Well Testing Alert

The Wing, or Hammer Lug, Union basic design originated in the 1930's and since that time has been in full term use. The original manufacturer "Weco®" was the precursor to the present day FMC Technologies – Fluid Control Division (and other manufacturers that also today manufacture similar products). FCE manufactures unions in its own right, primarily, for sour gas and well testing applications although we, as FCE, also provide substantial numbers of other "specials" for various applications.

The hazard potential of mismatching union connections is well known and generally falls into 3 main areas particularly relating to Figures 602, 1002 & 1502 unions. Figure 206 unions are also widely used in Well Testing applications but have a different sealing mechanism which is easily recognisable and can only be provided with captured (non detachable) nuts so are thus outside the scope of this alert.

A) Connecting the ñwrongò figure number or pressure rating together,

B) The usage of detachable nuts with incorrect assembly of nuts, segments and retaining clips or the incorrect use of detachable nuts on non-detachable assemblies and,

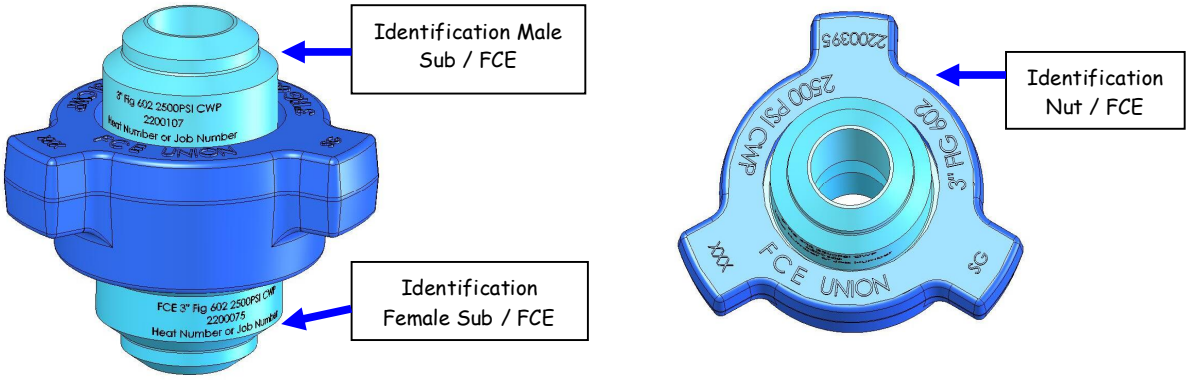
C) Connecting the ñrightò figure number together but with different pressure ratings.

Safety Alerts concerning these issues can be seen on the FMC Technologies / FCD website as follows: www.fmctechnologies.com/fluidcontrol.
"Avoiding the Dangers of Mismatching Hammer Unions"
"Avoiding the Dangers of Missing Retainer Segments in Detachable Union Connections"

This FCE Alert is not designed to replace these documents but to supplement them in terms of FCE's own production / clients.

A) Mismatching Union Figure Numbers or associated pressure ratings

Hammer Lug Union users should **ALWAYS** identify unions / piping / components / assemblies to ensure that only **IDENTICAL** union figure numbers, size and pressure rating are connected together.



1) The main potential Hazards for connecting the "wrong" figure numbers are as shown below:

- 5" Figure 400 & 1002 unions have the same ACME thread.
- 1 ½" Figure 600, 602 & 1002 unions have the same ACME thread.
- 2" Figure 602 & 1002 unions have the same ACME thread.
- It is possible to obtain a <u>partial</u> engagement of a female 2" 602 / 1002 end in a 2" 1502 nut, even though different threads are used, resulting in a hazard / potential incident.

All these combinations must be avoided and the majority of clients have taken steps in terms of their own internal procedures (one of which maybe to suspend the use of 2" 602 / 1002 by adopting to only use 1502 for higher pressures or 206 for low pressure) to eliminate such potential Hazards.
One of the biggest difficulties users may encounter can be identifying Female union ends particularly on 1 piece adapters etc. where markings may be erased. Tables are available that show the thread outside diameter & threads per inch which aid in identifying the ACME thread used & thus the particular size & figure number. Union nuts have the size / figure number shown on the forging & are thus generally not the same issue.
Size & Figure Number "thread" gauges are also available at specific request to aid in identification for the most commonly used sizes.

