

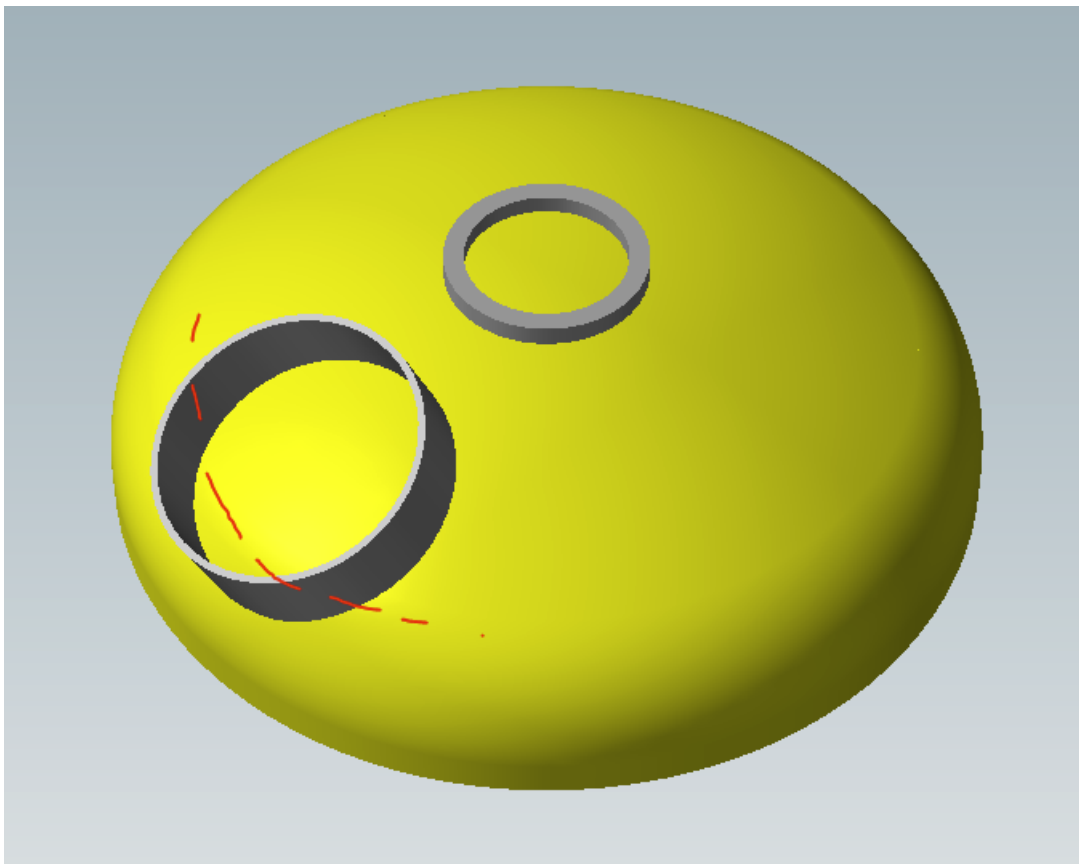
Design of adjacent VSR openings beyond 0.8 De of a formed head

How to overcome the limit in the VSR norm that defines a method to calculate adjacent openings only when they are entirely in the spherical portion of a formed head.

Online version: <https://nextgen.sant-ambrogio.it/KBo74493>

Latest update: 29 ott 2021

A common usage scenario for a formed head in the upper part of a vessel is the one with a reinforced ring positioned centrally, for example to attach an agitator, with a manhole that partially straddles the knuckle, the toroidal area of the bottom.



Concerning the calculation of the two isolated openings we do not encounter particular problems, but things get complicated when these two openings have their respective reinforcement areas overlapped: in this scenario it is necessary to perform the calculation of adjacent openings, defined in the paragraph VSR.1.K.4.

4. Compensazione di aperture non isolate su fasciami sferici e fondi curvi.

Per la sezione passante per i centri di due aperture adiacenti su fasciami sferico o **sulla parte sferica di un fondo curvo**, così come mostrato in figura 1.K.3.5., deve essere verificata la relazione del paragrafo 2. della regola VSR.1.K.3., per la cui formula:

