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Test Report

Draft

Client:	Environmental Gasket Company Ltd. 309 Hanzhongmen Ave. Nanjing, 210036 PR China
Order-No. (Client):	13EGC-MPA09
Order-No. (MPA):	**902 5864 002 /Hh/Mor/Scr**
Test Item:	**Fishbone Gasket**
Specification Applied:	compression tests according to EN 13555
Date of Receipt of Test Item	October 02. 2013
Date of Test:	October 11. to 15. 2013
Date of Report:	October 29. 2013
Page 1 of	4 text pages
Enclosures :	4
Supplements:	
Total Number of Pages:	8
Number of Reports:	2 x Environmental Gasket Company Ltd.

The test results relate only to the items tested.

1 Purpose of Investigation

Purpose of investigation were compression tests on a gasket, composed of a stainless steel body with graphite layers in both sides of Environmental Gasket Company Ltd. according to EN 13555. The material was delivered by the client and named as **Fishbone Gasket**.

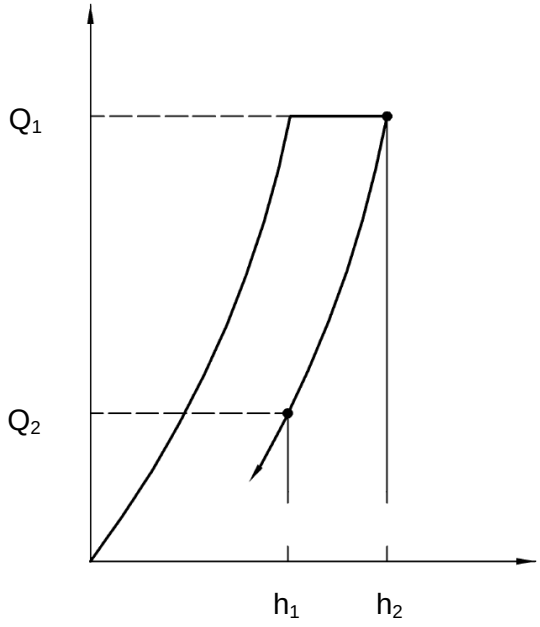
2 Tests and Analyses Performed

2.1 Compression Test

Compression tests result in the following parameters:

- Gasket parameter $Q_{S\,max\,(T)}$ is the maximum gasket surface pressure that may be imposed on the gasket at the indicated temperature T without collapse or compressive failure of the gasket.
- Gasket parameters $E_{G\,(T,Q_A)}$ are the unloading moduli, also called Secant unloading moduli or Young's moduli, determined from the thickness recovery of the gasket between the stepwise increasing initial compression surface pressure Q_A and unloading to a third of this initial surface pressure at the temperature level T.

2.1.1 Calculation of E_G According to EN 13555



$$E_G = \frac{h_1 \cdot (Q_1 - Q_2)}{h_2 - h_1} \qquad (1)$$

Figure 1: Calculation of E_G

Q_1 is one initial stress level. Q_2 is about one third of Q_1. h_1 is the gasket thickness at Q_1, h_2 the thickness at Q_2.

3 Results of Investigation

3.1 Results of the Compression Tests on Fishbone Gasket

The cyclic compression tests were carried out for **Fishbone Gasket** at ambient temperature (23 °C) and high temperature (400 °C).

At both test temperatures the thickness change per stress increase does not show a significant behavior up to the maximum gasket stress of 213 MPa (limited by the test rig), Figures 2 and 3 in Enclosure 1.

The Young's moduli are increasing until 213 MPa up to very high values of about 620000 MPa at ambient temperature or 330000 MPA at high temperature, Figures 4 and 5 in Enclosure 2.

The values of Young's Modulus are centralized in Table 1.

Gasket stress [MPa]	**Young's module**	
	ambient temperature 23 °C [MPa]	**high temperature 400 °C** [MPa]
5	672	641
10	1617	1227
15	9205	7136
20	9596	6908
30	8460	9548
40	10732	17940
50	10359	17930
60	11582	15265
80	19219	80281
100	83655	43324
120	40755	44674
140	159344	-
160	94144	79296
179	104288	191326
199	619503	326905
213	566395	140115

Table 1: Young's modulus of the gasket $E_{G(T)}$ [MPa]

In Tables 2 and 3 in Enclosures 3 and 4 the values of gasket thickness h_i, surface pressure Q_i and Young's modulus E_G are centralised. h_i means h_1 or h_2, Q_i means Q_1 or Q_2 in Equation 1.

