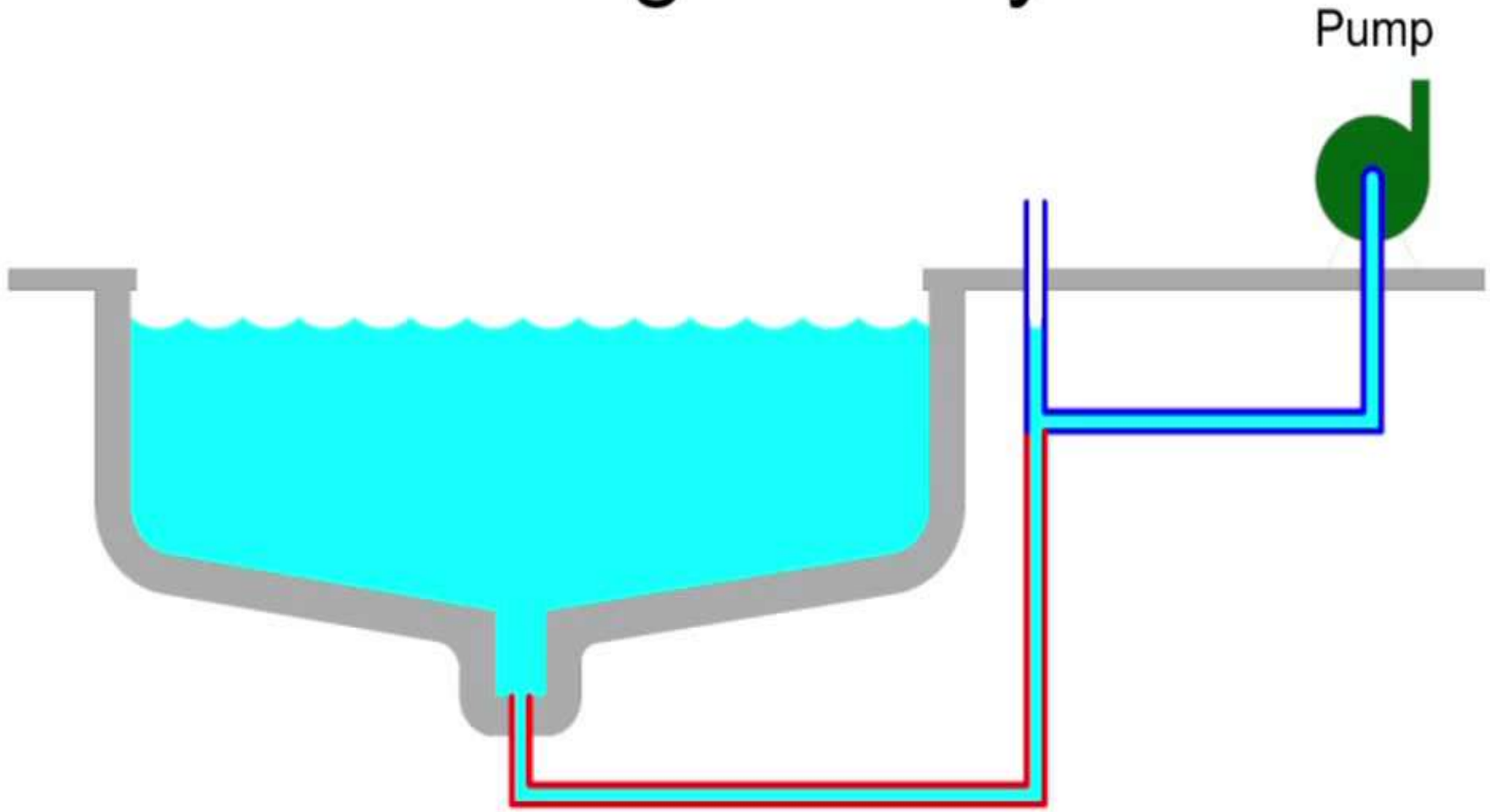
Non-compliant Drain “Update” Alternatives

Automatic Pump Shut-off

Suction Limiting Vent System



Legend
= Gravity

Gravity System

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Non-compliant Drain “Update” Alternatives

