

Modern methods of installing dependable hydrants

By Marc van den Bosch, Bernd Schuster and Manfred Schmidt

In cases of fire outbreaks, a constant and reliable supply of water must be readily available to enable the fire fighters to complete their allotted task. At the same time the water supply utilities are obliged to take the necessary measures to ensure that a piping network can be effectively filled, vented, flushed and drained as well as to be able to provide temporary or emergency supplies through the use of hydrants. Each and every pipeline component installed up to the hydrant outlet must function in a reliable manner. Other factors such as traffic flow, space requirements and hydrant type must be taken into consideration during the installation of such water hydrants. This paper is intended to give an overview of the products and methods in use today as well as future developments in this direction.

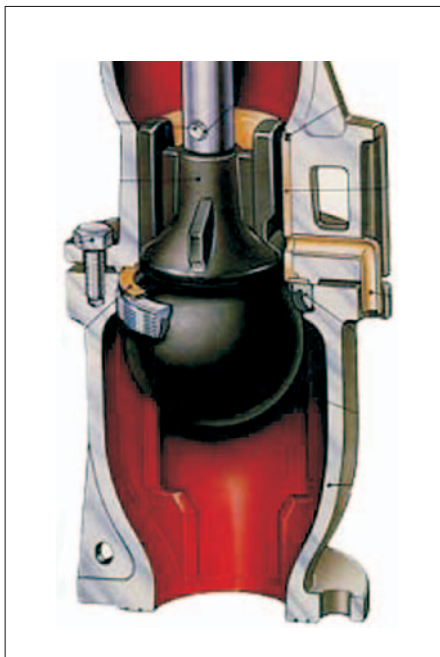
Hydrant systems

Fundamentally, there are two distinctly different types of hydrant; one is designed to be installed below the surface of the ground whilst the other is conceived for above ground installation. The respective standard applicable for installation in potable water systems for the underground types is DIN 3321 whilst DIN 3222 applies to the above ground types. The dimensions of below ground hydrants are in accordance with the

commonly used installation depths of 1.00 m, 1.25 m and 1.5 m. In Germany, the underground hydrant type finds more frequent usage due to its low purchase price, light weight and resultant simplified installation procedure coupled with the fact this variation offers no hindrance or hazard to road transport. However, wherever it is necessary to have a rapid site location, perhaps during hours of darkness or even after snowfall, fast water extraction with large throughputs, the above ground or so-called stand post hydrants are much preferred.

Both versions of these two hydrants can be sub-divided into two shut-off patterns; the simple shut-off and the double shut-off type. Double shut-off hydrants have two separate shut-off systems (Figure 1), which also enables all maintenance and repair work to be carried out under full working pressure. Simple shut-off types require an additional shut-off valve. The current trend is clearly towards double shut-off hydrants due to fundamental installation reasons and those of costs.

Fig. 1: Underground hydrant with double shut-off; ball body with flanges



Reliable and safe hydrants

Modern underground hydrants should fulfil the following requirements:

- Double shut-off design
- Fast and efficient exchange of the valve unit
- Safety inter-locking of the inner assembly
- One piece outer body
- Integrated multi-functional seal
- Optimum drainage.

Double shut-off design

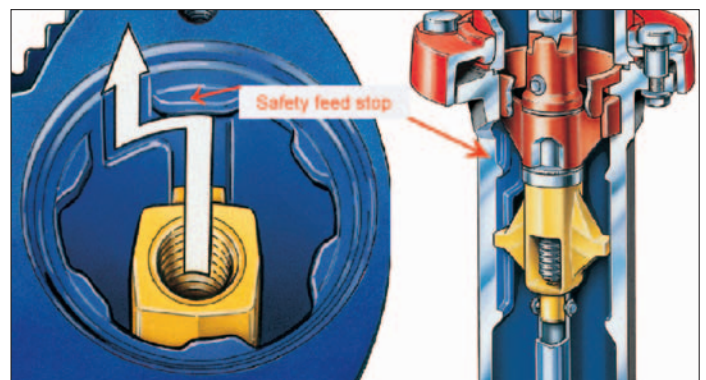
During recent years the hydrant types possessing an extra shut-off (**Figure 1**) have found increased interest amongst users. A major advantage is that when exchanging the inner parts there is no necessity to shut-down the flow of the medium in the main line. In this way any additional shut-off is not required.

