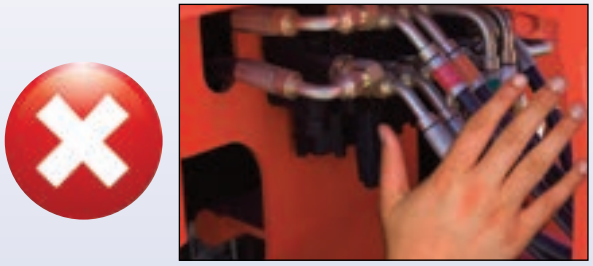
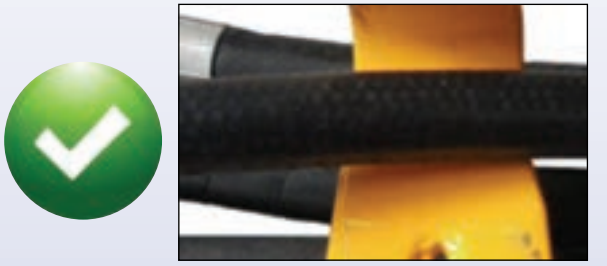
visual inspection

When inspecting hose assemblies (and any other item under pressure) it is imperative that any inspection is undertaken in a safe manner. BFPA publication P113, 'Fluid Injection Injury Emergency – The Facts' should be referred to for further details.

When examining hoses for damage/searching for a leak it is vital that the hands (and indeed any other part of the body) are kept away from equipment which is under pressure. The image below shows the incorrect way of doing this.



A long implement should be used when inspecting hoses for damage – this will reduce the risk of personal injury. A typical implement and how it is used is shown below.



visual inspection

The above photograph shows a hose which has been marked by the bonded method. This method of marking allows coloured (or indeed multi-coloured) tape to be bonded to the hose. In certain applications/industries this is the preferred method of marking – the use of coloured tape ensures that the marking is prominent.

The most common method of marking for thermoplastic hose is by either inkjet, or hot-foil transfer branding.

The above photograph shows a piece of thermoplastic hose which has been marked using white inkjet. As can be seen most of the branding has been worn off (in this case before the hose entered service).

Depending upon the application and service environment this type of branding can wear off thermoplastic hose much sooner than it does on rubber hose (given an identical application, handling and service environment). Therefore unless the hose assembly is adequately identified (e.g. by tagging) this can make correct hose identification very difficult.

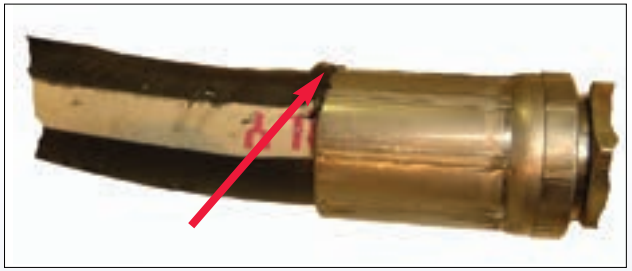
visual inspection

Examples of hose assembly damage/failure

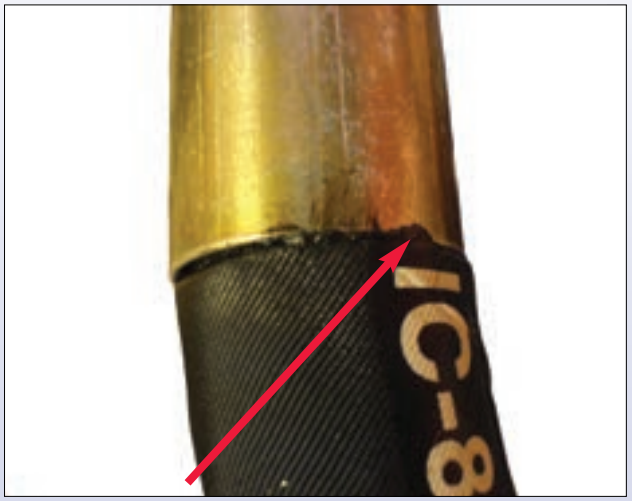
As identified within the Installation chapter of the BFPA 'Foundation Course in Working Safely with Hydraulic Hose and Connectors' and the Hose Assembly Routing & Installation chapter of the BPFA 'Hose Assembly Skills Training Programme', excessive stresses at the hose/coupling interface needs to be eliminated so as to reduce the likelihood of the hose assembly becoming damaged/failing at this area.

