A Strange Occurrence Makes Us Consider

Pipe and Tube Fittings

I recently experienced a strange situation with gasoline-line fittings. Strange enough that I would like to share the experience with you.

I purchased several new-old-stock (NOS) glass-bowl fuel filters. They were in the original carton, along with the original fittings and the original instructions. They had never been used or installed in a vehicle. I bought them because they were interesting pieces, were inexpensive and they didn't take up much room on a shelf. At the time though I had no specific use for them.

Recently I did find a use for one of them, took one off the shelf, examined it, and other than the fact that the original cork gasket was suspect, it looked good. The housing is cast – probably a zinc compound – but the gas line fitting is steel. The zinc housing showed absolutely no evidence of pot-metal degradation: no hair-line cracks, no crazing, no distortion, none of the tell-tale signs that cast metal has begun to degrade. The steel fitting screwed into the housing with no problem, and snugged-up, again with no problem.

The steel fitting looked just a little different than today's fittings, so I decided to replace it with a new brass fitting. I went through my box of fittings, but couldn't find one that would fit the NOS housing. I took the housing and the steel fitting over to Home Depot.

In their plumbing department they have a display board with samples of the various sizes of both male and female flare, compression and National Pipe fittings. My NOS steel fitting looked like a compression fitting, but none of the new parts would interchange with it. The male NOS fitting did fit into a female NPT, but my part certainly wasn't NPT (NPT is a tapered thread designed to seal with a mating component to prevent leaks.)

A new 1/4 male compression fitting did not fit at all – too small, and the 3/8 male compression (brass) didn't fit into my housing – too large. One or two threads felt like they were going to work, but then it jammed in the fitting and wouldn't tighten further. None of the other fittings on the display board came anywhere near fitting.

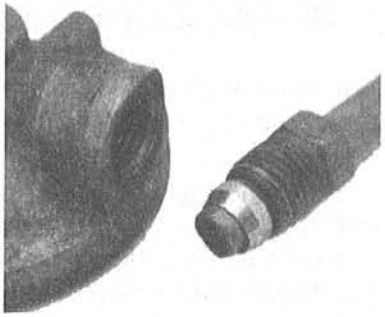
Another strange occurrence – not rare, but unusual – the hole in the center of my steel fitting was 5/16" O.D. 5/16" O.D. tubing today is quite unusual; 3/16", 1/4", 3/8", 1/2" – all common, but 5/16" is just not often used. I did find a small piece of scrap 5/16" O.D. tubing in my assorted parts, cleaned and annealed the copper tubing, and then proceeded to try and figure out the problem.

I searched the internet trying to locate another sized compression fitting, but had no success. The thread pitch (24 tpi) on the NOS fitting and on a new brass fitting were identical, but the parts were not interchangeable. Out came the calipers and micrometer. The new brass 3/8" compression fitting had an outside thread diameter of about 0.008" larger than the NOS steel fitting. It was close enough to be considered the same size, but too large to fit the old housing. I examined a second NOS housing and fitting. The two steel fittings were interchangeable with each other in the NOS housings, but neither matched the O.D. of the new brass compression fitting.

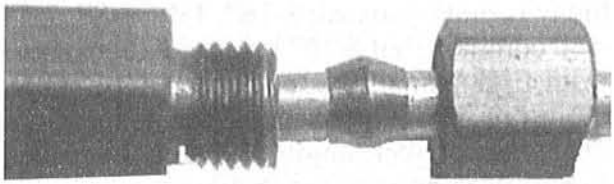
Thinking that perhaps my NOS fitting was not compression (it certainly looked like a compression fitting), I tried a flare on the end of a piece of 5/16" O.D. tubing. The flare

would not 'crush' when tightened – a requirement of a flare fitting to be leak-proof.

I finally resigned myself to the fact that over the past eighty years or so the measurements and tolerances have changed. With a modern compression sleeve on 5/16" tubing, the NOS fitting and housing works fine.



A compression fitting uses a copper (soft metal) sleeve which slips over the tubing between the male and female fitting. As the two fittings are tightened, the sleeve is 'wedged' onto the tubing offering a seal between the two lines.

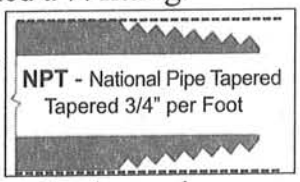


MALE COMPRESSION SLEEVE FEMALE COMPRESSION

PARTS OF A COMPRESSION FITTING

While on the subject, let me mention another one or two odd-ball facts about modern fittings. Their size is not what is described in their name. For example, a ¼ NPT (national pipe thread) does not measure 0.250" (1/4"). The actual outside thread diameter is 0.540" – over half an inch, yet it is called a ¼ fitting.

