



**JIG – 2026 MEMBERS’
TECHNICAL FORUM**
Rome, Italy
June 9 & 10, 2026

Fuel Hydrant Systems
Design and Sizing

JIG
MEMBERS TECHNICAL FORUM
ROME 2026

Argus
FUEL FORWARD

Airport's Fuel Hydrant Systems Design and Sizing



Topics for Discussion

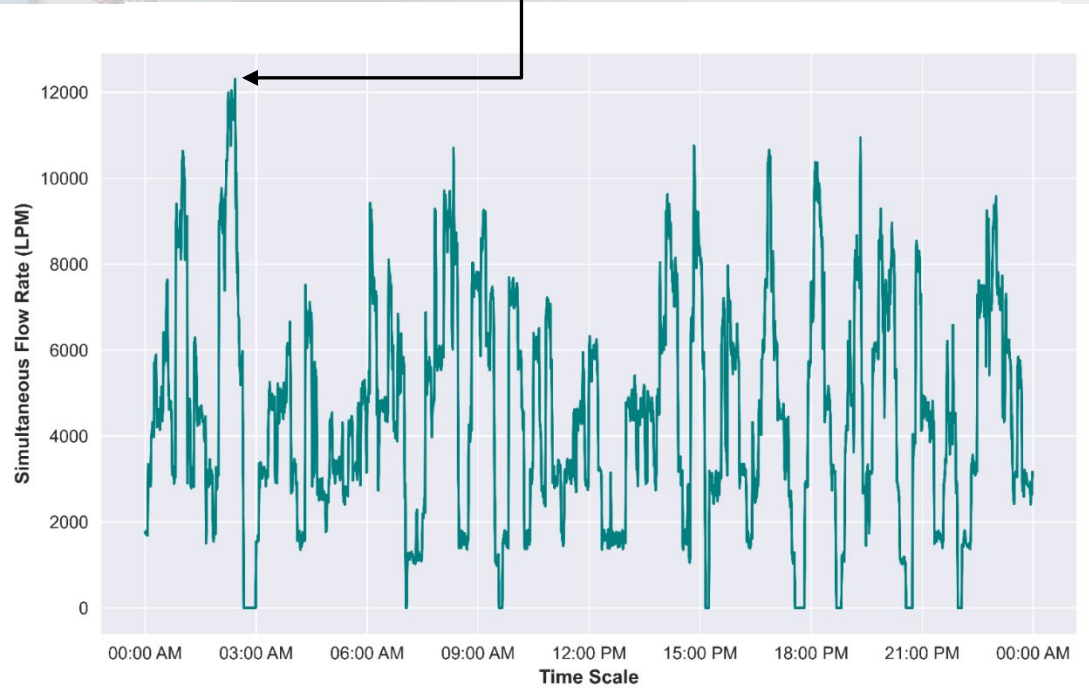
- Peak Simultaneous Demand (PSD)
- Parameters and Codes
- Hydrant System Components
- Hydrant System Configuration
- Steady State Hydraulic Analysis
- Distribution Pipes Sizing
- Consequences of the PSD
- Hydrant System Isolation Zones
- Acceptable Materials and Joints
- Residual Pressure
- Transient State Hydraulic Analysis
- Designing IVVs, LPDs and HPVs
- Placing Hydrant Pits

Maximum Flow Rate / Peak Simultaneous Demand (PSD) – 1 of 2

▶ Using *Monte Carlo Simulation*

Flowrate Distribution for a typical 24 hours Period

Aircraft Type	Fueling Rate (GPM)	Fueling Rate (LPM)
332	459	1,738
343	431	1,632
320	313	1,185
77W	839	3,176
781	420	1,590
772	838	3,172
PSD:	3,300	12,492



Maximum Flowrate to circulate through the hydrant piping network at any given time, in GPM or L/Min



