WEBINAR:
Hydrant Flow Testing: Purpose, Process, and Experiences

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Dawn Flancher is a standards engineer with the American Water Works Association. She provides guidance to AWWA committees to produce a wide range of AWWA standards, manuals, and training materials on topics covering water and wastewater treatment, infrastructure assessment and rehabilitation, and utility management.
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Panel of Experts

James Cooper
Senior Engineer & Water Distribution Management, Planning and Modeling
Arcadis

Frank Parsons
Water Utility Field Operations Administrator
City of Dayton, Ohio

Tom Walski
Senior Product Manager
Bentley Systems, Inc.
Agenda

I. Hydrant Testing Introduction and Procedure  James Cooper

II. Utility Experiences with Hydrant Testing  Frank Parsons

III. Hydrant Flow Tests and Model Calibration  Tom Walski
Ask the Experts

Jim Cooper  Frank Parsons  Tom Walski

Enter your question into the question pane at the lower right hand side of the screen.

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Hydrant Testing Introduction and Procedure

James P. Cooper
Water Distribution Modeling Discipline Leader
ARCADIS
Why Should We Flow Test Hydrants?

- Insight gained from proper hydrant flow testing
  - System Pressures and Flow Rates
  - Asset Condition and Operability
  - Water Quality Characteristics
  - Opportunity for Customer Interaction
Why is Hydrant Flow Testing Important?

- Increase Value of Hydrant Testing
- Reporting and Asset Mgmt.
- Utility Management
- Flow Testing Purpose
- Hydraulic Calculations
- What is a Valid Test?
- Testing Procedures
- Testing Sequence and Planning
- Safety Considerations
- Practical Experience
- Sharing Lessons Learned
- Addressing Common Questions
- Using Test Data
- Operations Insight
Learning Objectives

• Explain the multiple purposes of hydrant flow testing

• Apply described procedures of testing and data collection

• Be aware of unique conditions and understand how to address them

• Use test results for planning and during critical operational times
Why Should We Flow Test Hydrants?

Available Fire Flow Rates

System Planning Model Calibration

Maintenance Management
Hydrant Flow Testing Considerations

Site Conditions

Dechlorination

Orifice Size Matters
Hydrant Flow Testing Considerations
Hydrant Flow Testing Terms

**Flow Hydrant**
- Location of open hydrant flowing water

**Pitot Pressure**
- Pressure measured at center of flow stream
- Utilized to calculate the flow rate
Hydrant Flow Testing Terms

**Residual Hydrant**
- Located near Flow Hydrant
- Utilized to measure pressure within the distribution system

**Static Pressure**
- Pressure during typical demands with no hydrants flowing

**Residual Pressure**
- Pressure measured while the flow hydrant is open
Hydrant Flow Testing Terms

**Field Test Flow Rate**
- Flow rate measured during the hydrant flow test
- Actual flow rate of water exiting the flow hydrant

**Available Fire Flow Rate**
- Calculated value based on the field test flow rate and the measured residual pressure during the test
- Standard for determining the fire flow rate available occurs at a residual pressure of 20 psi.
Calculation of Available Fire Flow

\[ Q_R = Q_F \times \frac{h^0.54_r}{h^0.54_f} \]

Where:

- \( Q_r \) = the flow available at the desirable residual pressure, in gpm
- \( Q_f \) = the sum of the flows from all hydrants (from step 2), in gpm
- \( h_r \) = the difference in pressure between the static pressure measured at the residual hydrant and the desired residual pressure, in lb/in.\(^2\)
- \( h_f \) = the difference between the static pressure and the residual pressure measured at the residual hydrant, in lb/in.\(^2\)
Calculation of Available Fire Flow

<table>
<thead>
<tr>
<th>Time Zone: EST</th>
<th>Pitot Pressure (psi)</th>
<th>Field Flow Rate (gpm)</th>
<th>Residual Hydrant Pressure Readings</th>
<th>Available Fire Flow (at 20 psi res.)</th>
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<td>0</td>
<td>Static 53</td>
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</table>

- **Pressure from flowing hydrant**
- **Field Test Flow Rate**
- **Calculated Available Fire Flow Rate**
Hydrant Flow Test Setup

Residual Hydrant
- Static Pressure
- Residual Pressure
- Test evaluates water available at this location

