

TECH NOTE: SonTek-IQ Index Velocity Classification



The Index Velocity Rating principle is based on a stable and well-defined relationship between a Measured Velocity and the computed Mean Velocity. Mean Velocity is calculated from the total discharge and the submerged area within the channel section. The relationship between the Measured Velocity and Mean Velocity is a function of the velocity profile, cross-stream velocity, velocity distribution and stage. The relationship in its simplest form can be written with the following variables as a function,

index velocity	$V_m = a + V_i b$
index velocity and stage	$V_m = a + V_i (b + cH)$

Where:

- V_m = Mean Velocity
- a = Velocity offset
- V_i = Index Velocity
- b = Velocity coefficient
- c = Stage coefficient
- H = Stage

The relationship of the velocity component for the Index Velocity Rating can be accurately defined by the X component of the Measured Velocity only in ideal flow conditions. Ideal flow conditions seldom occur in natural or artificial channels and for this reason SonTek has developed a range of Index Velocity Types based on actual flow conditions measured with Acoustic Doppler Velocity Meter instruments. The Index Velocity Types available allows the user to determine,

- the index velocity that best defines the relationship with Mean Velocity
- other velocity components that may impact the relationship with Mean Velocity

The SonTek IQ measurement principle is based on upstream and downstream acoustic beams along the axis each slanted at 25° from the vertical and two skew beams. The system makes use of Smart-Pulse that adapts the profiling technique, cell size and number of cells based on the flow conditions and water depth. The profiling range of the IQ Plus and IQ Pipe are the following,

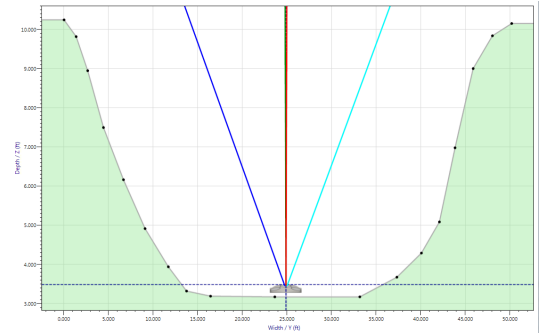
Instrument	Minimum	Maximum
IQ Plus	0.08m	5.0m
IQ Pipe	0.08m	5.0m

with up to 100 cells in the "Along Axis Beams" based on depth and velocity conditions. The X and Z velocity components measured at each multicell along the beams during profiling are used for developing the Index Velocity Types listed below (not applicable to IQ Standard).



The multi-cell velocity measurements are used to develop two main velocity groups,

- "Velocity (XZ).X-Center" and "Velocity (XZ).Z-Center" are the depth average velocity components calculated from the center beams.
- "Velocity (XZ).X-Left" or "Velocity (XZ).X-Right" is the depth average X-velocity for skew beams.



The index velocity types developed by SonTek for the SonTek IQ instrument are summarized below with the ADVM Velocity, Calculation and Description defined for each of the Index Velocity Types.

Velocity Types	ADVM Velocity	Description
Velocity (XZ).X-Center	Velocity (XZ).X-Center	The depth averaged X-velocity from the center beams
Velocity (XZ).Z-Center	Velocity (XZ).Z-Center	The depth averaged Z-velocity from the center beams
Velocity (XZ).X-Left	Velocity (XZ).X-Left	The depth averaged X-velocity from Beam 3 which points to the left bank
Velocity (XZ).X-Right	Velocity (XZ).X-Right	The depth averaged X-velocity from Beam 4 which points to the right bank
Average of all V_x	$\frac{[\text{Velocity (XZ).X-Center} + \text{Velocity (XZ).X-Left} + \text{Velocity (XZ).X-Right}]}{3}$	Calculated average of the depth averaged X-velocity from center beams and skew beams
Beam 1 Velocity	Velocity (beam).1	Beam Velocity, Beam 1
Beam 2 Velocity	Velocity (beam).2	Beam Velocity, Beam 2
Beam 3 Velocity	Velocity (beam).3	Beam Velocity, Beam 3
Beam 4 Velocity	Velocity (beam).4	Beam Velocity, Beam 4

We welcome any comments, questions, or suggestions you may have.

Founded in 1992 and advancing environmental science globally, SonTek manufactures acoustic Doppler instrumentation for water velocity measurement in oceans, rivers, lakes, harbors, canals, estuaries, industrial pipes and laboratories. SonTek's sophisticated and proprietary technology serves as the foundation for some of the industry's most trusted flow data collection systems. SonTek is headquartered in San Diego, California, and is a division of Xylem Inc.

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