

SPECIFICATION

Hose end connector for thermoplastic material hose

This invention relates to a hose end connector for attachment to hoses which are composed solely of thermoplastics material and which have no metal reinforcement within their wall.

- The connector is particularly suitable for mounting to a hose of a type having a three-layer wall, each layer being composed of a thermoplastic material. One particular type of hose to which the connector of the present invention may be mounted has an inner bore defining wall of Nylon (Reg'd Trade Mark), an intermediate layer of reinforcement constituted by Kevlar (Reg'd Trade Mark) and an outer wall or covering of Hytrel (Reg'd Trade Mark). Such thermoplastic hoses possess the property that, relative to a wire-braid reinforced synthetic rubber hose, they are smaller in diameter, lighter in weight and more flexible. However, with thermoplastic hoses, it has been found that considerable care must be exercised in the design and fitment of metal end connectors if the working pressure capacity and tensile loading capacity of the hose is to be preserved.

- When fitting hose end connectors such as those disclosed in Australian Patent Specifications Nos. 405,672 and 430,484 to a wire reinforced hose, it is usual to peel back a portion of the outer covering of the hose to reveal the metal reinforcement. The hose end is then clamped between stem and ferrule portions of the connector, and clamping of the hose end is effected between barb and buttress portions of the stem and ferrule respectively. A metal-to-metal clamping contact is established between the connector parts and the reinforcement and this contributes significantly to resist any tensile loading applied to the hose. Also, the ferrule of conventional connectors for wire-reinforced hoses is provided with a nib which, when the ferrule is swaged onto the hose, bites into the outer covering of the hose to provide a seal against ingress of moisture which would otherwise cause corrosion of the metal reinforcement.

- However, experimental work which has been conducted by the Applicant has shown that connectors of the type which are suitable for wire-reinforced hoses are not appropriate for fitting to thermoplastic hoses having a plastics material fibre reinforcement layer. If the working pressure and tensile loading capacity of the thermoplastic material is to be preserved after fitting of a connector, the following conditions should be satisfied. Firstly, contrary to the practice relating to wire-reinforced hoses, the outer covering of the hose should not be peeled back from the reinforcement layer. Secondly, any slip or movement between the various layers of the thermoplastic material hose, which is sufficient to cause breakage of the bond between the respective layers of the hose should be avoided during swaging of the connector to the hose end. Thirdly, it is important that sharp stress transitions should not be created adjacent the point of entry of the hose end into the connector as a result of clamping the hose to

the connector, lest weakened zones be created which would be liable to rupture in the event of in-service pressure surges occurring in the hose.

- The present invention seeks to provide a connector for which is suitable for use with thermoplastic hoses and which, when fitted to a hose end, satisfies the above conditions.

- The invention provides a hose-end connector for a thermoplastics material hose having no metal reinforcement, the connector comprising a hollow stem portion and a ferrule portion which is arranged both to connect with the stem portion and to clamp the hose wall to the stem portion, the stem portion having an annular peripheral groove and, spaced in an axial direction from the groove, a hose bore engageable portion for location within the bore of the hose, the ferrule having an annular inwardly directed flange at one end thereof which is arranged to be swaged into the annular groove of the stem portion during a first stage of assembly of the connector, and the ferrule having a main body portion which defines, with the stem portion, an annulus for receiving the hose end following the first assembly stage, the hose bore engaging portion of the stem portion being formed with a plurality of annular-form barbs for non-severing engagement with the inner wall of the hose, the interior of the main body portion of the ferrule being provided with annular-form buttresses for non-severing engagement with the outer wall of the hose, and the crests of the barbs being positioned to align with respective valleys between the buttresses when, during a second stage of assembly of the connector, the main body portion of the ferrule is swaged inwardly toward the stem portion with the hose end located therebetween; wherein the ferrule has an integral collar portion which surrounds the inwardly directed flange, the collar portion has a diameter substantially equal to that of the main body portion of the ferrule prior to the first assembly stage being effected and the collar portion is spaced in an axial direction from the main body portion by a relieved portion which, prior to assembly of the connector, has a diameter less than that of the main body portion.

