Parker Hannifin Plc
Product Training

Hose Fittings

Level 1

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1.0 Introduction

Level One training has been devised as a 'self teach' module for persons who have no, or very little, prior knowledge of the subject matter. The aim is for persons to work through the information provided at their own pace and in their own time. When they have completed the module and feel confident that they have increased their knowledge they can complete a test that accompanies the module. Successful completion of the module test permits progress onto Level Two.

1.1 What is a hose fitting?

A hose fitting is a machined connection, (of which there are many styles and standards), which is attached to the end of hose in order to create a hose assembly. Attachment of the fitting to the hose can be achieved by one of several methods e.g. swaged, crimped, screwed or in the case of low working pressure hoses, push on fittings may be used. The hose fitting enables the connection of a hose to be made between the various components of a hydraulic system. When correctly specified, and assembled onto a hose of corresponding specification, a fitting connection can hold very high pressures. Due to the flexibility of a hose, the complete assembly enables many vibration, noise and articulating problems found in modern hydraulic systems to be overcome. The swaged / crimped fitting which gives a permanent connection to a hose is generally available in two configurations known as one piece and two-piece. Screw on hose fittings are also two-piece but are rarely encountered on modern machinery today and will not be covered in this manual. The 'Push On' style fitting is more popular with low-pressure hydraulic systems and air lines.

2.0 How does a hose fitting attach to a hose?

2.1 Crimp (permanent) fittings

As mentioned in 1.1, a hose fitting can be attached to a hose by one of several methods depending on the type of hose and fitting being used. Before proceeding further the reader should refer to figure 2.1.1 for an understanding of the terminology being used. A swaged or crimped style fitting relies on the teeth of the ferrule biting onto the reinforcing of the hose, and at the same time gripping the hose bore with the insert. 'Push On' fittings rely on the friction force between the hose bore and the insert to hold them in place.

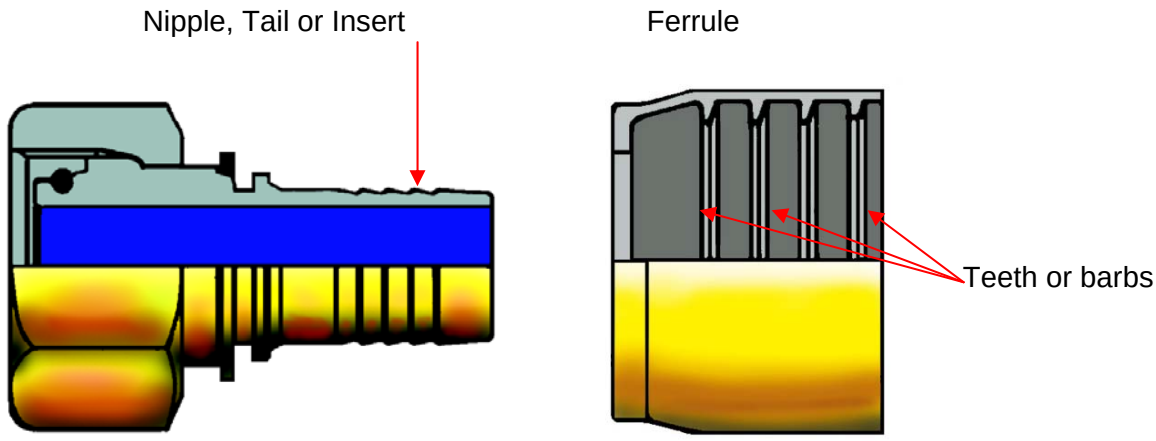

Figure 2.1.1 – The two parts of a crimp (permanent) hose fitting. These may be pre-assembled before assembly onto a hose giving a one piece fitting, or the two parts remain separate and are connected together during the crimping operation. This method allows greater flexibility for matching variations but requires greater skill to achieve a correct assembly

Swivel nut, which connects to an adaptor thereby joining together different components within a circuit

