PIPEOTECH

DeltaV-Seal 316L

The impact of using DeltaV-Seal™ on flange surfaces

DeltaV Seal™

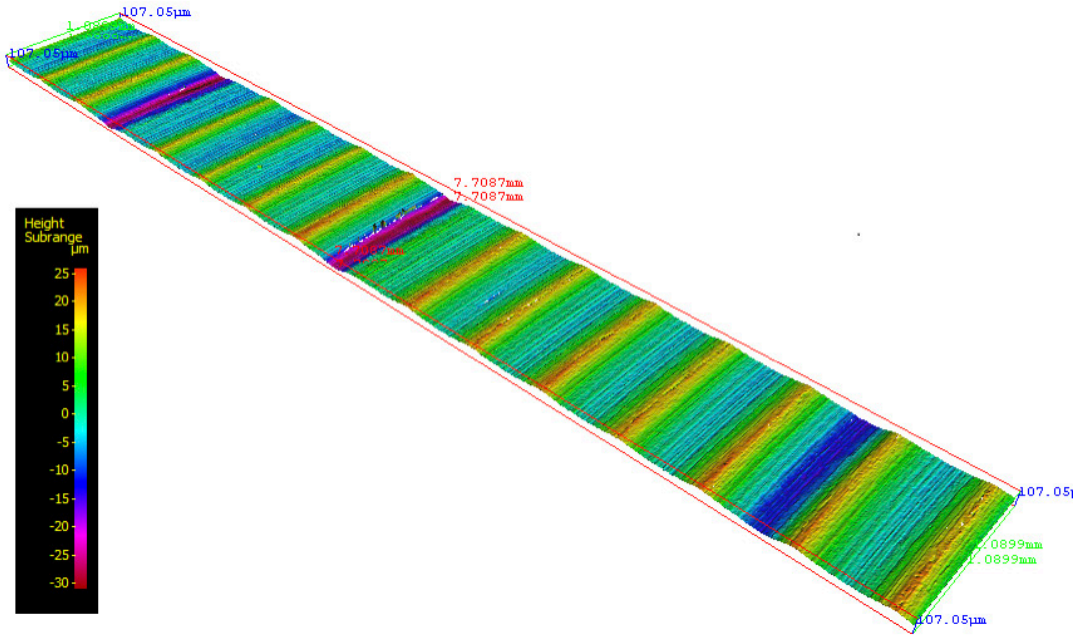
Introduction

Pipeotech have conducted flange surface profile measurements in cooperation with Sintef/DNV to investigate the impact of DeltaV-Seal on flange surfaces in bolted flange joints (BFJ).

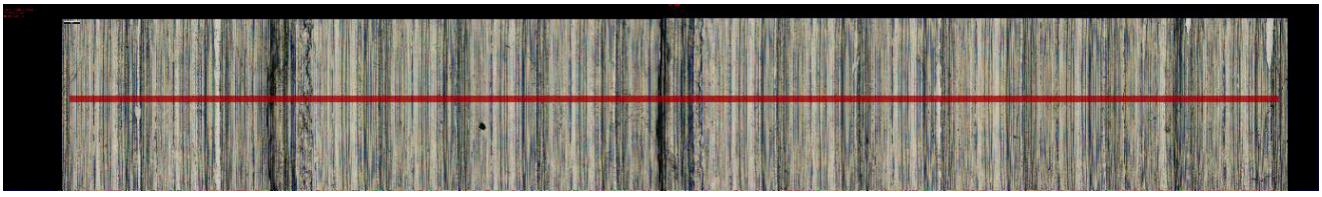
Flange surface profile measurements

To investigate the impact of 316L DeltaV-Seal on flange surfaces, surface profile measurements were performed after installation of the gasket in 1", 6" and 12" RF flanges, all in #300 and made from 316L. An Alicona Imaging 3D optical-based metrology and imaging system was used for the surface profile measurements and documentation.