Here are a few more examples:

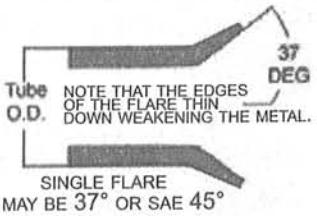


National Pipe Thread (NPT)
tapered ¾" to the foot
Seals due to the taper – both the male pipe and the female fitting have the same taper

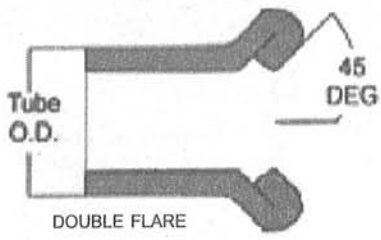
Size designation	Actual O.D. Thread Diameter
1/8 NPT	0.405"
1/4 NPT	0.504"
3/8 NPT	0.675"
1/2 NPT	0.840"

Another fitting is commonly known as the flare fitting. Within this category, though, there are a number of variations. Two flare angles are generally used: a 37° flare angle and a 45° flare angle. The flare fitting depends on the end of the tube being distorted to a male flare. It fits within a flare fitting and, when tightened against a matching flare fitting (the same angle of flare), is crushed between the two sealing the joint. Because the copper tubing is stretched to obtain the flare, the metal at the flare is thinner. This type of fitting is recommended for low pressure application such as fuel or refrigerant lines.

The 37° flare is used on high pressure lines, such as hydraulic applications. Again, a 37° flare must utilize both a 37° male and a 37° female fitting.



The third flare variation that we are most likely to come into contact with is a double flare. Creating the double flare is a two-step process, and requires a special tool to make the double flare. First a flare has to be formed on the tube, and in the second step, the metal is folded over itself increasing the strength.

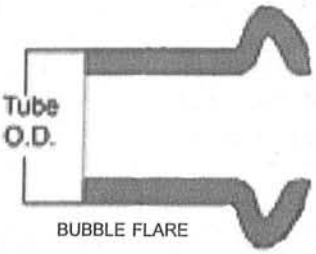


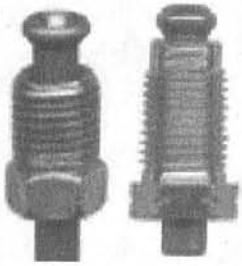
The second step in this process involves using a special die to fold the single flare over itself. A double flare tool is quite inexpensive and will create both single and double flares.

Brake lines, especially, require the strength of a double flare. It is a simple process when working with copper line, but if you are using steel or stainless, forming a double flare is almost certainly going to be a problem with a hand tool. We can highly recommend Eastwood's Professional Brake Tubing Flaring Tool. If you, or your car club or buddies do a lot of flaring, it is a great investment.

The fittings for a double flare are the same as for a 45° single flare. The double flare is actually (although it might not appear so) a 45° flare.

The final flare fitting that we will address is a 'bubble' flare. Occasionally found on U.S. vehicles, it is more often used on foreign marques. It requires a special tool to form the bubble flare. (The Eastwood tool will form single 45° flares, 45° double flares and bubble flares on a range of tubing sizes, and an optional 37° die set is available.)





Left: Double flare and correct flare fitting.

Right: 'Bubble' flare and correct bubble flare fitting.

There are numerous types of fittings and joints. We are familiar with just a couple. The most popular (in the U.S.) are mentioned above. Just for information, we have listed most of the joint fittings which are used in both the U.S. and internationally.

U.S.

NPSM
NPTF
NPSF
37° Flare (JIC)
SAE (45° Flare)
O-Ring Boss
O-Ring Flange (SAE J518)
O-Ring Flat-Face Seal
Ermetto Flareless Tube
SAE Inverted Flare
Female Braze-On Stems
Grease Fittings
Special Male Grease Fitting
Special Female Grease Fitting

FOREIGN THREAD TYPES

British

British Standard Pipe Parallel
British Standard Pipe Tapered
French GAZ 24°
492 GAZ Poclain 24° Flange

German DIN

DIN 24° Cone
DIN 60° Cone
DIN 3852 Couplings Type A & B
DIN 3852 Type C Metric and Whitworth Tapered Thread Connections
Metric Standpipe Assembly

Japanese

Japanese 30° Flare Parallel Threads
Japanese Tapered Pipe Threads
Komatsu Style 30° Flare Parallel Threads
Komatsu Style Flange Fitting

Fittings are not interchangeable, and a male fitting of one type will not properly fit with a female fitting of another type. Although the thread count might match that of another fitting, the angle of the thread or the configuration of the fittings themselves prevent a leak-proof joint.

'Crush' fittings, such as flares, distort the metal upon tightening and might not provide a leak-proof joint, if opened and refastened repeatedly.

	National Pipe Tapered		37°	45°		
Size	Pipe Size	O-Ring Face Seal	37° Flare (JIC)	45° Flare	Inverted Flare	Compression
1/16	1/16-27	–	–	–	–	–
1/8	1/8-27	–	5/16-24	5/16-24	5/16-28	5/16 -24
3/16	–	–	3/8-24	3/8-24	3/8-24	3/8-24
1/4	1/4-18	9/16-18	7/16-20	7/16-20	7/16-24	7/16-24
5/16	–	–	1/2-20	1/2-20	1/2-20	1/2-24
3/8	3/8-18	11/16-16	9/16-18	5/8-18	5/8-18	9/16-24
7/16	–	–	–	11/16-16	11/16-18	5/8-24
1/2	1/2-14	13/16-16	3/4-16	3/4-16	3/4-18	11/16-20

S.K.