CLAIMS

1. A restriction orifice plate comprising:

A plate configured to be positioned in a conduit through which a fluid passes, wherein the plate includes two or more openings therethrough;

wherein the two or more openings of the plate are configured to satisfy the relationship, $\Delta P = k\rho V^n/2G_c$, where,

ΔP = pressure loss across the plate;

n = velocity exponent;

k = velocity head loss;

ρ = fluid density;

V = fluid velocity; and

G_c = Newton's conversion constant.

2. The restriction orifice plate of claim 1, wherein the values for n range between 1.8 to 2, inclusive of 1.8 and 2.

3. The restriction orifice plate of claim 1, wherein the inlet of each of the two or more openings has a blunt edge.

4. The restriction orifice plate of claim 1, wherein the inlet of each of the two or more openings has a knife edge.

5. The restriction orifice plate of claim 1, wherein the inlet of each of the two or more openings has a tapered edge.

6. The restriction orifice plate of claim 1, wherein the inlet of each of the two or more openings has a contoured edge.

7. The restriction orifice plate of claim 1, wherein the outlet of each of the two or more openings has a blunt edge.

8. The restriction orifice plate of claim 1, wherein the outlet of each of the two or more openings has a knife edge.

9. The restriction orifice plate of claim 1, wherein the outlet of each of the two or more openings has a tapered edge.

10. The restriction orifice plate of claim 1, wherein the outlet of each of the two or more openings has a contoured edge.

11. The restriction orifice plate of claim 1, wherein the inlet of each of the two or more openings has a contoured edge and wherein the outlet of each of the two or more openings has a contoured edge.

12. A method of using a plurality of restriction orifice plates according to claim 1, the method comprising:

placing at least a first orifice plate according to claim 1 and a second orifice plate according to claim 1 in series;

rotating at least the first orifice plate so that the two or more openings of the first orifice plate are out of phase with the two or more openings of the second orifice plate; and

installing the series of orifice plates between two portions of a conduit.

13. An orifice plate comprising:

an orifice plate configured to be positioned in a conduit, the conduit having a diameter D_p,

the orifice plate has a central opening and a ring-shaped region, wherein the central opening has a diameter D_1 and the ring-shaped region is located at a radius R_2 from the center of the orifice plate and surrounds the central opening;

the inlet of the central opening has a contoured edge; and

the ring-shaped region includes two or more openings formed through the orifice plate with the center of each opening centered on the radius R_2, wherein the radius R_2

satisfies a relationship, $R_2 = (D_p + (D_1 + 2(RCo)))/4)$, where RCo is a radius of the contour of the central opening.

14. The orifice plate of claim 13, wherein the two or more openings have a diameter D_2 that is equal to the diameter D_1 of the central opening, each of the two or more openings equally satisfy a velocity distribution relationship

$$\frac{V_2}{V_1} = \left(1 - \frac{R_2}{R_p}\right)^b \text{ ; and}$$

the diameter D_2 of each of the two or more openings and the diameter D_1 of the central opening equally satisfy a Reynolds matching relationship

$$N_{RE,1} = N_{RE,2}$$

wherein;

$$N_{RE,1} = \frac{D_1 \rho V_1}{\mu};$$

$$N_{RE,2} = \frac{D_2 \rho V_2}{\mu};$$

$N_{RE,1}$ is a Reynolds number for the diameter D_1 of the central opening;

$N_{RE,2}$ is a Reynolds number for the diameter D_2 of each of the two or more openings;

V_1 = velocity of a flow through the central opening;

V_2 = velocity of a flow through the center of each of the two or more openings;

ρ = density of a fluid;

μ = viscosity of the fluid; and

R_p = radius of the conduit.

15. The orifice plate of claim 14, wherein the ring-shaped region includes six openings formed through the orifice plate with the center of each opening centered on the radius R_2.