2) Consideration, where applicable, should also be given to differences between sour gas and standard service unions. In FCE's case this will generally only apply to 1002 & 1502 where different materials or alternative heat treatments may be used to obtain the higher working pressures encountered in standard service [typically 1502 sour gas is 10000 psi working pressure whilst 1502 standard service is rated at 15000 psi working pressure].

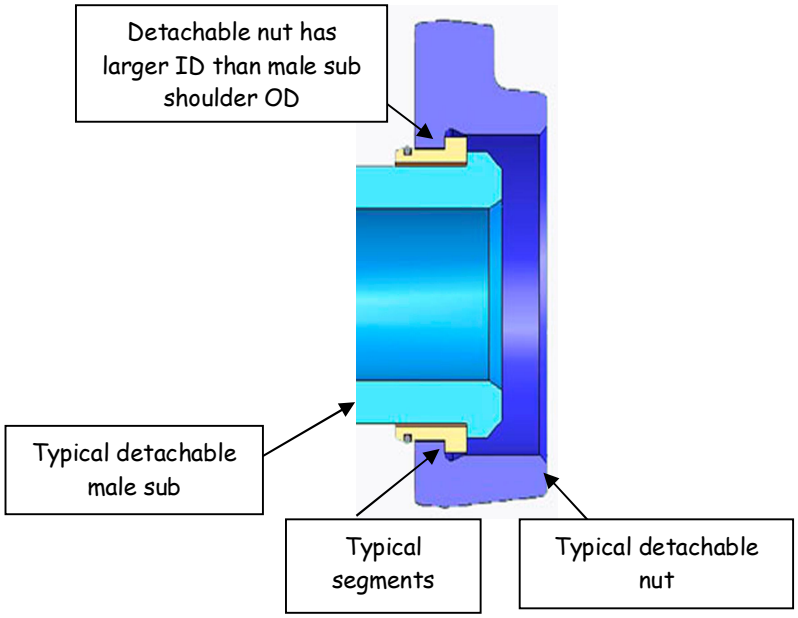
Similar comments are true with ‘’specials”, typically subs manufactured at client request etc., in stainless steel or with thin pipe schedule butt weld ends where the sub will thus have a lower design pressure than the normal union or nut rating.
Examples of such instances are discussed in section C.

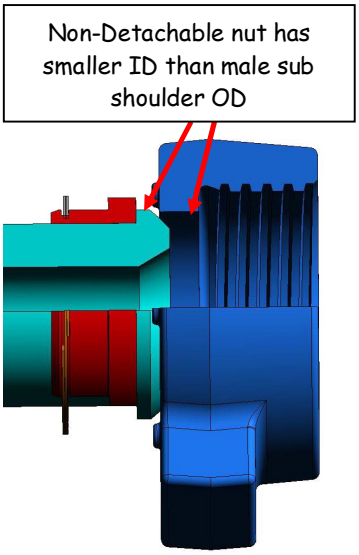
B) The use of detachable nuts versus non-detachable [captured] nuts

In general, FCE nuts are of the non-detachable type [except 1502 as noted below]. Consequently detachable nuts & any segments or segment retaining clips, used on an FCE product, are sourced from the original OEM, namely FMC Technologies, where required.

1) Nut Selection

On butt weld and threaded assemblies (piping, x-overs, etc) or butt weld and threaded unions supplied loose, non-detachable (captured) nuts are always supplied and are non-removable once the assembly is made up. However on same size ends 1 piece, integral assemblies with one or more Male ends, it is mandatory to use detachable nuts [Differing size ends may not need detachable nuts depending upon configuration]. These nuts are correctly fitted to the assembly by employing segments and segment retaining clips.





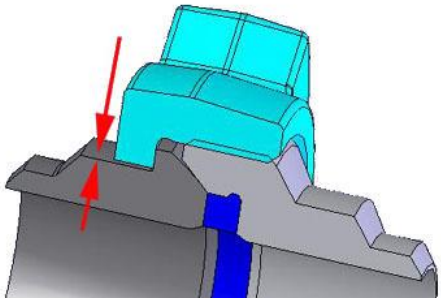
As such detachable and non-detachable nuts generally have different dimensions in terms of internal diameter at the nut shoulder with a longer internal thread thus requiring a dimensionally longer detachable nut forging. For the same size and figure number, the bore through the shoulder of a detachable nut can be larger than the bore through a non-detachable nut as this has to pass over the male sub shoulder in order to be installed. A captured non-detachable nut always has a bore smaller than the male sub shoulder diameter to retain it in place as this is installed before the union is threaded or welded on.

