Steinbeis-Transferzentrum
BWF Esslingen

**Akkreditiertes Prüflabor nach
DIN EN ISO/IEC 17025:2005**

MSI-Technik

Attempts in U-bolts with PE with PE liner

Under quasi-static demand

17. August 2012

Prof. Dr.-Ing. Peter Häfele

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Under quasi-static demand

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Treatment period	12.07.2012 – 17.08.2012
Project number	BWF4479

Prof. Dr.-Ing. Peter Häfele Dipl.-Ing. Thorsten Weissenrieder

Probenaufbewahrungsfristen:
Um Rücknahme der Prüfgegenstände wird gebeten. Lagerfähige Prüfgegenstände werden für 1 Monat, metallographische Schliffe für 3 Jahre aufbewahrt. Rücksendung oder längere Aufbewahrung nur auf Vereinbarung möglich.
Berichte dürfen ohne ausdrückliche Zustimmung der BWF-Leitung nur in voller Länge, nicht aber auszugsweise reproduziert werden. Falls im Bericht Prüfergebnisse enthalten sind, beziehen sich diese nur auf das untersuchte Probenmaterial. Sämtliche Prüfungen unterliegen einem Qualitätssicherungsprogramm gemäß EN ISO/IEC 17025. Die Ergebnisse beziehen sich ausschließlich auf die Prüfgegenstände.
Nicht akkreditierte Verfahren werden in Prüfberichten als solche gekennzeichnet. Beratungstätigkeiten (Untersuchungen, Gutachten) sowie Forschung und Entwicklung liegen außerhalb der Akkreditierung.

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1 Background and objective

Background and objective

- An aim of the investigation are attempts in U-bolts PE under quasi-static demand.

- With the test results the static load of the components should be determined for different component dimensions in different demand directions.
  - tensile loading in z-direction
  - tensile loading in y-direction
  - pressure test in x-direction

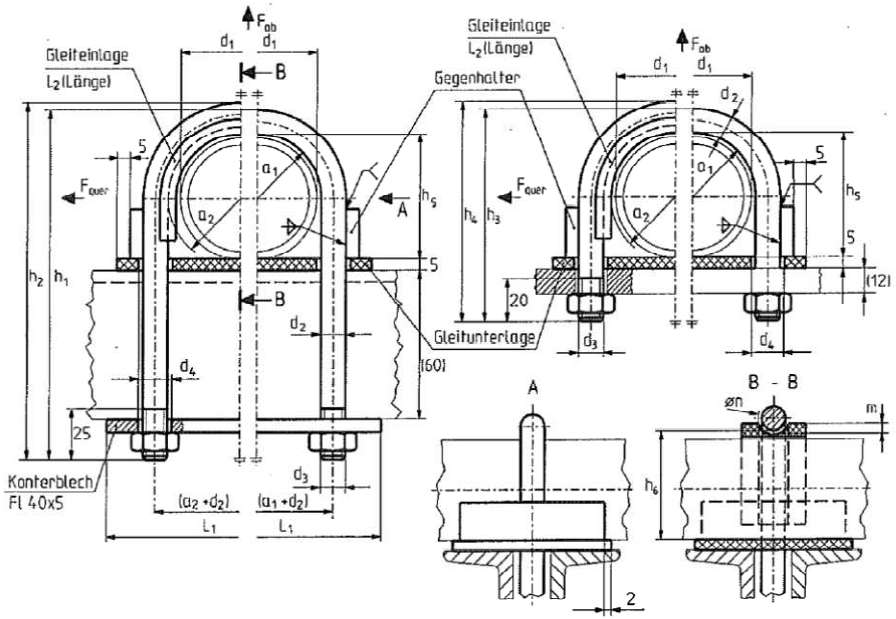
2 Test extent

Versuchsmatrix

Test matrix Attempts in U-Bolts PE			
Load direction	*DN 100*	*DN 250*	*DN 300*
x	3 x	3 x	3 x
y	3 x	3 x	3 x
z	3 x	3 x	3 x

3 Examined components

Untersuchte Rundstahlbügel

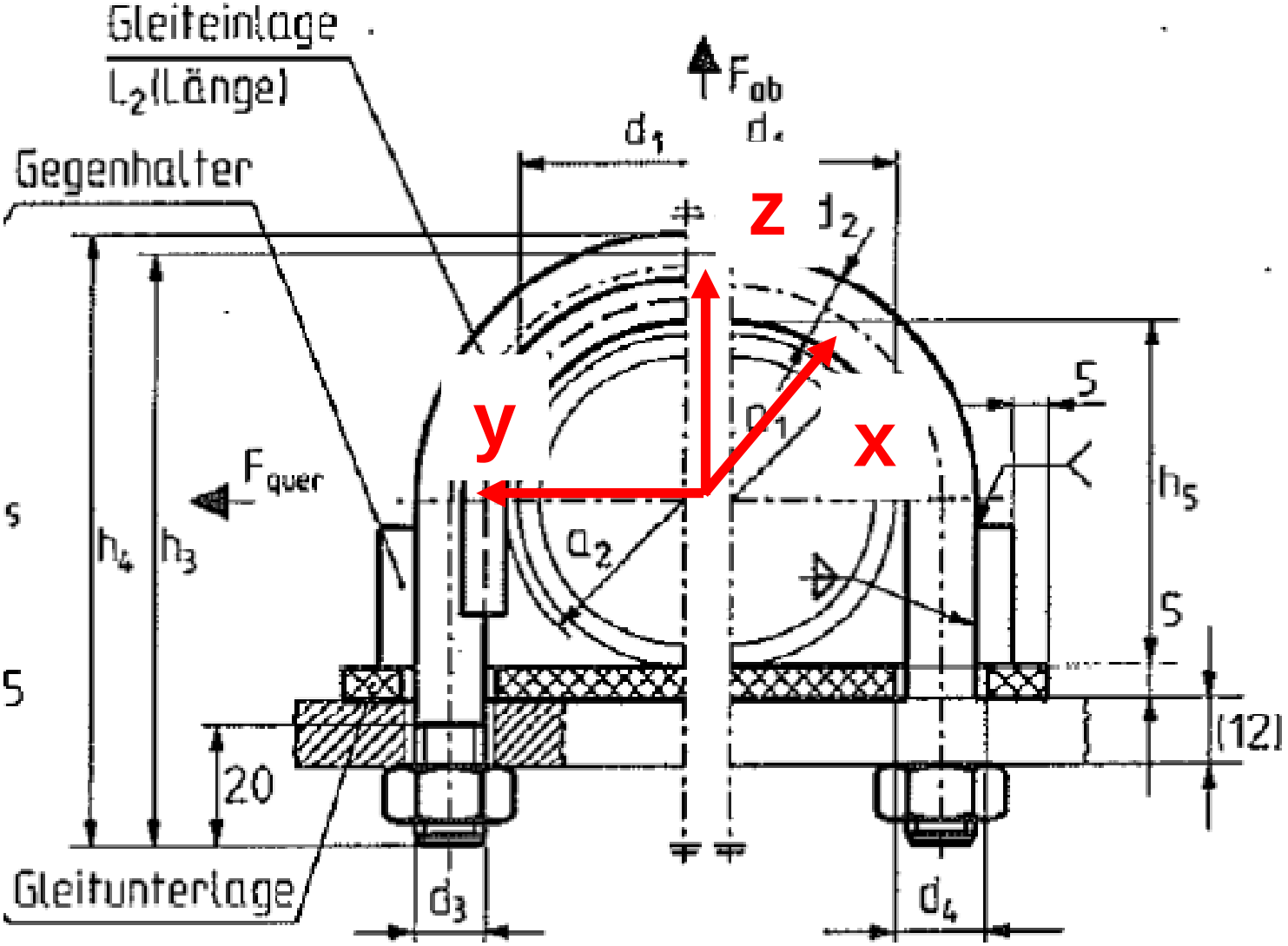


Nenn-maß DN	Durchmesser a_1	Durchmesser a_2	für rohr d_1	d_2	Ge-winde d_3	Bügelhöhe h_1	Bügelhöhe h_2	Bügelhöhe h_3	Bügelhöhe h_4	lichte Höhe h_5	lichte Höhe h_6	Konterblech L_1	Konterblech d_4 1)	Gegen halter	Gleiteinlage Flach	Gleiteinlage L_2	Gleiteinlage Nut m	Gleiteinlage Nut Ø n
15	25	29	21,3	8,8	M10	116	118	63	65	23	25	75	12	Flach 5 x 20 x 40	30 x 6	67	4	10
20	30	34	26,9			121	123	68	70	28,5	30,5	80				78		
25	38	42	33,7			129	131	76	78	36	39	88				97		
32	46	50	42,4			137	139	84	86	44	47	96				115		
40	52	56	48,3			143	145	90	92	50	53	102				129		
50	64	68	60,3			155	157	102	104	62	65	114				156		
65	82	86	76,1			173	175	120	122	79	82	132				198		
80	94	98	88,9			185	187	132	134	91,5	95	144				225		
100	120	124	114			211	213	158	160	117	120	170				285		
125	148	154	140	10,6	M12	244	247	191	194	144	147	208	14	Flach 8 x 20 x 50	40 x 8	354	5	12
150	176	182	168			272	275	219	222	175	175	236				420		
200	228	234	219			324	327	271	273	227	227	288				540		
250	282	288	273			378	381	325	328	281	281	342				664		
300					M16													