4 Interpretation[1]

Compression tests were carried out for **Fishbone Gasket** at ambient temperature (23 °C) and high temperature (400 °C). As expected the values of Young's moduli are very high because after the graphite layers are compressed very high the metallic body of the gasket is the only elastic component. It is very stiff and so the elastic recovery is very low - at some steps only one micrometer. This is also the reason for the scatter of the Young's modulus at high surface pressures.

Up to the maximum load of the test rig no collapse or compressive failure of the gasket could be found out.

Prepared by	Approved and released by
signed Dipl.-Ing. S. Moritz **Deputy Head of Sealing Technology**	**signed Dipl.-Ing. R. Hahn** **Head of Sealing Technology**

[1] Concepts and interpretations are not subject of the accreditation

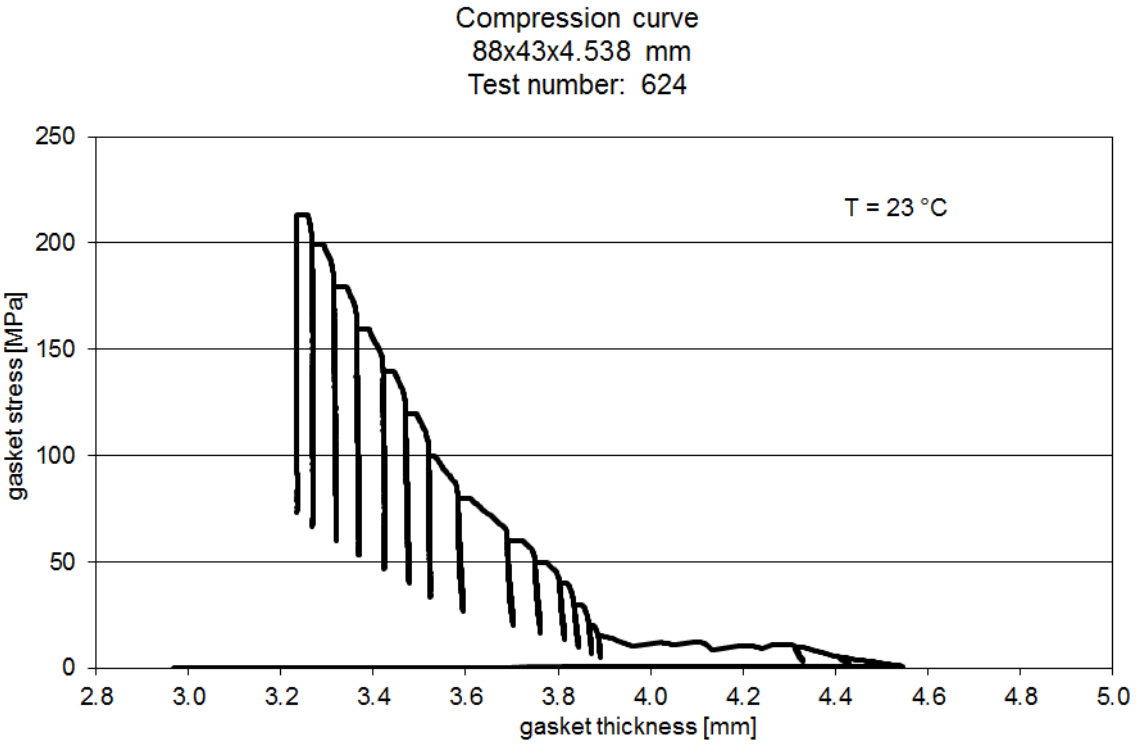


Figure 2: **Fishbone Gasket** of Environmental Gasket Company Ltd.
compression test at ambient temperature (23 °C)

