- Combination T/P Shower Valves
- Lavatory Tempering Valves
- Master Tempering Valves
- Hi/Lo Tempering Systems
- Emergency Tempering Valves
- Surface Mounted Shower Systems
- Pressure Balancing Valves
- ASSE/CSA Listed

Pressure Drop Basics & Valve Sizing

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WATER TECHNOLOGIES

What is Pressure Drop?

- The difference in pressure between two points in a system, caused by resistance to flow.

What Pressure Drop is Not?

- Pressure drop is pressure loss across the valve created by system demand - NOT by the valve alone.

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What is Pressure Drop?

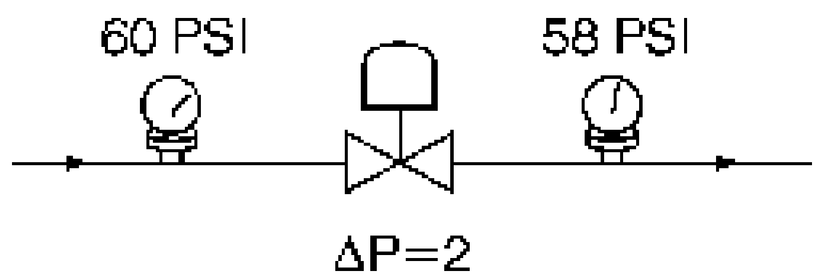
- Pressure Drop = △P = Pressure Differential = PSIG

- △ (from Greek Delta) is a change in something; in this case a change or drop in pressure at the valve as a result of system demand.

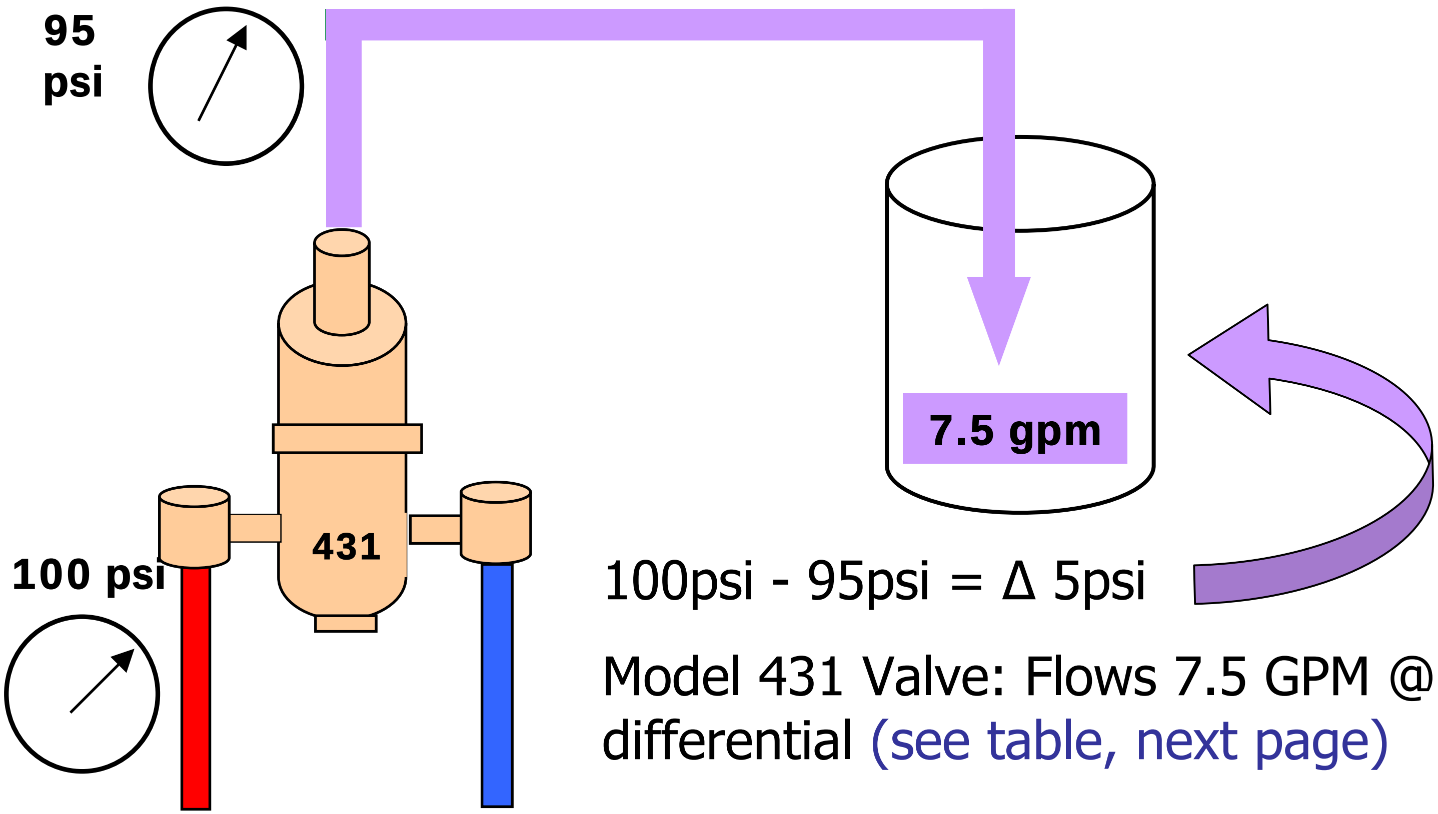
What is Pressure Drop?