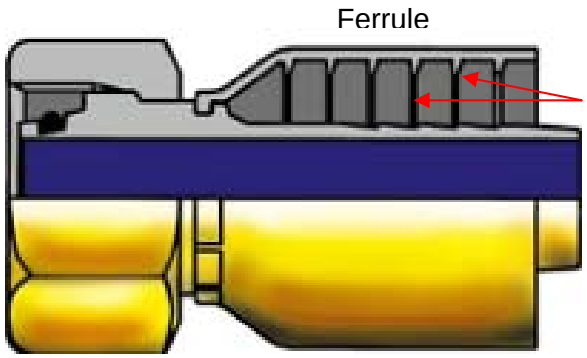

Figure 2.1.2 – A one piece, crimp type (permanent) hose fitting. The two parts of the fitting, (ferrule and insert) have been pre-assembled to form the one piece fitting prior to assembly onto a hose. In many instances these two components remain separate which increases the variation / matching possibilities. Greater care has to be taken with the two-piece when assembling to ensure that the two parts correctly latch together

Swaged or crimp (permanent) fittings are secured to a hose by means of a machine which squeezes the ferrule to a pre-determined, smaller, diameter, trapping the hose between the insert and the ferrule. The teeth on the internal wall of the ferrule are forced to bite onto the hose reinforcement creating a corrugated effect as shown in figure 2.1.3. During the crimping process the teeth of the ferrule are forced slightly forward. This action combined with the trapping action of the hose between insert and ferrule ensures a secure connection is achieved. Figure 2.1.3 shows the assembly of a fitting onto the end of a 'No Skive' hose. This system, employed by several leading manufacturers of hose and fittings today, does not require the removal of the hose outer cover before crimping takes place. The teeth of the ferrule are longer than the teeth found on ferrules used with skive hose assemblies. For comparison, a skive hose fitting assembly is shown in figure 2.1.4.

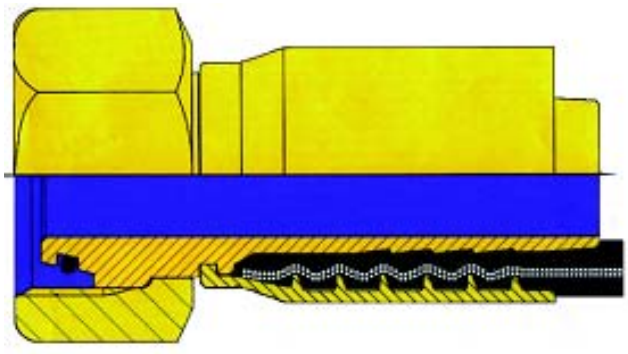

Figure 2.1.3 – A one piece fitting assembled onto a 'no skive ' hose. Note the longer teeth on the ferrule due to the fact that they have to pass through the outer rubber hose cover before contacting the reinforcement

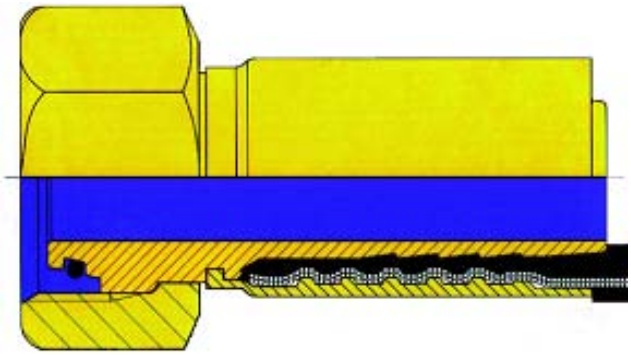

Figure 2.1.4– A two-piece fitting assembled onto a skive hose. Because the teeth do not have to pass through the outer cover of the hose they are shorter.

2.2 –Push On (reusable) fittings

With the exception of the older two-piece fitting, most reusable hose fittings are one piece. The screw on two-piece and other specific two-piece methods will not be covered in this manual.

'One piece' reusable fittings are often encountered on low-pressure hydraulic systems, pneumatic systems and water systems. Often, the insert of the end fitting is pushed into the bore of the hose and retention is achieved by the friction force between the two components, enhanced by the use of some form of clamp around the hose and insert. There are some systems, which do not require the use of a hose clamp to ensure the fitting retention to the hose. One such system is the *Parker Hannifin* 'Push Lok' system, which achieves hose fitting retention through use of the hose construction and design. Due to the mechanics of the hose design, the harder the pull on the fitting, the tighter the retention between hose and fitting becomes. Removal of the fitting from the hose can only be achieved by cutting the hose. This type of assembly is shown in figure 2.2.1 along with the one-piece push on end fitting.