Flow Hydrant
- Pitot Pressure

Test Area
Hydrant Flow Test Procedure

1. Preparation
   – Identify flow and residual hydrants
   – Evaluate traffic control needs
   – Confirm test equipment condition and availability
Hydrant Flow Test Procedure

2. Residual Hydrant
   – Locate hydrant and properly flush to remove sediment
   – Install pressure gauge
   – Open hydrant, confirm no leaking, read gauge and record as static pressure
Hydrant Flow Test Procedure

3. Flow Hydrant
   – Locate hydrant
   – Estimate discharge path, establish traffic control
   – Install pitot pressure measurement gauge
   – Open hydrant, record pitot pressure
Hydrant Flow Test Procedure

4. Documentation
   – Record all measurements
   – Record all asset information
   – Determine *Field Test Flow Rate*
   – Determine *Available Fire Flow Rate*
   – Record Lessons Learned
Published Guidelines

• National Fire Protection Association

• Hydrant testing every 5 years

• Drop in pressure of at least 25% during test

• Alternative – testing achieves desired flow rate needed for fire fighting
Published Guidelines

- American Water Works Association
- Hydrant testing every 10 years
- Drop in pressure of at least 10 psi during test
- Alternative – open multiple hydrants/ports to achieve pressure reduction
Flow-Based Hydrant Marking

Class AA (light blue) to Class C (red)
Many Lessons Learned...

- Clear distance for flow exiting hydrant
- Rain suit (even if the sun is shining)
- Consider Public Impact
Continue the discussion!

JAMES P. COOPER, PE, ENV SP
Water Distribution Systems
Management, Planning and Modeling Leader

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Ask the Experts

Enter your question into the question pane at the lower right hand side of the screen.

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Utility Experiences with Hydrant Testing

Frank Parsons
Water Utility Field Operations Administrator
City of Dayton, Ohio
Rationale

• We must consider potential problems

• Avoid mistakes by showcasing some examples
Learning Objectives

• Proper Operation of Fire Hydrants
• Proper Site Evaluation for Hydrant Flow Testing
• Minimize costly mistakes and customer complaints
Agenda

• Proper hydrant operation
• Water hammer
• Site considerations
• Water quality complaints
• Lessons learned
Proper Hydrant Operation

• Hydrant functionality
• Check for damage
• Proper wrench selection
Proper Hydrant Operation

- Stand to the side
- Remove Cap slowly
- Operate slowly
- Smooth is better
Water Hammer and Fire Hydrants

• Tom Walski’s Article “Not So Fast! Close Hydrants Slowly” Feb 2009 Opflow Magazine

• Employees instructed to close hydrants slowly
• Avoid damage to the water system
What is Water Hammer?

- Pressure wave, or hydraulic transient

- Change in Momentum

- Magnitude directly related to speed of hydrant operation
Water Hammer

Damaged pipes, and joint separation
Water Hammer

Hydrants can blow off the supply branch
Site Considerations

• Consider the season

• Look for Possible traffic disruptions

www.paintworks.com
sterlingrobson.tumblr.com
Site Considerations

• Take pictures before you flush
Site Considerations

• Think about where the water goes

• Use your vehicle for protection
Water Quality Complaints

• Is the area known for water complaints?
• Notify affected customers

• Flow Hydrants in advance
• Have lab test sample assure safety
Lessons learned

• Traffic vs water in major thoroughfare
Lessons learned

• Swimming pool filled from hydrant with rusty water
Lessons learned

• Fire hydrant shaking
Lessons learned

• Fire hydrant vs new water main
Lessons learned

• Diffuser work truck
Summary

• Hydrant flowing can cause damage
• Proper safe operation is key
• Know where you flow
Summary

Planning = no surprises!
Summary

• We want to deliver quality water

• And be able to put out the fires
Thank You For Your Time

Frank Parsons
Water Utility Field Operations Administrator
City of Dayton, Ohio
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937-333-4901
Enter your **question** into the **question pane** at the lower right hand side of the screen.

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Hydrant Flow Tests and Model Calibration

Tom Walski
Sr. Product Manager
Bentley Systems, Inc.
Learning Objectives

• Understand that hydrant flow test useful for model calibration
• What kind of data should you collect
• Using data for calibration
Agenda

- Why use flow test data
- How to collect data
- How to use data
What is Calibration?

