

WHAT IS CLAIMED IS:

1. An invasive medical device for insertion into a patient, the device comprising:
an elongate shaft having a diameter, an outer surface, a distal tip, and a proximal end,
5 the diameter of the elongate shaft sized to be inserted within an intravenous catheter, at least a portion of the elongate shaft having a first magnetic region and a discontinuity in the first magnetic region providing a diameter transition such that the shaft includes an increased diameter region.
- 10 2. The invasive medical device of claim 1, wherein medical device is selected from a guidewire, a catheter introducer, a stylet and a hypodermic needle, and the discontinuity is selected from the group consisting of a layer ferromagnetic metal, a layer of paramagnetic metal, a spot weld of magnetic metal, a ferrule and combinations thereof.
- 15 3. The invasive medical device of claim 2, wherein the shaft is disposed within intravenous catheter tubing.
4. The invasive medical device of claim 3, wherein the invasive medical device comprises a hypodermic needle.
- 20 5. The invasive medical device of claim 4, wherein the discontinuity comprises a layer of ferromagnetic metal or a layer of paramagnetic metal that increases the diameter of the shaft of the needle.
- 25 6. The invasive medical device of claim 4, wherein the discontinuity comprises a ferrule over the shaft of the needle, and the ferrule has an outer diameter greater than the diameter of the shaft of the needle.
7. The invasive medical device of claim 4, wherein the discontinuity comprises a
30 magnetic adhesive on the outer surface of the needle.
8. The medical device according to claim 7, wherein the adhesive includes an additive selected from a paramagnetic additive, a ferromagnetic additive and combinations thereof.

9. The medical device according to claim 8, wherein the additive includes a component selected from the group consisting of powdered iron, magnetic iron oxide, magnetic titanium oxide, magnetic powdered steel, and a magnetic iron alloy, and mixtures thereof.
- 5 10. The medical device according to claim 9, wherein the magnetic iron alloy includes one or more of nickel, zinc, and copper.
11. The medical device according to claim 10, wherein the additive further comprises a
10 component selected from chromium, magnesium, molybdenum and combinations thereof.
12. The invasive medical device of claim 4, wherein the needle comprises martensitic stainless steel.
- 15 13. The invasive medical device of claim 4, wherein the needle is part of a needle subassembly further including a needle hub mounted to the proximal end of the needle, and the intravenous catheter tubing is part of a catheter adapter subassembly.
14. The invasive medical device of claim 13, the catheter adapter subassembly including
20 catheter tubing and a catheter adapter body, wherein the shaft is slidably engaged with the intravenous catheter tubing.
15. The invasive medical device of claim 14, wherein the catheter adapter subassembly further comprises a magnetic feature.
- 25 16. A system for determining relative position of a needle comprising the invasive medical device of claim 15 and magnetometers positioned with respect to the first magnetic region and the magnetic feature.