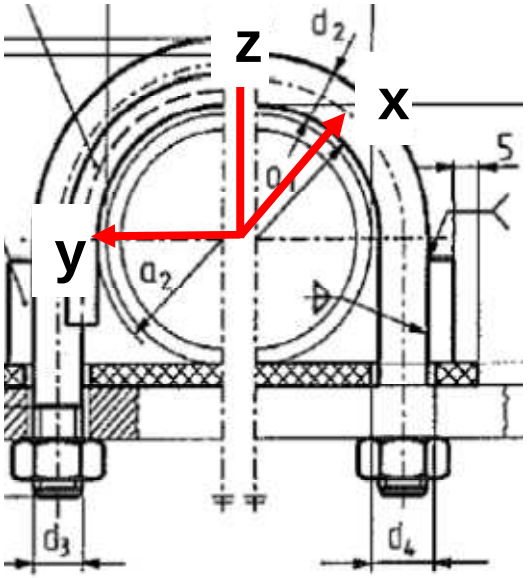
Quelle: MSI Technik

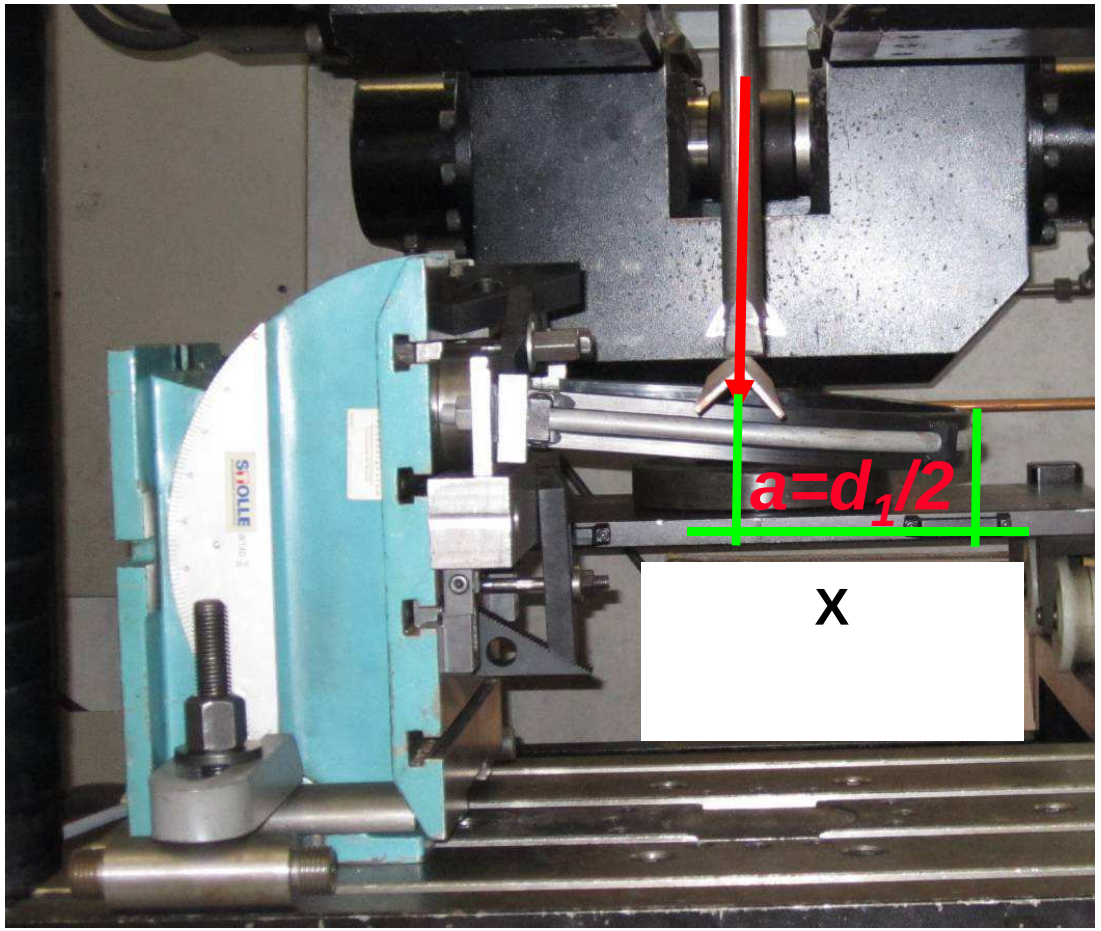
4 Test technology

Co-ordinate system



Test construction, Load in x direction

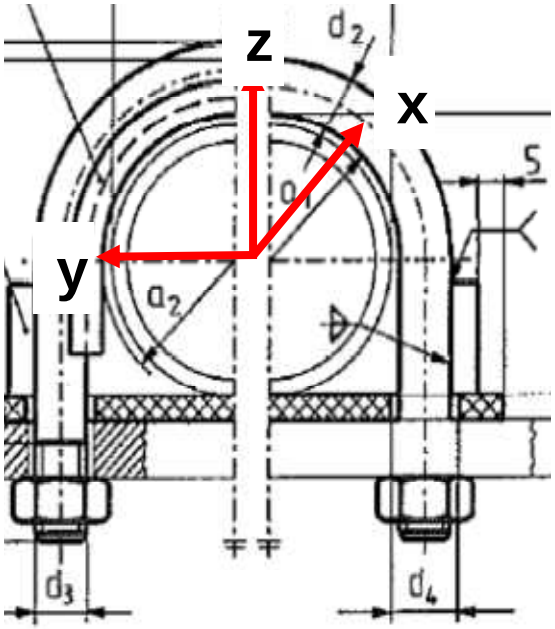


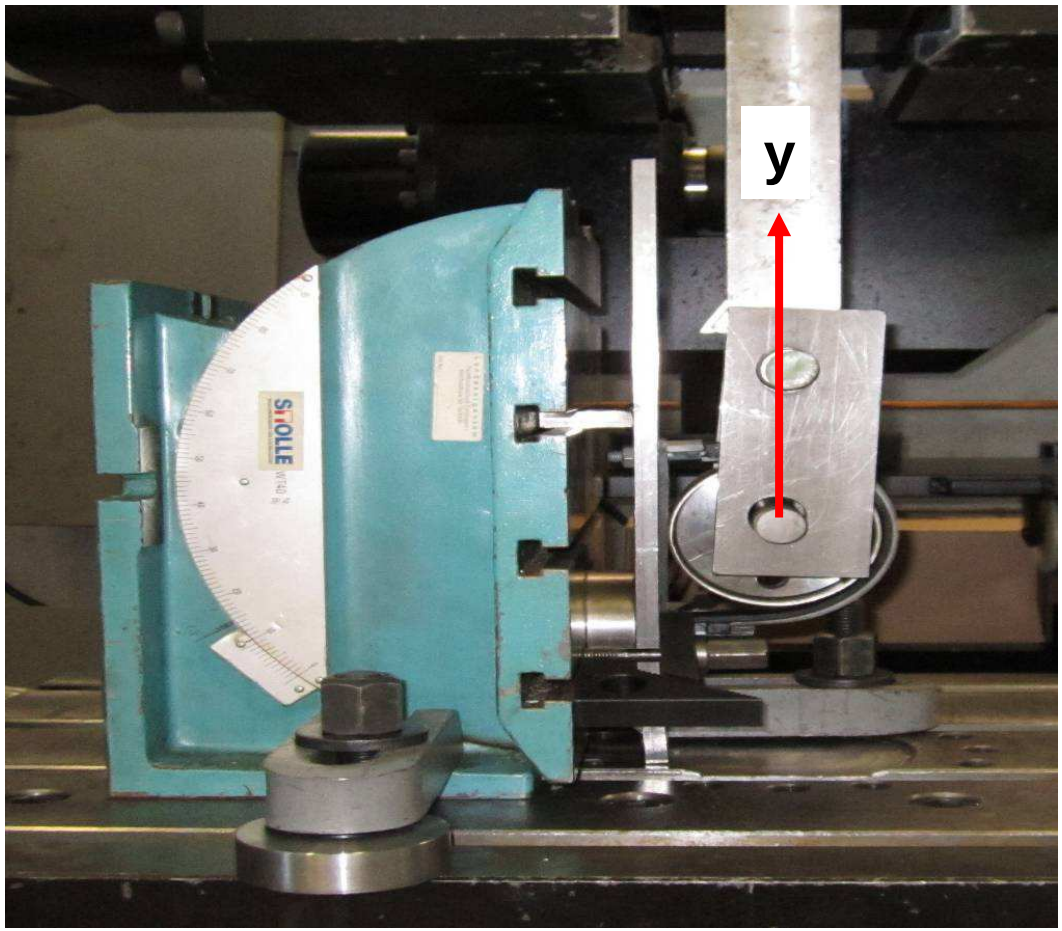


a = Radius of the pipe with diameter d_1

The load in x direction occurs about a steel profile forehead-sided in the mood on the extent