- To determine Delta P across a valve, subtract the outlet pressure (P2) from the inlet pressure (P1).

The equation is (P1) – (P2) = Δ P



Ex: Pressure Drop



100psi - 95psi = Δ 5psi

Model 431 Valve: Flows 7.5 GPM @ 5psi differential (see table, next page)

Pressure Drop Table

			Available Pressure at Valve						
Model #	Min Flow	Min Flow to	5	10	20	30	45	60	100
	* Rate	ASSE 1017	Flow Rate in GPM						
431	0.5	4	7.5	11	16	20	25	29	38.5
432	0.5	7	15	20	30	36	45	52	67
433	0.5	10	24	34	51	64	80	93	123
434	0.5	15	40	55	82	101	125	146	190
1432	0.5	1.5	14	18	27	33	40	46	60
1434	0.5	5	32	45	66	80	100	117	152

* Minimum flow when installed at or near hot water source with recirculating tempered water & continuously recirculating pump

Why is Pressure Drop Important?

- Pressure drop is a critical element in valve sizing and valve application. Pressure drop must be known by the engineer designing the system to ensure proper valve selection.

What Factors Determine Pressure Drop?

- Critical factors are orifice size and internal flow path.
- Ex: Full port-full open 1″ ball valve with a Cv of 40 vs. a full open 1″ diaphragm valve with a Cv of 15.

What is the Relationship between Flow Rate and Pressure Drop?

- Pressure drop and flow rate are dependant on one another. The higher the flow rate through a restriction, the greater the pressure drop. Conversely, the lower the flow rate, the lower the pressure drop.

What is Cv?

- The definition of Cv factor is the number of G.P.M. that will pass through a valve with a pressure drop of one (1) psi.
- A unit of measure for comparing valve flows.

How do ΔP, Cv and GPM work together to size a valve?

- Two of these elements are necessary to size a valve:

$$GPM = C_V\sqrt{\frac{\Delta P}{G}} \qquad C_V = \frac{GPM}{\sqrt{\frac{\Delta P}{G}}} \qquad \Delta P = \left[\frac{GPM}{C_V}\right]^2 G$$

Where G = Specific Gravity of the Fluid

System Design

- Estimating Water Demand
- Pipe Sizing
- System Operating Pressure
- Master Mixing Valves
- Design Temperature
- Maintaining Temperature

Estimating Demand: Methods

- Full Flow
  - ✓50 units or less
  - ✓Unusual demand
- Hunter’s Method
  - ✓More than 50 units
  - ✓Typical demand

Full Flow Sizing

- Used when there are less than 50 fixture units
- Add up requirement for all fixtures
- Multiply by H/C factor
- Determine Actual Flow Required (in gpm)

$$\text{H/C Factor} = \frac{\text{Shower temp - cold temp}}{\text{Mixing Valve temp - cold temp}}$$

Ex: Full Flow Sizing

- Outlet 105°F - CW 60 °F = 45 °F
- HW 125 °F – CW 60 °F = 65

  45 / 65 = 69%

- If the Fixture Requirement for 10 showers is 25 gpm, the valve should be sized at 69% of this requirement:

