Pipe and hose for civil defence

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SUBJECT Pipe and Hose for Civil Defence

The Committee on Plastics of the Canadian Government Specifications Board was set up in September 1952 to consider the specifications for plastic pipe required by Civil Defence, Central Mortgage and Housing Corporation and Canadian industries. A panel on plastic pipe was set up with Mr. J.E.Hanna of C.G.S.B. as Secretary. It was decided by that panel that in respect of the requirements for Civil Defence some preliminary study would be required. Accordingly, it was decided to procure from industrial suppliers samples of various kinds of plastic pipe which, it was planned, would be subjected to simulated field manipulations to provide some background information on the requirements. This part of the study was to be carried out by the staff of the Division of Building Research with assistance from the Department of National Defence. For various reasons this work was delayed, but is now well under way in the DBR laboratories.

The opportunity was provided for a visit by Dr. N.B.Hutcheon to Great Britain to obtain information at first hand of the criteria which had been used in the evaluation of plastic pipe for Civil Defence purposes. Accordingly, on October 24, 1956, Dr. Hutcheon visited Mr. H.M.Smith, Her Majesty's Chief Fire Inspector, Home Office, Horseferry House, London. Mr. Smith, who because of other commitments could spend only a short time, introduced his colleagues Mr. Killey and Mr. Shirling who were most kind in providing all the information required about the situation in Great Britain.

Old and New Requirements

During World War II, steel pipe was used extensively in Great Britain for emergency water supply. Much of this could be laid in advance of the actual need and remain in place for some considerable length of time in many instances. It is believed, however, that the requirements for Nuclear Warfare will be somewhat different. There may be little opportunity for prelaying and the major requirement may be for pipe to be laid as rapidly as possible on an emergency basis. The greatest emphasis is therefore placed

upon pipe which can be laid quickly. This, in turn, requires light weight and a substantial degree of flexibility. In addition to this it is important that the pipe be sufficiently stable and durable so that it can be carried for long periods in storage with the minimum of attention. Requirements such as the ability to resist high radiation from fires, and to resist damage from falling rubble are not of prime consideration at least in respect of the 6 in. pipe since this will not normally be used close to the actual fire. In view of these requirements attention has been directed for a number of years to plastic pipe, and steps, which will be described later, have been taken to establish a basis for evaluation.

The Basic System

A comprehensive system of fire appliances for Civil Defence purposes has been worked out by the Home Office. Various appliances proposed for this system are described in a publication by H.M.S.O. entitled "Manual of Fire Appliances for Mobile Fire Columns". For present purposes it may be noted that 6 in. pipe is standard. The pumper unit can deliver 900 gallons per minute at 100 lb. psi., which is sufficient to deliver water at this rate through half a mile of standard 6 in. pipe. Both 6 in. hose and 6 in. lightweight pipe are used. The lightweight pipe at present favoured is of polyethylene. All the piping is used in 16 ft. lengths and is equipped with toggle-type couplings. The standard pipe carrier will carry one-third of a mile of this lightweight plastic pipe. The 6 in. hose is supplied in 75 ft. lengths and is equipped with a bolted type coupling. The hose-layer vehicle will carry one mile of hose, i.e. half a mile of hose in each of two compartments which has already been coupled using the bolted couplings, and can be laid at a vehicle speed of from 15 to 20 mph. Muffs over the bolted couplings have been used to prevent snagging during the laying operation but are not now considered essential.

Plastic Pipe

Following the changed concept of the role of emergency water supply in future war emergencies, investigations were begun following 1945 into the possibilities of using semi-rigid pipe made of plastic. It appears that a fairly thorough investigation has been made, not only of the requirements but also of the capabilities of a great many types of plastic materials to satisfy these requirements. The method of evaluation employed has been to use a large obstacle or test course laid out on property belonging to the Middlesex Fire Brigade which presents in this limited area a simulation of the more common obstacles and situations encountered in the laying and use of 6 in. emergency piping. There seems to have been little tendency to develop rigorous engineering tests for the desirable properties, but rather to evaluate a particular type of pipe under simulated use conditions. It may be noted, however,

that the Home Office staff were in an excellent position following the many years of experience with fire fighting in World War II, to set up a suitable practice test course.

As a result of many trials with different plastics over a number of years, polyethylene pipe was found to be the most suitable. Very substantial purchases of this kind of pipe have been made according to a specification which has been revised a number of times. It is believed that the present specification calls up an excellent material but it was implied that still further improvements in the specification may be found to be possible. The flexibility provided in this pipe, i.e. a 90° bend in three lengths, is considered to be the minimum desirable. The burst pressure is about 210 psi. and it is now proposed to use a proof pressure of about 150 psi. This proof pressure should be carried by the pipe without damage which would interfere with its subsequent use. It was pointed out that the factor of safety called for was not as high as that which would be used in industrial applications.