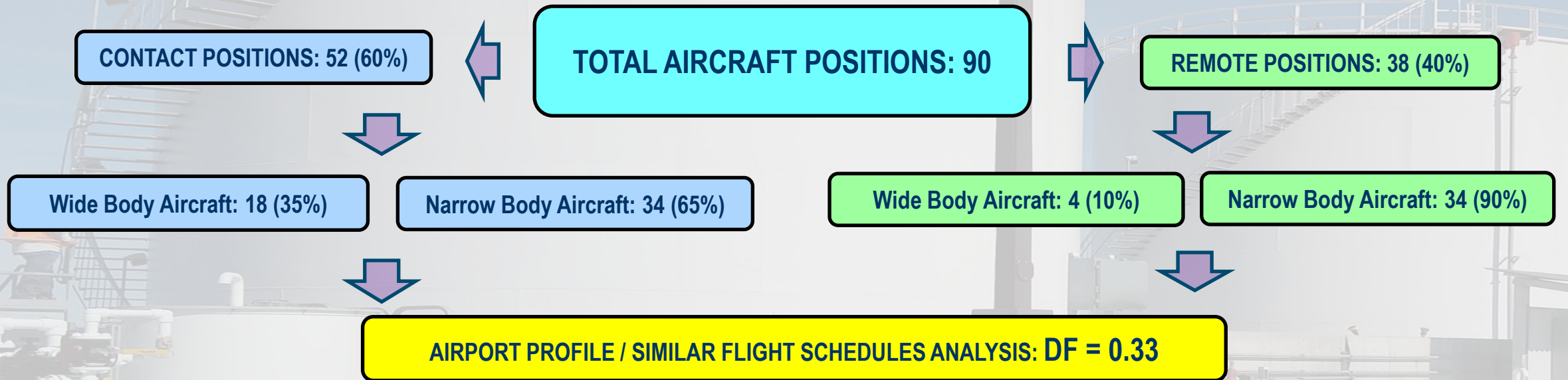
Flight Schedule – Airport Design Day

	A	B	C	D	E
1	FlightNumber	Equip	Destination	DepTime	DepTime_1
2	GFA168	A20N	Bahrain Int'l (BAH / OBBI)	Thu 05:52PM +03	11/17/2022 17:52
3	KNE74	A20N	King Fahd Int'l (DMM / OEDF)	Thu 05:49PM +03	11/17/2022 17:49
4	KNE209	A20N	Dubai Int'l (DXB / OMDB)	Thu 05:47PM +03	11/17/2022 17:47
5	FAD511	A20N	Dubai Int'l (DXB / OMDB)	Thu 05:45PM +03	11/17/2022 17:45
6	KNE37	A20N	King Abdulaziz Int'l (JED / OEJN)	Thu 05:39PM +03	11/17/2022 17:39
7	SVA1703	A20N	al-Baha Domestic (ABT / OEBA)	Thu 05:29PM +03	11/17/2022 17:29
8	OMA684	B732	Seeb Int'l (MCT / OOMS)	Thu 05:27PM +03	11/17/2022 17:27
9	SVA1041	B773	King Abdulaziz Int'l (JED / OEJN)	Thu 05:23PM +03	11/17/2022 17:23
10	ABY156	A321	Sharjah Int'l (SHJ / OMSJ)	Thu 05:20PM +03	11/17/2022 17:20
11	KNE133	A20N	Ha'il Regional (HAS / OEHL)	Thu 05:18PM +03	11/17/2022 17:18
12	FAD179	A320	King Fahd Int'l (DMM / OEDF)	Thu 05:12PM +03	11/17/2022 17:12
13	SVA1927	A321	Wadi al-Dawasir Domestic (WAE / OEWD)	Thu 05:09PM +03	11/17/2022 17:09
14	SVA1853	A321	Najran Domestic (EAM / OENG)	Thu 05:06PM +03	11/17/2022 17:06
15	FAD21	A320	Abha Regional (AHH / OEAB)	Thu 05:02PM +03	11/17/2022 17:02

- ▶ **Equipment** = Fuel Burning Rate
- ▶ **Destination** = Fuel Quantity Required
- ▶ **Departure Time** = Simultaneous Operations

Maximum Flow Rate / Peak Simultaneous Demand (PSD) - 2 of 2

Using *Diversity Factor (DF)*



Q is determined based on

- ✓ WB Loading Rate is 600 GPM (2.300 LPM)
- ✓ NB Loading Rate is 300 GPM (1.150 LPM)
- ✓ One Remote Refueling Station at 400 GPM (1.500 LPM)

DF is determined based on

- ✓ Experience
- ✓ Real projects data
- ✓ Airport Ops/size/relevance
- ✓ Seasonality

Main Parameters and Codes to Consider for Hydrant Systems Design

- ✓ Jet A/ A1 Specifications ASTM D-1655
- ✓ Flow Rate = Peak Simultaneous Demand

- ✓ $Q \text{ (flow)} = A \text{ (area)} \times V \text{ (velocity)}$

$\pi \times D^2 / 4$ or $\pi \times R^2$

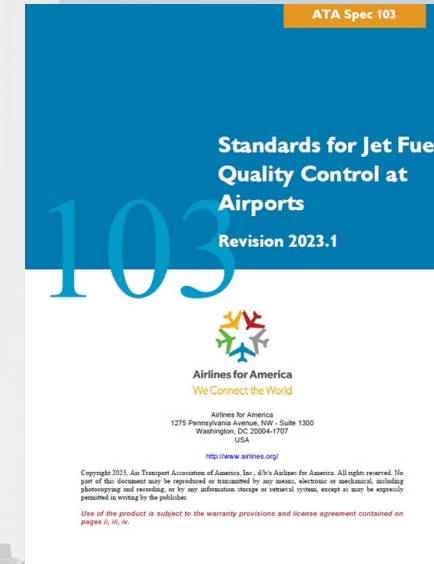
- ✓ **Velocity**

- ✓ Between 3 and 7 fpm (or 0.9 and 2 M/sec)
- ✓ Flushing at 10 fpm or 3 M/sec

- ✓ **Pressure (Under 285 PSI if ANSI 150#)**

- ✓ At the pumps' discharge manifold (X)
- ✓ At Pit, under the aircraft wing (X – PD)