  69% x 25 = 17 gpm

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Full Flow Sizing

Model #	Min Flow Rate	Min Flow to ASSE 1017	Available Pressure at Valve						
			5	10	20	30	45	60	100
			Flow Rate in GPM						
431	0.5	4	7.5	11	16	20	25	29	38.5
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1432	0.5	1.5	14	18	27	33	40	46	60
1434	0.5	5	32	45	66	80	100	117	152

If the pressure available at the valve is **45 PSI**, we can select a valve that will Flow 17 GPM @ 25 PSI. Our selection will be a 431.

Hunter's Curve

- Devised by Dr. Roy B. Hunter in the 1950s
- Report titled BMS65, Estimating Loads in Plumbing Systems
- Concept of fixture unit weights with probability curves or "Hunter's Curves"
- Modified since for today's requirements

Hunters Curve

- Method for determining valve size based on hot water demand in plumbing systems.

- The probability function is used to determine the number of plumbing fixtures that would reasonably be expected to be in simultaneous operation.

Hunters Curve

- The demand for any given fixture in the system is the combination of:

  1. Cycle time
  2. Demand flow rate
  3. Frequency of Use

Hunters Curve

- The Hunter method is applicable to the design of all plumbing systems, it is especially useful for systems that expect a high public demand -- such as healthcare facilities, sports stadiums, schools, hotels, etc.

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Hunter's Fixture Units by Facility Type

Fixtures:	Apart. House	Club or Gym	Hospital	Hotel / Dormitory	Industrial Plant	School Office Bld
Basins, Private Lavatory	0.75	0.75	0.75	0.75	0.75	0.75
Basins, Public Lavatory	-	1	1	1	1	1
Bathtubs / Showers	1.5	1.5	1.5	1.5	3.5	1.5
Dishwasher	1.5	-	Five (5) Fixture Units per 250 Seating Capacity			
Therapeutic Bath	-	-	5	-	-	-
Kitchen Sink	0.75	1.5	3	1.5	3	0.75
Pantry Sink	-	2.5	2.5	2.5	-	2.5
Service Sink	1.5	2.5	2.5	2.5	2.5	2.5
Circular Wash Fountain	-	2.5	2.5	-	4	2.5
Semicircular Wash Fount	-	1.5	1.5	-	3	1.5