- In accordance with a particularly preferred construction of the ferrule, its main body portion has a frusto-conical portion adjacent the free end of the ferrule (i.e. the end of the ferrule which is remote from the abovesaid one end). The frusto-conical portion has a diameter which decreases progressively toward the free end of the ferrule and it is therefore movable in a radial direction relative to the remainder of the main body portion of the ferrule during the course of a swaging operation performed on the ferrule. This permits the formation of a flared entry to the annulus between the stem portion and the ferrule during the second stage of assembly of the ferrule to the stem portion.

- The connector in accordance with the present invention may be marketed following the above stated first stage of assembly of the ferrule and stem portion. That is, with the ferrule and stem portion connected together. Then, it would remain only for a user to fit a hose into the hose wall receiving annulus

of the assembled connector parts and to apply a swaging force to the ferrule. Alternatively, the ferrule and stem portion may be sold as unconnected items, with it being left to the user to perform both the first and second assembly stages. It is to be understood that the present invention covers the defined connector whether unassembled, partially assembled or completely assembled to a hose end.

The invention will be more fully understood from the following description of a preferred embodiment of a connector which is suitable for mounting to a thermoplastics material hose having a non-metallic reinforcement. The description is given with reference to the accompanying drawings wherein:

Figure 1 shows an end-portion of a thermoplastic hose, partly in section,

Figure 2 shows a half-sectional elevation view of a hose end connector which is ready to accept a hose end portion,

Figure 3 shows a tubular stem portion of the connector illustrated in Figure 2,

Figure 4 shows, on an enlarged scale, a detail of the portion of the stem of Figure 3,

Figure 5 shows, on an enlarged scale, a cross-section through one-half of a ferrule portion of the end connector shown in Figure 2,

Figure 6 shows, on an enlarged scale, a detail of buttress formations on the inside wall of the ferrule of Figure 5,

Figure 7a shows a section through a peripheral part of the connector shown in Figure 2 after the ferrule portion has been swaged onto the hose end,

Figure 7b shows a detail of the portion of the connector shown encircled in Figure 7a, with the hose end omitted, and

Figure 8 shows the shape of the outside wall of the hose end portion as a result of the connector being applied to it, the hose end portion being shown removed from the connector.

The thermoplastic hose 10 as shown in Figure 1 has a three-layer construction and is formed from an inner Nylon (Reg'd Trade Mark) layer 11, an intermediate layer 12 of fibre reinforcement which is constituted by a material known as Kevlar (Reg'd Trade Mark) and an outer cover 13 of a thermoplastic material known as Hytrel (Reg'd Trade Mark). To prepare this hose for fitting to an end connector its end 14 is cut square with the longitudinal axis of the hose.

The connector assembly which is to receive the hose end portion is shown in Figures 2 to 7 and comprises a tubular stem portion 15 and a ferrule 16 which, between them, define a hose-end receiving annulus 17.

The stem portion has a hose bore engaging portion 18 which extends from a shoulder 19 to its free end 20. Ahead of the shoulder 19 is an annular channel 21, and bordering the channel is a further shoulder 22. The shoulder 22 forms portion of a land about which is fitted a female connector nut 23. The connector nut 23 is rotatable about the land 22 but is held captive to the stem portion in an axial direction between a flange 24 of the stem portion and the ferrule 16.

It is mentioned at this stage that, although the

illustrated hose-end connector comprises a female connector, the present invention is equally applicable to male connectors.

The stem portion 15 is shown in greater detail in Figures 3, 4 and 7b. A series of barbs 25 are formed integral with and surround the hose-bore engaging part 18 of the stem portion, the barbs being inclined in a direction which assists entry of the stem into the bore of the hose and being configured to resist retraction of the hose from the stem. As is most clearly shown in Figure 4, each of the barbs has a rounded crest 26 and a rounded root 27. The end one of the barbs forms a gently tapering nose 25a and joins the free end 20 of the stem by way of a radiused corner 28 which assists entry of the stem into the hose bore.

The shape of the ferrule 16 prior to an initial swaging operation is shown in Figure 5 of the drawings. Thus, the ferrule has a collar portion 30, which surrounds an inwardly directed flange 31, a relieved portion 32 and a main body portion 33 which is separated from the collar portion 30 in an axial direction by the relieved portion. Prior to swaging of the ferrule and as shown in Figure 5, the outside diameter of the collar is equal to the outside diameter of the main body portion 33. The relieved portion 32 has a diameter which, prior to assembly of the connector, has a diameter less than that of the main body portion 33. Also, the relieved portion 32 extends around (but has an axial length greater than) the shoulder 19 of the stem when the ferrule is assembled to the stem.