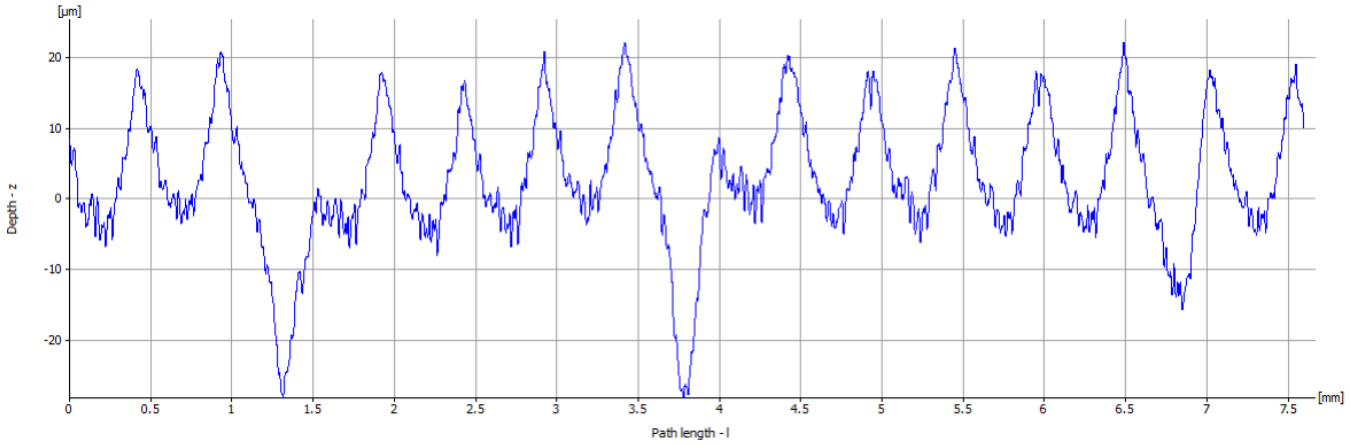
Typical result and documentation presentation from the Alicona Imaging system applied to the tested samples is shown below:



Colour-coded 3D surface profile variation visualization showing concentric flange grooves and three locations of DeltaV-Seal interaction with the flange surface. Purple colour: max. depth 30 µm; Red colour: max. height 25 µm.



Optical image of a 1" flange RF surface with the measurement line in red across with a radial distance of 6 mm between the visible outer and inner ridge interaction locations.



Typical flange surface profile of the tested flanges with the three DeltaV-Seal interaction locations clearly visible in-between the machined grooves with a radial distance of 6 mm between the inner and outer ridge gasket/flange surface interaction locations on the X-axis. Max. height on Y-axis is 20 µm and max. depth on Y-axis is 30 µm. RF width: ≈7.5 mm.

Note: *These plots are typically used for roughness average determinations (R_a-values): the arithmetic average of the absolute values of the profile height deviations recorded within the evaluation length and measured from the mean line in accordance with ASME B46.1. R_a-value determinations were not included in the scope of work of these investigations but were documented elsewhere, contact Pipeotech for further information.*

Summary of tested flange/gasket sizes and seating forces

For each size, two installations were done at two different levels of gasket seating force:

- Level 1: applied force according to Pipeotech recommendations
- Level 2: close to the limit of the bolt load capacity

All tests were done on unused flanges.

The applied force values and %-age calculated by using the root area of the bolts are shown in Table 1 below:

Nominal pipe size (NPS)	Level 1		Level 2	
	Total seating force (kN)	Bolt force (%-age of bolt capacity)	Total seating force (kN)	Bolt force (%-age of bolt capacity)
1”	126	33	341	91
6”	608	36	1520	90
12”	1608	30	4655	86

Table 1

Summary of measurements

After disassembly, all flanges were sent to Sintef for evaluation. Sintef used an Alicona Imaging 3D optical-based metrology and imaging system to determine the impact of the DeltaV-Seal on the flange surfaces. Measurements were performed on two separate laterals 180 degrees apart across the complete RF width including the sealing areas of the three ridges marked out with blue spots, refer to Figure 1 below.

Below is reported the measured depth and width values at the location of the blue spots, i.e., where the ridges of the DeltaV-Seal interacted with the flange surfaces. The maximum depth of the six (6) measured values are reported.

