

# **“FIRE & RESCUE SERVICES UNDER PRESSURE- TIME TO GO WITH THE FLOW?”**

**(A discussion paper for Fire & Rescue Services to consider the use of Flowmeters to produce more effective and efficient outcomes and improve Fire-fighter safety/professionalism).**

## **1 PURPOSE & BACKGROUND**

- 1.1 The purpose of this paper is to provide background information to assist Fire & Rescue Services (FRS's) to consider the use of flowmeters on pumping appliances to produce more effective and efficient outcomes at operational incidents and to improve fire-fighter safety/professionalism, and to generate discussion on the use of new technology associated with flowmeters.
- 1.2 The co-authors of the paper are John Harding and Tim Carew. John Harding served for 33 years as an operational Fire Officer in Greater Manchester FRS in a variety of roles, including that of Recruit/General Instructor and Senior Instructor at the Service Training Centre. His final role for four and a half years was that of Borough Commander (Area Manager) responsible for the largest and most populous fire borough (Wigan Borough) in Greater Manchester. Having retired from the Service in October 2009, he is now working with Tim Carew, the Managing Director of TSI Flowmeters, who heads the market leading company and global experts in flowmeter technology for the fire arena. Tim Carew has personally designed the flowmeter to precisely meet fire fighter needs, hence its rapid adoption by Fire & Rescue Services in England, Ireland and Germany. The opinions expressed in this document are the co-authors own opinions and are provided solely to offer a basis for discussion and consideration.

## **2 EXECUTIVE SUMMARY**

- 2.1 Traditionally, operational fire-fighters have (since their basic training) been taught to request a specific **pressure** when acting as branch operator and, when operating as a pump operator, to attempt to deliver that pressure at the branch by making mental calculations as to pressure losses due to friction in delivery hose and pressure changes due to “head” (height differences between pump and branch). This process is open to inaccuracies through miscalculation. The current approach takes no account of the amount of flow produced at the branch, nor does it deliver the optimum flow for any given branch. Hence, water delivered onto any fire may not be at the most efficient or effective, which could result in outcomes such as incidents taking longer to extinguish, greater run-off of contaminated water entering watercourses, more Carbon emissions entering the atmosphere due to the fire burning for longer and more resources being required at incidents for water management. FRS's continually strive to improve the way in which they deliver their service to the public and new technology has been adopted in many areas. Branch technology has moved on significantly over the past 30 years and new branches are hi-tech pieces of equipment that

work most effectively at specific flow rates. However, without flowmeters, it is difficult (if not impossible) to know if branches are being used to their best effect. The use of flowmeter technology has the potential to improve the way water is managed on the incident ground and to contribute to positive impacts on the environment and the community.

- 2.2 The fitting of flowmeters to delivery and input sides of pumping appliances provides a cost-effective solution to water management on the fireground providing pump operators with reliable, accurate and timely information as to how much water is being delivered/received and therefore what additional capacity is available to supply further jets/pumps. The fitting of Data Loggers to pumping appliances allows for all information regarding flow to be remotely uploaded onto a database for use by the Officer-in-Charge or nominated Water Officer to support Incident Command decisions on the availability of water supplies and number of additional resources required at the incident.
- 2.3 Well-managed water supplies at incidents, both by pump operators and officers, can result in a requirement for fewer pumping appliances being mobilised, thereby reducing costs and for potentially less fuel usage.
- 2.4 Flowmeters are currently in use in an increasing number of UK FRS's and have been fitted to all pumping appliances in one Metropolitan FRS since 1993. They provide pump operators and officers with options to use a number of branch combinations from any single pump and deliver different flow rates from each, whilst also increasing the safety of fire fighters by reducing the risk of injury from jet reaction. As the pump operator is able to see the flow at each delivery (in Litres Per Minute [LPM]) there is an instant indication when flow ceases (for example: debris on the delivery hose) and actions can immediately be taken to ascertain any problem and rectify it, thereby mitigating risks to branch operators.
- 2.5 As the current financial climate increasingly impacts upon the FRS, this paper seeks to provide opportunities for FRS's to consider the installation of flowmeters to their new or existing pumping fleets to ensure FRS's can manage water supplies on the fireground to best effect and ultimately, improve service delivery and environmental/sustainability outcomes whilst reducing longer term costs.

### **3 INTRODUCTION**

- 3.1 An increasing number of FRS's are changing their traditional approach of using pressure as the basis on which they operate their pumps and as the basis to train their fire fighters to operate their pumps. Using pressure as the unit of measurement on which to base the amount of water produced at the branch is a fundamentally flawed principle in that there is no way of measuring how much water is being delivered at the branch for any given pressure set at the pump. For example, a pump pressure gauge could be showing 4 Bars being delivered by the pump but the branch may not be delivering any water at all (due to a number of reasons such as branch shut-down, debris/vehicles fully restricting hose lines, debris blocking the branch). A flowmeter would show the number of litres per minute being delivered by the pump and (as water is virtually incompressible) this would be the flow actually being delivered at the branch. In

the example above, any restriction on the hose line would result in a reduction on the flowmeter at the pump and, in the case of full restriction, in a zero flow reading.