Fast and efficient exchange of the valve assembly

The reason behind the exchange of the entire inner unit is usually the result of damage to the rubber sealing on the valve cone. The design of the valve cone containment must be made in such a way so that it can be exchanged without difficulty and is also available as a separate assembly complete with all relevant parts.

The economics behind the provision of a separate valve cone lie not only with the reuse of valuable parts such as pressure pipe and spindle nut, but they also include the possibility to use the identical cone for both

Fig. 2: Hydrant with safety mechanism



underground and above ground standpost hydrants at all depths of pipe cover.

Safety inter-locking of the inner assembly

Uncontrolled internal pressure can represent a hazard to maintenance personnel when working on opened-up hydrants. A safety inter-locking mechanism prevents the sudden ejection of the inner assembly in such cases.

Following removal of the bonnet any internal water pressure will force the inner assembly upwards. However, a fixed stop prevents an unexpected and possibly dangerous ejection of the inner unit. The assembly can be subsequently unlocked with a turning action and then removed (**Figure 2**).

One-piece outer body

The conception of a one-piece outer body represents a substantial advancement (**Figure 3**). Otherwise a flange connection between the outer body and housing around the double shut-off itself (Figure 1) would be necessary. Leakages can no longer occur at this point. Additionally, an enormous weight saving is achieved considerably easing transport and installation.

Integrated multi-functional seal

As can be seen in the sectioned hydrant (Figure 3) the cone for the additional shut-off is assembled from below. A plastic reinforced sealing ring set in the connector flange

Fig. 3: Underground hydrant with one-piece body



Fig. 4: Damage frequency for underground hydrants

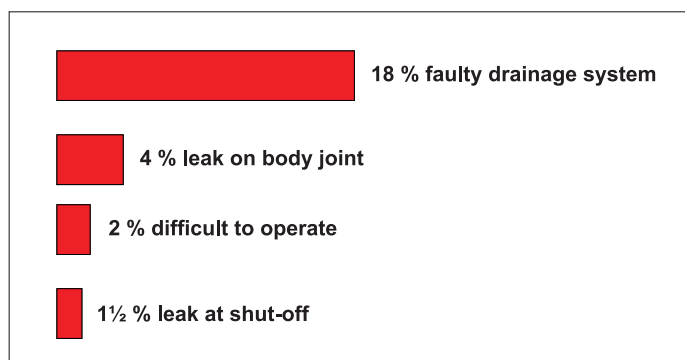
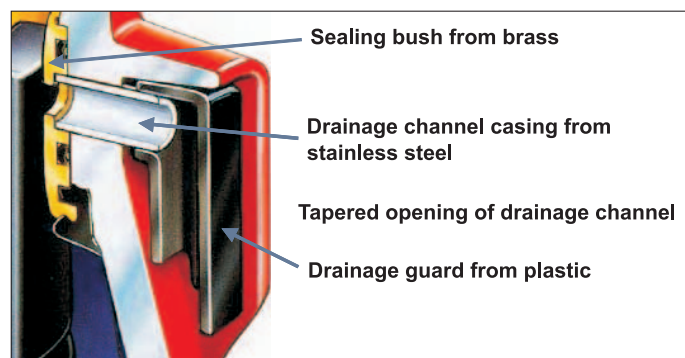


Fig. 5: Optimum drainage



serves primarily as an integrated seal to the flange used to attach the pipeline. Neither supports or adjustment is necessary, as a tiresome lining-up of the loose flange gasket is avoided. Assembly can be achieved easily and without great effort.

Furthermore, this seal retains the cone in the outer casing. When filling sections of pipeline from the hydrant, four cams serve as a seat for the cone and provide the necessary free cross-sectional area between cone and outer casing.