Within the main body portion 33 are buttresses 34, each of which has a trapezoidal cross-section as shown in greater detail in Figure 6. The buttress formations 34 are separated by valleys 35 and the sides or flanks of each buttress diverge, from the radial plane, by an angle lying between 10° and 40° and, preferably, 20°. The corners of the buttresses 34 and of the valleys 35 are rounded as shown by numerals 36 and 37 in Figure 6.

The relationship of the buttresses 34 and valleys 35 to the barbs 25 on the stem portion is critical to ensure positive locking of the hose end to the connector without undue stress being induced in the material of the hose under either static or dynamic conditions. The crest 26 of each barb should be centrally positioned with respect to the adjacent valley 35, as shown specifically in Figure 7b, it having been found that random positioning of the valleys and barb crests can lead to early failure under severe operating conditions.

The end portion 38 of the ferrule body which is remote from the flange 31 has an annular inside wall 38 which has the same diameter as the crests of the buttresses 34. A further inside wall portion 39 of the same diameter extends between the flange 31 and the first of the valleys 35. A portion of the length of the outside wall of the main body portion surrounding the wall 38 has a frusto-conical taper, as shown by numeral 40, and terminates in a rounded end 41.

When the ferrule 16 is fitted to the stem portion 15 as shown in Figure 2, the flange 31 of the ferrule is aligned with and is swaged into the channel 21 of the stem portion. This results in the relieved surface 32

of the ferrule being deformed from the cylindrical shape shown in Figure 5 to the slightly curved frusto-conical shape shown in Figure 2.

After the ferrule is fitted to the stem portion and when the connector assembly is to be fitted to a hose, the hose end portion is pushed into the annulus 17 between the stem 15 and the ferrule 16 until its end 11 contacts the abutment face of the shoulder 19. The outside wall of the main body portion 33 of the ferrule is then subjected to a swaging force and is deformed into the shape shown in Figure 7a. This swaging force results in the buttress formations 34 compressing the hose wall between their crests 26 and the barbs 25 on the stem. As all of the stem and ferrule zones which contact the inner and outer walls of the hose are rounded, there is no tendency for the hose material to be severed, and the compression exerted between the ferrule and the stem causes material of the hose wall to tend to flow into the valleys 35 and around the barbs 25.

The gripping force exerted from the hose wall by the swaging action is relieved progressively, rather than suddenly by a flared entry 42 to the annulus 17 which is formed between the stem 15 and the swaged ferrule 16 as shown in Figure 7a. Formation of the flared entry occurs during swaging of the ferrule due to the provision of the frusto-conical taper 40 on the unswaged ferrule as shown in Figure 5. It will also be noticed from Figure 7a that a shallow annular cavity 43 is formed between the wall portion 39 of the ferrule and the stem as a result of the swaging operation. The material at the terminal end of the hose is caused to flow into the cavity 43 during the swaging operation and is thereafter locked in the cavity axial displacement.

As abovementioned and as shown in Figure 7b, when the ferrule is swaged onto the stem, the crests 26 of the stem barbs locate centrally with respect to the ferrule valleys 35. This results in a corrugated formation being imparted to the hose wall and it avoids undue stress being induced in the hose wall. Some tolerance does exist in location of the barb crests relative to the ferrule valleys, this being indicated by the dimension X shown in Figure 7b, but the hose wall would be excessively stressed if, for example, the barb crests 26 were to be located below the buttresses 34 rather than below the valleys 35.

Figure 8 of the drawings shows the shape of the outside wall of the hose after the connector has been swaged onto it, but with the hose subsequently removed from the connector. The wall of the hose is distorted, as a result of being located in the annulus between the stem 15 and the ferrule 16, into three axial zones. The first of these three zones is referenced 45 and is a pressure-relief zone which is formed by the flared entry 42 to the annulus. The progressive flaring lessens the possibility of undue stress occurring and provides for gradually increasing compression of the hose end where it first enters the connector.

The second or intermediate zone is referenced 46 and is where the major gripping of the connector on the hose is effected. The corrugated deformation of

the hose wall which results is clearly shown, this being a product of the special relationship between the barbs and buttresses and providing for resistance against tensile removal of the hose from the connector.