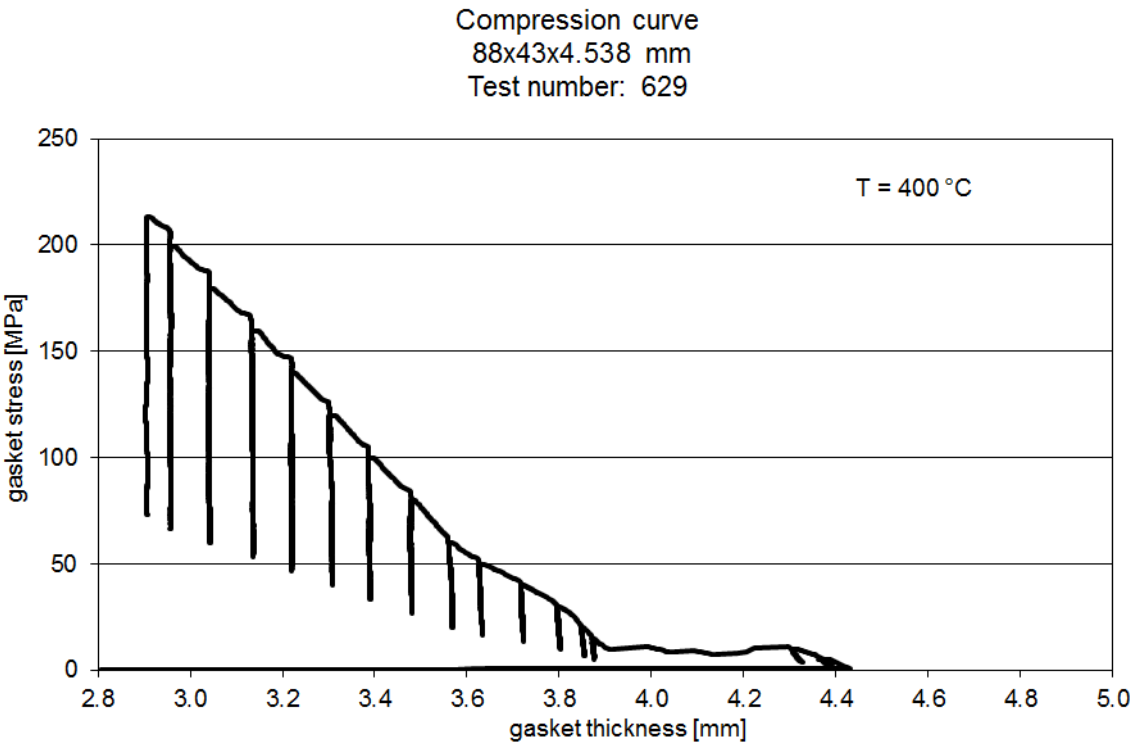


Figure 3: **Fishbone Gasket** of Environmental Gasket Company Ltd.
compression test at high temperature (400 °C)

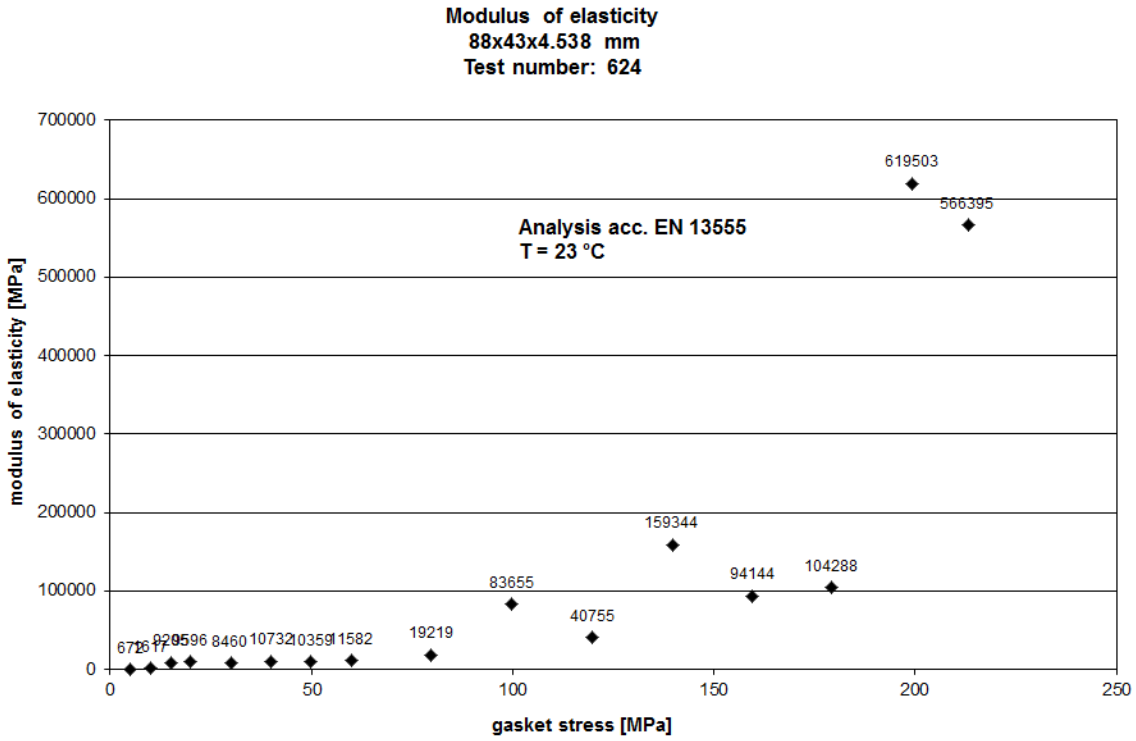


Figure 4: **Fishbone Gasket** of Environmental Gasket Company Ltd.
Young's modulus at ambient temperature (23 °C)