Fig. 6: Standpost Hydrant VAG NIVO NIRO



Optimum drainage

As a result of tests on more than 50,000 underground hydrants from 20 utility companies, it was established that for approximately 9,000 hydrants, the most common cause of a malfunction (**Figure 4**) was a defective (blocked) drainage system. Such faults can often only be remedied following time consuming and costly repairs (e.g. drilling out the drainage channel). In many cases it is necessary to dig out and exchange the complete hydrant. The resultant costs in many cases exceed the original procurement price by up to ten times. For these reasons it is very important to pay close attention to the drainage method adopted for the hydrant in question. Ideally, hydrants should possess a water drainage channel from a non-corrosive material (**Figure 5**) in order to prevent a potential build-up of corrosion. Just as important is to integrate a tapered design for the drainage channel to prevent any possible blockage caused by foreign bodies (stones, sand).

The VAG hydrant types UH SUPRA and UEH NOVA fulfil the afore-mentioned points in all respects. Above ground hydrants should only be of the robust and maintenance-free types



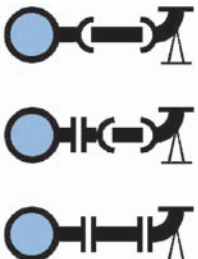
Type	Arrangement	Characteristics	Requirement
Directly on mains		Maximum two joints before hydrant	Tee fitting (MMA, MMB) Possibly flange
Adjacent to mains		Maximum two joints before hydrant	Tee fitting (MMA) Ducks-foot bend (N-piece)
End hydrant or off-set to mains		Fixed distances for feeders or flexible lengths for feeder lines	Tee fitting (MMA, MMB) Distance piece Ducks-foot bend (N-piece)

Table 1

such as the VAG NOVA NIRO (Figure 6) and possess the following characteristics:

- all above ground components to be from corrosion resistant materials
- have a chalk resistant polyester coating in a bright fade-proof, warning colour
- if aluminium alloys are used, these are to be corrosion and salt water resistant
- hydrant head to be directionally adjustable with a free orientation
- have a reliable by-pass system

Pipelines

There has been an extensive network of water distribution pipes in Europe since the 19th century. Cast iron was the predominant material up to the 2nd world war. Pipes from this material were originally connected together using flanges and then later overlapping jointing methods were used. However, cast iron as a piping material was substitut-

ed successively by ductile cast iron as well as various plastics. Until the end of the 1980's PVC was the dominant plastics material but today, pipes in PE are normally used.

As a result of the historical background, a variety of methods have been created to couple the various pipeline materials with their differing jointing techniques to hydrants. Particular attention must be given to the point of connection. The chances of a leakage occurring reduces in adverse proportion to the number of joints in use whatever quality they possess.

Types of hydrant connection

In principle there are three different configurations. The choice is usually dependant upon the actual hydrant itself, local conditions as well as the customs practised by the

network engineer. These configurations are as follows:

- direct mounting on the mains pipe
- off-set to the mains pipe
- as end hydrant or in feeder line.

Table 1 illustrates the different characteristics and particulars.

Applied connection methods

The flange connection is the classic way for tying a hydrant and other valves into a pipeline network. Unfortunately, this jointing technique is especially susceptible to aging and this is the reason why it has been given particular attention.

As with joining pipelines, the overlapping push-fit joint finds increasing popularity for hydrants. The BAI0 Plus[®] system (Figure 7) is the principle method in use for hydrants because a positive locking system assures for the necessary retention and safety.

When applying modern, heat fusible plastic materials an increased demand exists for jointing methods which, like for pipe connections, ensure the highest levels of reliability and a long working life.

Classic methods of attaching hydrants

Tying into cast-iron pipelines

As a rule cast-iron pipes are joined together using overlapping jointing techniques. Should it be necessary to install a hydrant, this is accomplished by using standard fittings (Figure 8), which allow a direct upright assembly, an off-set installation and which can also be used for the various styles of hydrant attachment.

Tying into PVC piping

Lengths of PVC pipe are joined together using specially designed push-fit fittings from either cast-iron or PVC. Flanges are generally used when installing a hydrant into such piping systems. Ancillary fittings (Figure 9) from cast-iron or PVC permit an off-set attachment. A direct vertical mounting is usually avoided for various reasons.