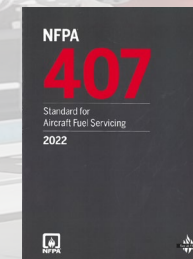
ATA 103



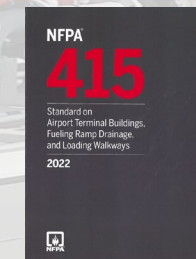
JIG 2



NFPA 407



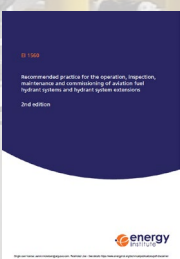
NFPA 415



EI 1540

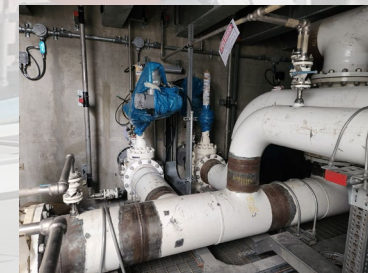
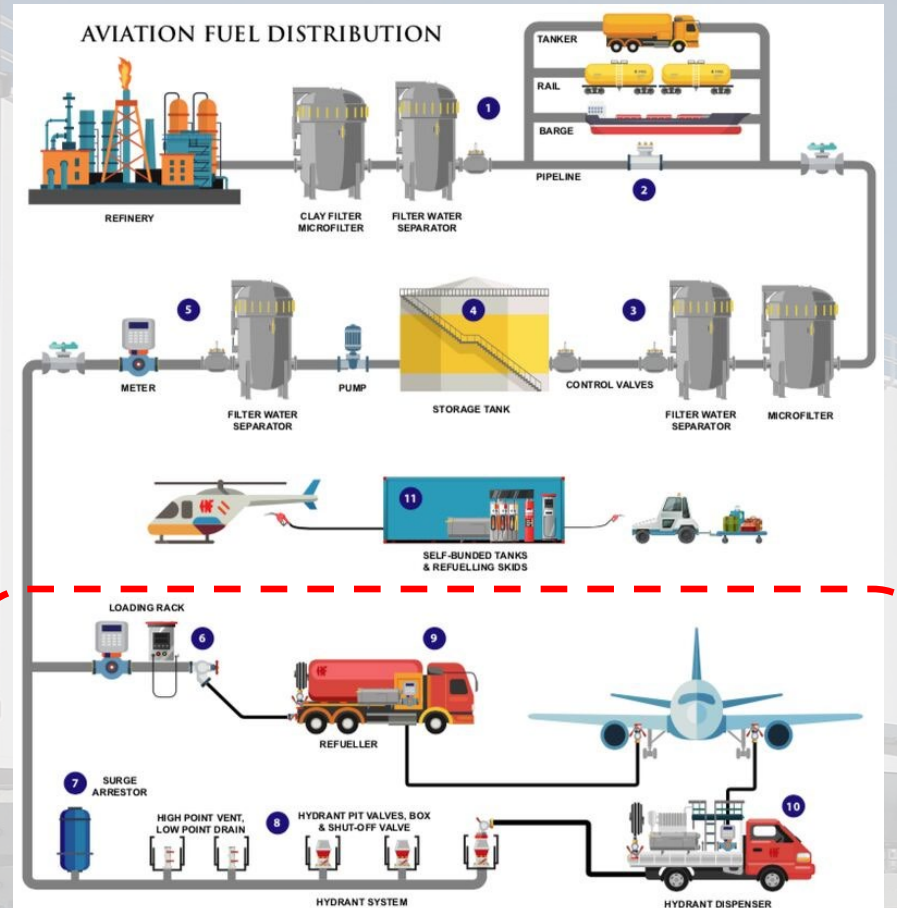


EI 1560



Hydrant System Components

- ✓ Pipes and Fittings
- ✓ Fuel Isolation Points
- ✓ Low Point Drains
- ✓ High Point Vents
- ✓ Emergency Fuel Shutoff System
- ✓ Cathodic Protection System
- ✓ Leak Detection System
- ✓ Hydrant Pits
- ✓ Hydrant Pit Valves



Hydrant System Loop Configuration - Dual vs Single Pipe

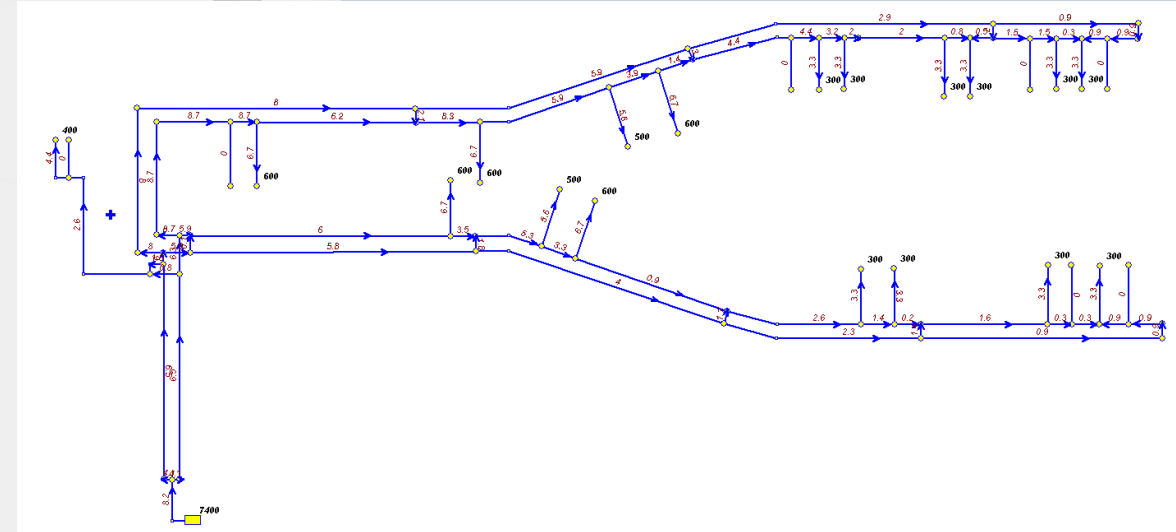
Dual pipes Loop (Alternated vs Single Connection Pattern)