These stresses do not just occur during installation – they become more prominent during their service life (due to factors such as impulse pressures, surge flows, vibration and movement). The results of these stresses and changes to the integrity of the hose assembly at the hose/coupling interface can often be seen (for example by seepage of fluid, movement of the hose within the coupling, bulging of the hose outer cover) prior to a hose assembly failing in service. Particular care should be taken to ensure that this area of a hose assembly is examined for any obvious signs of damage during the hose inspection procedure.

The photographs to the right show some examples of damage at the hose/coupling interface.

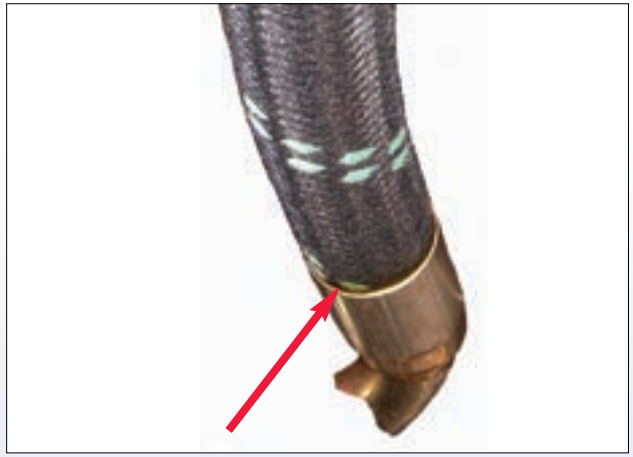


Hose cover extruding out of the ferrule



Hose cover extruding out of the ferrule

visual inspection



Witness of oil which shows on the hose cover

visual inspection

This type of damage can result in the hose bursting at the hose/coupling interface – typically some examples of this are in the following photographs.

Burst at the hose/ferrule interface

Hose pulled out of ferrule

Hose burst near the ferrule

visual inspection

Certain failure modes can occur either near the hose/coupling interface, or in the bulk of the hose itself. The 2 photographs below give examples of the medium within the hose escaping through the hose liner and not being able to escape through the hose outer cover. This effect is not covered within the scope of this course, the route cause for this type of failure can be complicated. The period of time that a hose assembly is in service before this type of problem manifests itself can vary and depend on a number of factors. The medium in one of the applications where these photographs were taken from was nitrogen, the other was mineral oil.

Should a hose assembly have any obvious damage similar to the above it is imperative that personnel are aware that the bleb/blister will contain a medium which is under pressure – therefore, if burst, making it a potential for a fluid injection injury and also in the case of gas could release a large amount of energy with obvious consequences – including noise!

visual inspection

Leakage at the hose/coupling interface can in some instances be the result of there being an incompatibility between the hose/insert/ferrule – or with the crimping/swaging of the coupling.

The timing for these types of problems to become evident can vary depending on a number of factors (which are beyond the scope of this course). The photographs below show examples of damage to the hose liner such that leakage occurred whilst the hose assembly was in service.

