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CodeNotes™

Velocity Limits in the 2015 International Swimming Pool and Spa Code® (ISPSC®)

Velocity is the speed at which water moves through pipe. It is calculated in both feet per second and centimeters per second. Velocity is used to help designers select the minimum pipe size for the design flow rate for a specific application. Increasing the pipe size while maintaining the same flow rate reduces velocity in the system *(see Figure A)*.

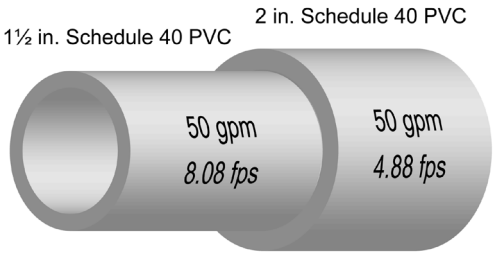
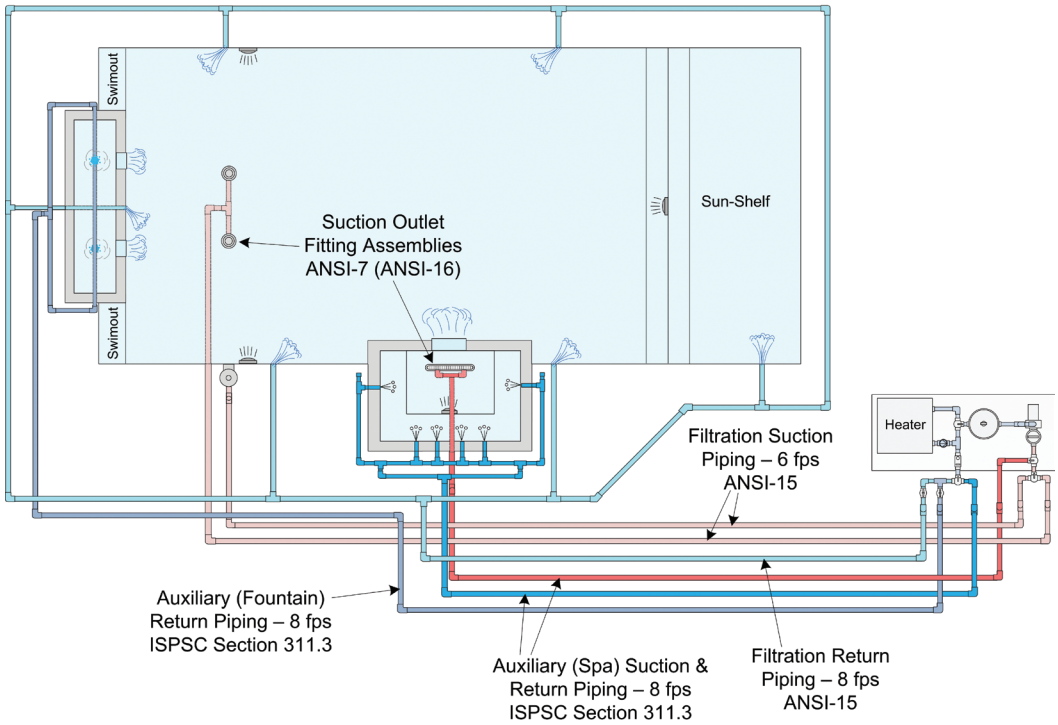


Figure A

NOTE: The velocity limits in the 2015 ISPSC are found in Section 311.3 and in the standards listed below. These standards are referenced in the code and all velocities are based on maximum design flow rates for the specific feature and piping circuit, e.g., pool recirculation versus a water feature. Lower flow rates are allowed and encouraged.

ANSI/APSP/ICC-4, 2012 Standard for Aboveground/Onground Residential Pools
ANSI/APSP/ICC-7, 2013 Standard for Suction Entrapment Avoidance
ANSI/APSP/ICC-14, 2011 Standard for Portable Electric Spa Energy Efficiency
ANSI/APSP/ICC-15, 2011 Standard for Residential Swimming Pool and Spa Energy Efficiency
ANSI/APSP-16, 2011 Suction Fittings for Use in Swimming Pools, Wading Pools, Spas and Hot Tubs

