

ACL® Clamp Information

The Omega Profile

The Omega profile was designed to overcome issues made apparent from the use of components in the hygienic processing industries. There are a number of areas of concern which are reduced in severity with the application of the ACL® Omega Clamp profile:

- **Ferrule flatness after welding**

Hygienic process ferrule flanges are deformed after welding. As this increases the union width, a clamp is required that is able to impart the correct clamping force. The omega profile will ensure the union seals and the gasket is not over compressed even after the stress relaxation of the union components.

- **Even intrusion of the gasket**

As the connection is made by applying a single point of contact at the gauging point, the gasket compression and resultant extrusion is controlled. The profile contact force vectors attempt to direct the majority of the clamping force toward the ID of the union. This differs from other clamp profiles which have a tendency to seal on the gasket bead (it should be noted that different gasket supplies also contribute to this problem).

- **320°- 345° of contact on the ferrule**

The circumferential contact on the union (at the correct gasket compression) differs between clamp sizes and styles. The contact arc length is determined by the pressure requirements of the union and

thus the total clamping force imparted to ensure the union does not fail by gasket extrusion. It should be noted that the higher the angle of contact, the more reliable the pressure holding ability.

- **Correct gauging point**

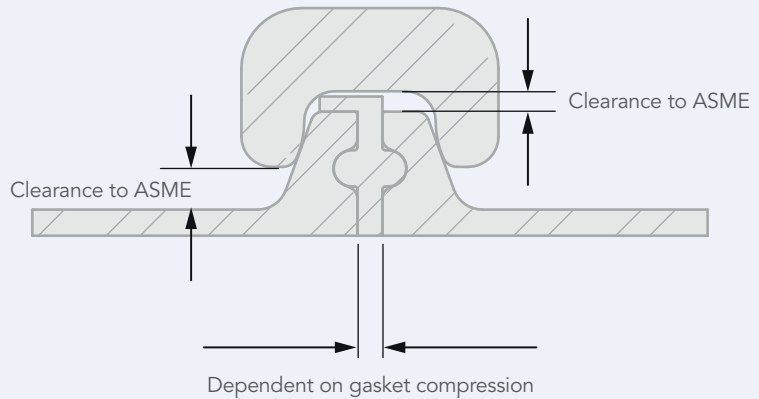
The gauging width is of course dependent on various factors. The manufacturing tolerances certainly contribute to the difference in clamp segment position (affecting degrees of contact, intrusion and compression of gasket).

- **Form of the clamp**

The clamp can only fit correctly (segments forming a circular geometry) in one position and this ideally occurs in

the fully tightened state. From the initial un-tightened assembly the clamp compresses the gasket by 0.2 to 0.4mm. This means that the two segments cannot have circular geometry in the unclamped state. Ideal clamp form is oval on first inference. This ensures an even distribution of the clamping force on the gasket and thus an even compression.

It is due to these important functional aspects that the Omega design of internal profile used for clamp type couplings is by far the most suitable and superior profile for the clamp type coupling. Not only is it more tolerant of manufacturing tolerances but it gives a far more efficient clamping action.



The Case for the Omega Profile

The S type, SH type and SSH clamps are not designed to the ASME code as this is not applicable to the application. These clamps are designed to be used in conjunction with clamp type coupling as given in published standards i.e. BS 4825-Part 3, ISO 2852, DIN 32676, DIN 11864-3, ASME BPE etc.

Currently there is no design code or published standards specifically for clamp type coupling clamp elements, other than

that given in the ASME VIII code. Clamps designed for the ASME VIII Class 1 vessels are specifically for that application and not general use. If the ASME design code for clamp type connections as given in Appendix 24 were to be considered the following formulae for various parameters would be relevant.

- **Clamp longitudinal stress – S5**

This formulae lip bending is considered,

where the lip is loaded by a point load (W) acting at C dia. This is therefore unaffected by the area of contact. Our FE stress analysis shows the most important aspect of the lip bending is the corner radius dimension. For a minimum hub clearance (which is most desirable and very influential on the whole strength of the section) the omega shape allows the optimum sized corner radius with a low stress raiser, hence a very strong clamp lip design.

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• Lip shear – S7

This is based on point load (W) acting at C dia point of the lip depth. Where C dia is based on the depth of the active lip which is unaffected by the contact profile. Hence as this is the actual point of contact with the 'omega design' this formulae returns the same result for either straight taper or omega shape.

• Lip bearing stress – S9

This is based on the point load (W) acting on the contact area between hub and clamp, obviously with the theoretical point load of the omega shape this will return a higher value than a flat surface. However, with the low values of W involved with these clamps it can be shown that the material is not over-stressed. In practice, permissible elastic deformation of the clamp profile takes place and the load is transmitted to a larger area.