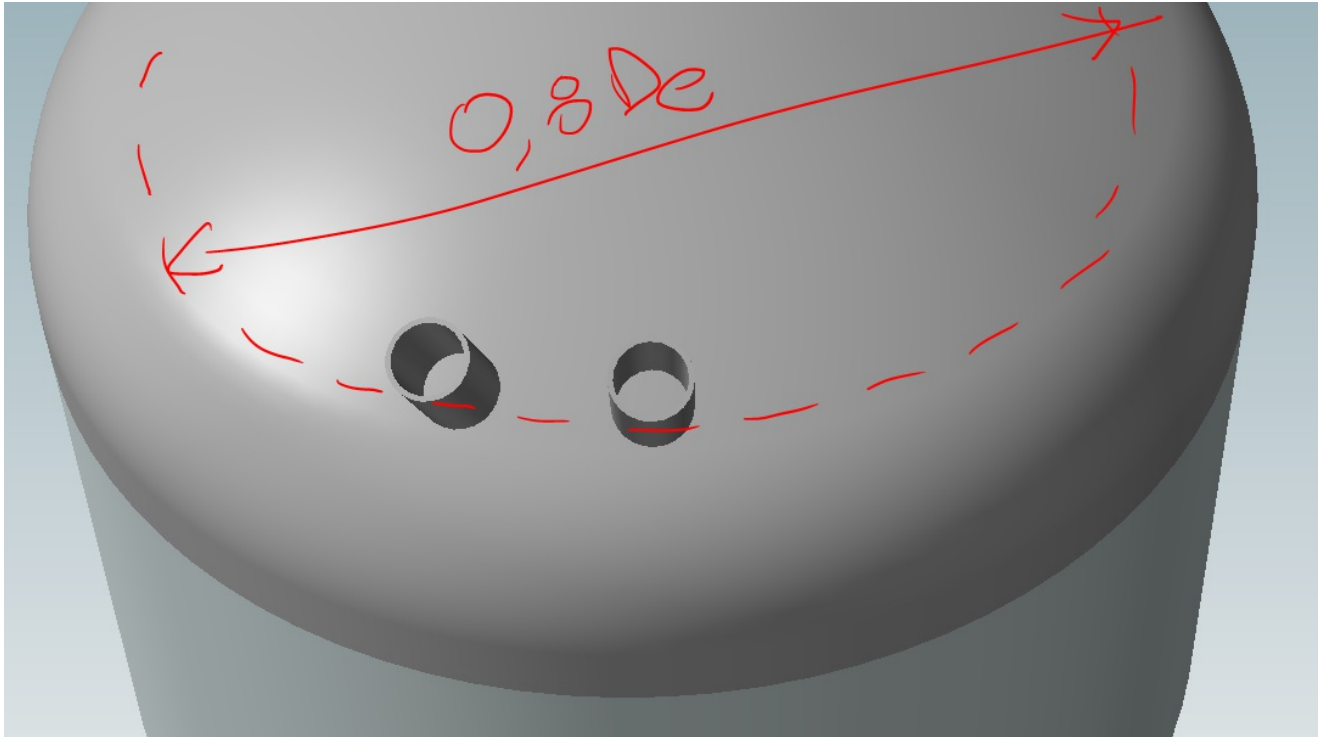
The paragraph limits the applicability to the presence of two openings on the spherical part of the head and the standard does not provide indications on how to proceed in case of openings partially or totally positioned on the toroidal part.

In our experience as a design company we have seen several methods to get around this problem and

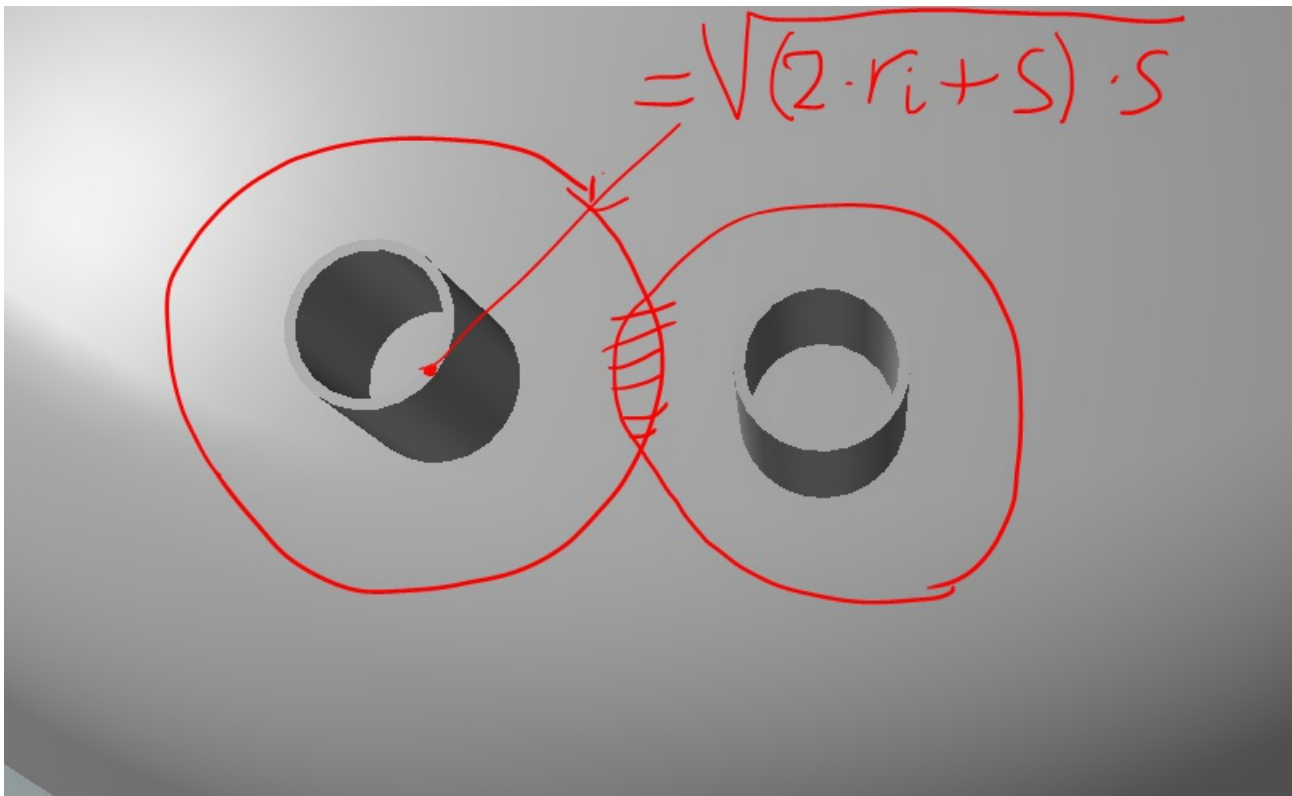
from NextGen version 2021.2 it is possible to take advantage of the limitation of the reinforcement on the head to get out of this impasse.