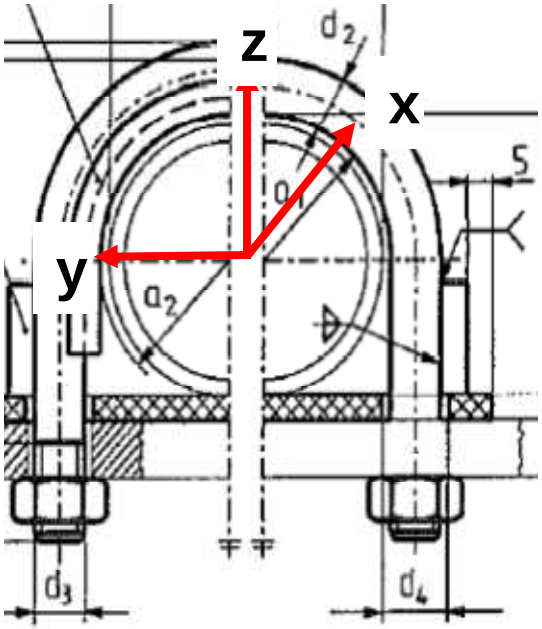
Test construction, Load in y direction

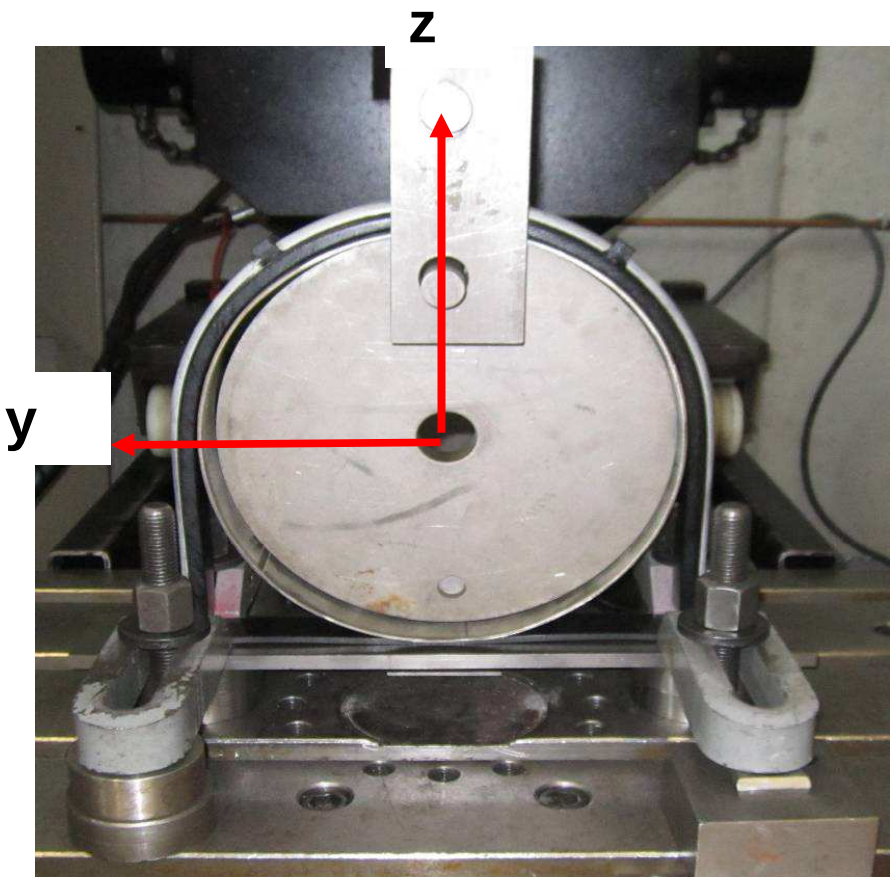




For the check in y-and z direction the provided pipe segment is clamped on the hanger. The load introduction occurs about a steel disc about a fork.

Test construction, Load in z direction





For the check in y-and z direction the provided pipe segment is clamped on the hanger. The load introduction occurs about a steel disc about a fork.

5 Test results

5.1
U-Bolt DN 100

U-bolt DN 100 x - direction

U-bolt DN 100 Load in x direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**comment**
DN 100-X-1	3,0	
DN 100-X-2	2,9	
DN 100-X-3	3,0	
Average	**3,0**	
Divergence	0,05	

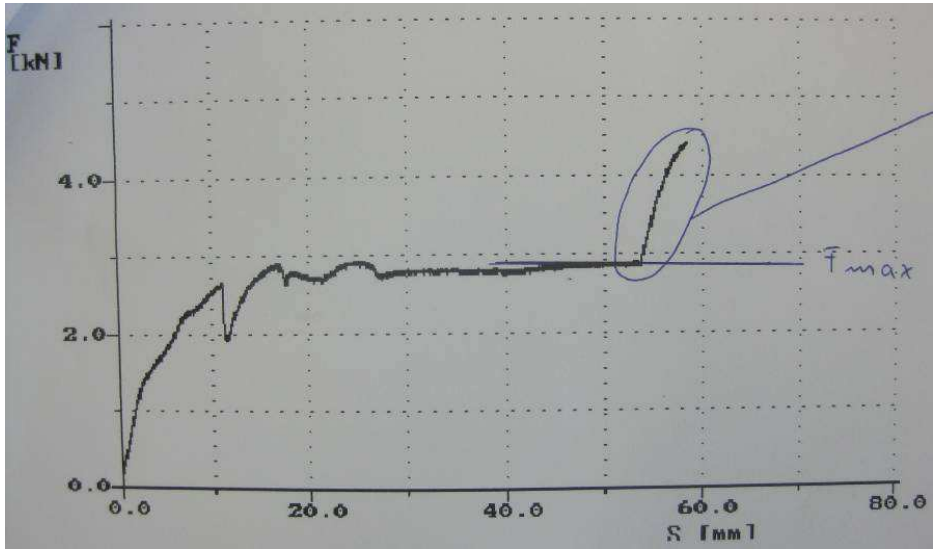
U-bolt DN 100 y - direction

U-bolt DN 100 Load in y direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**Comment**
DN 100-Y-1	27,3	
DN 100-Y-2	27,2	
DN 100-Y-3	26,9	
Average	**27,1**	
Divergence	0,2	

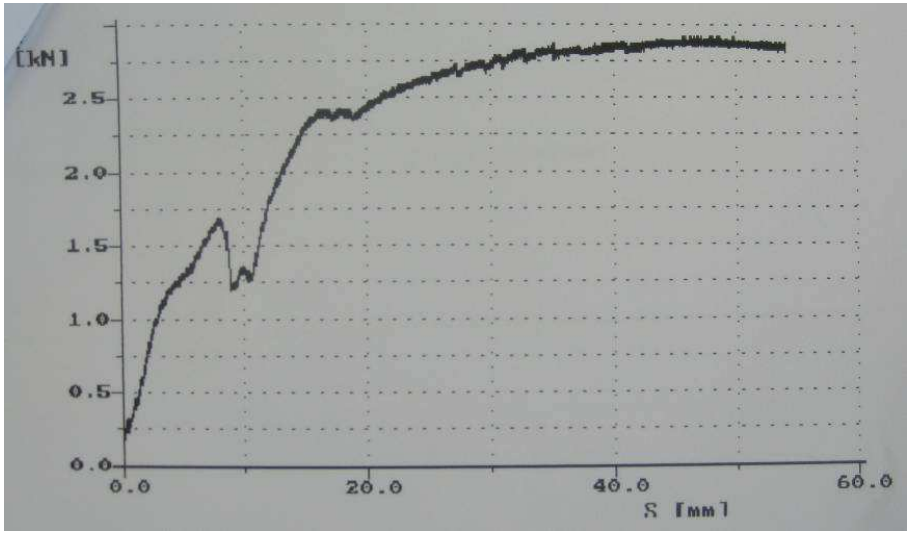
U-bolt DN 100 z - direction

U-bolt DN 100 Load in z direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**Comment**
DN 100-Z-1	48,8	
DN 100-Z-2	54,6	
DN 100-Z-3	47,8	
Average	**50,4**	
Divergence	3,7	