16. The orifice plate of claim 14, wherein the central opening and the two or more openings each have an inlet, each inlet having a curvature in the magnitude of 0.003 percent to 50.0 percent of the holes radius.

17. The orifice plate of claim 14, wherein the inlet of each of the two or more openings has a blunt edge.

18. The orifice plate of claim 14, wherein the inlet of each of the two or more openings has a knife edge.

19. The orifice plate of claim 14, wherein the inlet of each of the two or more openings has a tapered edge.

20. The orifice plate of claim 14, wherein the inlet of each of the two or more openings has a contoured edge.

21. The orifice plate of claim 14, wherein the outlet of each of the two or more openings has a blunt edge.

22. The orifice plate of claim 14, wherein the outlet of each of the two or more openings has a knife edge.

23. The orifice plate of claim 14, wherein the outlet of each of the two or more openings has a tapered edge.

24. The orifice plate of claim 14, wherein the outlet of each of the two or more openings has a contoured edge.

25. The orifice plate of claim 14, wherein the inlet of each of the two or more openings has a contoured edge and wherein the outlet of each of the two or more openings has a contoured edge.

26. The orifice plate of claim 14, wherein the central opening and the two or more openings are circular.

27. The orifice plate of claim 14, wherein the orifice plate further comprises a tap extending into an interior portion of one of the two or more openings of the ring-shaped region.

28. The orifice plate of claim 14, wherein the orifice plate further comprises a first tap and a second tap, wherein the first tap is located upstream of the orifice plate and the second tap is located downstream of the orifice plate.

29. The orifice plate of claim 14, wherein the orifice plate further comprises a first tap, a second tap, and a third tap, wherein the first tap is located upstream of the orifice plate, the second tap is located downstream of the orifice plate, and the third tap extends into an interior portion of one of the two or more openings of the ring-shaped region.

CLAIMS

1. A restriction orifice plate comprising:

a plate configured to be positioned in a conduit through which a fluid passes, in which the plate includes two or more openings therethrough; and

each of the two or more openings include an inlet and an outlet, the inlets of the two or more openings are the same diameter and the outlets of the two or more openings are the same diameter;

in which the two or more openings of the plate are configured to equally satisfy the relationship $\Delta P = k\rho Vn/2Gc$, where,

ΔP = pressure loss across the plate;

n = velocity exponent;

k = velocity head loss;

ρ = fluid density;

V = fluid velocity; and

Gc = Newton's conversion constant.

2. A restriction orifice plate according to Claim 1, in which the plate includes a non-perforated central region about which the two or more openings are positioned.

3. A restriction orifice plate according to Claim 1, in which the values for n range between 1.8 to 2, inclusive of 1.8 and 2.

4. A restriction orifice plate according to Claim 1, in which the inlet of each of the two or more openings has a blunt edge.

6. A restriction orifice plate according to Claim 1, in which the inlet of each of the two or more openings has a knife edge.

7. A restriction orifice plate according to Claim 1, in which the inlet of each of the two or more openings has a tapered beveled edge.

8. A restriction orifice plate according to Claim 1, in which the inlet of each of the two or more openings has a contoured edge.

9. A restriction orifice plate according to Claim 1, in which the outlet of each of the two or more openings has a blunt edge.

10. A restriction orifice plate according to Claim 1, in which the outlet of each of the two or more openings has a knife edge.

11. A restriction orifice plate according to Claim 1, in which the outlet of each of the two or more openings has a tapered beveled edge.

12. A restriction orifice plate according to Claim 1, in which the outlet of each of the two or more openings has a contoured edge.

2. A restriction orifice plate according to Claim 1, in which the inlet of each of the two or more openings has a contoured edge and in which the outlet of each of the two or more openings has a contoured edge.

13. A method of using a plurality of restriction orifice plates constructed in accordance with claim 1, the method comprising:

placing at least a first restriction orifice plate according to claim 1 and a second restriction orifice plate according to claim 1 in series;

rotating at least the first restriction orifice plate so that the two or more openings of the first restriction orifice plate are out of phase with the two or more openings of the second restriction orifice plate; and

installing the series of restriction orifice plates between two portions of a conduit.