The exception to this rule is Figure 1502 nuts which utilise the same nut in both detachable and non-detachable applications thus the male sub diameter is always different between the 2 applications.

Detachable nuts always use 3 segments to retain the nut on the detachable male sub O/D with the applicable segment retaining clip (spiral lock) to hold the segments in place external to the nut. It is imperative that all 3 - correct & in good condition - segments are in place together with the clip when in service to prevent catastrophic failure.

The extra length required on a detachable nut, as described earlier, also encompasses additional thread length. This is required due to the shoulder length on the male sub plus the segment shoulder compared to the single shoulder on the male sub with a non-detachable nut.

In general the nut is free to revolve on the male sub – with the correct segments as applicable – however where there is excessive "play"/ looseness between the nut and the male sub, this may well indicate that the incorrect nut has been fitted. Segmented end connections are generally "tighter" than non segmented (non-detachable) but even in the case of non-detachable nuts the clearance between the male sub O/D and I/D of the nut shoulder should not be more than 1/8"/ 3 mm on 2" unions through 9/64" / 3.6 mm on 4" unions as shown below.

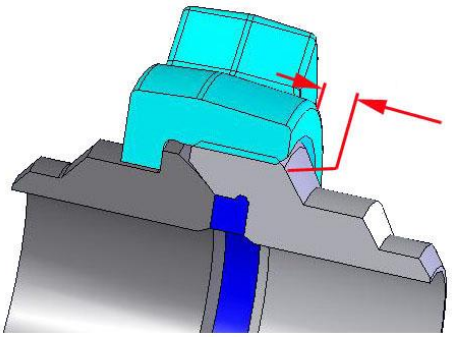


Should the clearance between nut & male sub exceed this figure then the connection should not be used & the root cause of the problem determined, namely excessive nut wear, incorrect dimensions on the nut or sub or the incorrect utilisation of components - possibly a detachable nut on a non detachable component.

2) <u>Incorrect Assembly</u>

End users must take particular care to match detachable and non-detachable nuts with the correct and applicable male sub to ensure there is no mismatch i.e. 1502 to 1502 etc., not 602 or 1002 to 1502.

Particular care needs to be taken with union ended adaptors / x-overs where one end (usually the female) is a smaller size than the other. It is possible in certain circumstances where a non-detachable nut can be inadvertently fitted to a "detachable" male sub in 602 / 1002 ratings with insufficient thread & shoulder engagement when made up to the female to retain full rated pressure.



In these circumstances, this situation may possibly be recognised by an excess of female sub thread protruding from the face of the nut, when fully made up with the seal compressed. [Some protrusion maybe considered normal due to the thread manufacturing process, even with a captured nut & sub, but this is generally limited to a maximum of approximately / maximum 3/16" / 5 mm].

C) Matching Size & Figure Numbers but different Working Pressure

This is particularly prevalent with 1502 & 602 unions but can also exist in other circumstances i.e. Sch. 40 206 etc.

1) A 1502 Standard Service union is 15000 psi Cold Working Pressure whilst a 1502 Sour Gas Service union is 10000 psi Cold Working Pressure due to the differing material hardness in the "standard" materials used in each application & with XXH Subs.

2) 602 unions are common with well testing contractors but some may be Sch. XXH (5000 psi) Rating whilst others can be Sch. 80 (2300 – 2500 psi) dependant upon the contractor. Care should thus be exercised when connecting pipework together from different service companies.

3) In some instances, operating companies have selected to use only 1 Figure Number, typically 1502 Sour Gas – theoretically a 10K psi rating – but then have opted to use lower rated pipe attached to the unions i.e. carbon steel XXH or Sch. 80 thus making a 1502 5000 psi or 1502 2500 psi Assembly. Always check the pipe rating & any applicable Identification Bands or data book.

