CLAIMS

WHAT IS CLAIMED IS:

1. A flow restrictor for restricting the flow of a gas, the flow restrictor comprising:

a first end;

a second end, a longitudinal axis extending from the first end to the second end;

a plurality of first layers extending from the first end to the second end along the longitudinal axis;

a plurality of second layers extending from the first end to the second end along the longitudinal axis;

a first aperture at the first end defined by the plurality of first layers and a first layer of the plurality of second layers;

a second aperture at the second end defined by the plurality of first layers and the first layer of the plurality of second layers;

wherein a flow passage is defined by the plurality of first layers and the first layer of the plurality of second layers, the flow passage extending from the first aperture to the second aperture; and

wherein the first aperture comprises a first edge formed by a first layer of the plurality of first layers, a second edge formed by a second layer of the plurality of first layers, a third edge formed by the first layer of the plurality of second layers, and a fourth edge formed by the first layer of the plurality of second layers.

2. The flow restrictor of claim 1 further comprising a plurality of first apertures, a plurality of second apertures, and a plurality of flow passages, each of the plurality of flow passages extending from a single one of the first apertures to a single one of the second apertures.

3. The flow restrictor of claim 1 wherein the plurality of first layers and the plurality of second layers are arranged in a resistor stack, the resistor stack comprising alternating ones of the plurality of first layers and the plurality of second layers.

4. The flow restrictor of claim 1 wherein each layer of the plurality of first layers is spaced and isolated from every other layer of the plurality of first layers.

5. The flow restrictor of claim 1 wherein the plurality of first layers and the plurality of second layers form a resistor stack.

6. The flow restrictor of claim 5 wherein the resistor stack further comprises a plurality of outer layers forming a front face and an opposite rear face of the flow restrictor.

7. The flow restrictor of claim 1 wherein each of the plurality of first layers comprises a first side, a second side opposite the first side, a third side, a fourth side opposite the third side, a front face, and an opposite rear face, the flow passage comprising a longitudinal passage formed into the front face of the first layer.

8. The flow restrictor of claim 7 wherein each of the plurality of second layers comprises a first side, a second side opposite the first side, a third side, a fourth side opposite the third side, a front face, and an opposite rear face, the flow passage comprising a first entry passage and a second entry passage formed into one of the front face of the second layer or the rear face of the second layer.

9. The flow restrictor of claim 8 wherein the first and second entry passage extend from the front face of the second layer to the rear face of the second layer.

10. The flow restrictor of claim 8 wherein the flow passage comprises a U-passage formed into one of the front face of the second layer or the rear face of the second layer, the U-passage fluidly coupled to the longitudinal passage.

11. The flow restrictor of claim 7 wherein the longitudinal passage extends from the front face of the first layer to the rear face of the first layer.

12. The flow restrictor of claim 1 wherein the flow passage crosses from a first one of the plurality of first layers to a first one of the plurality of second layers.

13. The flow restrictor of claim 1 wherein each of the plurality of first layers are identical and each of the plurality of second layers are identical.

14. A mass flow control apparatus for delivery of a fluid, the mass flow control apparatus comprising:

a valve comprising an inlet passage, an outlet passage, a valve seat, and a closure member; and

a flow restrictor, the flow restrictor positioned in one of the inlet passage or the outlet passage, the flow restrictor comprising:

a first end;

a second end, a longitudinal axis extending from the first end to the second end;

a plurality of layers extending substantially parallel to the longitudinal axis;

a first aperture at the first end;

a second aperture at the second end; and

a flow passage defined by the plurality of layers, the flow passage fluidly coupled to the first aperture and the second aperture;

wherein the plurality of layers comprises a plurality of first layers and a plurality of second layers, the first aperture comprises a first edge formed by a first layer of the plurality of first layers, a second edge formed by a second layer of the plurality of first layers, a third edge formed by a first layer of the plurality of second layers, and a fourth edge formed by the first layer of the plurality of second layers.

15. A method of manufacturing a flow restrictor, the method comprising:

a) providing a plurality of layer blanks, the layer blanks having a first edge, a second edge opposite the first edge, a third edge, a fourth edge opposite the third edge, a front face, and a rear face opposite the front face;

b) forming a first cavity in the front face of a first one of the plurality of layer blanks;

c) stacking the plurality of layer blanks;

d) bonding the plurality of layer blanks to form a resistor stack having a first unfinished end and an opposite second unfinished end, the first unfinished end of the resistor stack formed by the first edges of the plurality of layer blanks and the second unfinished end of the resistor stack formed by the second edges of the plurality of layer blanks;

e) removing material from the first unfinished end of the layer stack to expose the first cavity and form a first aperture.