- ✓ More robust
- ✓ Allow for back-feeding and segmentation
- ✓ Expensive to design, build, operate and maintain
- ✓ Add more flexibility
- ✓ Better to absorb shock waves

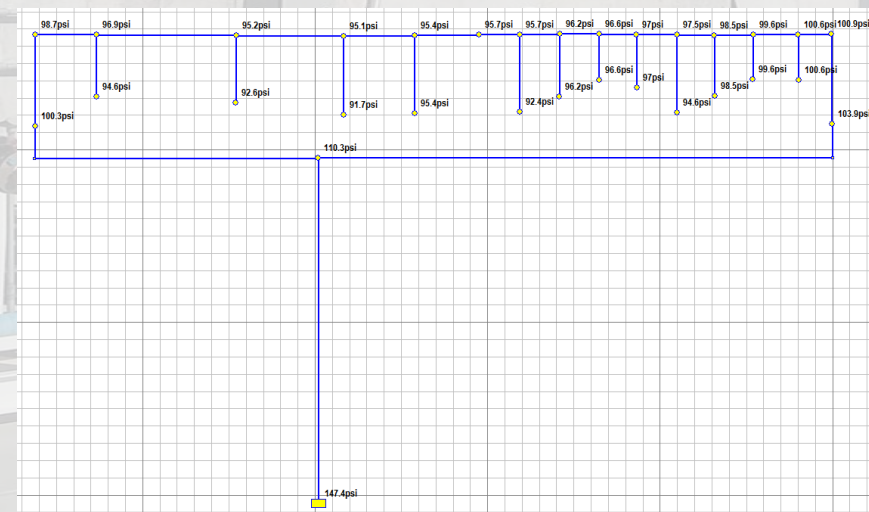
Single pipe Loop

- ✓ Less expensive to design, build, operate and maintain
- ✓ More suitable for small and medium size airports
- ✓ Easier to operate
- ✓ Less Redundancy