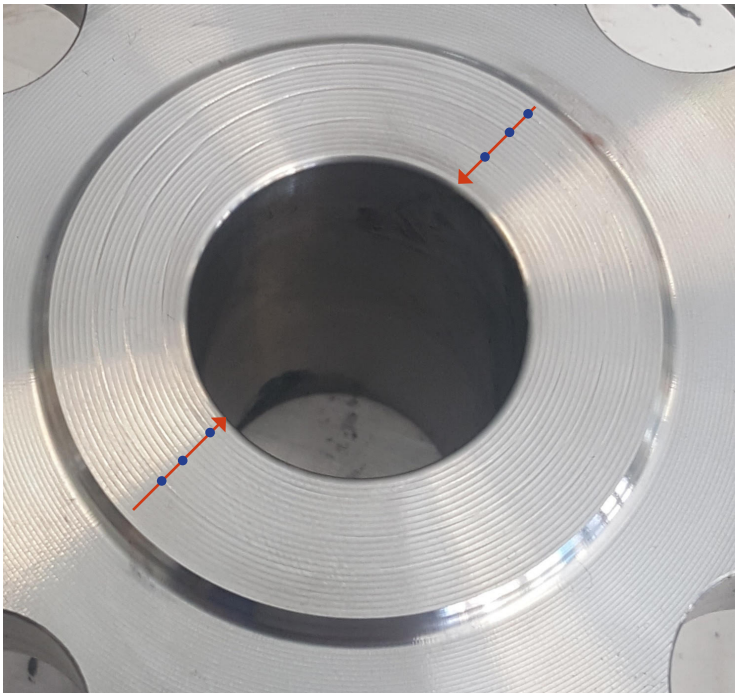


Figure 1. (Note: the gasket was not seated concentrically with the flange bore on this sample)

The following depth and width values were reported for each sample, refer to Table 2 (Level 1) and Table 3 (Level 2) below:

- h_{max}: maximum depth value of the measured marks at the six (6) locations (blue spots)
- h_{actual}: actual impact considering existing grooves from the flange surface finish at the six (6) locations
- w: maximum width (radial) of marks at the six (6) locations

Level 1				
NPS/class	Sample	h_{max} (µm)	h_{actual} (µm)	w (mm)
1"/#300	1	35	15	1.1
	2	45	25	1.1
6"/#300	1	0	0	0
	2	0	0	0
12"/#300	1	70	50	0.6
	2	0	0	0

Table 2

Level 2				
NPS/class	Sample	h_{max} (µm)	h_{actual} (µm)	w (mm)
1"/#300	1	150	130	1.1
	2	130	110	1.0
6"/#300	1	80	60	1.4
	2	75	55	0.8
12"/#300	1	90	70	1.2
	2	170	150	1.3

Table 3

Summary of investigations

The investigations showed a vast variety in terms of visibility of marks/indentations as viewed by the naked eye. This visibility was clearly depending on several factors, e.g., the width and the depth of the marks/indentations.

The measured depths/widths showed to be consistent, depending on if the DeltaV-Seal ridges made contact at the top or bottom of the existing grooves on the serrated surface finish. If it made contact at the bottom only a small additional width was created. If it made contact at the top, the width was approximately doubled, as the width measurements were done from groove-top to groove-top. In conclusion, none of the specimens in these tests show unacceptable dent widths.

The depths of the marks were in some cases difficult to distinguish from the pre-existing flange grooves, which were in the range of 20 to 30 µm deep with a width of 0.3 to 0.4 mm and with a frequency of around 44 grooves/inch typical of spiral and concentric serrated flange surface finish.

This was particularly true in the tests where Pipeotech's recommended torque was applied. But in general, only a very small increase of pre-existing groove depth was found.

Conclusions

1. DeltaV-Seal gaskets do not cause any unacceptable damage to flange surfaces.
2. Depth and width of normal pre-existing flange surface serrations (concentric or spiral) will only marginally increase at the locations of DeltaV-Seal interaction with the flange surface.
3. Naked eye observations of flange surfaces are not sufficiently reliable for detecting flange surface damages due to DeltaV-Seal interaction and should not replace physical or other suitable flange surface inspection and/or testing, contact Pipeotech engineering staff for further information.