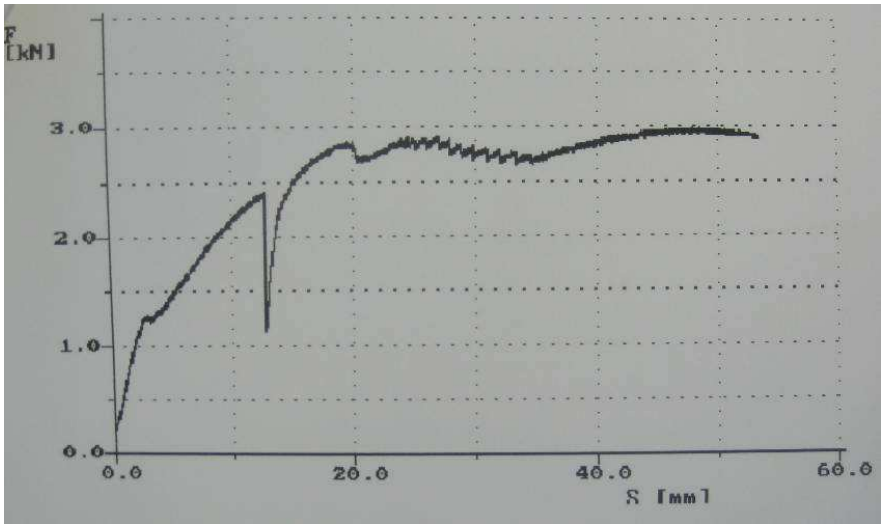
Strength way diagrammes DN 100 x direction



Probe_1

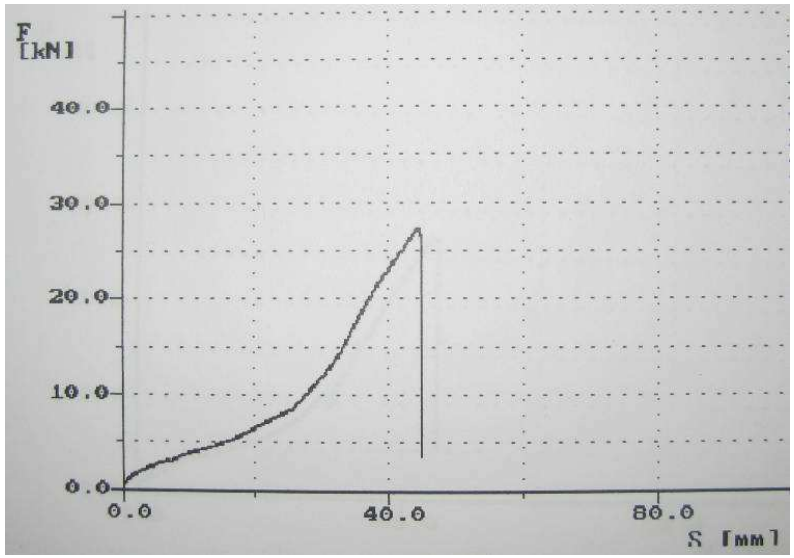


Probe_2

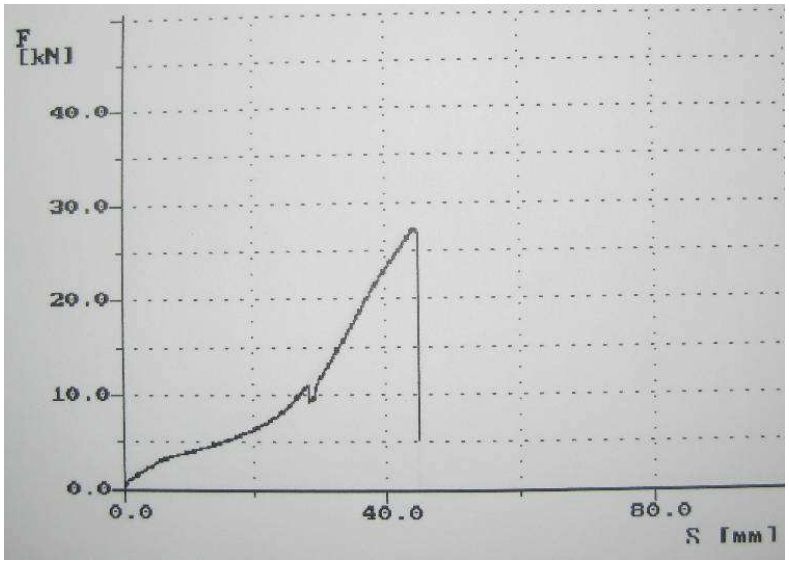


Probe_3

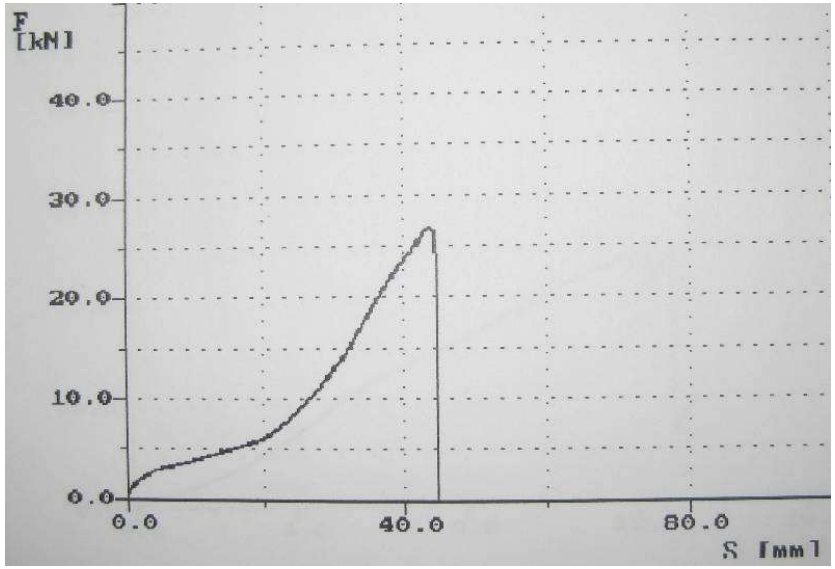
Strength way diagrammes DN 100 y direction