The ultimate storage life is not known but it is believed to be from 5 to 10 years. Some plastic pipe made according to the earlier specifications has been stored in the open without protection for 6 to 7 years and is still considered to be in good condition. It was pointed out that in contrast to the storage properties of plastic pipe that steel pipe required much attention by way of inspection, spraying and so on, to maintain its quality in storage. A substantial amount of 6 in. aluminum pipe was purchased before the present satisfactory polyethylene pipe was developed. It was said that no more rigid pipe would be purchased. The present supply of aluminum pipe will be used in making pipe bridges which will be described later. As an example of the evaluation technique it was pointed out that one pipe of a particular plastic was found to be excellent in all respects except that of buckling when laid over an obstruction. Doubling the wall thickness which was required to prevent such buckling rendered the pipe too rigid and it was therefore rejected.

Hose

Two possibilities of using 6 in. hose in place of rigid or semi-rigid pipe offered rather obvious advantages in rapid laying of lines. The present hose is of circular woven construction with nylon weft, flax warp and rubber lining. This hose has two main disadvantages. First, its increase in length under pressure is sufficiently great to cause undesirable "snaking" in use. Secondly, it is not resistant to rotting in storage. A fungicide treatment, called Mistox, is considered one of the better treatments and is commonly used. It is considered, however, that even this treatment will provide only about one year of protection in storage. Much of the hose is used for training purposes and it is considered necessary in maintaining the hose in good condition, to wash and dry it after use. This is a very difficult and costly operation with hose of this size in the lengths used. Some tests have been made of the life of the hose without drying.

There is much interest in a new 6 in. hose developed in Belgium and now available in England from the British Tar and Rubber Company. The fabric part of this hose is a nylon weft and rayon warp and it has a polyvinyl chloride lining and outer cover. Some further experiments are now being made with a similar hose having a terylene weft. Tests have been made on the rayon by the Forest Products Laboratory and it is said to be mildew proof for all practical purposes. From 5 to 10 miles of this new type of hose have been purchased. It is not as flexible as the original rubber-lined hose but is still quite acceptable and can be handled in the hose laying procedure. It has a great advantage in that it does not need washing and drying and, so far as is known, will require little maintenance. It has a much smaller elongation. Some difficulties have been experienced with adhesion of the jacket to the fabric. Adhesion has now been improved and the most recent results obtained from the Fire Research Station have been good. The same standard test as is employed to test the adhesion of the rubber lining of the original type of hose is now employed for this new plastic one and the results obtained for the plastic have been rather better than those required as a minimum for the rubber-lined hose. It was said originally that the new hose could not be repaired by patching but recently the manufacturer has been able to produce a suitable patching kit. On the whole this new plastic hose is considered good, particularly for training purposes. No specifications exist at present. The present burst pressure requirements are at 300 psi. and the hose provides 400 psi. on actual tests. It is proposed to adopt a proof test pressure of about 300 psi.

Miscellaneous Information

Two methods are employed in passing traffic across a pipe line. The first of these, a ramp, has not been found particularly satisfactory. A special one of aluminum has been devised but it is not considered a good way to handle heavy traffic. A pipe bridge constructed of 16 ft. lengths of rigid pipe is considered to be quite satisfactory. The 6 in. aluminum pipe with standard tee and elbow fittings is used in the construction of a bridge resembling a simple sawhorse which provides 16 x 16 ft. clearance for traffic. It may be inserted in flexible hose lines. There is no provision for thrust of the hose and there is said to be no difficulty from this source.

The design of the original toggle type coupling required that two special rubber rings be located at the two ends of the pipe before closing the coupling. This was found to be troublesome and to cause delays in laying, although experienced teams were able to manage with it reasonably well. Studies are now being made to produce a new design in which the rubber gasket is divided in two parts along the diameter so that it can be preset in the two halves of the coupling. It is anticipated that some extra leakage will occur but this might be tolerated, especially if the speed of making such joints can be substantially increased.

It was noted that hose which remained for some time as laid usually suffered quite severely from abrasion due to traffic. Piping was said to be much better than hose where lines had to remain in service for some time. This was considered, however, to be the only real advantage of pipe over hose.

Mr. Killey has very kindly agreed to provide photographs of the pipe test course employed and to comment on the experiences of the various plastics which have been tried. This information should be most useful to Canada in establishing a suitable basis for the evaluation of Civil Defence piping and hose, although it would seem to be possible with the aid of the British information to proceed now to set up engineering requirements rather than duplicate exactly the British method of test.