Fig. 7: Underground hydrant with BAI0 Plus[®] bayonet connection

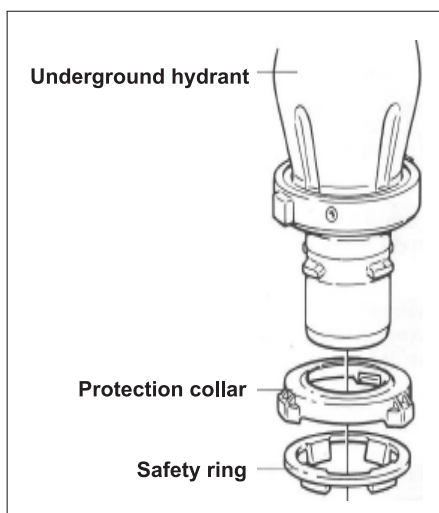


Fig. 8: Hydrant assembled directly above cast-iron mains



Fig. 9: Combination of PVC tee and cast-iron ducks-foot bend



Tying into PE piping

Heat fusion tees are used almost without exception when installing hydrants in PE pipelines. The hydrants are either mounted directly above the mains line or are mounted in an off-set manner. In such cases a combination similar to that illustrated in **Figure 10** is generally used.

Modern concepts for installing hydrants

The demands and requirements for the procedures applied when installing hydrants have altered. Changed environmental factors and constant technical progress necessitate revised needs. Amended environment-related conditions such as the constant need to reduce costs, traffic densities or rehabilitation instead of replacement, just to mention a few, demand an optimisation of installation method and a more refined product. The constant technical progress taking place with respect to pipeline materials and installation practices encourages a rethinking of traditional methods and applied products. As a subject "Installation of Hydrants" has clearly defined issues which are extensively covered in various standards, instructions and codes of practice. Minimum throughput performance levels for hydrants and standardised coverage for pipes are typical examples of these. With respect to these new fundamental requirements the following section describes application possibilities using new products, modern techniques and case histories.

Hydrant bases for PE and other pipe materials

All ducks-foot fittings (**Figure 11**), whether for PE or other pipeline materials, for hy-



Fig. 10: Combination of PE fitting and cast-iron ducks-foot bend



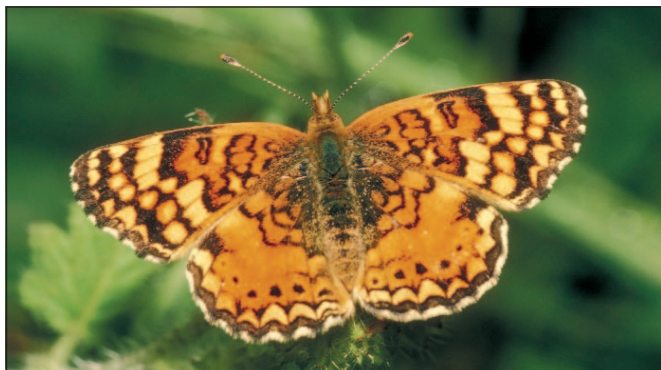
Fig. 11: Ducks-foot bend with MULTI/JOINT® couplings

drants with PE stub ends or with flange connections, must fulfil their purpose with complete safety. The purpose of a hydrant foot is to prevent the product sinking into the earth due to its own weight or through traffic loading. This must be assured over the entire minimum working life of 50 years. The second reason for the hydrant foot is effective immediately following the initial installation. Until the final fixation after backfilling is complete the hydrant must remain upright in an absolutely vertical position. Before then, it has to withstand winds, weather and the daily hard conditions experienced on building sites. These conditions often prevail for many days or even weeks until the trench is filled or the manhole cover is finally attached.

Most hydrants are tied-in to a pipeline network using flange connections. The flange connection represents the absolute classic technology ever since there have been hydrants. It is clearly obvious that the more

modern methods to install hydrants should be also taken into consideration. This thought is applicable for both metal and for plastic solutions irrespective of which pipeline material is being used. Furthermore, hydrants with PE stub ends have been available for some time now. Such products can be fused directly into a mains network. Therefore, an assurance is given that the complete system has an identical system of jointing throughout. Thus differences within the system regarding concerns for aging, pressure resistance and flexibility of the applied product, are deliberately avoided.