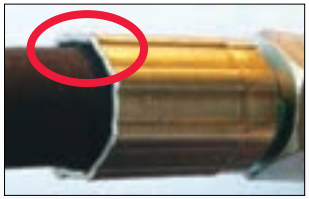
The above photograph shows a thinning of the liner such that leakage occured

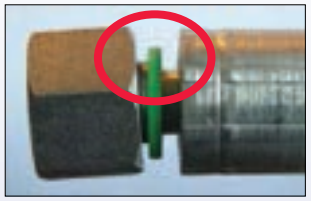
The above photograph shows radial cracks in the hose liner

visual inspection

The above photograph shows a hose which was located in service near to an external heat source. Although the hose assembly was working well within its design parameters (temperature, flow and pressure) the ambient temperature caused the hose to take set in its installed form. You can see that the hose assembly is not supported but still retains its in service shape.

Take special notice aroung the crimped ends, when inspecting hose assemblies which have been recently installed/being inspected pre-installation. The quality of the crimp should be visually inspected for any obvious manufacturing defects. The following show typical crimp defects, each of which would justify not allowing the hose assembly to enter service:





Prior to being installed and during any subsequent inspection programme the hose outer cover should be thoroughly inspected for any obvious signs of damage. A robust inspection programme should ensure that hose assemblies are correctly routed and installed before being commissioned therefore ensuring that abrasion and chaffing relating damage is minimised.

visual inspection

The photograph below shows a hose assembly which was inspected shortly after going into service. As can be seen there is a slight amount of abrasion damage on the outer cover – the impression left from the wrapping tape and the wrapping tape pitch is still visible. Damage such as this would not justify taking the hose out of service.

Damage such as that shown above can be minimised by providing the hose assembly with abrasion protection before the damage to the outer cover becomes excessive, such as to expose/almost expose the reinforcement.

visual inspection

Corrosion of wire reinforcement

Once the wire reinforcement becomes exposed it will start to corrode, this will ultimately cause the hose to fail in service if not replaced in time.

The onset of corrosion can be seen in the photograph below. This photograph was taken within 7 days of the outer cover being worn away and exposing the spiral reinforcement.

If not replaced in sufficient time the reinforcement will fail due to corrosion, such heavy corrosion is shown in the 2 photographs below.

visual inspection

If bulk hose is stored outdoors, or in a humid/damp environment it can result in the hose corroding at the end(s) of the coil, an example of this is shown in the photograph below.

visual inspection

If the corrosion is severe, it can result in the hose reinforcement becoming corroded some distance down the bulk hose. This corrosion can lead to loss of adhesion between the hose inner liner, reinforcement and outer cover. If the end of the coil is corroded, the hose should be cut back to a point where there is no visual evidence of corrosion before the end connectors are assembled.

Inspection of equipment

There are instances where equipment is used on a less frequent basis – this often results in rubber hose assemblies being exposed to the elements if the equipment is located /stored outside.

As identified within the Hose Management chapter of the BFPA 'Hose Assembly Skills Training Programme', BS 5244 gives test recommendations for hose assemblies fitted to stored equipment – consideration also needs to be given to the inspection of these hose assemblies.

The photographs below show examples of hose assemblies and ancillary products which are used on equipment which has just come out of storage. Do any of these hose assemblies/ancillary products (for example quick release couplings) look suitable for on-going safe use?

visual inspection

visual inspection

Particular attention for abrasion damage should be made when inspecting hoses which are located near to fabrications, running through bulkheads, hose supports etc. The photographs below show typical abrasion damage due to a combination of incorrect hose routing and inadequate protection. This would necessitate replacement of damaged hose assemblies.

Damage along almost the full length of each hose assembly

Hose assemblies with this type of damage should be identified during the hose inspection process. Additional protection/hose assembly re-routing to prevent further damage should be completed at the earliest possible opportunity (a time for which should form part of the inspection plan). A 'to be completed by' for rectification should be added to the inspection document. As previously stated, the use of some hose protection (e.g. spiral wrap, PU sleeve, fire sleeve etc.) will prevent the inspection of the hose

visual inspection

cover and hose branding for date codes etc. therefore consideration should be taken regarding removal and replacement of the hose protection for inspection purposes.