As can be seen extreme care should be exercised with regard to the maximum Working Pressure of the lowest rated item in an "assembly" and this should be regarded as the maximum rating of the entire system as applicable. This comment is also true for flanged x-overs, i.e. a 602 union x ANSI 150 lb flange etc...

A Guide to Nut component identification is attached in Appendix 1.

Such unions have been used safely for many years & any issues relating to safety have generally been operator orientated rather than issues due to design or materials used in their manufacture. The purpose of this alert, & of the FMC Technologies documents referenced, is therefore to address areas that can arise due to operator mis-use in the field & clients should ensure their personnel are fully aware of the correct usage of such equipment when placed into operation in the field.

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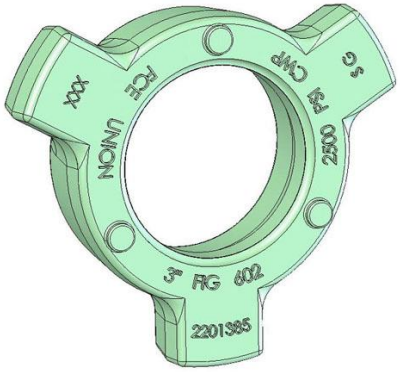
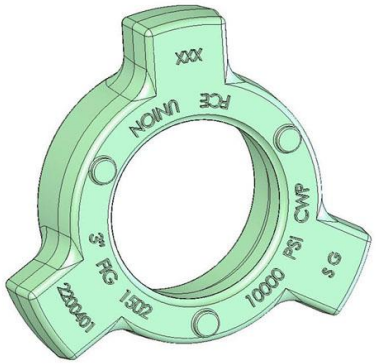
Appendix 1 - Identification Aids For Nuts, Segments and Retaining Clips

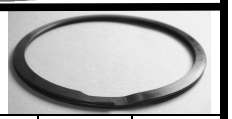
Detachable Nut Fig. 602 / 1002	Non-Detachable Nut Fig. 602 / 1002	Non or Detachable Nut Fig. 1502 (Nut is the same for both designs)
		
DET= Detachable Nut / FMC Identification (Add. Marking for SG)	**SG = Sour Gas Service (H2S) FCE or FMC Identification**	**SG = Sour Gas Service (H2S) FCE or FMC Identification**

Segment for Detachable Connections – Retainer Segments (From FMC Technologies Only)

Marking On Segment

Service	Reference	From
SG for (H2S)	In Accordance with Product	FMC Technologies

Identification: Retaining Clip

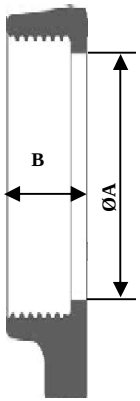


MARKINGS ON NUT FACE

From	Name	SIZE	Figure	Det.	Pressure	Service	Reference	Serialisation
FCE or FMC Technologies	Union or Weco	2" through 4"	602 Or 1002 Or 1502	If Det. Nut FMC Technologies	In Accordance With Fig. N° and Schedule	SG for (H2S)	In Accordance with Product	Heat or Cast Number

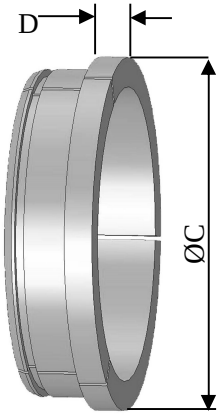
Type	Size	Ext. Ø	Int. Ø	W
602 / 1002	2	84.5	74.5	2.4
	3	120.5	108	3
	4	151	132	3.3
1502	2	87	74.5	2.4
	3	120.5	108	3
	4	164	144	3.3

NUT DIMENSIONS



	Non-Detachable Nut		Detachable Nut	Non or Detachable Nut
FIGURE	602	1002	602 & 1002	1502
SIZE	**B**			
2"	48	48	65	63.5
3"	52	54	63.5	68
4"	57	61	76.2	92
SIZE	**ØA**			
2"	79.5	79.5	79.5	85
3"	110	110	117.9	117.9
4"	136.5	136.5	140	150

SEGMENT DIMENSIONS



602	1002	1502	
D			SIZE
11	11	11	2"
11	11	11	3"
12.5	12.5	16	4"
ØC			
91.2	91.2	94	2"
128	128	128	3"
150	150	163	4"
////////////////////////////////////			