

T400-Series Technical Note

PR-, PS- & V-Series Flowprobes Flow Measurement Accuracy Profiles

Optimum Accuracy Vessel Positioning

All PR- and PS-Series Probes sold for acute use (MA-) are calibrated for optimum accuracy with the vessel positioned in the inner corner of the reflector bracket. Probes for chronic implants (MC-) are calibrated with accuracy optimized for vessel positioning centered within the vessel window. All V-Series Probes have optimum accuracy within the bottom of the V groove.

ACUTE USE

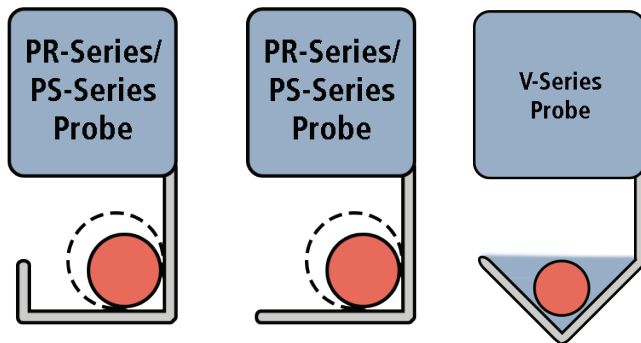


Fig. 1: Vessels are most easily placed in the corner of the PR- or PS- reflector bracket and bottom of the V-bracket and Transonic's calibration adjustments optimize Probe accuracy for such placement.

CHRONIC USE

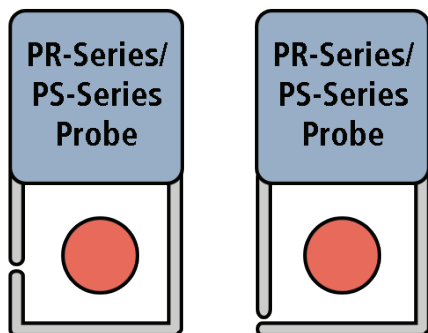


Fig. 2: Fibrous tissue encapsulation of all Probe parts will automatically center the vessel within the vessel window. V-Series Probes are not available for chronic use.

Flow Sensitivity Profile Across the Probe's Ultrasonic Window

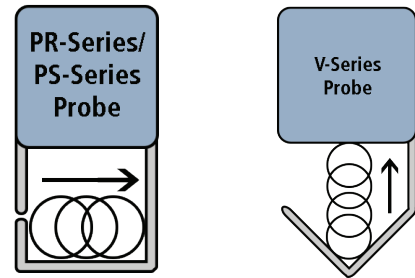


Fig. 3: For these measurements, a small vessel was scanned along the arrow.

ACUTE USE PROBES

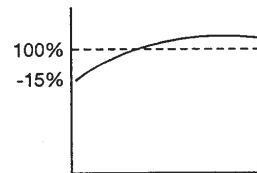


Fig. 4: Vessel is best positioned in the corner of the PR- or PS- bracket.

CHRONIC USE PROBES

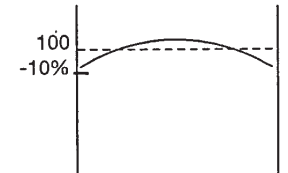


Fig. 5: Optimal vessel placement for chronic implants is in center.

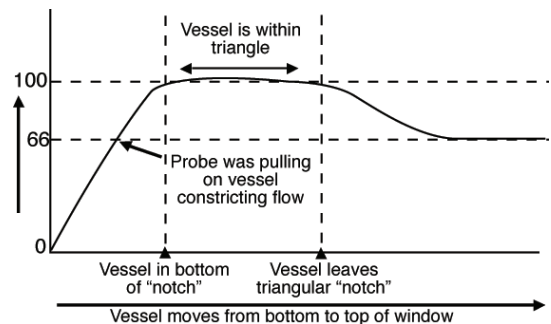


Fig. 6: The vessel must be positioned within the V-Series Probe's reflector bracket's high-sensitivity triangle for optimum results.

PR-, PS- & V-Series Flowprobes Flow Measurement Accuracy Profiles Cont.

Vessel Diameter Sensitivity

For best results the vessel diameter should be between 75% and 100% of the flow sensing window for PS- and PR- Probes.

V-Series Probes require the vessel to be fully contained in the sensing area for best results.

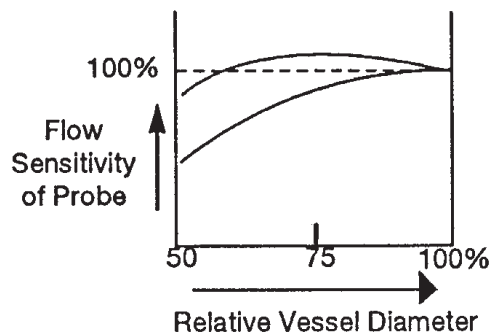


Fig. 7: Graph showing vessel diameter sensitivity of PS- & PR-Probes.

$$\text{Relative Vessel Diameter} = \frac{\text{vessel outside diameter}}{\text{Probe size}}$$