Safety Vacuum Release System (SVRS)

ASME A112.19.17 - 2002 (SVRS), or ASTM F 2387 (SVRS)

Non-compliant Drain “Update” Alternatives

Drain Disablement

Non-compliant Drain “Update” Alternatives

Other Systems

System Update Alternatives

- Permanently disable the “single-drain”
- Convert “single-drain” system into a “dual-drain” system
  - Covers and piping must have flow rating equal to, or greater than Maximum System Flow
  - Branch pipe flow rating based on 6 feet per second to limit differential hold-down force
- Convert “Blockable,” single-drain system into “Unblockable” single-drain system

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It may not be as it appears

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Suction Fitting Requirements

- Not a Simple Plastic Swap…
- Suction Fittings include *Cover, Frame, Sump, Hardware and Fastening System*.
  - Existing frames, sumps, and fasteners must meet ASME A112.19.8-2007 standard, or be replaced
  - Field built sumps (cover and frame not connected to pipe) must comply with cover manufacturer's instructions
  - When cover manufacturer's instruction **DO NOT** include compatible sump details, follow ASME A112.19.8-2007 Standard

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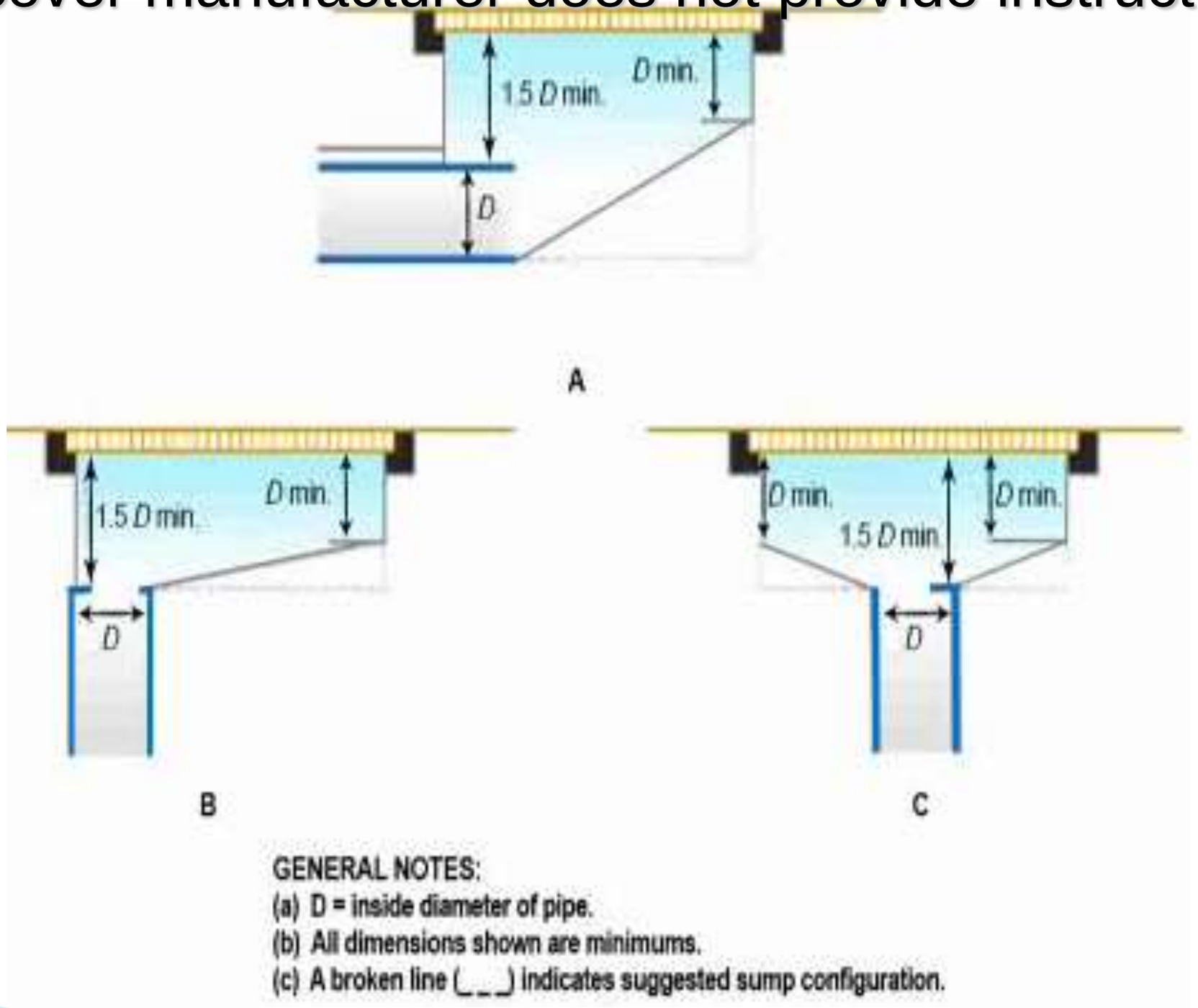
Field Built Sumps