- 3.2 There are many advantages to using flowmeters as the method of monitoring and using available water to greatest efficiency and effectiveness and these are outlined below. However, for clarity, also set out below is information on what a flowmeter is and how it works.

#### **4 WHAT IS A FLOWMETER?**

- 4.1 A flowmeter is a device designed to accurately measure flow. TSI flowmeters operate by measuring the electromotive voltage at a given point caused by the flow of water through each delivery outlet and can also be used to measure the flow coming into the pump. By fitting on the inlet side of the fire pump they can also provide instant information to pump operator/OiC as to the amount of water still available for use by that pump when jets are already at work from it. This gives a complete picture of flow in and out of the pump and allows for more efficient management of available water supplies.
- 4.2 As TSI flowmeters have no moving parts they do not interfere with the hydraulic efficiency of the pump (they do not restrict the flow of water in any way).
- 4.3 Flowmeters are fitted between the pump manifold and each delivery outlet to measure flow from the delivery and are powered by the vehicle 24V system.
- 4.4 They are accurate regardless of the flow (from 30 LPM to 3000 LPM) to a +/- 2% tolerance.
- 4.5 The flowmeters can be linked to a Data Logger and the information from the Data Logger can be downloaded (in real time) onto a database held in the FRS Incident Command Unit or other remote location and used within the Incident Command System to provide to the OiC and/or the nominated Water Officer the exact position in terms of water availability. This information can result in evidence-based decisions being taken regarding the best use of available water supplies and could result in the need for fewer fire appliances being required to respond to the incident.
- 4.6 Flow data can be stored electronically via the Data Logger fitted to the fire appliance and analysed post-incident to inform the FRS of operational performance issues. This information can be used during debriefing to evaluate performance of individual pumps/pump operators and Incident Command in terms of effective use of available water supplies.
- 4.7 Due to their simplicity and construction, flowmeters have a proven longevity with expected lifespan equal to at least that of the working life of the fire pump.

## 5 WHAT ARE THE PRACTICAL ADVANTAGES OF FLOWMETERS?

- 5.1 There are many advantages for FRS's to operate using water flow rather than pressure and these can be categorised into several areas. These advantages are briefly outlined below: -
- 5.2 **Fully utilised water supplies.** Flowmeters provide the ability for pump operators (and OiC's) to see exactly how much water is being delivered via each delivery and therefore in total per pump. Where flowmeters are also fitted to the inlet side of pumps, the pump operator can instantly determine if there is sufficient capacity to supply further branches and what type of branch can be supplied to produce the optimum flow rate. This compares favourably to the situation where a pump operator may be asked by the OiC if s/he can supply a further branch and then has to rely on "squeezing the inlet hose by hand" and making a judgement on whether there is sufficient incoming water to supply further jet(s). Errors in judgement by the pump operator in this situation could result in staff resources being deployed to run out hose and supply a jet only to find that the branch delivers insufficient flow and their efforts and time have been wasted. At worst, attempting to supply additional jets without the knowledge that there is sufficient incoming supply could result in depletion of supply to branches already working on the fireground thus putting fire fighters and public at further risk.
- 5.3 Where pumping appliances are not being used to full capacity on the fireground they can be used to supply other fireground pumps that require extra water. The pump operators/Water Officer/OiC at an incident will, by reading the flow meters and/or utilizing information provided to the Incident Command Unit via the Data Logger, know exactly how much water is being used. Decisions regarding requirements for additional water/resources can then be made (if deemed necessary). By managing the available water supplies more effectively, it may be possible to reduce the number of fire pumps required on the fireground thereby producing cost savings. An example of this more scientific approach to managing water by a Water Officer could be where three jets are delivering 600 LPM each. The Water Officer could determine that three adequate jets could be supplied at 450 LPM each. This creates capacity for a further jet to be brought into use, also at 450 LPM. Such decisions could be useful in rural areas where water is scarce and supporting pumps have significant distances to travel.
- 5.4 **Branches can be used to their optimum.** By using deliveries fitted with flow meters different flows can be safely provided to each branch thus providing flexibility and a greater degree of control. Flowmeters enable each individual branch to work at its optimum flow rate, thereby providing the most efficient and effective delivery of water onto the fire. By having the ability to simultaneously use differing combinations of branches from one pump, it may be possible to reduce the number of fire pumps required on the fireground thereby producing cost savings.
- 5.5 **Increased fire fighter safety.** There are a number of areas where operational fire fighters can benefit from the use of flowmeters and these include the fact

that fire fighters can work at a safe distance from the fire due to optimum flows produced at the branch and resulting in good throw.