14. A method according to Claim 13, further comprises rotating at least the first restriction orifice plate so that the two or more openings of the first restriction orifice plate are 90 degrees out of phase with the two or more openings of the second restriction orifice plate.

15. An orifice plate comprising:

an orifice plate configured to be positioned in a conduit, the conduit having a diameter Dp;

the orifice plate has a central opening and a ring-shaped region, in which the central opening has a diameter D1 and the ring-shaped region is located at a radius R2 from the center of the orifice plate and surrounds the central opening;

the inlet of the central opening has a contoured edge;

the ring-shaped region includes two or more openings formed through the orifice plate with the center of each opening centered on the radius R2, in which the radius R2 satisfies a relationship, R2 = (Dp + (D1 + 2(RCo)))/4, where RCo is a radius of the contour of the central opening; and

in which the two or more openings have a diameter D2 that is equal to the diameter D1 of the central opening, each of the two or more openings equally satisfy a velocity distribution relationship

$$\frac{V_2}{V_1} = \left(1 - \frac{R_2}{R_p}\right)^b$$; and

the diameter D2 of each of the two or more openings and the diameter D1 of the central opening equally satisfy a Reynolds matching relationship

NRE, 1 = NRE, 2

in which;

NRE, 1 = $\frac{D_1 \rho V_1}{\mu}$;

NRE, 2 = $\frac{D_2 \rho V_2}{\mu}$;

NRE, 1 is a Reynolds number for the diameter D1 of the central opening;

NRE, 2 is a Reynolds number for the diameter D2 of each of the two or more openings;

V1 = velocity of a flow through the central opening;

V2 = velocity of a flow through the center of each of the two or more openings;

ρ = density of a fluid;

μ = viscosity of the fluid; and

Rp = radius of the conduit.

16. An orifice plate according to Claim 15, in which the ring-shaped region includes six openings formed through the orifice plate with the center of each opening centered on the radius R2.

17. An orifice plate according to Claim 15, in which the central opening and the two or more openings each have an inlet, each inlet having a curvature in the magnitude of 0.003 percent to 50.0 percent of the holes radius.

18. An orifice plate according to Claim 15, in which the inlet of each of the two or more openings has a blunt edge.

19. An orifice plate according to Claim 15, in which the inlet of each of the two or more openings has a knife edge.

20. An orifice plate according to Claim 15, in which the inlet of each of the two or more openings has a tapered edge.

21. An orifice plate according to Claim 15, in which the inlet of each of the two or more openings has a contoured edge.

22. An orifice plate according to Claim 15, in which the outlet of each of the two or more openings has a blunt edge.

23. An orifice plate according to Claim 15, in which the outlet of each of the two or more openings has a knife edge.

24. An orifice plate according to Claim 15, in which the outlet of each of the two or more openings has a tapered edge.

25. An orifice plate according to Claim 15, in which the outlet of each of the two or more openings has a contoured edge.

26. An orifice plate according to Claim 15, in which the inlet of each of the two or more openings has a contoured edge and in which the outlet of each of the two or more openings has a contoured edge.

27. An orifice plate according to Claim 15, in which the central opening and the two or more openings are circular.

28. An orifice plate according to Claim 15, in which the orifice plate further comprises a tap extending into an interior portion of one of the two or more openings of the ring-shaped region.

29. An orifice plate according to Claim 15, in which the orifice plate further comprises a first tap and a second tap, in which the first tap is located upstream of the orifice plate and the second tap is located downstream of the orifice plate.

30. An orifice plate according to Claim 15, in which the orifice plate further comprises a first tap, a second tap, and a third tap, in which the first tap is located upstream of the orifice plate, the second tap is located downstream of the orifice plate, and the third tap extends into an interior portion of one of the two or more openings of the ring-shaped region.