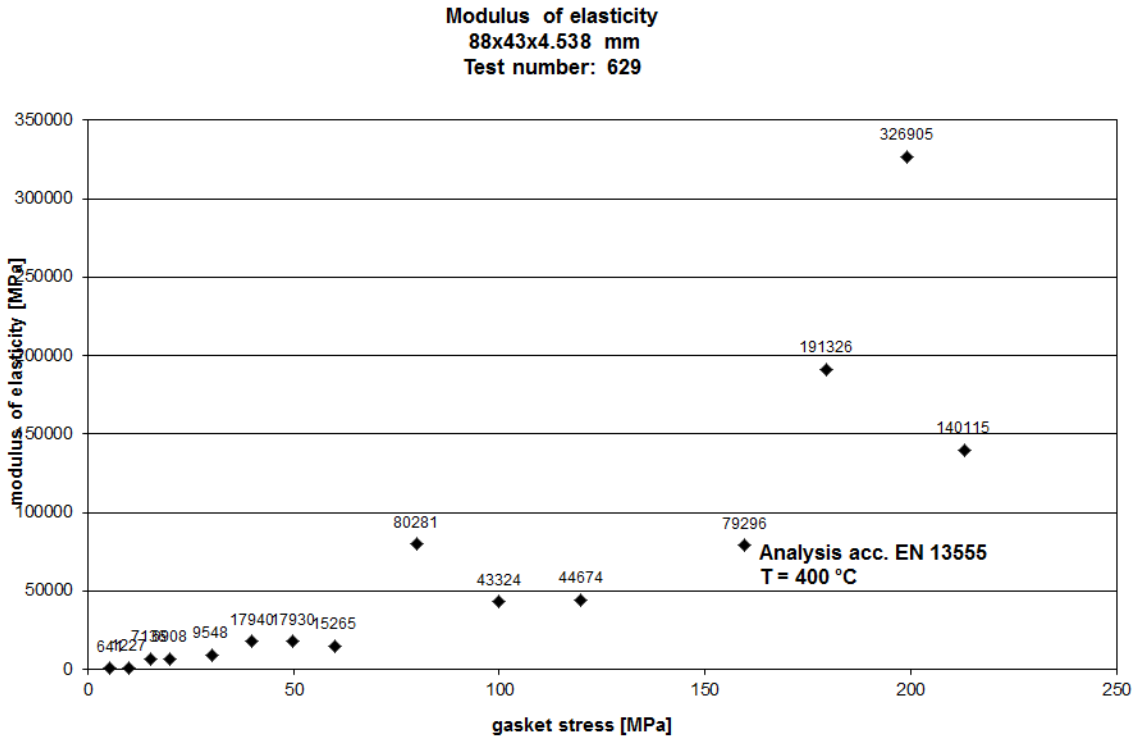


Figure 5: **Fishbone Gasket** of Environmental Gasket Company Ltd.
Young's modulus at high temperature (400 °C)

h_D	Q_i	E_G
4.409	5	672
4.430	2	
4.312	10	1617
4.329	3	
3.888	15	9205
3.892	5	
3.868	20	9596
3.873	7	
3.835	30	8460
3.844	10	
3.804	40	10732
3.813	13	
3.750	50	10359
3.762	17	
3.690	60	11582
3.703	20	
3.584	80	19219
3.594	27	
3.521	100	83655
3.524	33	
3.471	120	40755
3.477	40	
3.422	140	159344
3.424	47	
3.365	160	94144
3.369	53	
3.316	179	104288
3.320	60	
3.268	199	619503
3.269	67	
3.234	213	566395
3.235	73	

Table 2: gasket thickness hi, Surface pressure Qi and Young's modulus of the gasket $E_{G\,(RT)}$ at ambient temperature.

h_i	Q_i	E_G
4.369	5	641
4.391	2	
4.304	10	1227
4.327	4	
3.871	15	7136
3.877	5	
3.848	20	6908
3.855	7	
3.795	30	9548
3.803	10	
3.717	40	17940
3.722	13	
3.626	50	17930
3.632	17	
3.561	60	15265
3.570	20	
3.478	80	80281
3.480	27	
3.386	100	43324
3.391	33	
3.301	120	44674
3.307	40	
3.221	140	-
3.221	47	
3.133	160	79296
3.137	53	
3.042	179	191326
3.043	60	
2.957	199	326905
2.958	67	
2.905	213	140115
2.907	73	

Table 3: gasket thickness hi, Surface pressure Qi and Young's modulus of the gasket $E_{G\,(400\,°C)}$ at high temperature.