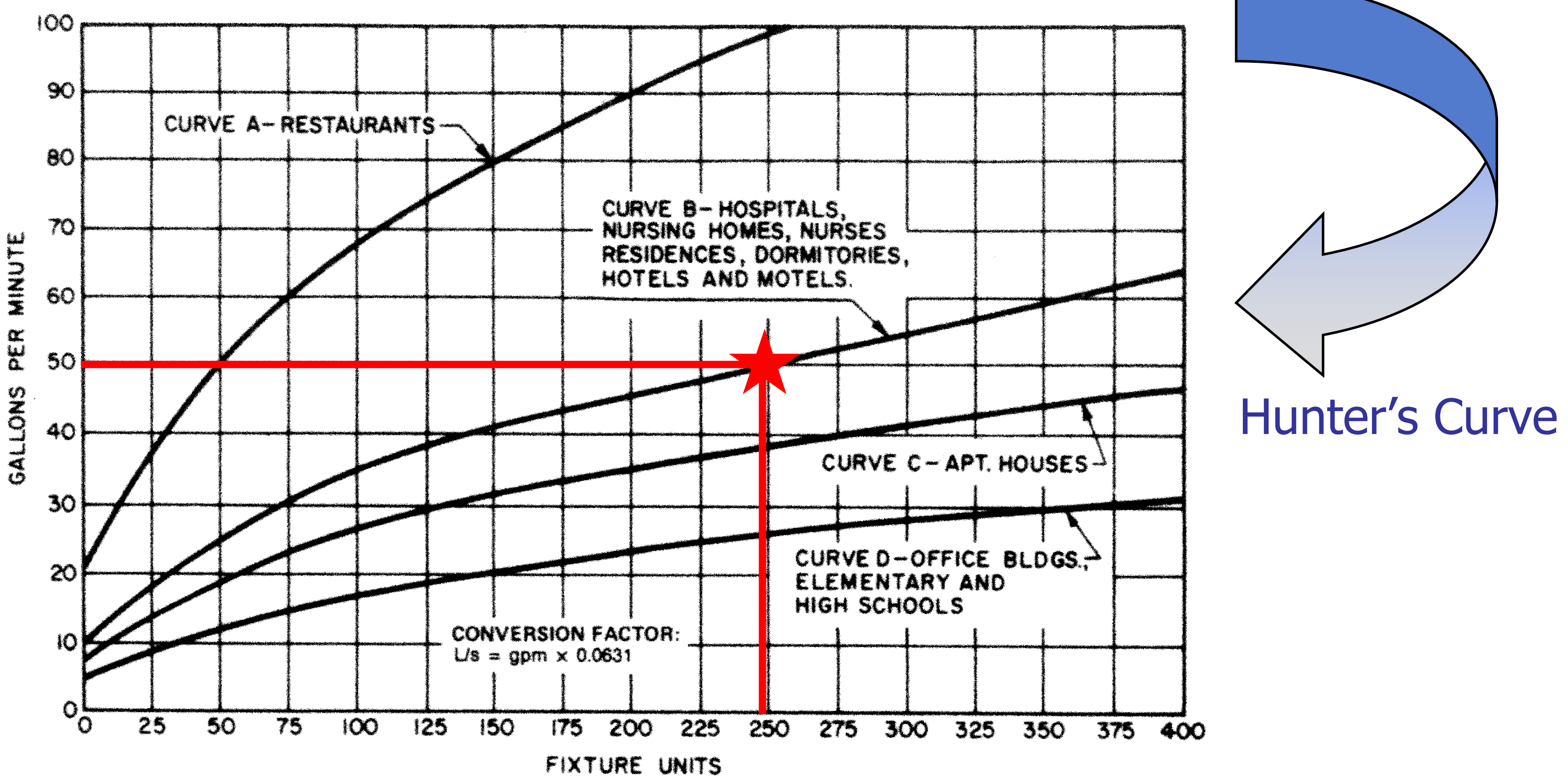
In applications where the principal use is showers, as a gym, use conversion factor of 1.00 to obtain design water flow rate in gpm.

Ex: Hunters Method Sizing

(Hotel w/100 Rooms)

100 Showers:	100 x 1.5 = 150 Fixture Units
100 Private Lavs	100 x 0.75 = 75 Fixture Units
10 Public Lavs:	10 x 1 = 10 Fixture Units
2 Kitchen Sinks	2 x 1.5 = 3 Fixture Units
5 Service Sink	5 x 2.5 = 10 Fixture Units
TOTAL :	248 FIXTURE UNITS