Probe_1

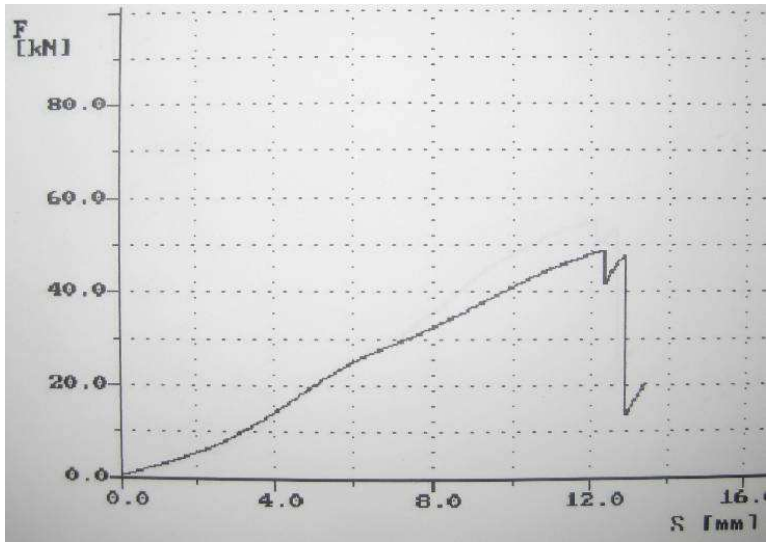


Probe_2

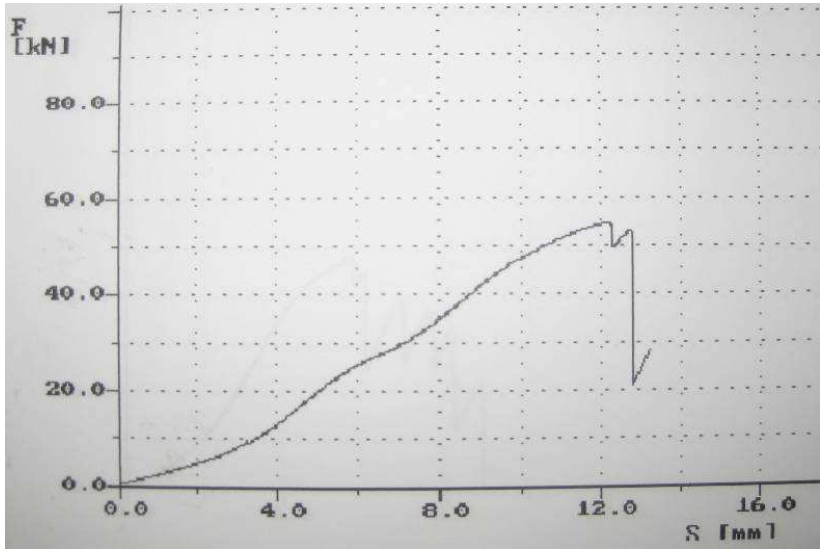


Probe_3

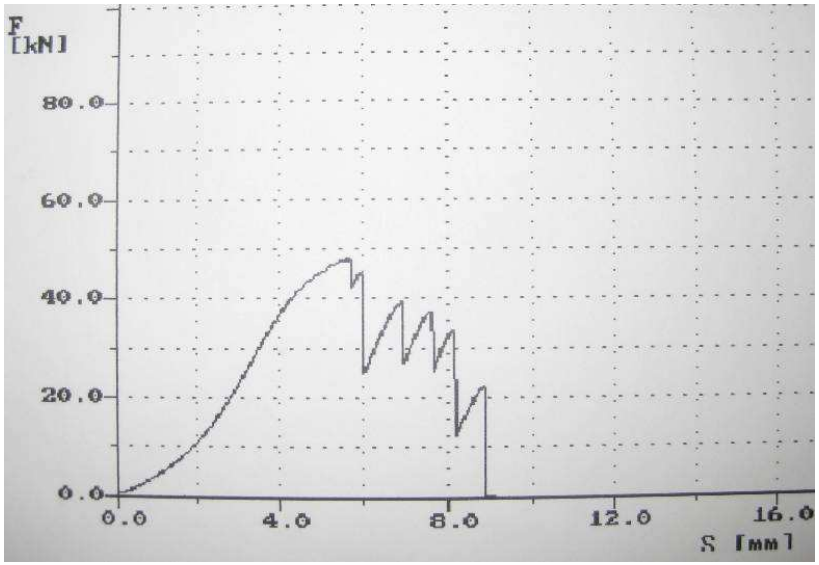
Strength way diagrammes DN 100 z direction



Probe_1



Probe_2



Probe_3

5.2
U-bolt DN 250

U-bolt DN 250 x - direction

U-Bolt DN 250 Load in x direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**Comment**
DN 250-X-1	1,8	
DN 250-X-2	1,8	
DN 250-X-3	1,9	
Average	**1,8**	
Divergence	0,04	

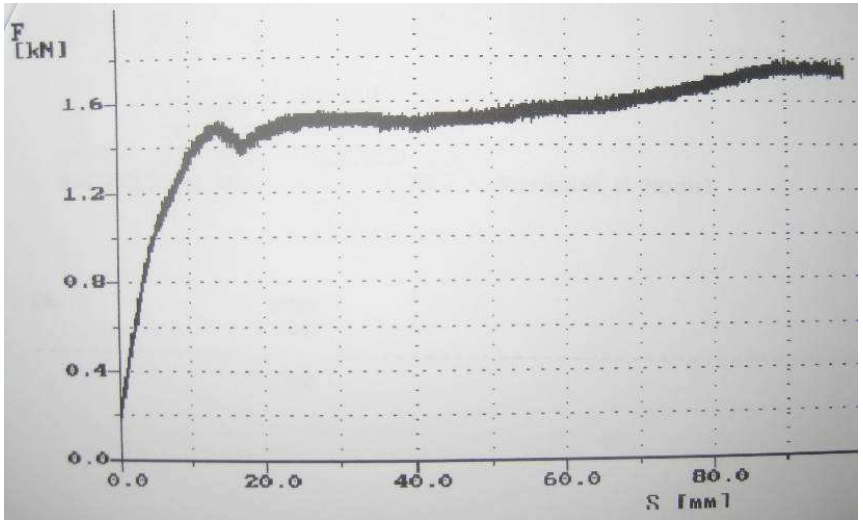
U-bolt DN 250 y - direction

U-bolt DN 250 Load in y direction		
Probe Nr.	**Maximum strength** **F_{max} [kN]**	**Comment**
DN 250-Y-1	44,7	
DN 250-Y-2	34,6	
DN 250-Y-3	45,3	
Average	**41,5**	
Divergence	6,03	

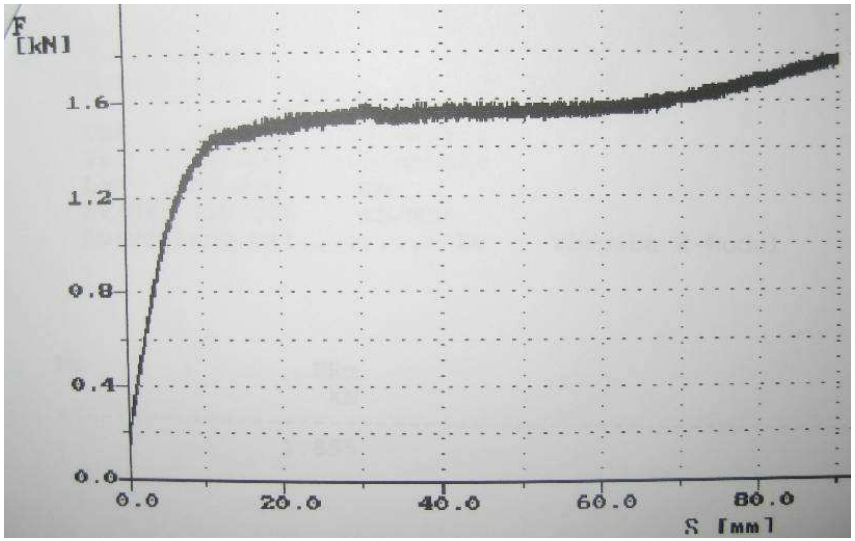
U-bolt DN 250 z - direction

U-bolt DN 250 Load in z direction		
Probe Nr.	**Maximum strength** **F_{max} [kN]**	**Comment**
DN 250-Z-1	79,1	
DN 250-Z-2	79,6	
DN 250-Z-3	83,3	
Average	**80,7**	
Divergence	2,3	

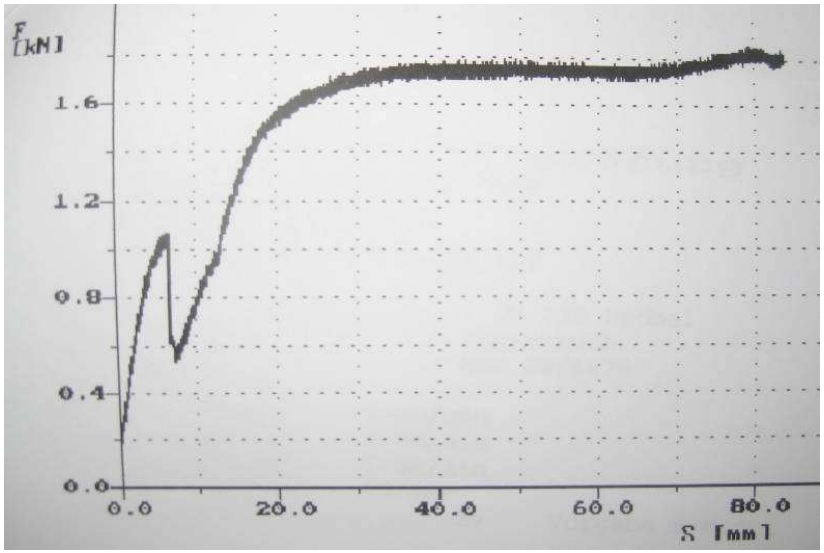
Strength way diagrammes DN 250 x direction