When cover manufacturer does not provide instructions



Why Sumps Matter

- 8” suction pipe approximately 3 inches from the cover - high flow in the center - low flow around the outer edges.
- And this one has a screw missing

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Why Sumps Matter

Installing a new compliant cover will not make this drain safe, or compliant. This is a good example of why you cannot simply "swap the plastic".

Remember, the drain includes:

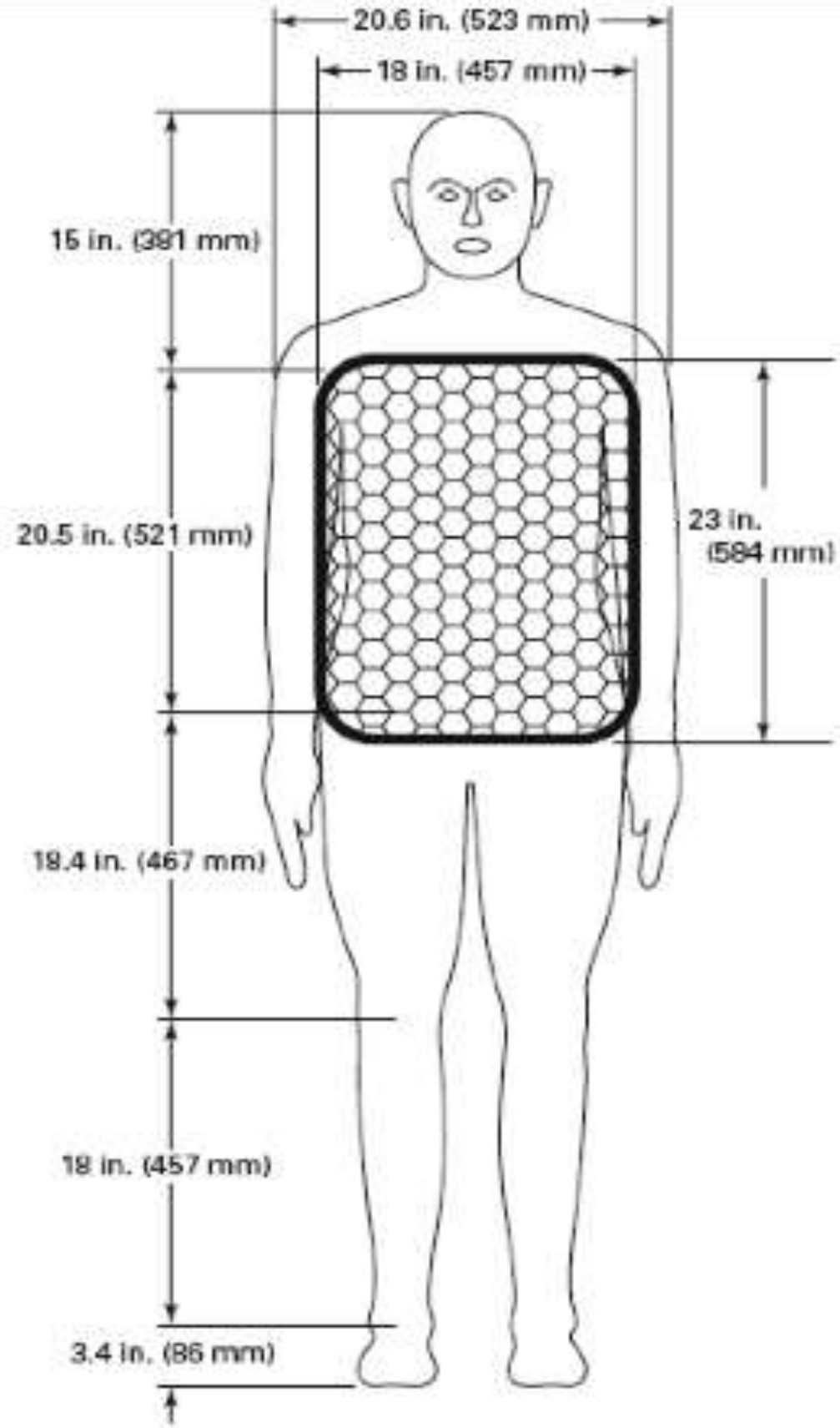
- **cover/grate**
- **sump**
- **fasteners**
- **related components**