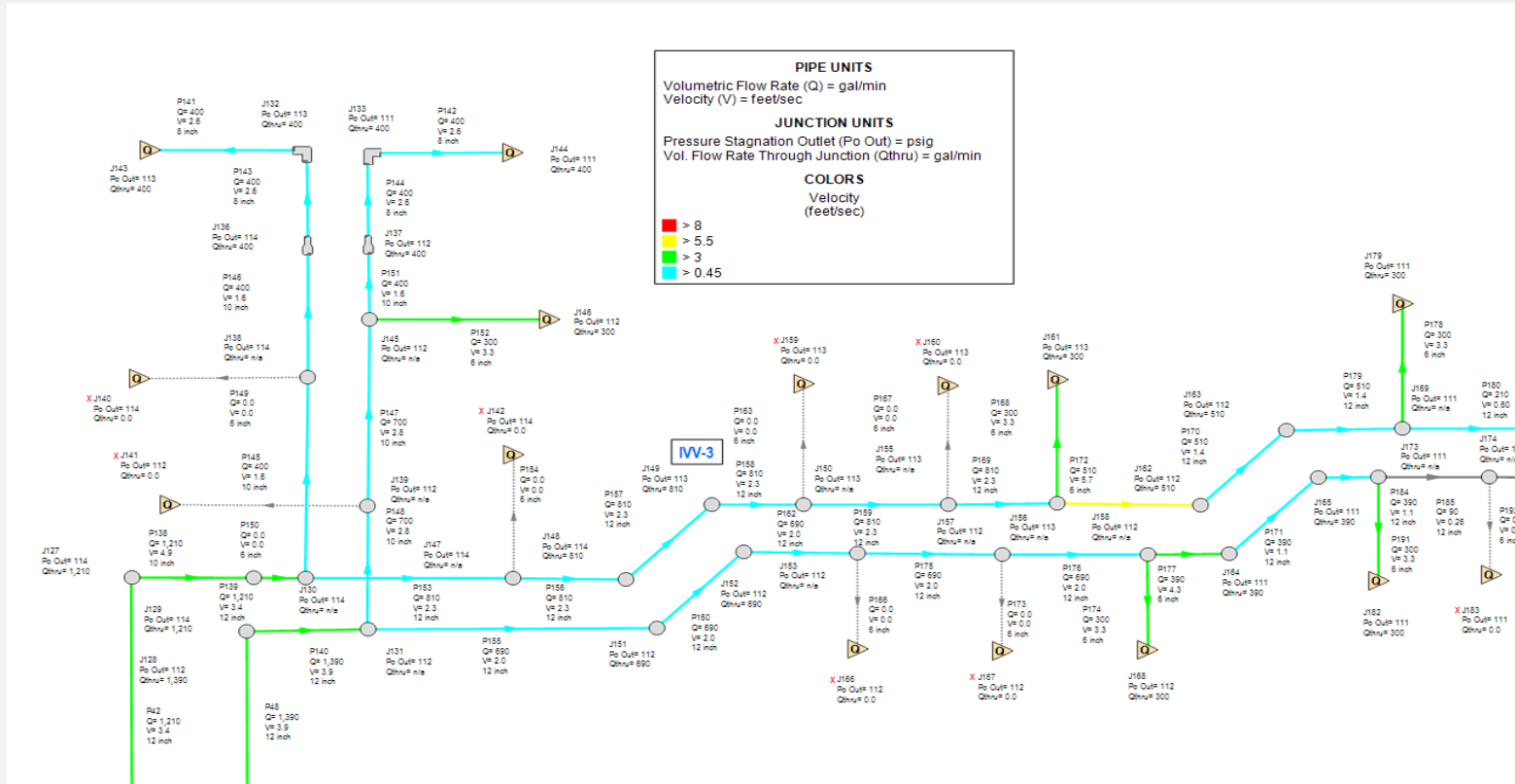
Typical Dual Pipe Distribution Loop



Typical Single Pipe Distribution Loop



Hydraulic Modeling / Steady State Hydraulic Analysis



Pipe Results

Max. Velocity: 10.45 ft/s pipe section(s): ['P-47']

Min. Velocity: 1.30 ft/s pipe section(s): ['P-2']

Max. Pressure Drop: 7 psi pipe section: ['P-60']

Velocities < 2.5 ft/s in 11 pipe section(s):

Node Results

Max. Pressure: 134.40 psi at Node(s): ['J-51']

Min. Pressure: 127.42 psi at Node(s): ['J-80']

Average System Pressure: 129.66 psi

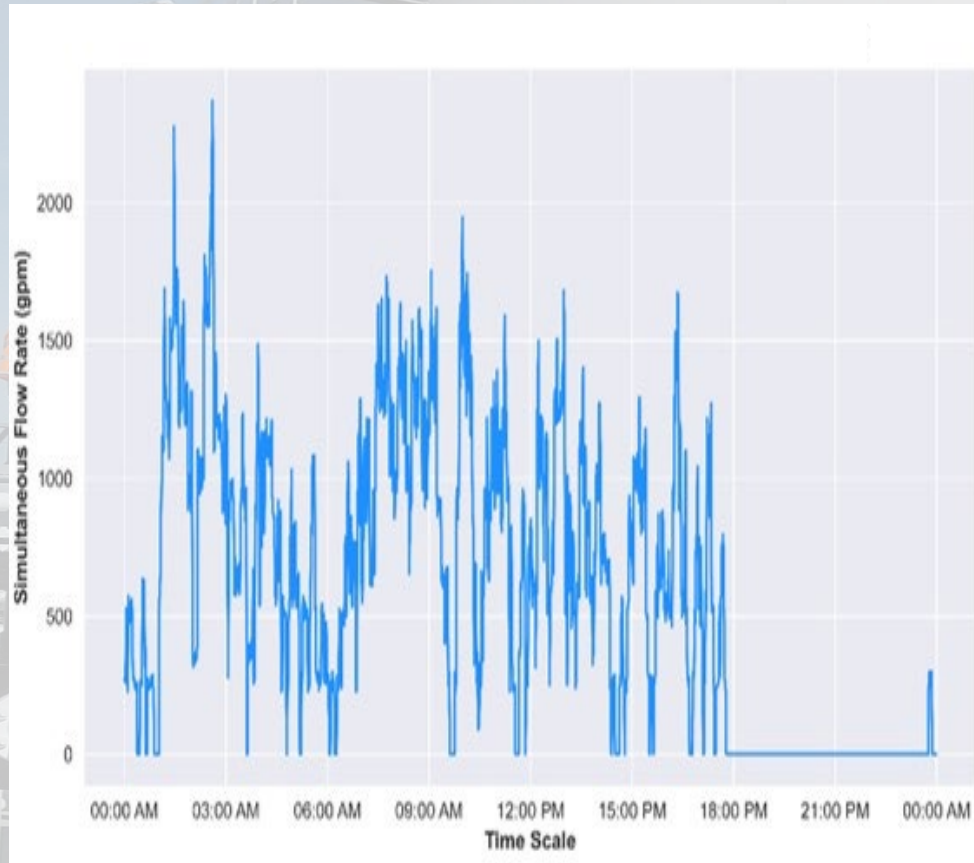
All Pressures > 100 psi

Total Flow Rate: 7,600 gpm

The Hydraulic Model is a powerful design tool that allow engineers customizing the hydrant system to better serve the airport's peak simultaneous demand. At the same time, allow operators to better understand the hydrant system performance, real capabilities, possibilities of expansion, and weak points