A ducks-foot bend made entirely from PE with integrated ELGEF Plus® electrofusion technology especially designed for hydrant applications is on offer. A MULTI/JOINT® ducks-foot bend is also available which is suitable for all materials including PE. In contrast to the version completely from PE, which is designed for flange connections as well as direct fusion jointing, the metal



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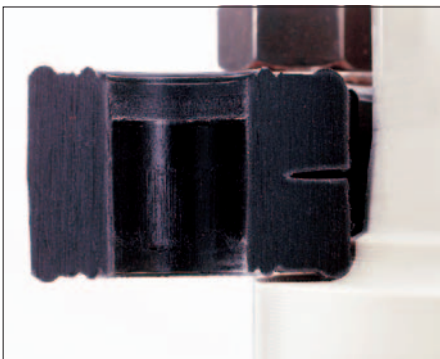
Fig. 12: Saturn branch saddle



Fig. 13: Draw-lock®

ducks-foot bend is more popular for flanging to hydrants. Although influenced by the material in question, the all-metal version remains decidedly more flexible in use because of the proven multi-dimension mechanical pipe coupling it is equipped with. Another advantage is that such couplings are end-load taking for all pipe material types. As no-one knows the local conditions and requirements better than the respective network operator, the decision should be left to him if the choice should be, flexibility at the attachment and to remain standard for the mains pipe, or alternatively, to be stand-

Fig. 14: PP-V flange



ardised for the connection and then maintain flexibility at the mains pipe. However, whatever the final decision, Georg Fischer has a suitable solution.

Integrated service connection avoids standing water

Water quality and hygiene are becoming more and more important in today's world. Hygiene in particular, is a constant discussion topic amongst utilities, the media and during public debates. According to EN 805 feeder lines to hydrants, amongst other things, must be carefully considered. It is recommended to install a service branch-off at the end of each feeder line to avoid a possible build-up of stagnant water. In this way the work to carry out a time-consuming flushing operation of the feeder line is either minimised or completely avoided. The simplest solution is to install a ducks-foot bend with integrated service branch outlet. Such fittings are available not only especially for PE but also for all other pipeline materials.

Connector fittings for PE piping systems

There are many utility companies that value the flexibility of PE as a pipeline material. Originally, house service connections were made using one single piece of uncoiled PE pipe which was joined at one end to the branch take-off at the mains and to a wall inlet fitting at the other end. Irrespective of the length of the service no further connections were necessary between these two points. For the same reason many engineers appreciated the possibility to be able to uncoil PE pipes with outside diameters of up to d 180 mm in the same way from drums and in long lengths. In this manner, and like with no other material, trench-less installation procedures could be adopted. Relining is another ideal application. It hardly makes sense to interrupt an unbroken continuous length of installed pipe just to insert a branch tee. In our opinion the branch fittings from Georg Fischer +GF+ (Figure 12) offer a considerable potential with respect to improvements concerning installation procedures and overall cost savings. ELGEF Plus® branch fittings are available for all common mains sizes and are equipped with outlet sizes of d 90, d 110 and d 125 mm. An electrofusion socket is an integral part of the fitting so that a valve or flange adapter, for example, can be fused directly into the outlet. Branch fittings are therefore, both time-saving and economical in use.

Draw-lock® Flanges for optimum transitions from PE to metal

Transitions from PE to metal require studied solutions. PE has a tendency to creep under

high stress conditions. High stress levels can be induced when flange or compression joints are over-tightened. The patented Draw-lock® (Figure 13) offers a viable transition from PE to metal which is ideally suited to both materials. Forces and stresses are equally distributed. The metal flanged ends on tee and flange fittings permit the usual and familiar connections to metal valves. The range of Draw-lock® fittings offers an optimal connection possibility for long-term reliable transitions using the proven metal flange jointing procedure.

PP-V flange for plastic flange connections

Special loose flanges should be used on the PE side of metal to PE flanged connections to prevent cold material creep. The V in the product name represents an integral v-shaped groove (Figure 14). Each groove ensures an even distribution of forces over the shoulder of the stub end. The stress built-up in the v-groove assists the tightening torque to produce an improved jointing action. The design of these PP-V flanges includes an integral bolt fixation which effectively prevents a falling-out of the bolt during the assembly of the flange connection. This installer- friendliness and corrosion resistance reflect the hidden advantages of this innovative loose flange.