Hunter's Method Sizing



Actual Flow Requirement at 248 Fixture Units = 50 gpm

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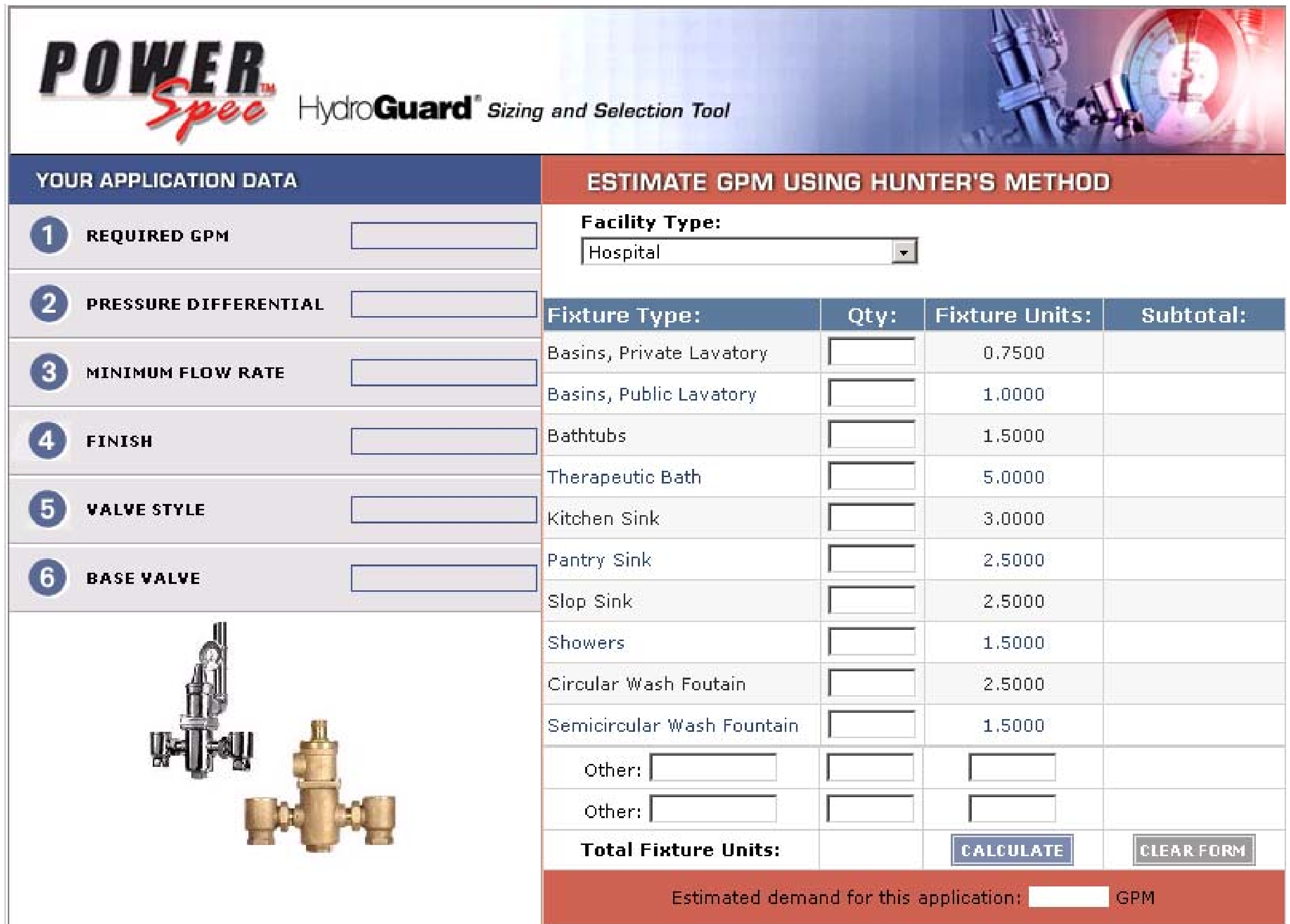
Hunter’s Method Sizing

Most manufacturers have sizing programs available that make demand estimation with Hunter’s Curve a snap!



POWER Spec™ HydroGuard® *Sizing and Selection Tool*

YOUR APPLICATION DATA

1. REQUIRED GPM
2. PRESSURE DIFFERENTIAL
3. MINIMUM FLOW RATE
4. FINISH
5. VALVE STYLE
6. BASE VALVE

ESTIMATE GPM USING HUNTER'S METHOD

Facility Type: Hospital

Fixture Type:	Qty:	Fixture Units:	Subtotal:
Basins, Private Lavatory		0.7500	
Basins, Public Lavatory		1.0000	
Bathtubs		1.5000	
Therapeutic Bath		5.0000	
Kitchen Sink		3.0000	
Pantry Sink		2.5000	
Slop Sink		2.5000	
Showers		1.5000	
Circular Wash Foutain		2.5000	
Semicircular Wash Fountain		1.5000	
Other:			
Other:			
Total Fixture Units:		CALCULATE	CLEAR FORM

Estimated demand for this application: GPM

www.powerscontrols.com

Estimating Available Pressure

- Available Pressure
  - Water Pressure At Valve
  - Minus 20 psi For the Last Fixture
  - Minus 5 psi for each floor the highest fixture is above the valve
  - Minus 2 psi for each 100’ of horizontal piping

Ex: Hunter’s Method Sizing

Pressure At the Inlet of the Valve:	+60 psi
Min. Design Pressure @ Fixture:	- 20 psi
2 Floors above Valve location: 5 psi x 2	- 10 psi
300’ of Horiz. Friction Loss: 300 x 0.02:	- 6 psi
Total Available Pressure at the Valve:	+24 psi

We now need a valve that will flow **50 gpm @ 24 psig**

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Select a valve with enough flow to meet your demand at the available pressure differential

