HYDRAULICALLY ACTUATED FITTINGS FOR HIGHER PRESSURE

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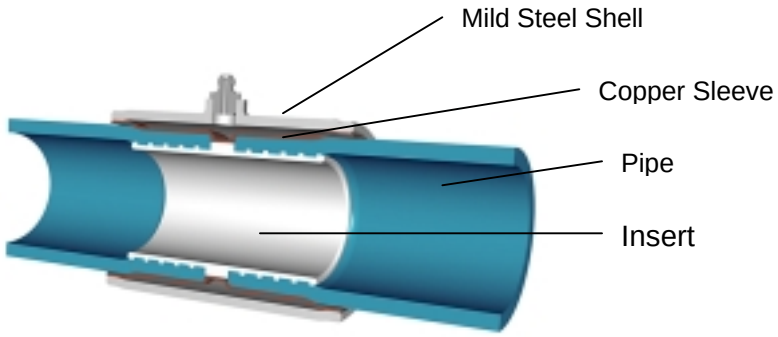
ABSTRACT
It is generally considered that joints present the weakest element in any pipeline. In response to this the Redman hydraulic fitting has been developed to provide a unique and cost effective method of joining plastic pipe. No heat source or bolts are required to form the joint and installation can be completed regardless of site conditions. The system has been developed and used successfully on polyethylene, barrier polyethylene, polyester reinforced polyethylene and molecularly orientated PVC pipelines.

INTRODUCTION
Joint failures can often be attributed to originally careless installation practices. This may include lack of pipe preparation or adverse site conditions, making it difficult to produce the clean, dry environment required for electrofusion and butt fusions jointing methods.

The Redman fitting has been designed to allow high integrity joints to be made regardless of site conditions and with the minimum of pipe preparation. The system can be used on polyethylene, barrier polyethylene, polyester, reinforced polyethylene and molecularly orientated PVC pipelines. The joints provide full end load resistance capability and will withstand pressures far in excess of pipe bursting pressures.

DESIGN PRINCIPLES
The fitting consists of two components, a coated mild steel outer shell with coaxial internal copper sleeve, brazed around the circumference at each end and a steel insert. Polymeric electrostatic powder coating provides corrosion protection. The insert fits into the bore of the adjoining pipes and the outer shell covers this union.



Preparation is minimal with the operator only being required to ensure that the pipe ends have been cut reasonably square, any large burrs removed and that the outer shell is located centrally over the joint.

Biodegradable oil from a specially designed hand pump is introduced under pressure through a nipple on the shell filling the void between steel and copper. The copper increasingly deforms with increasing hydraulic pressure and in turn provides annular compression to the external wall of the pipe forcing the polymer into the slots machined in the insert. The insert now acts as a mould. Although there are large stress concentrations in the wall of the pipe over time or at elevated temperatures, these will relax out and the pipe will permanently take up the profile of the insert as in a cold moulding process. The properties of the copper have also changed. The deformation work hardens the copper ensuring a permanent joint after the pressure has been released.

The width and depth of the slots machined on the insert together with the distance between them are very important. The slots provide two functions. Firstly they penetrate the thermoplastic pipe to a minimum set depth in order to carry the axial loads after the joint has been made. Secondly, they ensure that buckling under the large hoop stress does not take place when the joint is being made.

Very little preparation is necessary with this jointing system significantly reducing many of the potential sources of failure. There are no requirements for scraping, degreasing, accurate cutting of pipe ends or protection from weather conditions. Pipes can be joined when wet or even submerged. In addition there are no bolts eliminating the possibility of incorrect torque settings being used.

APPLICATIONS AND PERFORMANCE

Primary application areas to date have been PE80 and PE100 pressure pipe and PE pressure pipe that incorporates a metal barrier for use in contaminated land. Fittings are available in sizes 63mm to 180mm and with inserts available for both SDR11 and SDR17 pipe. Product has been trialled and used successfully in the UK and Belgium. Independent testing has been undertaken by WRc and has included the following, as detailed in table 1.

Short-term performance to WIS 4-24-01
Positive pressure: 26 bar for 1 hr @ 20°C (PE80)
Positive pressure: 30 bar for 1 hr @ 20°C (PE100)
Negative pressure: 0.25 bar vacuum for 8hrs @ 20°C
End load resistance (Type 1)
Long Term Performance to WIS 4-24-01
Positive pressure: 22 bar for 100 – 1000hrs @ 20°C (PE80)
Positive pressure: 20 bar for 5000 – 10000hrs @ 20°C (PE80)
Positive pressure: 24.8 bar for 100 – 1000hrs @ 20°C (PE100)
Positive pressure: 23 bar for 5000 – 10000hrs @ 20°C (PE100)
Fatigue: 40000 cycles 0-8 bar @ 80°C
AREL: Type 1 axial load 500hrs @ 80°C followed by pull out test @ 23°C

Table 1. Summary of testing on hydraulic fitting.

In addition in house testing has confirmed that the joint performance far exceeds the burst pressure of the PE. Fig 1 shows a typical example of the failure mode.

Fig.1. Typical failure mode at elevated pressure

A variation of the fitting has also been developed for use with molecularly orientated PVC pipe. Primarily this was to provide a means of testing formed bends where the usual methods of restraint for test pieces could not be achieved. In order to accommodate the different properties of the PVC the spacing and depth and form of the slots machined on the insert are different to the PE fitting. Fig.3. Shows a typical insert.

Fig.3.

Long term pressure tests have shown positive results.

SUMMARY

The hydraulic fitting is a simple and extremely effective method of producing joints in polyethylene pipe. By reducing the amount of pipe preparation required and removing the need for clean/dry conditions, the potential for installation errors is significantly reduced. No heat source or bolts are required with the only specialised equipment used being a portable hand pump. The joints provide full end load resistance and have been shown to be effective well beyond the burst pressure of the polyethylene pipe**.**