When the problem occurs

Imagine such a scenario: two, or more, of the inserted nozzles are positioned astride the bottom knuckle



Since their reinforcement limit on the bottom overlaps, the standard imposes at this point the calculation of adjacent openings:



The limit of the reinforcement is defined in VSR.1.K.3 1.2 and is equal to $\sqrt{[(2r_i+s) \cdot s]}$

Upon encountering this configuration, NextGen shows the following error:

Errors (1) Warnings (2) Message (0) Expand		
Description	Required	Actual
The couple of adjacent openings Nozzle #2 and Nozzle #1 is not entirely within 0.8 De as prescribed by VSR.1.K.4: calculation of adjacent openings can't be applied. To avoid this error you can manually reduce the "Useful length on vessel wall" in the Geometry category, to make the actual value lower than the required and evaluate the openings as isolated. Check NextGen's support website from the Help menu for more info. Please ensure with your Authorized Inspector that this procedure is deemed acceptable.	139.09 mm	228.08 mm

The required and actual values shown refer to the geometric distance between the centers (required) and the sum of the radii and horizontal reinforcement limits measured on the line joining the two centers

How to get around the problem

What can be done is to manually limit the length on the head that contributes to the reinforcement, defined as L in the standard

- L** lunghezza massima della sezione della parete principale utile per la compensazione dell'apertura, presa sul raggio medio di curvatura della parete a partire dal bordo esterno del tronchetto o massello penetrante o appoggiato alla virola, oppure dal bordo della foratura in assenza del tronchetto, in mm;

To do this, simply unlock the padlock icon located next to the Useful length of the vessel wall property, then enter a manual value.

Category	Property	Value	Unit	Lock Icon	Info Icon
Geometry	Nozzle height	L 100	mm		
Position	Nozzle thickness	s 3.91	mm		
Welds	Unsupported length for external pressure calculation		mm	🔒	ℹ️
Pad	Inside diameter	Di 52.48	mm	🔒	
WRC	Outside diameter	De 60.3	mm	🔒	
External loads	Reference diameter	Outside diameter			< >
Weight	Standard schedule	STD			< >
Reporting	Nominal size	50			
	Blind flange connected	<input type="checkbox"/>			ℹ️
	Out of roundness	0			
	Useful length of the vessel wall	30	mm	🔒	ℹ️
	Wall thickness		mm	🔒	ℹ️
	Calculate deformation factor	<input type="checkbox"/>			

In the error message, the difference between the requested and the current value can help you get an idea of how much this size needs to be reduced to avoid the error. Naturally, this operation involves a lower contribution of the bottom material for the purposes of compensation, which will weigh more on the nozzle.

Once there is no more interference between the two openings, the error message will disappear and a warning will be shown instead:

Errors (0) Warnings (1+2) Message (0)		
Description		
Openings Nozzle #2 and Nozzle #1 are adjacent but their limits of reinforcement on vessel wall have been reduced to consider them as isolated		

Proceed with caution

The illustrated procedure is not regulated, it is the result of experience and good construction practice. The most correct solution to approach this problem would be to proceed with a calculation according to a standard that supports this configuration or a finite element analysis.

For these reasons, we invite you, if you opt for this solution, to evaluate it with caution and in agreement with the parties involved such as customer, control body, manufacturer.