We want to show that symmetrical distortion does not produce a difference frequency. By symmetrical distortion, we mean that if a positive input x gives an output y, then a negative input $-a$ gives $-y$. That is,

$$f(x) = -f(-x) \tag{1}$$

Now consider a way of generating a symetrical distortion function f from a general function.

$$f(x) = g(x) - g(-x) \tag{2}$$

Check it by substituting $-x$ for x, and we get

$$-f(x) = g(-x) - g(x), \tag{3}$$

and so this gives us the function we need. This will work for any well behaved function that we are interested in.

So let g be represented by a series:

$$g(x) = \sum_{0,1,2,3,...} a_n x^n \tag{4}$$

We have $x^n = (-x)^n$ for n even and $x^n = -(-x)^n$ for n odd. Thus

$$f(x) = g(x) - g(-x) = \sum_{1,3,5...} a_n x^n. \tag{5}$$

That is, only the odd terms in the expansion for f are non zero.

Now look at two sinusoidal waveforms of frequencies ω_1 and ω_2, not harmonically related. We are using angular frequency here, that is 2π times the frequency in Hz. Thus our input signal is

$$x(t) = \cos\omega_1 t + \cos\omega_2 t. \tag{6}$$

The linear term in equation 5 cannot make new frequencies, but the cubed term can. Take the cubed term as the product of a squared and a linear term.

This identity is needed:

$$2\cos a \cos b = \cos(a-b) + \cos(a+b) \tag{7}$$

First do the squared term:

$$x(t)^2 = (\cos\omega_1 t + \cos\omega_2 t)^2 = 1 + .5\cos 2\omega_1 t + .5\cos 2\omega_2 t + 2\cos\omega_1 t\cos\omega_2 t \tag{8}$$

Expanding the last term with the identity gives:

$$x(t)^2 = (\cos\omega_1 t + \cos\omega_2 t)^2 = 1 + .5\cos 2\omega_1 t + .5\cos 2\omega_2 t + \cos(\omega_2 - \omega_1)t + \cos(\omega_1 + \omega_2)t \tag{9}$$

So the squared term generates a difference term, but what happens when we multiply by $x(t)$ to get the cube? Sum and differences with the two frequencies in $x(t)$ are generated with each term in equation 9. The frequencies generated are $2\omega_1 \pm \omega_1$,, $2\omega_1 \pm \omega_2$,$2\omega_2 \pm \omega_1$, $2\omega_2 \pm \omega_2$, $\omega_2 - \omega_1 \pm \omega_1$, $\omega_2 - \omega_1 \pm \omega_2$, $\omega_2 + \omega_1 \pm \omega_1$, and $\omega_2 + \omega_1 \pm \omega_2$. The difference term $\omega_2 - \omega_1$ is not there. One could work out the results for higher order odd terms, but by inspection it looks as though none of them will generate the difference term either because you can always represent the term with an even power times the linear term, which can destroy simple difference terms, but not generate them.