Unblockable Drain

"A suction outlet defined
as all components, including:

- sump
- Body
- cover/grate
- hardware

such that its perforated (open) area cannot be shadowed by the area of the 18 x 23 Body Blocking Element of ASME/ANSI A112.19.8 - 2007



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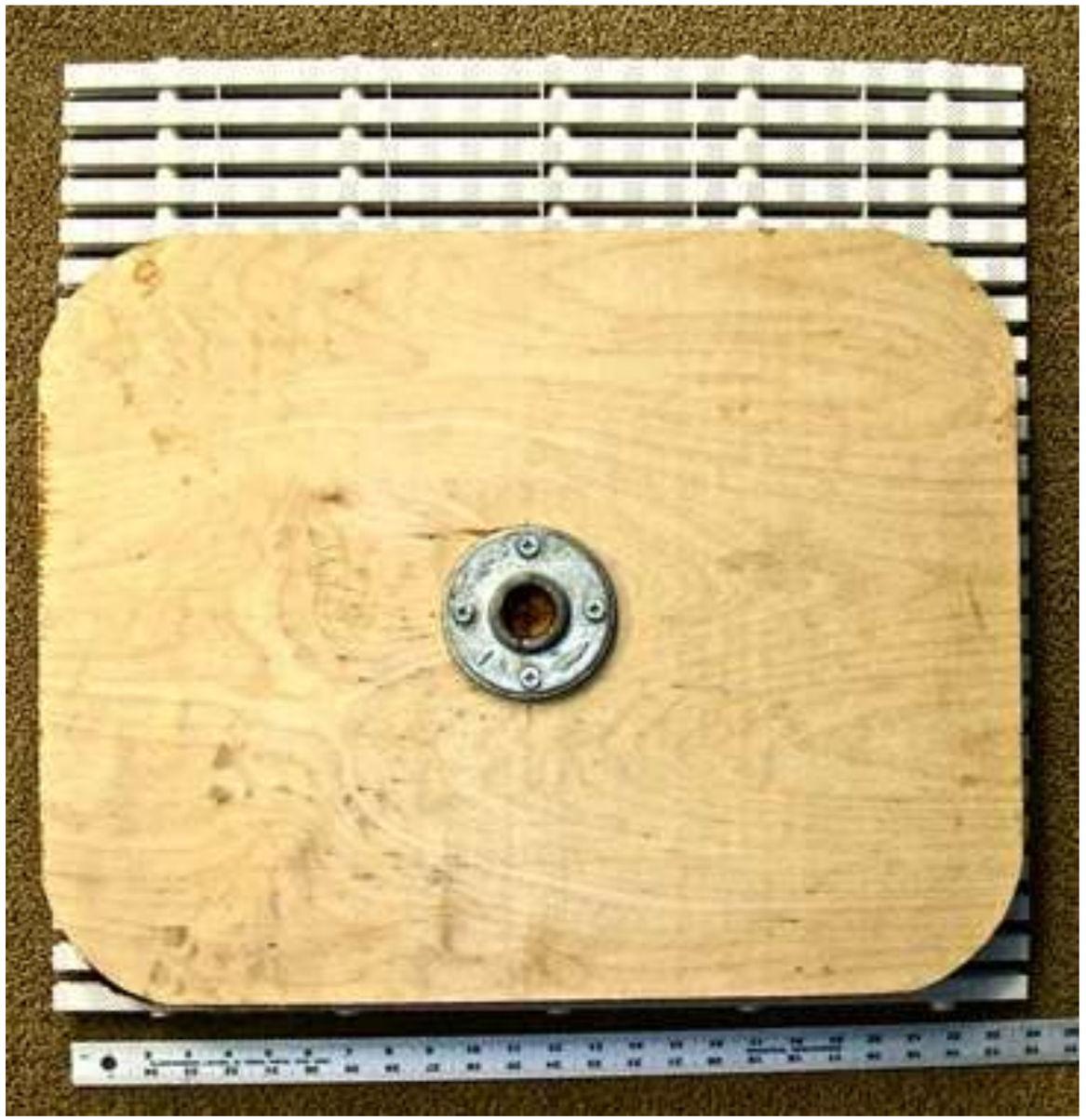
Unblockable Drain