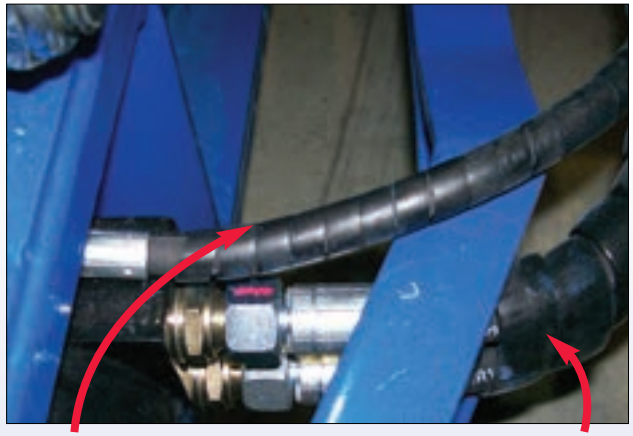
As there may be a delay between the inspection and follow up actions the hose assembly should be re-examined at the point the follow up action takes place as further damage may have occurred during this time such that the hose assembly should be taken out of service.

Hose burst sleeving should also be checked for damage, such sleeving is designed to protect personnel against fluid injection hazards.

The photograph below show a hose assembly where the sleeve has split. Damage such as this would cause a hose to fail inspection.

Hose burst sleeve split

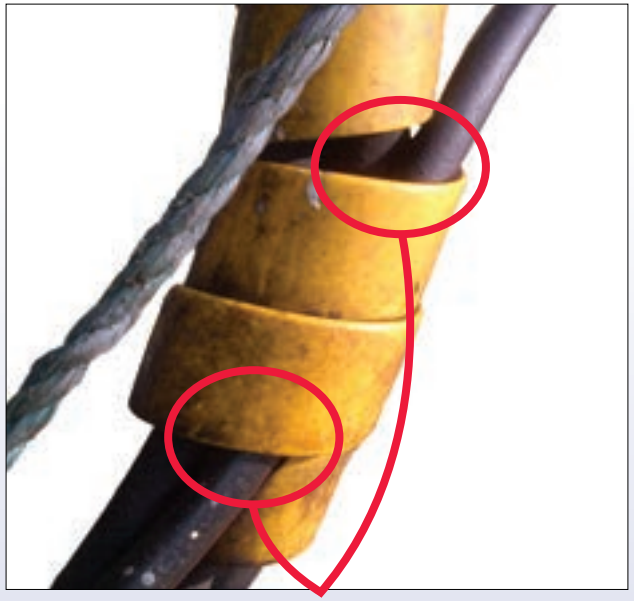
visual inspection



A hose wrapped individually

Hose bundled together

Hoses bundled in spiral wrap can cause chaffing between bulk wrapped hoses, it is more preferable to wrap hoses individually.



The hose is trapped within the spiral wrap

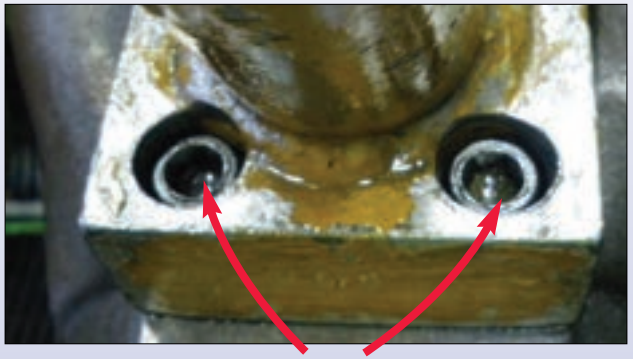
Spiral wrap should be sized and positioned to protect the hose assemblies. The spiral wrap shown on the above photograph has trapped a hose, thus causing additional damage to the hose.