Transmission Lines and Main Distribution Pipes Sizing

Flowrate Distribution Density (24 hours)



Design Criteria

Stat. Parameter	Flow_GPM
count	1440
mean	582.56
std	521.57
min	0
10%	0
20%	0
25%	0
30%	0
40%	288
50%	532
60%	692
70%	913
80%	1,104
90%	1,302
95%	1,499
99%	1,750
max	2,370

$$Q \text{ (Flow)} = \text{Velocity} \times \text{Area}$$

$$\text{Flow} = \text{PSD}$$

$$\text{Velocity} = 3 \text{ to } 7 \text{ fps (0.9 to 2.1 m/s)}$$

$$\text{Area} = \frac{\pi \times D^2}{4} \quad \text{Where } D = \text{Pipe Diameter}$$

For this case, Q=1,500 GPM (5.678 L/min)

$$D \text{ (3 fps)} = 1.19 \text{ ft} = 14.28 \text{ inches (362 mm)}$$

$$D \text{ (5 fps)} = 0.92 \text{ ft} = 11.06 \text{ inches (280 mm)}$$

$$D \text{ (7 fps)} = 0.78 \text{ ft} = 9.35 \text{ inches (237 mm)}$$

Pipe Selection = 12" Ø

$$V \text{ (@2,370 gpm)} = 6.7 \text{ fps on a 12"Ø pipe}$$

$$V \text{ (@8.970 L/min)} = 2.04 \text{ m/sec on a 12"Ø pipe}$$

$$V \text{ (@2,370 gpm)} = 9.5 \text{ fps on a 10"Ø pipe}$$

$$V \text{ (@8.970 L/min)} = 2.89 \text{ m/sec on a 10"Ø pipe}$$

Conversion: 3 fps = 0.9 m/s, 5 fps = 1.5 m/s, 7 fps = 2.1 m/s, 10 fps = 3 m/s

Consequences of Miscalculating the PSD

➤ Incorrect Fuel Pipes Sizing

Oversized Pipes Diameter

Slow velocity = Dirty system and potential quality issues

Undersized Pipes Diameter

High velocity = Potential pressure surges, high pressure drop, High Energy Consumption

➤ Incorrect Hydrant Pumps Selection

PSD is overestimated (Most Common case)

Pumps are too large, or too many

- ✓ Difficulties to control the system, equipment malfunction
- ✓ Higher Cost, High Energy Consumption, Higher Footprint, Inefficient operation

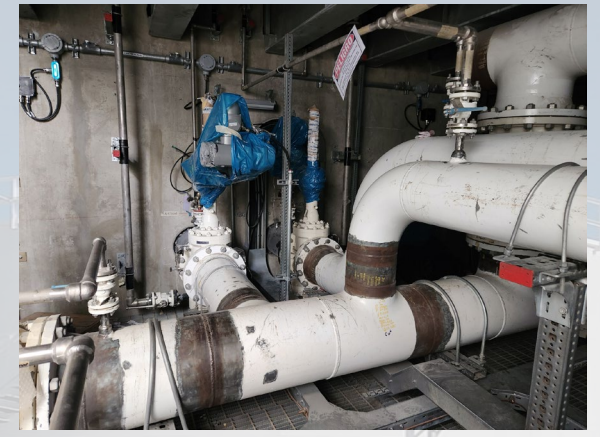
PSD is underestimated (Less common case)

Pumping Capacity is not enough (Flow and/or Head)

- ✓ Low residual pressure = Slow fuel loading operations
- ✓ Insufficient flow rate to serve simultaneous fuel loading operations



Isolation Valve Stations (IVSs) vs Hydrant Chambers/Isolation Valve Vaults (IVVs)



IVS Advantages

- Easier to build
- Easier to modify
- Easier to commission
- Easier to Operate
- Easier to Maintain
- Lower cost when compared to Vaults

IVS Disadvantages

- Potential aesthetic issues
- Exposed to weather, unless covered with canopy or within structure.
- Apron footprint of approx. 10 Sq.Mts

IVV Advantages

- No footprint, other than access lids flush to the ground
- Protected from weather and ground vehicle collisions