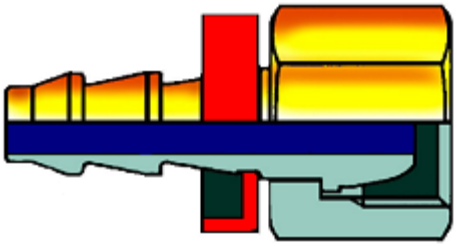

Figure 2.2.1 – Example of a push on fitting and assembly with a *Parker Hannifin* 'Push Lok' hose

2.3 Assembly Methods

For crimped hose fittings different machines can be used to produce the crimp. The arrangement and setting of these machines may differ but they all produce the same end result; the fixing of the fitting onto the end of the hose. A few examples are shown in figures 2.3.1 and 2.3.2. When assembled, the dimension of the across flats is checked against the design recommendation.

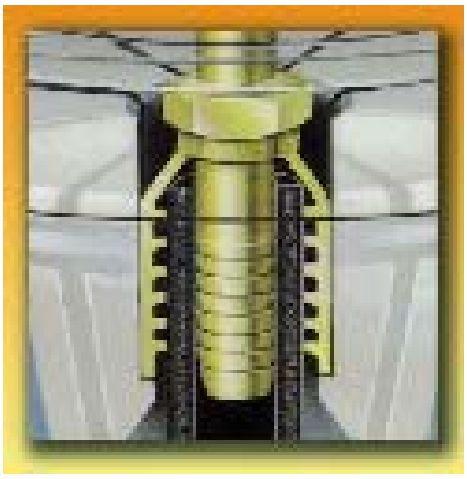

Figure 2.3.1 – One type of hose / fitting assembly machine uses a bespoke machine and die arrangement, which is sized correctly for the hose and fitting to be crimped. The hose is inserted into the die and rests on a machined step. The die is forced downwards into a vee shaped bowl in the machine base. A spacer plate between the die and the pusher ensures that the die is prevented from being pushed too far into the vee thereby preventing the fitting from being over crimped. View (a) shows the hose and fitting in position prior to crimping. View (b) indicates the movement of the pusher onto the spacer plate forcing the die downwards into the vee shaped base. Travel of the pusher is stopped once all the clearance between spacer plate and machine base is taken up.

Figure 2.3.2 – Variation of a more traditional and popular crimping press. These machines have a number of die sets, which have to be selected according to the fitting and hose size being crimped. Each die set comprised several individual ‘fingers’, which are arranged around the inside of the machine mouth. The desired crimp diameter has to be set on the machine and the hose placed into the mouth. During operation the ‘fingers’ are forced to close in around the ferrule of the fitting, squeezing it onto the hose until the desired crimp setting is reached. Further compression is then automatically stopped. These machines are faster in operation than the bespoke example in fig 2.3.1 making them more popular for production work.

When correctly assembled and crimped, the crimp dimensions of the ferrule needs to be checked. This should fall within the manufacturers tolerance limits and be consistent every time an assembly is made. Figure2.3.3 shows this method being employed with a thermoplastic hose fitting. Correct assembly is critical in ensuring safety standards are met as well as ensuring a long hose assembly life. When correctly assembled, the fitting should never part (blow off) from the hose. During manufacturers' burst tests, it is the hose itself, which should fail before anything else. If this is not the case then the assembly method or the components used are wrong. With this in mind it is recommended that for good, sound and secure hose assemblies only hose and fittings produced by the same manufacturer should be assembled together. Mixing and matching different manufacturers' components, even when crimp dimensions are met, results in an untested and potentially dangerous assembly.

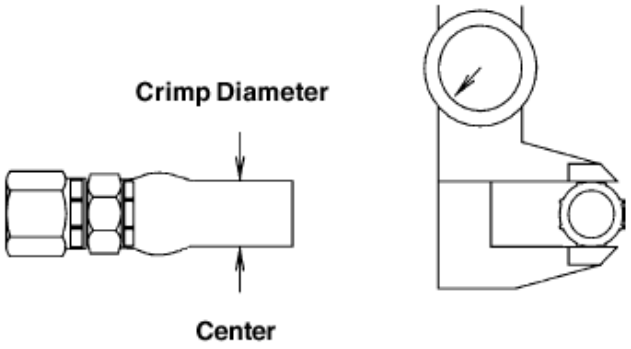

Figure 2.3.3 – Checking the crimp diameter of a hose fitting after assembly onto the hose.

