Bottom Loading - Preventing Leaks

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Product: **Bottom Loading - Preventing Leaks**

To: **General Distribution**

It is common to be asked the question "How can I stop the dry break couplings dripping?"

This is a guide to helping the customer achieve his or her aim.

1. Is the leak occurring only when parked?

The API code allows a liquid volume loss of up to 10 mL when disconnecting an API coupling from an API adaptor.

When loading petrol, this quickly evaporates as the coupler is returned to the park position and very few drips occur. Also, petrol is essentially non-staining and therefore few marks result.

Other products, particularly distillate, cling to the coupler and will slowly drip off in the parked position until the wet surfaces have drained. If there is no leak the dripping will slow and cease after a few minutes.

1.2 If the dripping persists in the parked position, there are two possibilities.

1.2.1 Too much pressure in the system, typically caused by thermal expansion. This is most easily diagnosed by the coupler handle becoming very hard to swing open when connecting to load. Liquip recommend these pipe pressure limits:

For ease of operation, maximum pressure	500 kPa
API design pressure for no leaks	1,000 kPa
Liquip API 513 set to leak at	1,500 kPa

1.2.2 Worn or damaged seals and components in the inner and intermediate poppets.

Overhaul is required at this stage

Note: The most frequent cause of seal damage is not wear. It is due to the coupler being opened without an adaptor - nose cone being inserted. The intermediate poppet o-ring is not designed to pop out and in of the bore and nicks can be put into the o-ring surface. See Figure A

2. Is the leak occurring only when coupled?

If the coupler is leaking while coupled but not when parked, there is only one place it is leaking from - the front face seal of the coupler which sits against the front face of the API adaptor. See Figure A

There are, however, many reasons why this seal can leak and it starts with the design of the API coupling.

The coupling and adaptor form only a sloppy assembly when connected with essentially no contact between the two until the handle is opened. When the handle is turned the two poppets (in the coupler and the adaptor) push each other and force the two even further apart. The seal is obtained by the spring loaded intermediate poppet being pushed out by its own spring to seal against the API adaptor face. If this seal is poor, leaks while loading will occur. Again there are several possibilities, but in particular the introduction of the Liquip "Super" spring in Mid 1994 has been of tremendous help in sealing this joint.

2.1 Weak intermediate poppet spring

The spring or "Super" spring must overcome friction in the intermediate poppet plus make up for the inevitable minor amount of misalignment between the coupler and adaptor.

Since Mid 1994 Liquip's API 513 has had a "Super" spring in the intermediate poppet which is three times stronger than the original design. It will Retrofit into older units and all Liquip refurbishments incorporate this spring as standard.

2.2 Loading arm type and setting

It is essential that the loading arm puts minimal force on the coupling when it is connected, whether the tanker is a low centre of gravity style or a high table-top agent unit. Any significant up or down force may throw the face seal out and cause a leak.

The Velvet Touch system was designed to provide not only a constant force over a large height spread but also to be easy and safe to adjust. This latter point is extremely important as if adjustment is difficult or dangerous, it will not be attended to. Park height should equal the mid-range of tanker adaptor heights.

NOTE: Liquip produce a very comprehensive instruction book for their Velvet Touch loading arms.

2.3 Coupler Angle of Attack and Balance

2.3.1 Liquip's cast 15° spool piece which fits between the coupler swivel and the coupler ensures that the coupler matches the tanker adaptor angle. Note the correct installation which is the "flat" side to the coupler and the 15° angle to the swivel. It is very educational to fit them the wrong way round and then find out how difficult it is to operate the system when it is not set up correctly. See Figure B

2.3.2 "Balance" refers not to the loading arm as such but to the coupler and swivel assembly as it hangs on the end of the hose.

Naturally the coupler weight causes the assembly to hang down and the manoeuvring handle is there to help straighten it for operation. Once coupled to the tanker, however, that force due to the weight ***is still there*** - it is being held up by the adaptor.

This is another cause of misalignment which can lead to drips. Liquip specify aluminium construction for the swivel and spool piece assembly to minimise the weight and hence misalignment.

If you are tempted for economic reasons to re-use the existing old "bottom end" of the loading arms, be aware that some old cast steel assemblies have weighed in at 30 kg more than a Liquip unit. This puts what is almost an unfair strain on the face seal. Illustrated on Figure B

2.4 Minimising wear

Some installations have discarded parking adaptors altogether to prevent wear on the catches during this operation.

Where parking adaptors are fitted in older terminals they are generally vertical. However, the tankers adaptors are at 15°. So we have two operations by the same equipment but to different geometries.