IVV Disadvantages

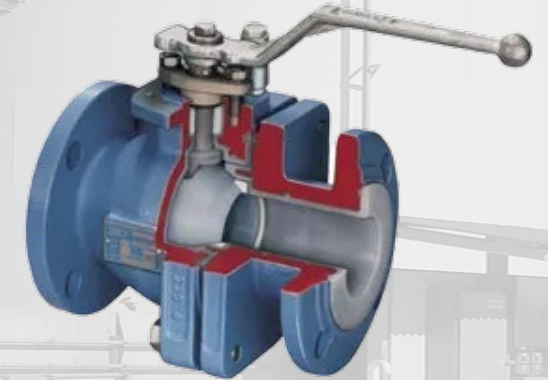
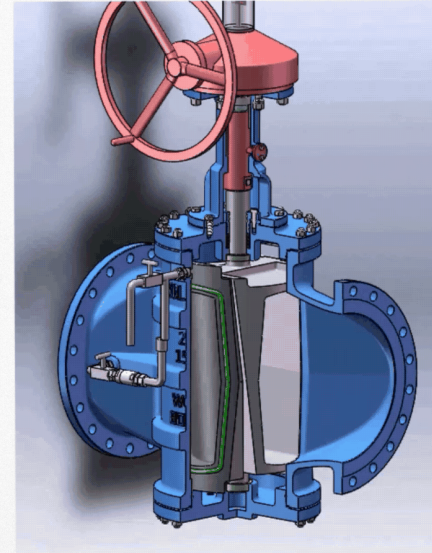
- Confined Space permit required to access
- Exposed to floods
- Require artificial lighting and ventilation
- Limited space for maintenance and repairs
- Some lids are heavy and require tools to open

Our recommendation is using Isolation Valve Stations (IVSs) as much as possible, even when sometimes a hybrid solution, mixing IVSs and IVVs, makes more sense.

Acceptable Materials and Joints for Piping, Valves and Accessories

- ✓ Under ASME B31.3 (Process Piping)
- ✓ Pipes Size 2-1/2" and Larger (ANSI 150# Class)
- ✓ Pipe Size 2" and Smaller
- ✓ Interior and Exterior Pipe Coating
- ✓ Flanged and Welded Pipe Joints
- ✓ Valves (DBBS, Ball and Butterfly)

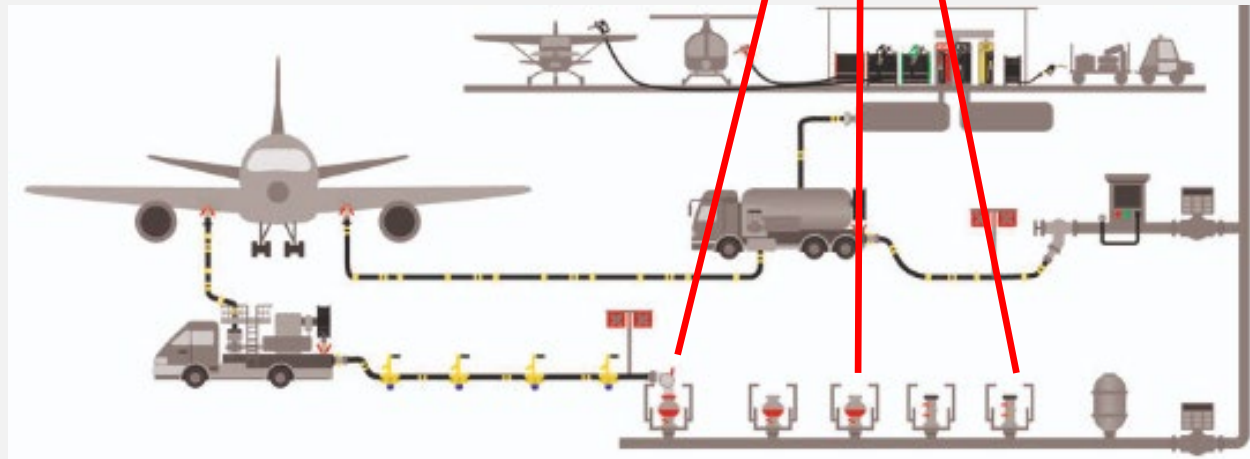
Never Use Cast Iron, Aluminum, Bronze or Plastic Equipment and Components in Jet Fuel Hydrant Systems



Residual Pressure

Maintain Acceptable Residual Pressure at the furthest Pit

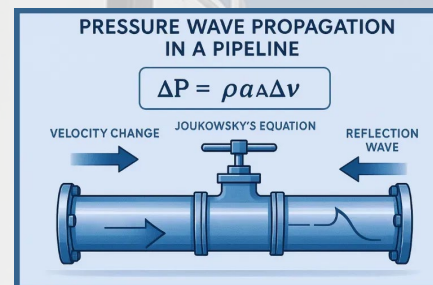
- ✓ What is Residual Pressure
- ✓ Why is Important
- ✓ Where should be Measured
- ✓ What is an Acceptable Range
- ✓ How it can be Maintained



Transient-State Hydraulic Analysis

Minimizing the Effects of Pressure Surges

- ✓ Understand why pressure surges occur
- ✓ The unwanted effects of pressure surges
- ✓ Importance of transient-state hydraulic analysis
- ✓ Predict pressure surges behavior and intensity
- ✓ Determine what part of your system is exposed
- ✓ Learn how to manage pressure surges