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Unblockable Drain

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Is the existing pool safe?

- "Audit" the existing pool to determine if it's compliant with the Act

- Use the ANSI/APSP-7 Appendix B Field Checklist for identifying suction entrapment hazards

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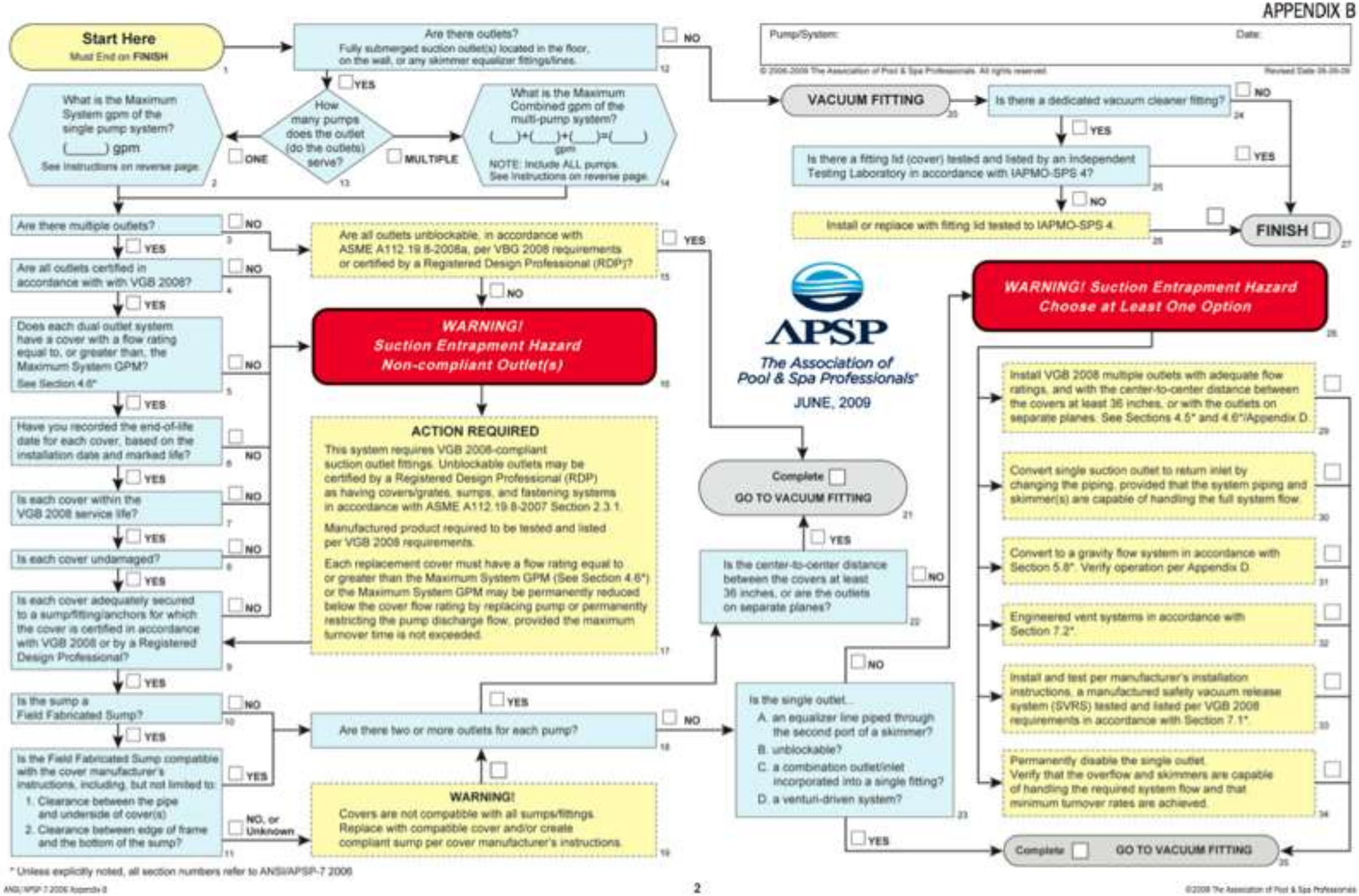
Appendix B - Field Checklist