The third of the three zones is referenced 47 and is formed into a bell-mouth configuration as a result of the terminal portion of the hose being deformed into the cavity 43 between the stem and ferrule.

Tests which have been conducted by the Applicant have shown that a hose connector which is constructed as abovedescribed is capable of being used with a thermoplastic hose without there being a risk of premature failure of the hose in the vicinity of the connector and without there being risk of the connector being blown from the end of the hose as a result of pressure surges.

CLAIMS

1. A hose-end connector for a thermoplastics material hose having no metal reinforcement, the connector comprising a hollow stem portion and a ferrule portion which is arranged both to connect with the stem portion and to clamp the hose wall to the stem portion, the stem portion having an annular peripheral groove and, spaced in an axial direction from the groove, a hose-bore engageable portion for location within the bore of the hose, the ferrule having an annular inwardly directed flange at one end thereof which is arranged to be swaged into the annular groove of the stem portion during a first stage of assembly of the connector, and the ferrule having a main body portion which defines with the stem portion an annulus for receiving the hose end following the first assembly stage, the hose-bore engaging portion of the stem portion being formed with a plurality of annular-form barbs for non-severing engagement with the inner wall of the hose, the interior of the main body portion of the ferrule being provided with annular-form buttresses for non-severing engagement with the outer wall of the hose, and the crests of the barbs being positioned to align with respective valleys between the buttresses when, during a second stage of assembly of the connector, the main body portion of the ferrule is swaged inwardly toward the stem portion with the hose end located therebetween; wherein the ferrule has an integral collar portion which surrounds the inwardly directed flange, the collar portion has a diameter substantially equal to that of the main body portion of the ferrule prior to the first assembly stage being effected and the collar portion is spaced in an axial direction from the main body portion by a relieved portion which, prior to assembly of the connector, has a diameter less than that of the main body portion.

2. A connector as claimed in claim 1, wherein the main body portion includes a frusto-conical portion adjacent the end of the ferrule which is remote from said one end of the ferrule, the frusto-conical portion being movable in an outward direction relative to the remainder of the main body portion during a swaging operation to thus provide a flared entry to the annulus between the stem portion and the



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of the ferrule being deformed from the cylindrical shape shown in Figure 5 to the slightly curved frusto-conical shape shown in Figure 2.

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The gripping force exerted from the hose wall by the swaging action is relieved progressively, rather than suddenly by a flared entry 42 to the annulus 17 which is formed between the stem 15 and the swaged ferrule 16 as shown in Figure 7a. Formation of the flared entry occurs during swaging of the ferrule due to the provision of the frusto-conical taper 40 on the unswaged ferrule as shown in Figure 5. It will also be noticed from Figure 7a that a shallow annular cavity 43 is formed between the wall portion 39 of the ferrule and the stem as a result of the swaging operation. The material at the terminal end of the hose is caused to flow into the cavity 43 during the swaging operation and is thereafter locked in the cavity axial displacement.

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Tests which have been conducted by the Applicant have shown that a hose connector which is constructed as abovedescribed is capable of being used with a thermoplastic hose without there being a risk of premature failure of the hose in the vicinity of the connector and without there being risk of the connector being blown from the end of the hose as a result of pressure surges.

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2. A connector as claimed in claim 1, wherein the main body portion includes a frusto-conical portion adjacent the end of the ferrule which is remote from said one end of the ferrule, the frusto-conical portion being movable in an outward direction relative to the remainder of the main body portion during a swaging operation to thus provide a flared entry to the annulus between the stem portion and the



ferrule during said second stage of assembly.

3. A connector as claimed in claim 1 or claim 2,
wherein the barbs of the stem portion are of
saw-tooth configuration, with each barb having a
slightly rounded crest, and the buttresses of the
ferrule are of trapezoidal form.
4. A connector as claimed in any one of claims 1
to 3, wherein a shoulder separates the annular
groove in the stem portion from the hose-bore
engageable portion of the stem and the relieved
portion of the ferrule extends around the shoulder
but has an axial length greater than that of the
shoulder.
5. A hose-end connector substantially as shown
in the accompanying drawings and substantially as
hereinbefore described with reference thereto.