Pipe support as foundation

Hydrants which are mounted directly on the mains pipe can subject the pipe to radial stresses during the installation phase. However, a pipe support can be placed as a stabiliser under the PE mains in order to prevent any undesired radial movement away from the vertical axis and resultant misalignment of the hydrant. This pipe support plate also acts as an ideal foundation for a mains pipe and represents an effective safeguard against any sinking of such pipes due to the high inherent weight of hydrants. These pipe supports can be used universally for the pipe sizes from d 90 to d 160 mm. The support includes a strap which is used to attach the support beneath the respective pipe.

Application examples

Made entirely from plastic. Simple, elegant and corrosion-free

The simplest and most economical method to create a lateral branch take-off from a PE pipe (Figure 15a) is by using a branch fitting. This particular fitting is tailor-made for the installation of hydrants and is available for all mains and branch dimensions. This product is suitable for the installation of new pipelines as well as for extension work on pressurised networks. The design of the PE ducks-foot bend is based on the well-proven

ELGEF Plus® technology. A hydrant with PE stub ends can be electrofused directly into the socket outlet, or, can be attached using a flange adaptor and PP-V flange. This flange is corrosion-proof and has the strength of equivalent metal flanges. Another possibility is offered by Georg Fischer +GF+ namely, a plastic ducks-foot bend with integrated flange outlet and service connection.

Subsequent installations, universal application

The stainless steel saddle (**Figure 15b**) allows all hydrants to be connected easily to any mains pipe. Additionally, suitable tapping equipment is available permitting under-pressure tapping. Therefore, and if so required, a hydrant can be attached to a pressurised mains. The MULTI/JOINT® ducks-foot bend can be supplied if necessary with a female thread incorporated in the body. This means that a service connection can be made directly from the bend itself. Transition fittings with metal threads from the ELGEF® Plus or POLY 16 ranges enable a simple connection to be made to a service line. Similarly, any trapped and subsequently stagnant water will be avoided.

MULTI/JOINT® universal pull-out resistant couplings

MULTI/JOINT® tee pieces with flanged branch connections (**Figure 15c**) enable a leak-tight tie-in of hydrants in all piping systems quite independent of pipe material. These couplings are end-load taking up to a working pressure of 16 bar and accept a wide tolerance range of pipe outside diameters. In addition, MULTI/JOINT® fittings can be installed under all weather conditions.

PE to metal transitions, material-matched flange connections with Draw-lock®

The Draw-lock® transitions with flanged ends (**Figure 15d**) permit an optimum transition from PE pipes to metal hydrants. The connection is material-matched i.e. possible stresses can be correctly absorbed. There is a variety of ways to install these transitions on PE pipes. Butt-fused or electrofusion versions (tees) can be used for new installations. At the same time, the transition fitting is recommended for use on pressurised pipelines. Additional support can be achieved using pipe supports when mounting the hydrant vertically on a plastics pipe.

Conclusion

Both underground and above ground hydrants are used for fire extinguishing purposes. Basically, there are two different types of hydrant; the simple shut-off type and the double shut-off type. Many metal and plastic



Fig. 15: a) Saturn branch fitting with ducks-foot bend from PE, b) Stainless steel saddle, c) MULTI/JOINT® tee with flanged branch, d) Draw-lock® flanged transition

material types have been used to date in pipeline construction but, nowadays, PE finds the greatest usage for distribution networks. Hydrants are either mounted directly above the mains line or are off-set. Traditionally, such hydrants are connected to the water supply system by means of flanges. Demand for alternative methods, for example, BAIO Plus® is steadily increasing.

New techniques can be introduced to polyethylene network systems using the ELGEF® Plus range. The classic tee piece, can be replaced by the use of branch fittings. Ducks-foot bends from PE are equipped with the very well-proven electrofusion technology. Special loose flanges and product groups permit highly reliable flange connections over the entire operational life span.

The MULTI/JOINT® range of fittings provides optimum solutions for the ever-growing spheres of rehabilitation and maintenance. The same fittings can be used under all site conditions and for all pipe materials.

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