3.0 Skive and no skive hose fittings

As mentioned in the level 1 hose products module, hydraulic hoses can be termed skive or no-skive. As a recap, some hoses require the removal of the outer cover where the end fitting is to be fitted. Some machinery used for this purpose is shown in figure 3.1. This was especially true of hose as used by the former NCB, which had an extra thick outer cover due to its fire resistant capabilities. Because of this, a hose fitting would require very long teeth to penetrate though the rubber before making contact with the reinforcement. The amount of material collapse required to achieve this during the crimping process would be quite considerable and a good secure retention difficult to achieve. The cover of the hose therefore had to be removed and a fitting with short teeth used in order to achieve a good, secure and reliable connection between the fitting and the hose. An example of such a connection is shown in figure 3.2. Note that in this example part of the inner tube (internal skiving) has had to be removed.

Many manufacturers today produce hoses with much thinner outer covers. This enables the use of fittings with slightly longer teeth to be pushed over the end of the hose without the need to remove the outer cover. The amount of material collapse required to achieve a secure connection is less due to the cover thickness being

reduced. Discussion as to which method is the best is still contended between different manufacturers, however, with modern methods of manufacture and control processes both methods prove very reliable and have found their own market niches. As a comparison figure 3.3 shows a high pressure no skive hose with a fitting attached.