- 5.6 Additionally, as water flow is controlled at the delivery outlet by only partially opening the delivery until the required flow rate is displayed, fire fighter strain as a result of “Jet Reaction” at the branch is reduced and fluctuations in inlet pressures will not result in any significant increase in the volume of water being delivered. As deliveries are not fully open, any shutting down of other branches operating from the same pump will also not result in any significant increase in jet reaction thus making for a safer working environment for branch operators.
- 5.7 Stress on Pump Operators could be reduced, as they are not required to make mental calculations for pressure losses due to frictional loss/pressure loss due to head, thus making pump operating simpler and less stressful. The simplicity of using flowmeters to deliver a specific flow also means that pump operator training is simplified, which is particularly important where training time is limited as in the case of retained crew training time.
- 5.8 The Pump Operators’ working environment is improved due to reductions in engine/pump noise. This makes pump operating less stressful, reduces the impact on the hearing of the Pump Operator and provides for easier fireground communications due to reduced background noise from pumping appliances. Using flowmeters means that the pump can be set at specific revolutions and the flow is then determined by the amount by which the deliveries are opened with only minor adjustments being necessary.
- 5.9 Branch operators are not put at risk of water loss due to the pump operator overdrawing the supply, as the pump operator knows exactly how much water is being delivered and (with a flowmeter on inlet side) how much water is still available.
- 6.0 **Diminished environmental impact.** The Water Act 2003 places a duty on all public bodies to conserve water. In the UK the Audit Commission, by means of the Comprehensive Area Assessment (CAA) process, considers (among other issues) how public services are working to minimise the impact of their service delivery upon the environment. The CAA process uses Key Lines of Enquiry (KLOE’s) to provide focus to their auditing. KLOE 3.1 asks public services “Is the organisation making effective use of natural resources?” and provides, by way of focus, the following: -
- (That) The organisation:
- Understands and can quantify its use of natural resources and can identify the main influencing factors;
  - Manages performance to reduce its impact on the environment; and
  - Manages the environmental risks it faces, working effectively with partners.

Flowmeters can assist FRS's in reducing the impact on the environment in a variety of ways including: -

- 6.1 Enabling branches to be used at their most efficient settings, which can lead to the fire being extinguished more quickly and therefore result in less water damage being caused to property.
- 6.2 Less water being used results in less contaminated run-off entering drains & watercourses, which, in turn, may result in less clean up work being required by external agencies. All mains water used for fire fighting purposes has had to be treated by the public utilities companies and the pumping of water to and from consumers and treating it at water treatment plants uses energy and thus contributes to climate change. Any reduction in the volume of water extracted from water mains by FRS's therefore results in reductions in environmental costs based on water treatment costs of these companies.
- 6.3 Fires extinguished more quickly result in fewer fire generated pollutants entering the atmosphere, thereby reducing the Carbon footprint. Fires extinguished more quickly also require less fuel to be used by pumps as they are not running for as long, resulting in fewer pollutants entering the atmosphere and fuel cost savings for FRS's. Pumps running for shorter periods can also result in less wear and tear and appliance downtime for mechanical breakdowns and the pump is not "over-revved" as pump operators are not working to deliver pressure but to deliver flow.
- 6.4 Flowmeters can provide FRS's with accurate real time and post-fire data regarding the total volume of water delivered. This information could be communicated to the Environment Agency or other agencies (for example; local Emergency Planning Unit) for chemical or large incidents, to assist in their decision making/actions to protect the environment.
- 6.5 Flow information gathered by operational crews whenever hydrants are accessed can be gathered and stored for operational pre-planning purposes and used to provide information to operational appliances at subsequent incidents, thus providing opportunities for quicker extinguishments and reductions in Carbon emissions.
- 6.6 Flowmeters can be used when appliances are involved with the production of foam and the amount of foam used can therefore be very accurately determined thus ensuring optimum usage.

## **7 FLOWMETER INSTALLATION**

- 7.1 TSI Flowmeters can be fitted to new build fire appliances (TSI is a registered "Firebuy" company) or can be easily retrofitted, with simple annual recalibration forming part of the workshop maintenance routine. Some fire services opt to put flowmeters on the low-pressure deliveries. The more typical installation is to equip the fire appliance with flowmeters on each Low Pressure delivery, one flowmeter on the inlet side of the pump, one on the High Pressure hose-reels and provide Data Logging capability.

- 7.2 It should be borne in mind that the flowmeter can be expected to have a lifespan equivalent to at least the life of the pumping appliance and so represents significant long-term value.

## **8 SUMMARY**

- 8.1 Flowmeters have been in use for a number of years in some UK Fire & Rescue Services and the benefits of this technology is being recognised by an increasing number of FRS's. They are easy to install, require little attention once fitted and have proven longevity. In an increasingly performance managed environment where Central Government and the public's expectations are for FRS's to deliver continually more efficient and effective services, the question which must be asked is not "Can FRS's afford to fit flowmeters?" but "Can FRS's NOT afford to fit flowmeters?"

## **FURTHER INFORMATION**

**This paper has been specifically written in a non-technical manner to stimulate initial discussion in FRS circles. Technical papers expressing opinions of other FRS staff regarding flow/flowmeters are available on the TSI website. TSI FLOWMETERS are happy to discuss flowmeters with you. Please contact John Harding direct in the UK on +44 (0) 7879 667 436 or Tim Carew (Managing Director) at TSI Flowmeters, 24 Rockdale, Mountrath Rd, Portlaoise, Co Laois, Ireland on +353 87 235 2107 or on the TSI website, [www.tsi.ie](http://www.tsi.ie) .**