for identifying suction entrapment hazards



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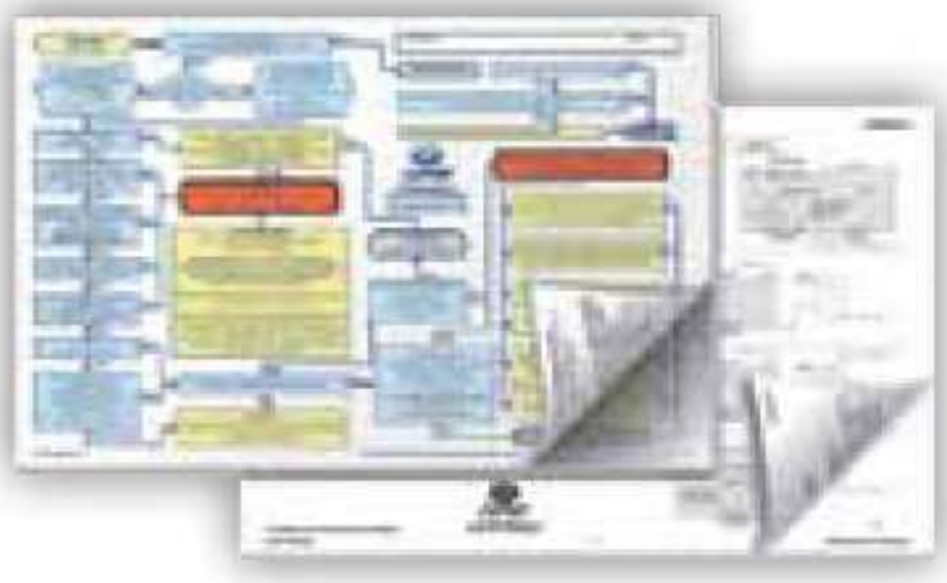
Field Checklist

Field Checklist to Identify Suction Entrapment Hazards + FREE Verification Procedures for Suction Outlet Safety Pads



Take these checklists to each building or service project site to keep customers safe—and reduce your risk. Use the field checklist to identify suction entrapment hazards that may exist with your customers' pools, spas, or hot tubs, and use the test procedures information to determine whether suction outlets meet the flow rating required by the Virginia Graeme Baker Act. (Each pad has 25 sheets.)

20-200 – Single copy of both pads

$49 **$29 member price**

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U.S. Consumer Product Safety Commission

- PoolSafely.gov
  - Awareness
  - Education
  - Outreach
  - Join the team

Pool simple steps save lives SAFELY

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