Select a Valve

Model #	Min Flow Rate	Min Flow to ASSE 1017	Available Pressure at Valve						
			5	10	20	30	45	60	100
			Flow Rate in GPM						
431	0.5	4	7.5	11	16	20	25	29	38.5
432	0.5	7	15	20	30	36	45	52	67
433	0.5	10	24	34	51	64	80	93	123
434	0.5	15	40	55	82	101	125	146	190

1432	0.5	1.5	14	18	27	33	40	46	60
1434	0.5	5	32	45	66	80	100	117	152

Our choice will be the 433 valve

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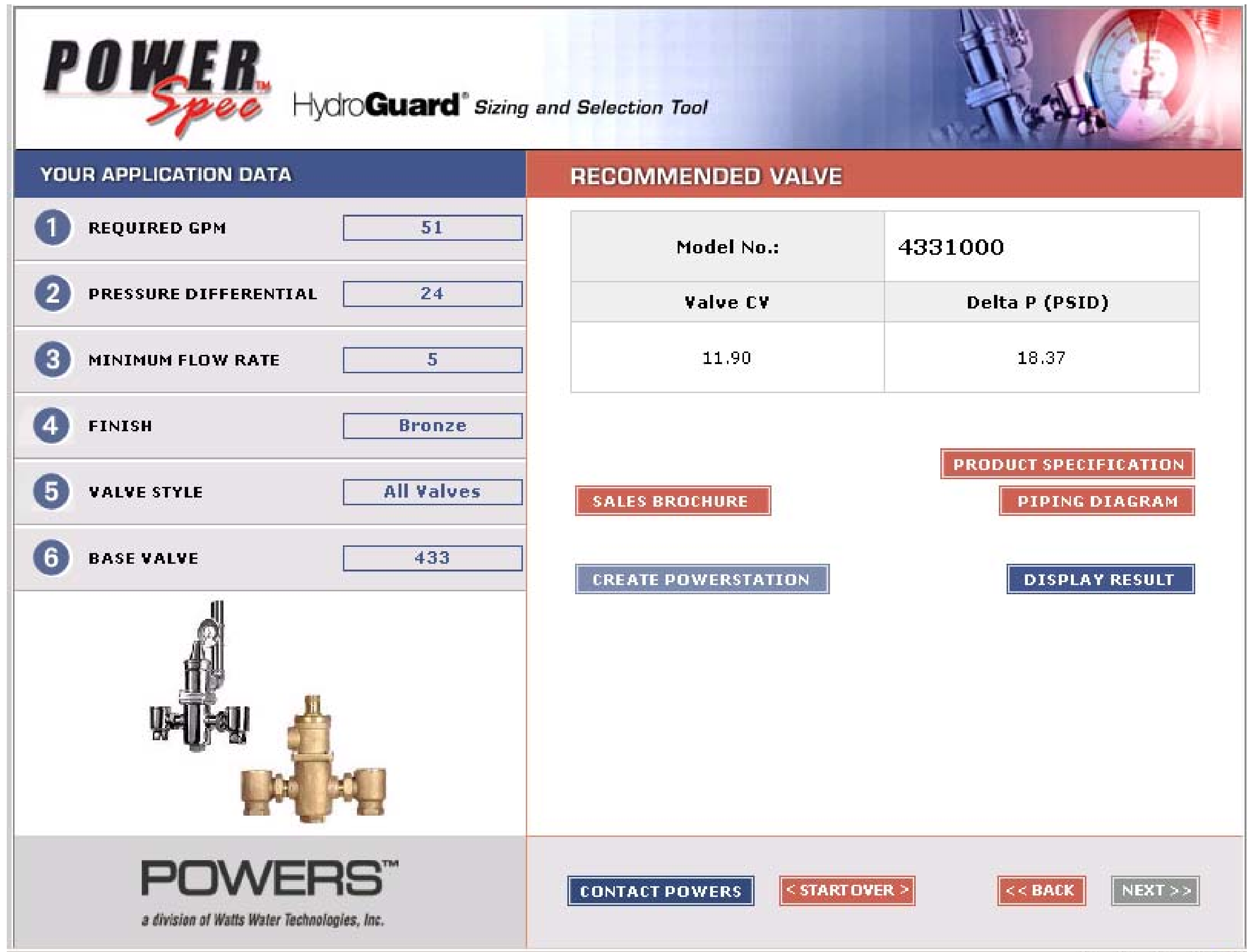
Sizing Programs

Simple to use valve sizing programs will help you select the proper valve for any application by answering simple questions.