Having vertical parkers is clearly going to increase coupler wear as the geometry is inconvenient for the driver - and as the attached sketches show, the hose suffers kinking which will markedly affect its life. See Figure C.

Liquip now manufactures parking adaptors with extra features to extend coupler life. They angle down at 15° and can incorporate sensors if required. Spring clips engage in the coupler collar to prevent any possibility of it sliding down under its own weight. A groove is machined in the front face opposite the face seal so no extra wear occurs on that item (as it is not now in contact when parked). See Figure D.

These parking adaptors are available as nose-cones-only to fit to your own stand or as complete assemblies ready to bolt into concrete. If they are to be fitted to existing stands the parker height may have to be lifted 50 mm to 100 mm to accommodate the new geometry.

2.5 Temperature

All seal types used in couplers perform well at high ambient temperatures. However, the Viton A normally used in Australia starts to harden at temperatures below zero and loses elasticity at -30°C. Not a problem in Australia but to internationalise the API 513 Liquip now fit low-temperature-capable seals as standard.

3.0 Gauging the coupler

When is a leak due to wear? How do we gauge the wear for acceptability?

3.1 As noted above, if a coupler is leaking while parked, the inner poppet sealing system is suspect. This is a straight forward strip and inspect and generally will require seal replacement only.

Remember - Liquip's API513 is incredibly quick and easy to strip. Remove one R-clip only.

3.2 Leaking while coupled is due to poor face seal contact. If all other aspects mentioned above are satisfactory then it is possible the body and catches have worn too much to allow the intermediate poppet and seal to take up the slack.

Attached is a simple check for coupling wear by attaching it to an unworn adaptor. See Figure E.

A go/no go gauge is under development and trials are taking place. The veracity of such a gauge requires collation of data over a period as the geometry within a coupling's catch mechanism is extremely complex.

4.0 API Adaptor Wear

Liquip's experience is that if the seal-face is in good condition, wear on the rear of the nose cone where the API coupler catches sit is relatively unimportant as a stand alone issue.

Ie, a very good API coupler on a very good API adaptor will still leak if the loading system as a whole is badly set up. Conversely a very good system will be extremely tolerant of even badly worn couplers and adaptors.

Safety Issue: Some manufacturers are anodising their nose cones to minimise wear. This coating is non-conductive and in Liquip's opinion increases the danger of static electricity forming. Warn against their use.

5.0 Overhaul

The Liquip factory is fully equipped with jigs, fixtures, gauges and the correct spare parts to not only overhaul your API 513 but also ensure it is fully up-dated, and we recommend factory service exchange or Liquip over-hauling.

The in-house overhaul instruction sheet runs to five pages, it is so detailed and thorough. Every overhauled coupler is fully tested at high pressure, low pressure, coupled and uncoupled. It is also checked for fluid volume loss at disconnection.

6.0 The "Bell-Mouth" under trial

Older installations may not be readily open to fitting the various features and improvement described here.

In order to help the driver attach the coupler under less than ideal conditions, Liquip have been trialing a coupler with a bell-mouth on the opening. To date these trials have been very satisfactory and if reports continue to be good this feature will be introduced as standard.

7.0 Summary

The development of the "Velvet Touch" loading arm concept was all related to reducing the stress on the coupler when the tanker settled during loading. The combination of a Liquip "Velvet Touch" loading arm correctly adjusted and using the Liquip API 513 with "Super" spring gives you the best combination possible to load without leakage.

Within this context, Liquip suggest other issues should also be addressed if loading safety and containment are to be further improved.

(a). Industry can consider formalising the vehicle adaptor angle at 15° down from horizontal, plus or minus a small tolerance. AIP CP6 still allows between 0° and 25°. See Figure F.

Thought should be given to modifying all existing vehicles. (Note: essentially all semi-trailers built in the last decade have a 15° angle).

(b). Industry can consider re-defining the API envelope, which is already unique to Australia, to a narrower vertical spacing to lessen the force variation on the coupling.

(c). Loading arm adjustment to be checked regularly and any tuning carried out only by Liquip or Liquip-trained staff.

It is very obvious that what started out as a programme to improve a component became an investigation and improvement of a System.

If the System is not looked at as a whole, expensive components can be bought and fitted to your gantry without any improvement. This Tech Note is the result of lessons learnt during a real-life development of an elderly terminal: it is not a theoretical text-book.

Attachments

Testing for excessive wear
Part of drg 1399
Drg S1400
Parking adaptor