In consequence we dispute that our 'S', 'SH' or 'SSH' type clamps do in any way contravene any published design code or that the strength of the section is not based on anything but the best possible design criteria. The section if anything offer an improved profile to a straight tapered face.

Consideration of the Straight Sided Clamp Profiles

There are no published angular tolerances for either clamp internal profiles or even those of the ferrule flange. With consequence at the extremes of both conditions there could be either point contact on the ferrule tip or point contact on the clamp inside groove tip.

It is not excessive to consider a tolerance of ± 1.5 degrees as a total tolerance on the two items. If these were both in the extremes a fit problem would be encountered.

A further consideration would be the tolerance on the ferrule and clamp thickness dimensions and their effects on the fit between the two elements. This bearing in mind that the clamps are investment castings and not precision machined.

Point contact on the ferrule tip leads to excessive ferrule flange bending stresses and lack of hub/clamp clearance.

Point contact on clamp inside groove tip will result in excessive clamp lip bending stresses and also increase lip shear due to the reduced shear area.

Another problem encountered due to the above would be lack of circumferential contact (clamp being either too far open or too far closed – past centre) leading to poor and irregular gasket compression. The circular inner profile of the clamp can only be truly circular in one position i.e. at the correct gasket compression.

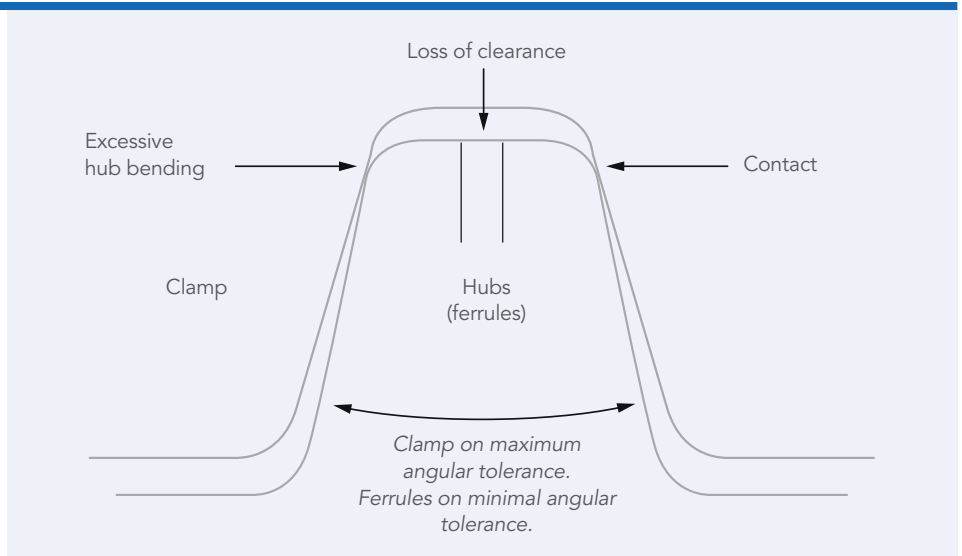


Figure 1. With the clamp sitting low the segments are not truly circular.

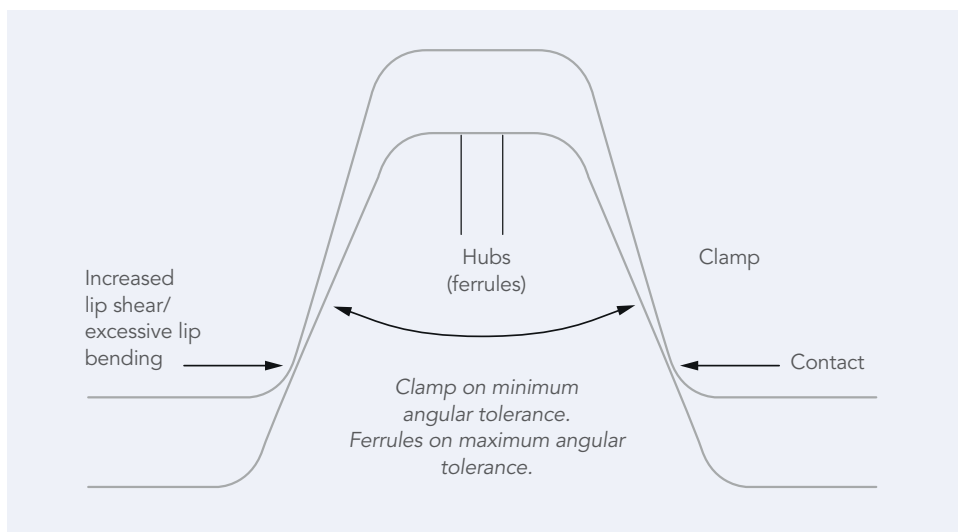


Figure 2. With the clamp sitting high the segments are not truly circular.

Note: In both of the above cases there is a loss of circumferential contact, resulting in uneven gasket compression.