visual inspection

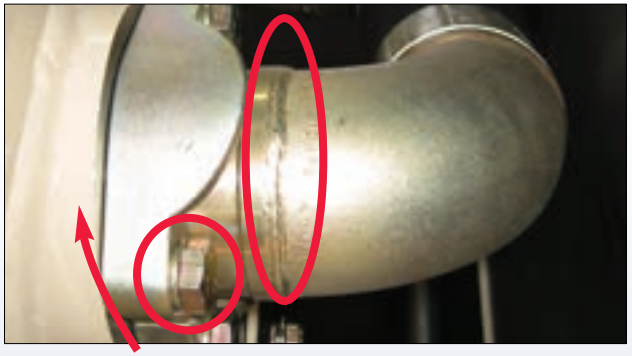
Inspecting around mating parts

A regular 'port to port' inspection should be undertaken to ensure that the hydraulic circuit is not suffering from leakage. This type of inspection should also be used to ensure/determine the on-going suitability of bolts, capscrews and other associated parts. The following photographs show typical areas for inspection along with some good and bad points which were identified.

Ensuring no movement and leakage of an adjustable elbow.



Checking if capscrews and bolts are still in good condition.



Checking for any leakage around flange connectors and welded joint within a fabrication. Check for loose/ damaged bolts.

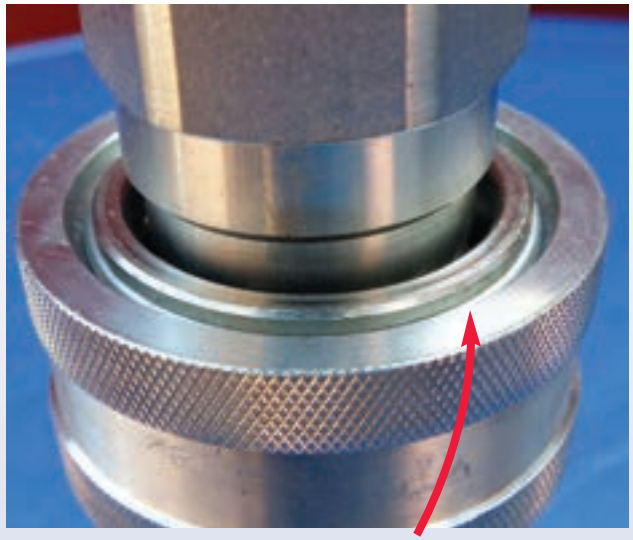
visual inspection

Checking for leakage around every threaded joint.

Checking that each elbow and T Piece remains firmly positioned and that there are no leaks around the port threaded interface and cone sealing areas.

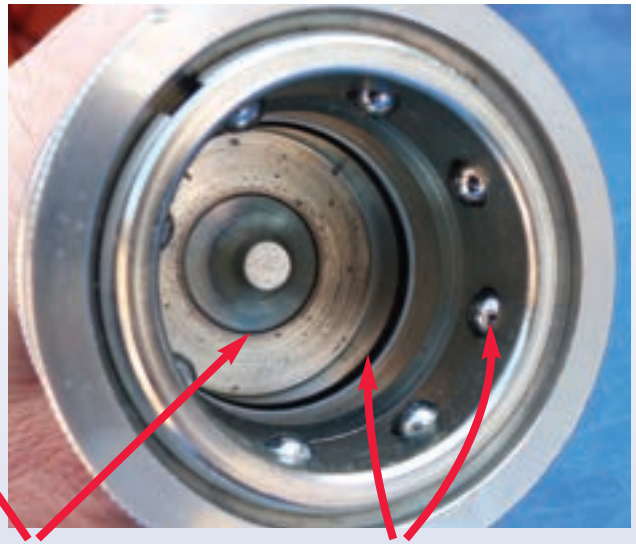
visual inspection

Inspecting ISO A, B (and similar) quick release couplings



Check that carrier sleeves return to their correct position when coupled and uncoupled