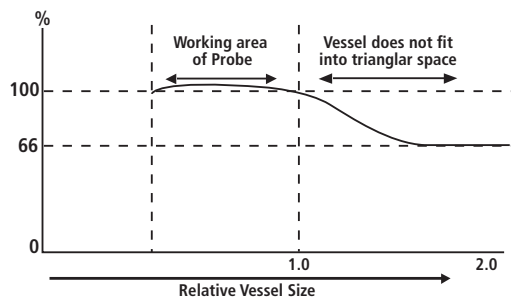


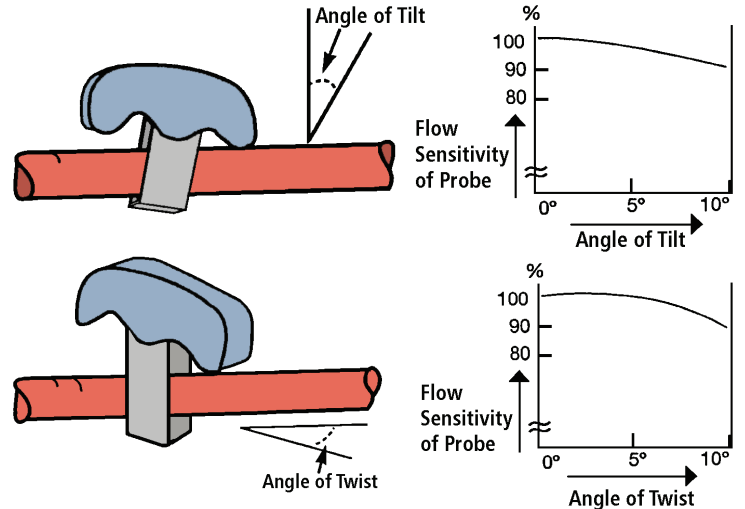
Fig. 8: Graph showing vessel diameter sensitivity of V-Probes.

V- Probe Size Based on the Vessel Diameter:

- 0.5 V: for vessels 250 - 500 μ diameter
- 0.7 V: for vessels 350 - 700 μ diameter
- 1.0 V: for vessels 500 μ - 1 mm diameter

Vessel Misalignment Influence within the Probe

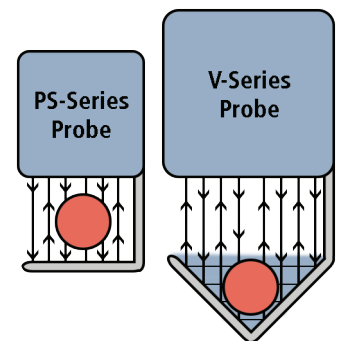
Vessel misalignment can exist in two directions:



Probes are pre-calibrated to slightly (5%) “over-estimate” the flow when properly positioned. This is done because most deviations from “perfect” (i.e. fat globules; mismatched couplant, Probe angled on the vessel) tend to reduce flow sensitivity. This allows for more accurate results in the less-than-ideal real world.

Reflective Path

In V-Probes, the ultrasonic rays intersect the flow four times: the incident beam intersects the flow; then, on the first reflection off the mirror surfaces, part of the beam traverses the vessel from right to left, another traverses it from left to right; the flow is sampled a fourth time when these two halves of the beam, are reflected back to the receiving transducer. This 4 X sampling of the flow gives extra resolution for micro-sized vessels, but also limits the vessel position to the bottom of the triangle.



PS- and PR-Series Probes utilize a single reflection for an ultrasonic beam which intersects the vessel twice as opposed to 4 times.

PR-, PS- & V-Series Flowprobes

Flow Measurement Accuracy Profiles Cont.

Couplant Mismatch

Couplant mismatch is only a concern during acute use as chronically implanted Probes are invaded by fibrous tissue which is an excellent acoustical match for blood. During acute use having adequate amounts of the correct couplant is key to good accuracy and signal quality. The best choice is Surgilube. For other options see Acoustic Couplants (RL-9-tn).

Other Tissues within the Probe's Window

Most tissues have ultrasonic properties close enough to blood so as not to interfere with the accuracy of a Transonic® Flowprobe. Remains of fatty deposits are to be eliminated from the acoustic field, since their acoustic properties deviate considerably from blood and vessel wall. Fatty deposits within a Probe's ultrasound field tend to reduce the flow reading reported by the Flowmeter. A fat globule with a diameter of 0.5 wavelength of ultrasound or smaller can be tolerated, which leads to the following table:

PROBE SIZE	FREQUENCY MHZ	MAX PERMITTED FAT GLOBULE DIAMETER (MM)
16PS, 20PS	0.6	1.3
12PS, 14PS	0.9	0.9
8PS, 10PS	1.2	0.7
6PS	1.8	0.4
4PS	2.4	0.3
2PS, 2.5PS, 3PS	3.6	0.2
1.5PR, 0.7V	4.8	0.16
1PR, 0.5V	7,2	0.1

Appropriate Surgical Procedures

While not directly an issue of Flowprobe accuracy, following an appropriate surgical procedure is essential to producing quality measurements. Proper selection of anesthetic agents, maintaining body temperature at the measurement site, using minimally invasive surgical procedures all contribute to maintaining blood flow at the normal physiological levels. The smaller the animal, the more unfavorable its ratio between body volume (i.e. heat reservoir) and body area (heat loss), and the larger the incision is, relative to body size. It is a critical but delicate art to maintain physiological parameters during surgery.



Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.

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