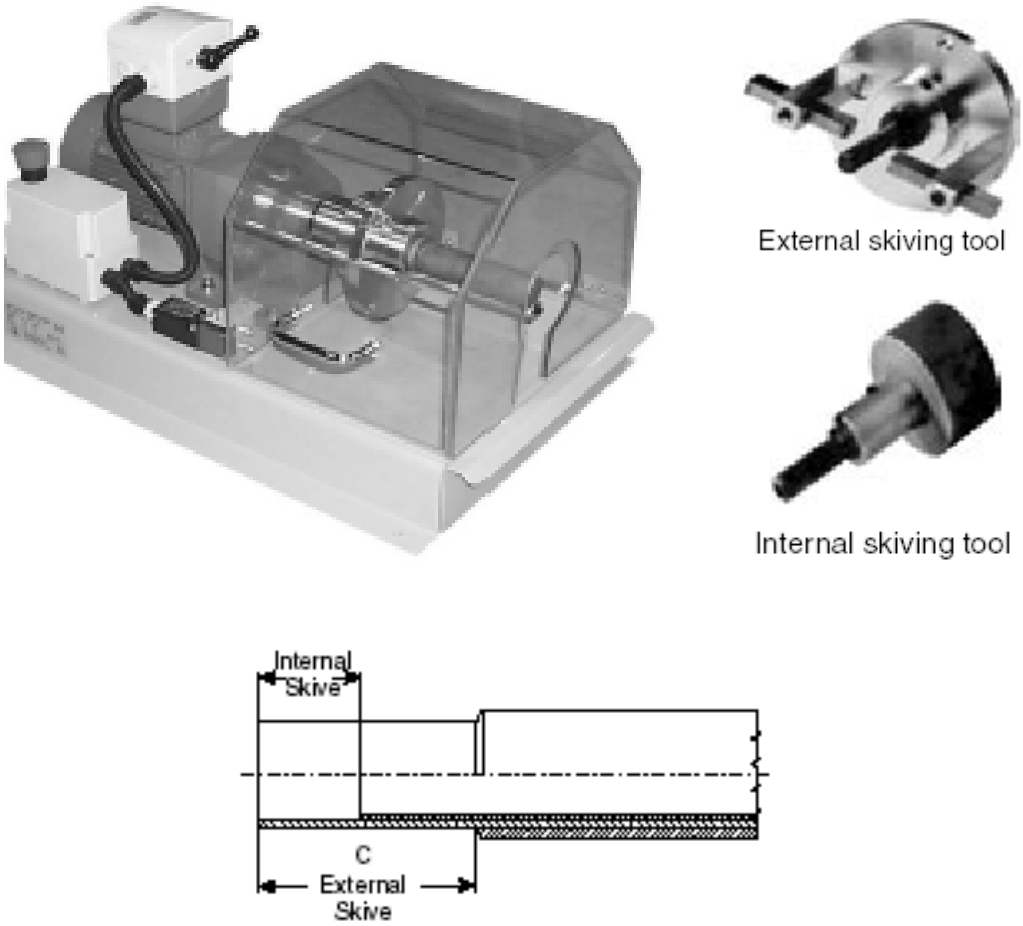

Figure 3.1 Machinery used for accurate hose skiving, both internal and external

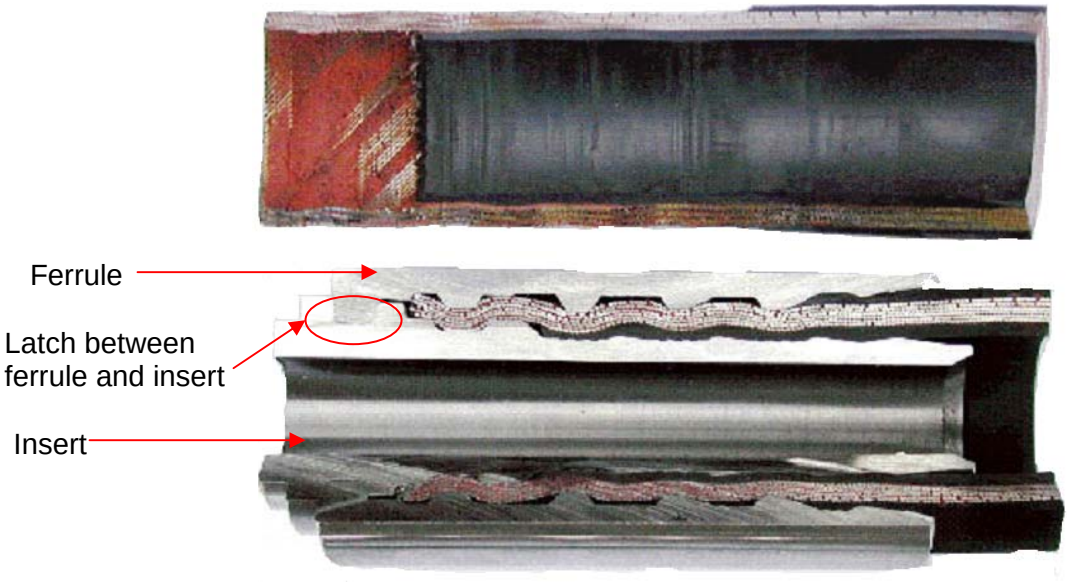

Figure 3.2 – Top view shows a hose with internal and external skiving. Note on the lower view the short tooth length of the ferrule biting onto the reinforcement. When removing the outer cove, great care has to be taken to ensure that the correct amount (length) is removed. Too much rubber removal will result in the reinforcement being exposed and subject to corrosion and damage.

Figure 3.3 – High-pressure hose with a fitting attached to a no skive hose

4.0 Thermoplastic hose fittings
Due to the designs of most thermo plastic hoses, the design of ferrule teeth/barbs is slightly different. The cover a thermo plastic hose is much thinner in construction and in some cases the reinforcement is only a fibre weave. The correct connector is therefore vital and only hose fittings for use with thermoplastic hoses must be used. One and two-piece fittings are available and in some circumstances skiving may be required.

4.1 Ultra high-pressure hose fittings For ultra high-pressure thermo plastic hose rated above 700bar, a licence is required to manufacture any hose assembly. In these instances the swage / crimp dimension is not used as a check of correct assembly. Instead measurement checks are taken on the amount of tail collapse (bore reduction using sized gauges) in order to ensure that the fitting insert has swaged the hose enough to slightly collapse the bore of the hose and ensure a secure attachment.

Summary

Hose fittings are generally referred to as one or two piece. Both consist of a hose insert and a ferrule.

The insert fits into the hose bore; the ferrule fits around the outer cover or reinforcing in the case of a skived hose.

Permanent hose fittings can be swaged or crimped onto a hose.

Push on hose fittings are known as reusable fittings.

Correct skiving of hose should be performed with the use of appropriate machinery.

Ferrules used with skived hose have shorter teeth or barbs than ferrules used with no skive hose types.

The retention of the fitting to the hose is achieved by squeezing the hose between the insert and the ferrule. The ferrule teeth are forced to bite onto the reinforcement creating a corrugated effect which prevents the fitting blowing off the when the hose is pressurised.

When using two-piece fittings it is critical to ensure that correct latching between insert and ferrule has taken place during the crimping process.

Correct crimp dimensions are checked using a vernier calliper, measuring across the flats of the crimp.

Thermo plastic hoses use a different type of ferrule compared to rubber hoses.

A license is required to make hose assemblies for working pressures over 700 bar.

For high-pressure thermoplastic hoses, correct crimp dimensions are checked using special gauges, which measure the bore collapse of the insert.

For reliable and tested hose assemblies only use components (hose and fittings) manufactured by the same manufacturer. DO NOT MIX AND MATCH!