Probe_1

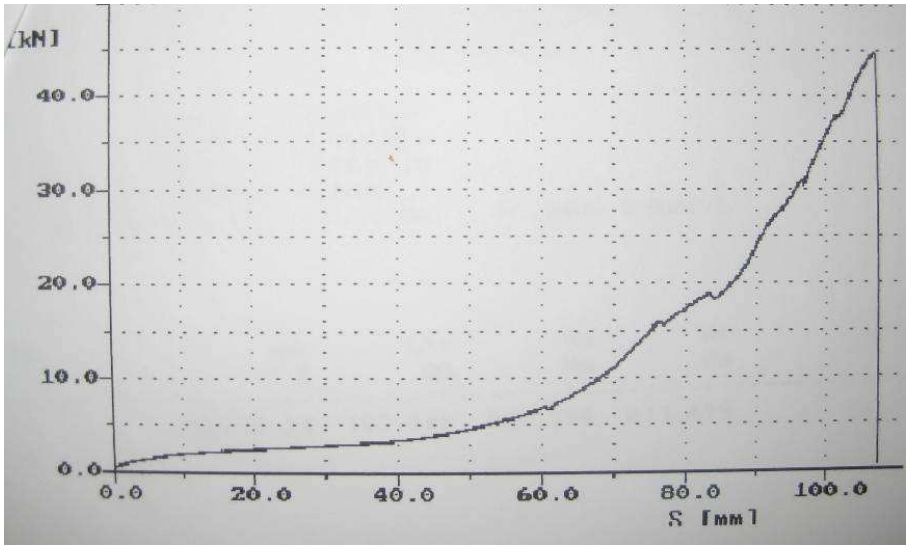


Probe_2

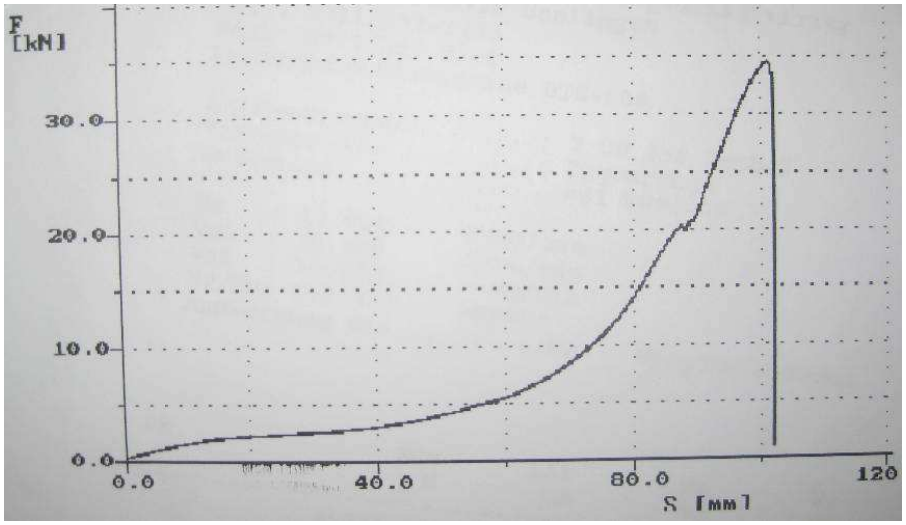


Probe_3

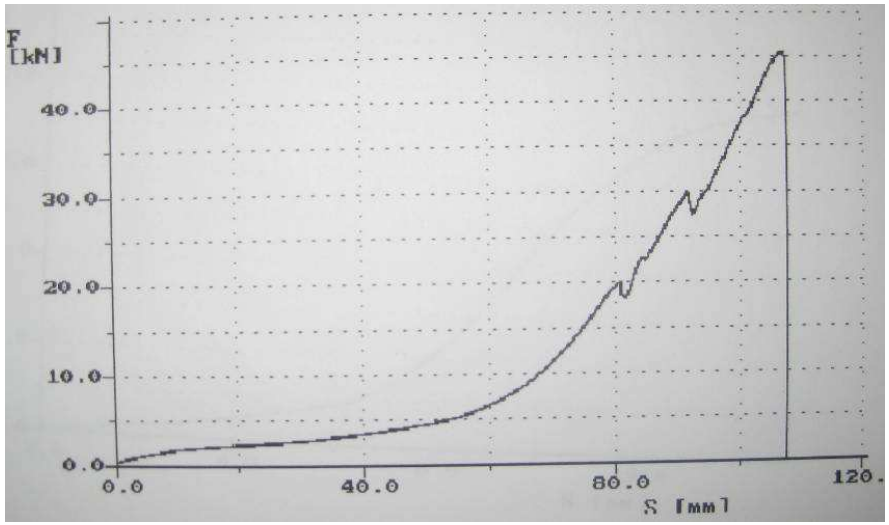
Strength way diagrammes DN 250 y direction



Probe_1

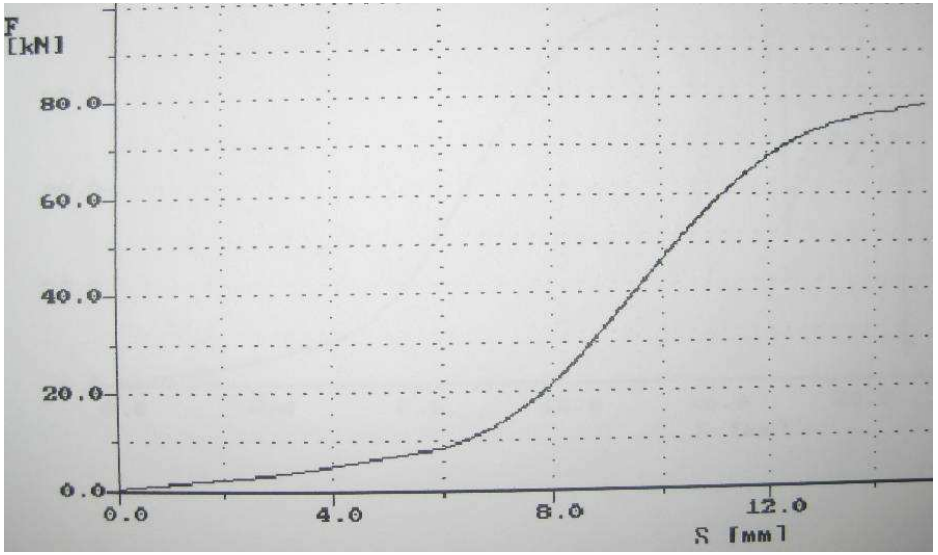


Probe_2

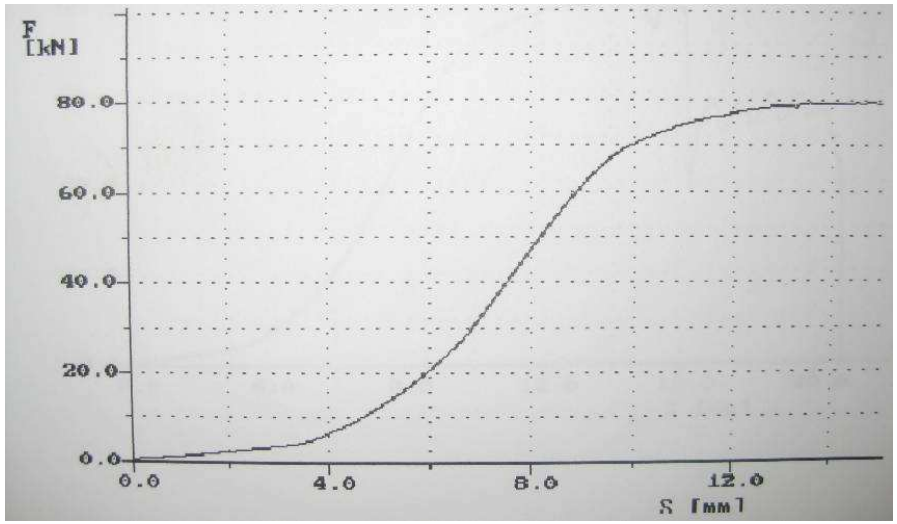


Probe_3

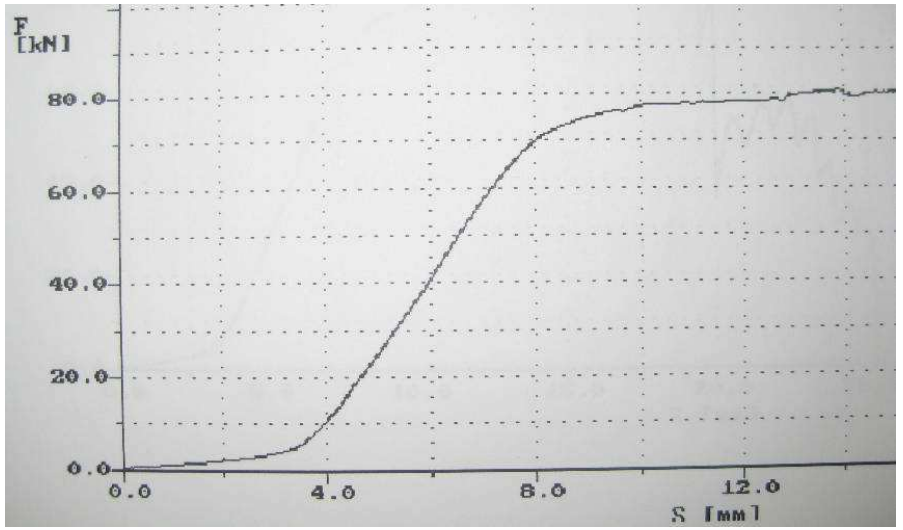
Strength way diagrammes DN 250 z direction



Probe_1



Probe_2



Probe_3

5.3
U-bolt DN 300

U-bolt DN 300 x - direction

U-bolt DN 300 Load in x direction		
Probe Nr.	**Maximum strength** **F_{max} [kN]**	**Comment**
DN 300-X-1	5,4	
DN 300-X-2	4,6	
DN 300-X-3	4,4	
Average	**4,8**	
Divergence	0,5	