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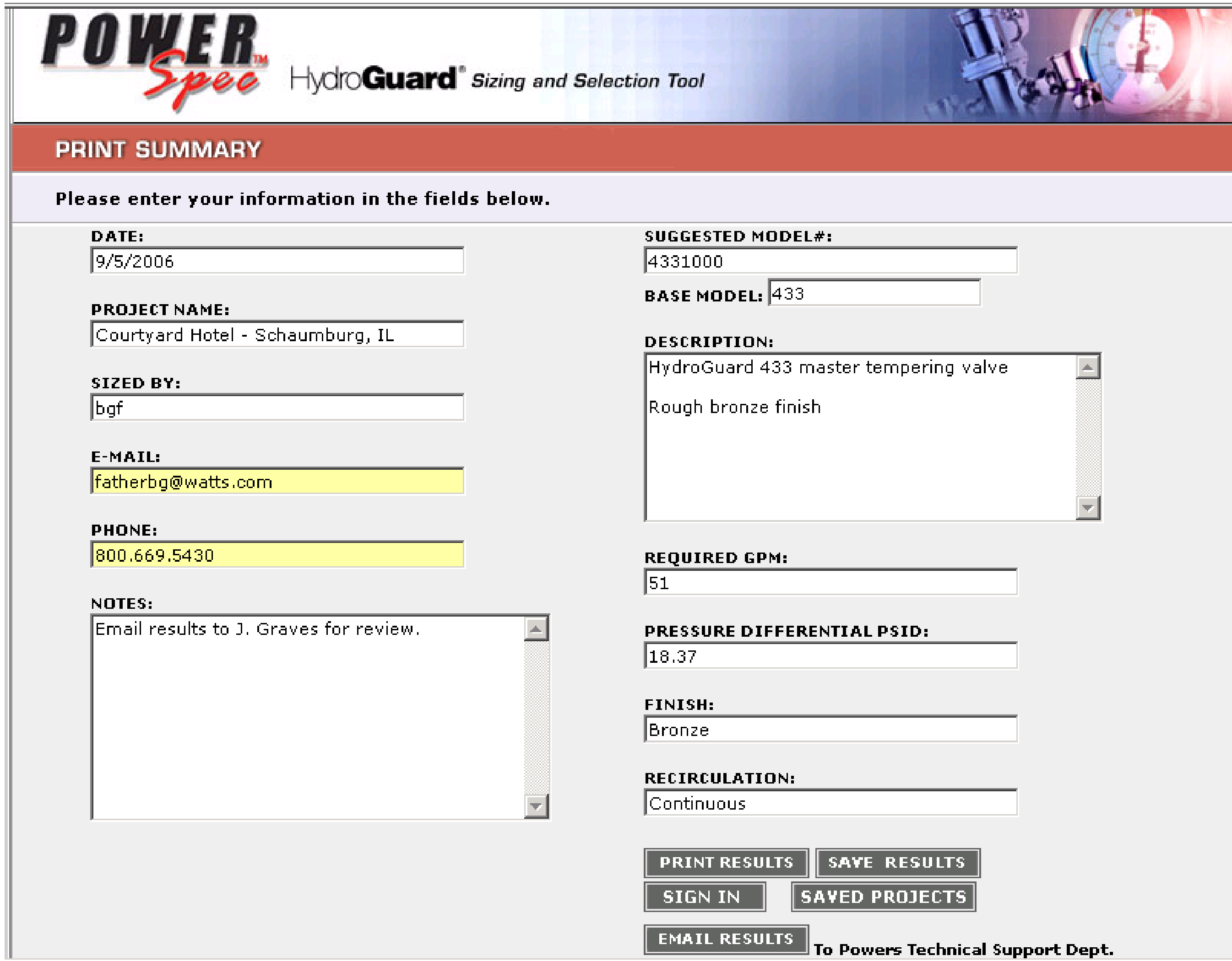
Sizing Programs

- Notes and Summary of Section.
- Save Projects
- Email/Share



Thank you.