Examine the probe for signs of damage and wear



Check the valve sealing area to ensure there is no leakage

Check to ensure all locking balls are present and the internal seal is not damaged

visual inspection

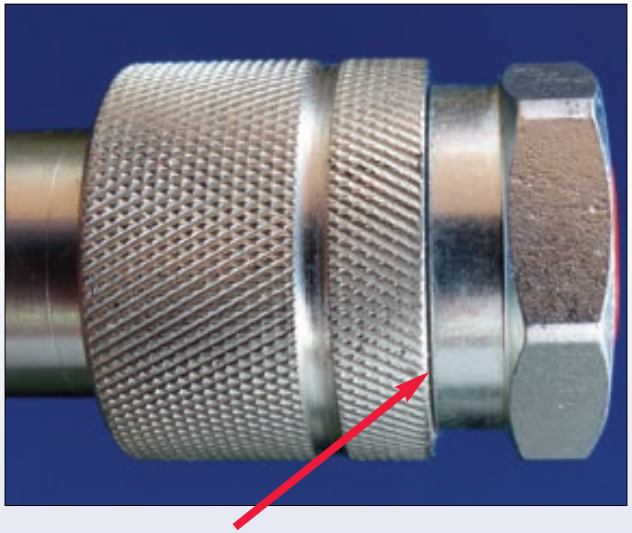
As well as being checked for correct connection and that there are no leaks in the coupled condition, Flat Face type Quick Release Couplings should be checked for damage in the uncoupled condition. The uncoupled checks should include examining the nose end of the probe for any signs of brinnelling around the locking groove. The carrier should be checked to ensure that the inner sleeve has returned fully to its correct uncoupled position.

Examine the nose of the probe for signs of damage and wear

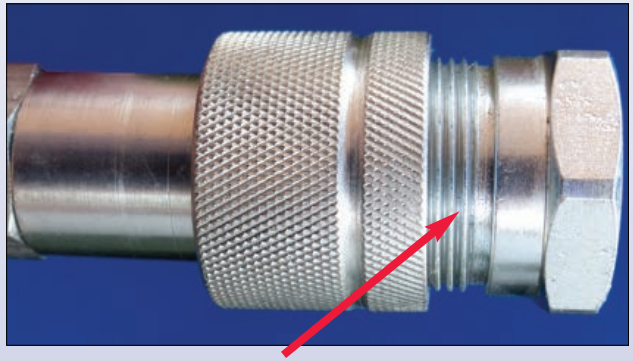
Examine the end face of the flat face carrier sleeve for signs of damage and wear ensuring that the inner sleeve has returned fully to its correct uncoupled position (almost flush to the end of the carrier body).

visual inspection

As with other types of Quick Release Couplings, Screw together type couplings should be checked that there are no leaks in the coupled condition. When correctly coupled there should be very little (if any) linear movement of the probe inside the carrier. The mating threads should be fully engaged, the photographs below show the coupling incorrectly and correctly connected.

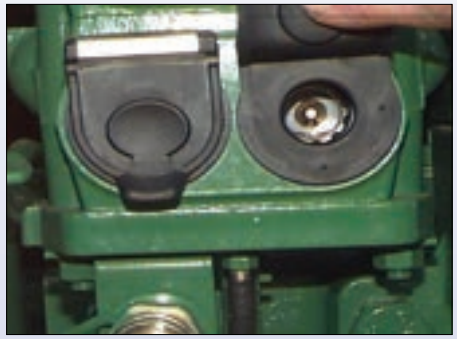


Coupling correctly connected



Coupling incorrectly connected

visual inspection



Checking that protective caps are fitted to disconnected probe and carriers where such caps are provided – and if not provided should they be fitted? i.e. is there a danger of dirt/contamination entering the system?

QUICK THOUGHT

Do you know that the majorityof hydraulic system failures are caused by dirt. Disconnecting and reconnecting dirty quick release couplings is one way that dirt can enter the system.