U-bolt DN 300 y - directions

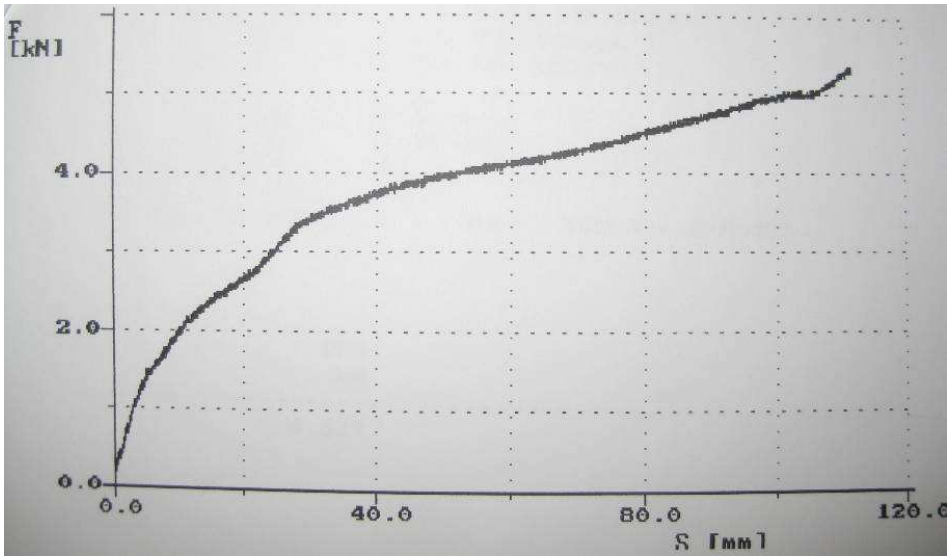
U-bolt DN 300 Load in y direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**Comment**
DN 300-Y-1	65,4	No break
DN 300-Y-2	60,3	No break
DN 300-Y-3	60,5	No break
Average	**62,0**	
Divergence	2,9	

U-bolt DN 300 z - direction

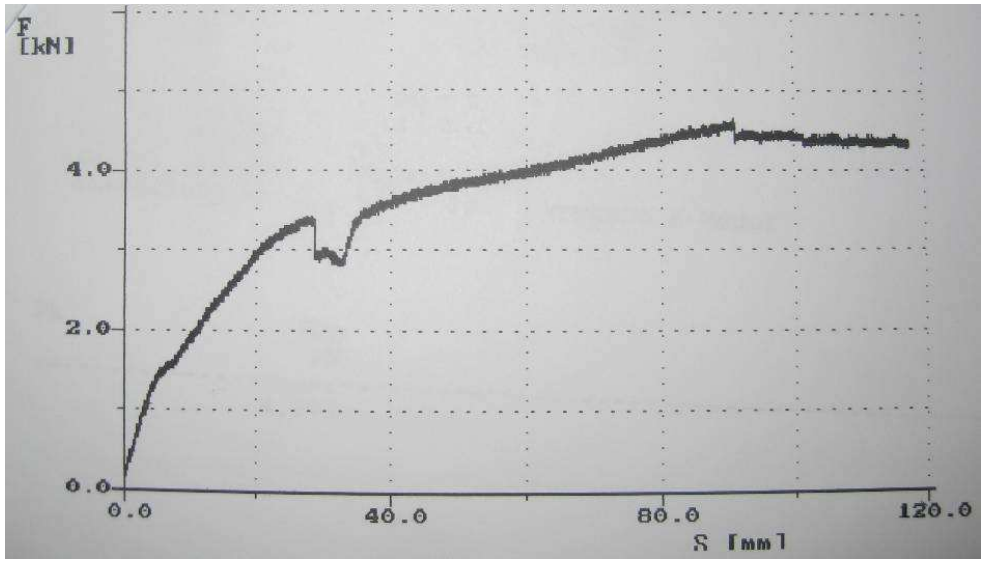
U-bolt DN 300 Load in z direction		
Probe Nr.	**Maximum strength F_{max} [kN]**	**Comment**
DN 300-Z-1[1)]	118,5	Durchbiegung der Vorrichtung zu groß
DN 300-Z-2	151,4	
DN 300-Z-3	147,3	
Average	**149,4**	
Divergence	2,9	

1) Average without this test investigates

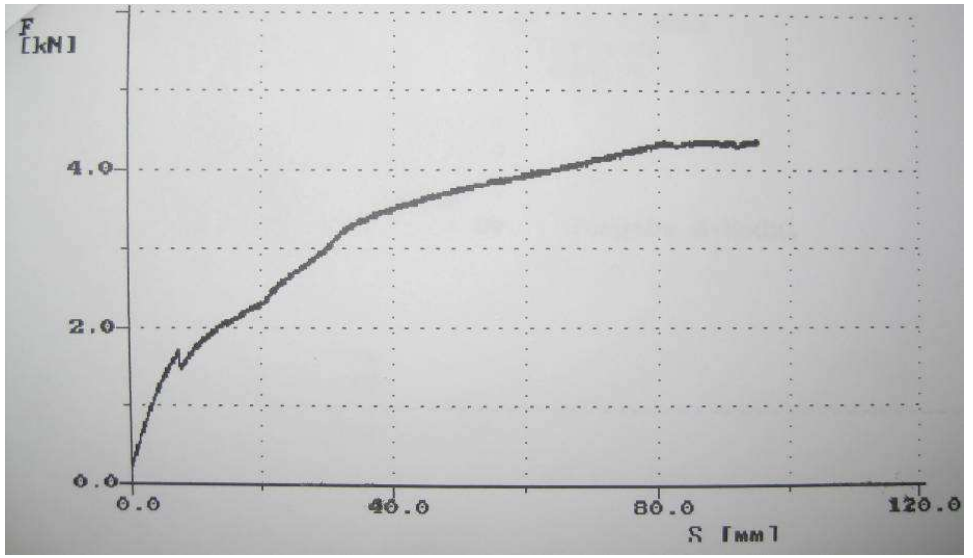
Strength way diagrammes DN 300 x direction



Probe_1

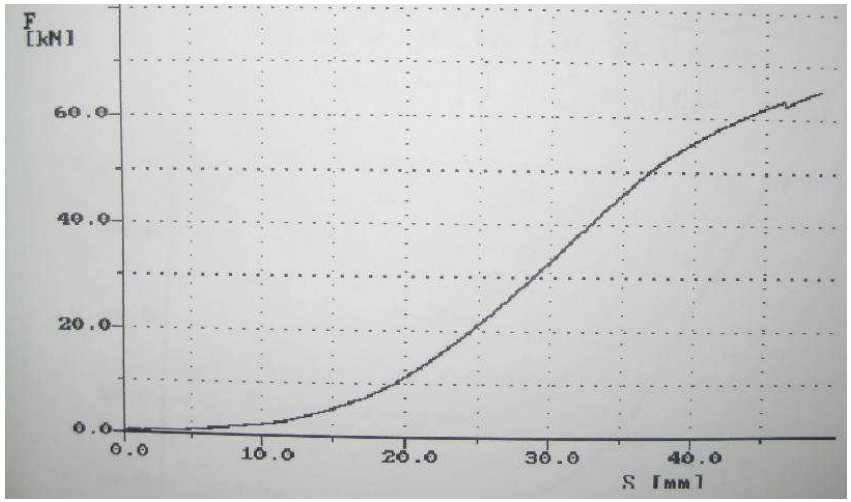


Probe_2

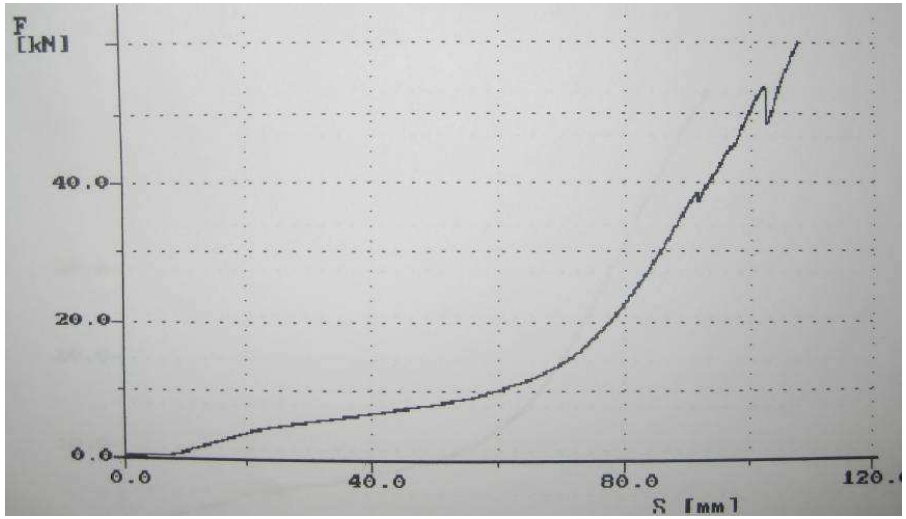


Probe_3

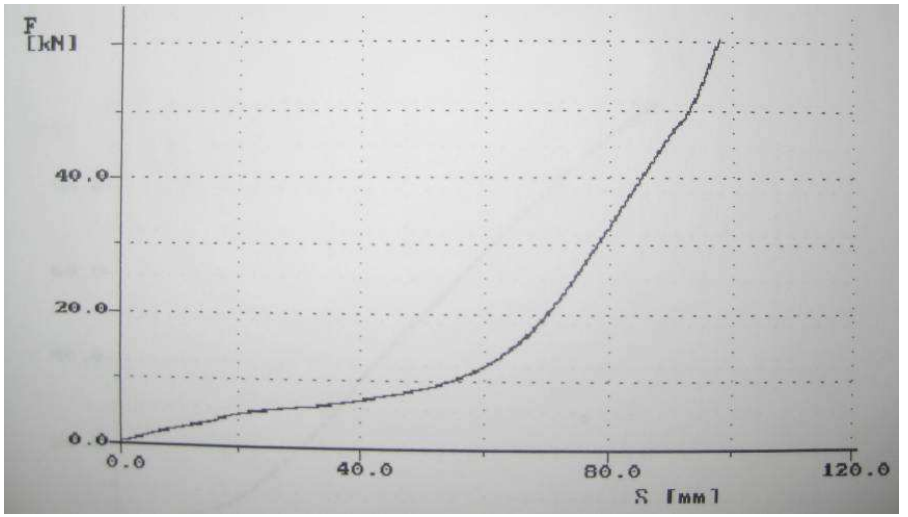
Strength way diagrammes DN 300 y direction