Comparing observed values to modeled values

Adjusting model variables to match observed values
Value of Hydrant Flow Tests

• Model applied during high flows
• Static pressures don’t provide enough info
  – Normal velocities are low
  – Insufficient head loss
  – Model insensitive to roughness
• Checking model over range of flow builds confidence
Head Loss Needed

- Tank
- Actual Normal HGL
  - Negligible difference
- Model Normal HGL
- Actual High Flow HGL
- Model High Flow HGL
- Detectable Difference
Data Collection

• Accuracy \( H = z + 2.31 \, p \) (US)
  • \( H \) = hydraulic grade, \( z \) = elevation, \( p \) = pressure
• Accuracy in Measurement
  – Pressure, Elevation Gradient: ±1 psi – 3 ft / (±0.5 – 1 m)
  – Flow – 5% accuracy
  – Tank levels – ±1 ft (±50 cm)
• SCADA data
• Chart recorders/data loggers
• Calibrate gages and meters
Where to Collect Data?

• Away from
  – Tanks
  – Pumps
  – PRVs
• Near model nodes
• Number of tests depends on system
When and How to Collect Data?

• Periods of high demand
• Not to disrupt service/operation
• Record boundary head
  – Tank levels
  – PRV status
  – Pumps status/speed
Comparisons

• Compare Hydraulic Grade Line not pressure
Flow and Pressure Hydrants
Digital Pressure Gage
Digital and Analog Pressure Gages
Pressure Measurements

![Graph showing pressure measurements over time. The graph displays multiple lines and shaded bars indicating different flow conditions at various pressures and time intervals.](image-url)
What Parameters to Adjust?

- Primary parameters to Adjust
  - C-factor/Roughness
  - Demands
  - Valve states

- Identify source of error
  - If errors present at Average flow/demand, verify:
    - Elevations
    - Boundary heads
  - If errors present at High flow/demand, verify
    - Closed valves
    - C-factor/roughness
    - Demands
24 in

8 in.

12 in.

Residual

88

88

88

62
Resources

• AWWA EMAC Calibration Subcommittee
• AWWA M-32
• Video
  • [http://www.youtube.com/watch?v=aasoxEm4i0c](http://www.youtube.com/watch?v=aasoxEm4i0c)
• Forum –
• tom.walski@bentley.com
Calibration Tips

• Perform field data tests to confirm model
• Record boundary conditions at time of test
• Use calibrated equipment
• Know the elevations of the pressure gauges
• May need to repeat tests if system changes
• Avoid calibration by compensating error
Good Calibration Leads to Good Decisions
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Bookstore Resources

M31 Distribution System Requirements for Fire Protection, Fourth Edition
Catalog No. 30031

M17 Installation, Field Testing, and Maintenance of Fire Hydrants, Fourth Edition
Catalog No. 30017

Water Distribution Operator Training: Hydrants DVD
Catalog No. 64322

Repairing & Replacing Fire Hydrants DVD
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Presenter Biography Information

Mr. Cooper serves as the firm’s water distribution management, planning, and modeling discipline leader, drawing on his practical operations experience and technical expertise in distribution system design and modeling. Mr. Cooper has assisted numerous systems with planning solutions, performance evaluations and holistic system optimization. His research has resulted in the development of calibration techniques via data mining and advanced statistical analysis with emphasis on smart water solutions. Jim is a certified water distribution operator and regularly performs hydraulic and quality testing, including hydrant flow testing.

Mr. Parsons is a 25-year veteran of the utility business, and he has served in various capacities with the Dayton Water Department. He progressed from a frontline employee through various management roles with the Department, including managing the city’s dedicated Hydrant Shop. In this capacity, Mr. Parsons oversaw the maintenance and operation of approximately 5,800 fire hydrants in Dayton’s distribution system. In his current role, Mr. Parsons oversees approximately 70 employees who operate and maintain the distribution system, which includes approximately 800 miles of piping.

Tom Walski has 40 years of experience in water and wastewater design and operation. He is currently senior product manager for Bentley Systems and has previously served as civil engineer for the Army Corps of Engineers, distribution system manager for the City of Austin, Tex., executive director the Wyoming Valley Sanitary Authority, and engineering manager for Pennsylvania American Water. He has written several books and hundreds of journal and conference papers on many aspects of water distribution systems.
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