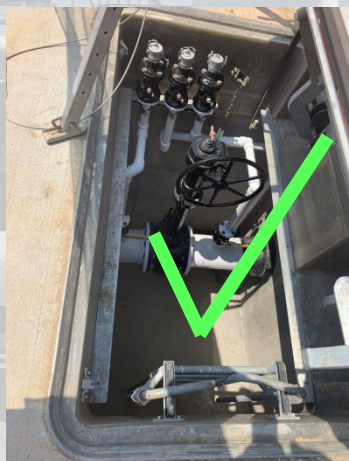
Start Node	End Node	Max. Pressure_psi	Min. Pressure_psi
J-47	J-3	193.99	111.28
J-5	J-11	205.91	88.23
J-2	J-43	203.38	97.18
J-47	J-48	183.73	128.30
J-9	J-14	281.99	43.70
J-2	J-13	205.79	96.29
J-5	J-13	205.91	96.21
J-32	J-28	248.01	4.51
J-13	J-4	224.47	96.10
J-19	O-AV-3	209.13	82.21
J-9	J-34	284.76	42.41
J-24	J-6	243.21	47.43
J-14	J-26	275.13	44.31
J-14	J-18	278.98	43.98
J-10	J-23	208.59	82.24
J-11	J-8	208.04	83.36



Properly Design IVVs, LPDs and HPVs

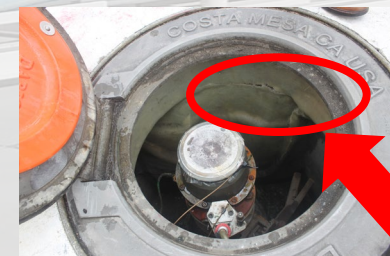
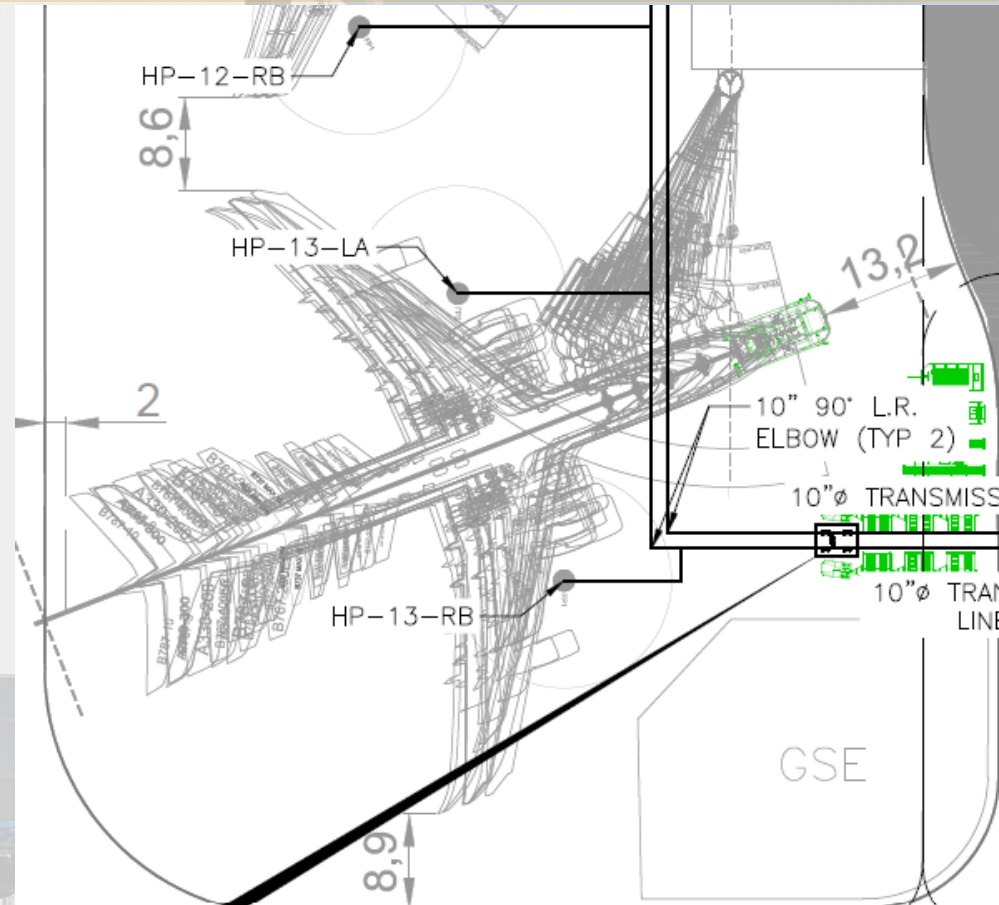


- ✓ Avoid to interfere with regular airport operations
- ✓ Easy access and enough clearances
- ✓ Provide assisted opening aluminum lids,
- ✓ Add lighting fixtures, flushing tees, and sump pits
- ✓ Away from service roads
- ✓ Design LPDs to work.
- ✓ Everywhere is possible, locate LPDs and HPVs within the Hydrant Chambers



Considerations for Placing Hydrant Pits

- ✓ Range to fueling ports
- ✓ Never under the fuselage or the aircraft engines
- ✓ Away from the front and rear side of aircraft engines
- ✓ Away from service roads
- ✓ Away from pavements panels intersection
- ✓ Protected by a reinforced concrete
- ✓ Near a ESB push button station



Fuel Hydrant Systems Design and Sizing



Questions



Thank You

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