2015 ISPSC
Maximum Piping Velocity Illustration



VELOCITY LIMITS 2015 ISPSC	
SECTION 311.3	The water velocity in return lines shall not exceed 8 feet *(2.4 m)* per second. The water velocity in suction piping shall be as required by Section 310. NOTE: Section 310.1 references the APSP-7 standard.
VELOCITY LIMITS: RESIDENTIAL STANDARDS	
ANSI/APSP/ICC-4	Maximum 8 ft. *(2.4 m)* per second in all piping suction and return.
VELOCITY LIMITS: ENERGY EFFICIENCY	
ANSI/APSP/ICC-15	**NOTICE:** The velocity limits in ANSI/APSP/ICC-15a apply to the swimming pool filtration piping only. Non-filtration piping is subject to the velocity limits in the code and the residential standards listed above. **NOTE:** The swimming pool filtration flow rate (6-hour turnover rate, or 36 gpm, whichever is greater) must be calculated to determine minimum pipe sizes using the velocity limits below. After determining the residential swimming pool capacity in gallons, use the following formula to determine the filtration flow rate. Pool gallons ÷ 360 minutes = filtration flow rate Maximum 8 ft. *(2.4 m)* per second in return filtration piping and 6 ft. *(1.8 m)* per second in suction filtration piping. The velocity limitations in this standard are intended to reduce the friction loss (resistance) as the water moves through the filtration system, thereby reducing the amount of energy required to move the water through the system. **NOTE:** Pipe sizing to achieve a specific velocity at a given flow rate can be determined by using *Table 1*.
VELOCITY LIMITS: SUCTION OUTLET SAFETY STANDARDS **NOTE: Suction outlet safety standards apply to all facilities – Public and Residential.**	
ANSI/APSP/ICC-7	Velocity limits are no longer specified in this standard, because they are regulated as part of the suction outlet fitting assembly (drain cover, fastener, and sump) certification process mandated by the 2007 Federal VGB Pool & Spa Safety Act. APSP/ICC-7 does require conformance with ANSI/APSP-16 standard (below) in all cases.
ANSI/APSP-16	This standard requires product manufacturers to provide the maximum flow rate for each cover, sump, and fitting assembly; a flow rating that has been tested and certified by an accredited test lab. Because of this, product specific installation instructions must be followed and including minimum pipe sizes when specified. **NOTE:** Every bather-accessible body of water with a circulation system is a candidate for a suction entrapment incident, and measures must be taken to prevent such an occurrence. Whatever entrapment avoidance methods or systems are employed, they must be in conformance with the ANSI/APSP/ICC-7 and ANSI/APSP-16 standards.

Matching the velocity in all system piping achieves a relative balance of flow on the suction and return sides of the system. This helps prevent mismatched systems (i.e., over-pumping and under-piping), which leads to highly inefficient systems creating high pressure, excessive noise, vibration, and potentially decreased equipment life.

CodeNotes Design Tip #1: The requirement for the listing and labeling of plastic pipe to NSF 14 ensures that the pipe manufacturing process is closely monitored to ensure the quality of the product. The pipe used in the circulation system must be listed and labeled to any of the standards identified in Table 311.4.

CodeNotes Design Tip #2: Fittings for the pipe material chosen must comply with any of the standards indicated in Table 311.4. Fittings must be listed and labeled to the standard. The exceptions recognizes special fitting assemblies, such as suction outlet fittings, skimmers, and gutter overflow grates, that do not meet the standards indicated in Table 311.4.1 but are an integral part of many pools and spas designs.

CodeNotes Design Tip #3: The choice of what pipe material to use in an application must also consider the pressure and temperature of use.

See the *2015 International Swimming Pool and Spa Code® and Commentary* for additional information on these code requirement and many others.

The Design/Build Process for Compliance

Compliance requires conformance with ISPSC Section 311.3 and all referenced standards. For best results the following design/build sequence is recommended:

1. Design the body of water, and then calculate the water volume to determine the filtration flow rate. When applicable, design and specify flow requirements for all other features, such as therapy jets, fountains, solar heaters, sanitizers, etc. Using these design flow rates, use the velocity limits in the code and the referenced design standards to size all piping.
2. For residential swimming pools:
   a) Calculate the pool's filtration flow rate as described above to comply with ANSI/APSP/ICC-15a and size the suction filtration piping to comply with the lower velocity limit in this standard. For velocities in all other piping, see ISPSC Section 311.3.
   b) Then check pipe sizing for compliance *(See Table 1, below).*
3. Finally, ensure that all suction outlet fittings, piping and components, are designed in compliance with *ANSI/APSP/ICC-7, 2013 Standard for Suction Entrapment Avoidance* (or most recent version), and that the suction outlets, if any, are certified by a test lab in conformance with the *ANSI/APSP-16, 2011 Standard for Suction Fittings* (or most recent version). Compliance with both the *ANSI/APSP/ICC-7 and ANSI/APSP-16* standards requires the suction system components to have a flow rating higher than the maximum system flow rate of any and all installed systems.

TABLE 1 MAXIMUM FLOW RATES, Schedule 40 PVC Pipe								
Pipe Size (U.S. sizes)	1.5 in	2 in.	2.5 in.	3 in.	3.5 in.	4 in.	5 in.	6 in.
Nominal gpm @ 6 fps	38	63	90	138	185	238	374	540
Nominal gpm @ 8 fps	51	84	119	184	247	317	499	720
Nominal gpm @ 10 fps	62	103	146	227	303	391	616	890
Table B-2 Metric Equivalent	*38 mm*	*51 mm*	*64 mm*	*76 mm*	*89 mm*	*102 mm*	*127 mm*	*152 mm*
Nominal m^3 @ 1.83 mps	*0.144*	*0.238*	*0.341*	*0.522*	*0.700*	*0.901*	*1.416*	*2.044*
Nominal m^3 @ 2.44 mps	*0.193*	*0.318*	*0.450*	*0.697*	*0.935*	*1.200*	*1.889*	*2.725*
Nominal m^3 @ 3.05 mps	*0.235*	*0.390*	*0.553*	*0.859*	*1.147*	*1.480*	*2.332*	*3.369*