Probe_1

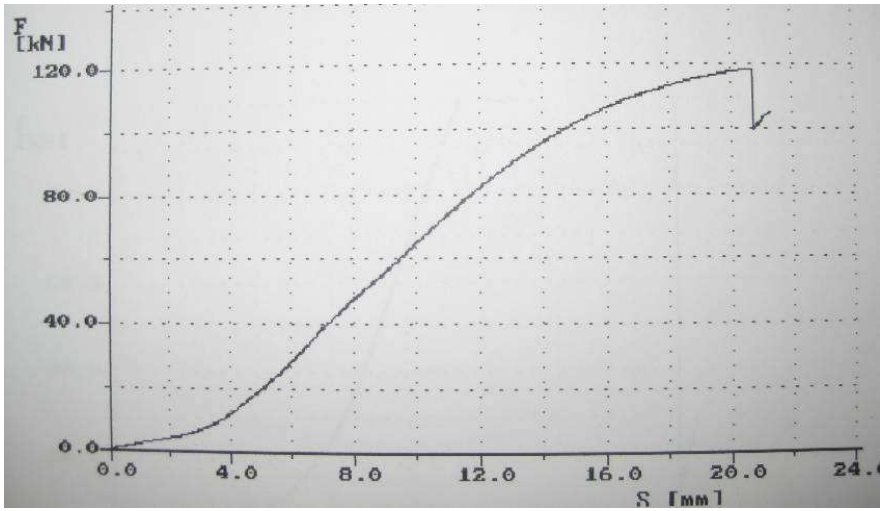


Probe_2

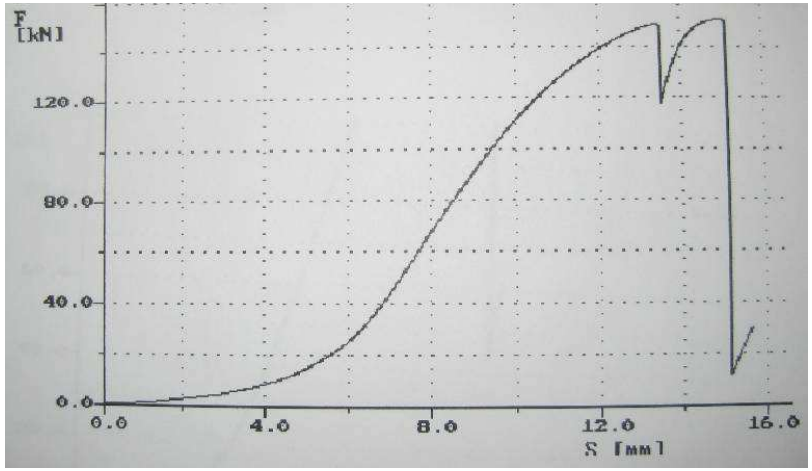


Probe_3

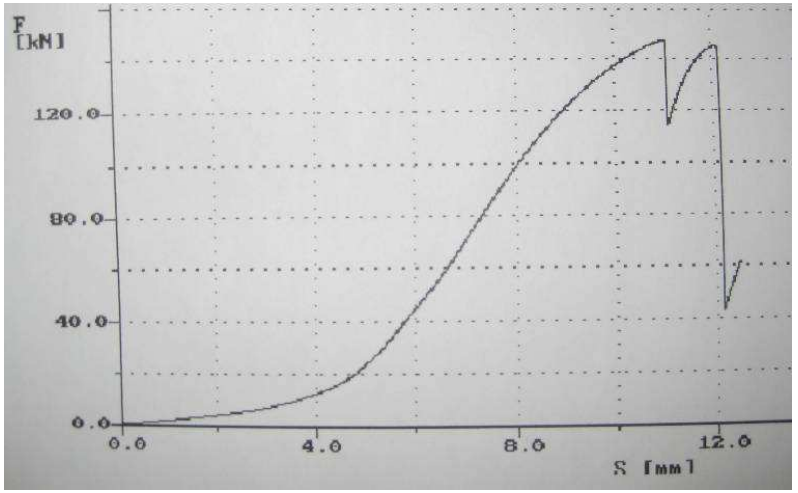
Strength way diagrammes DN 300 z direction



Probe_1



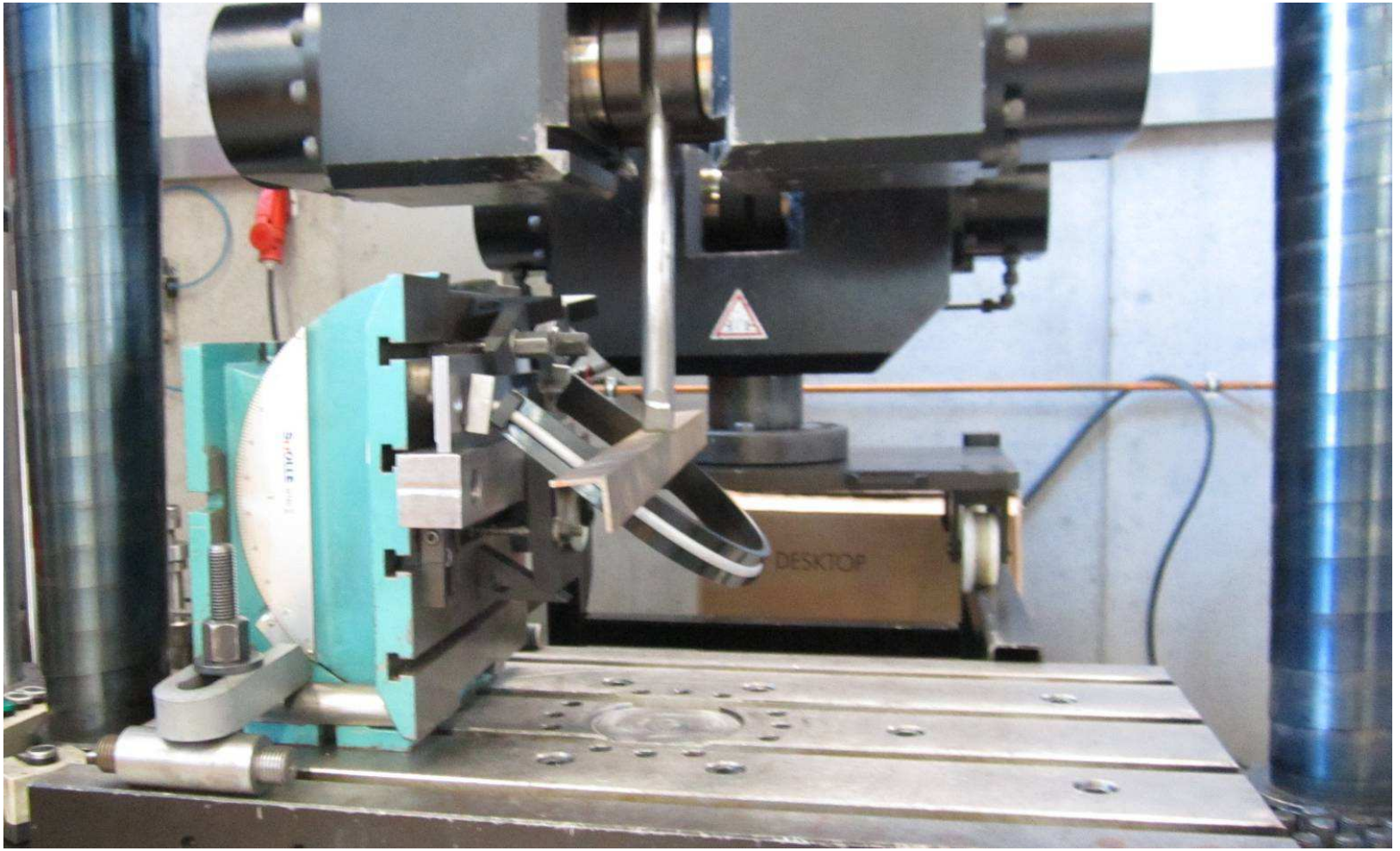
Probe_2



Probe_3

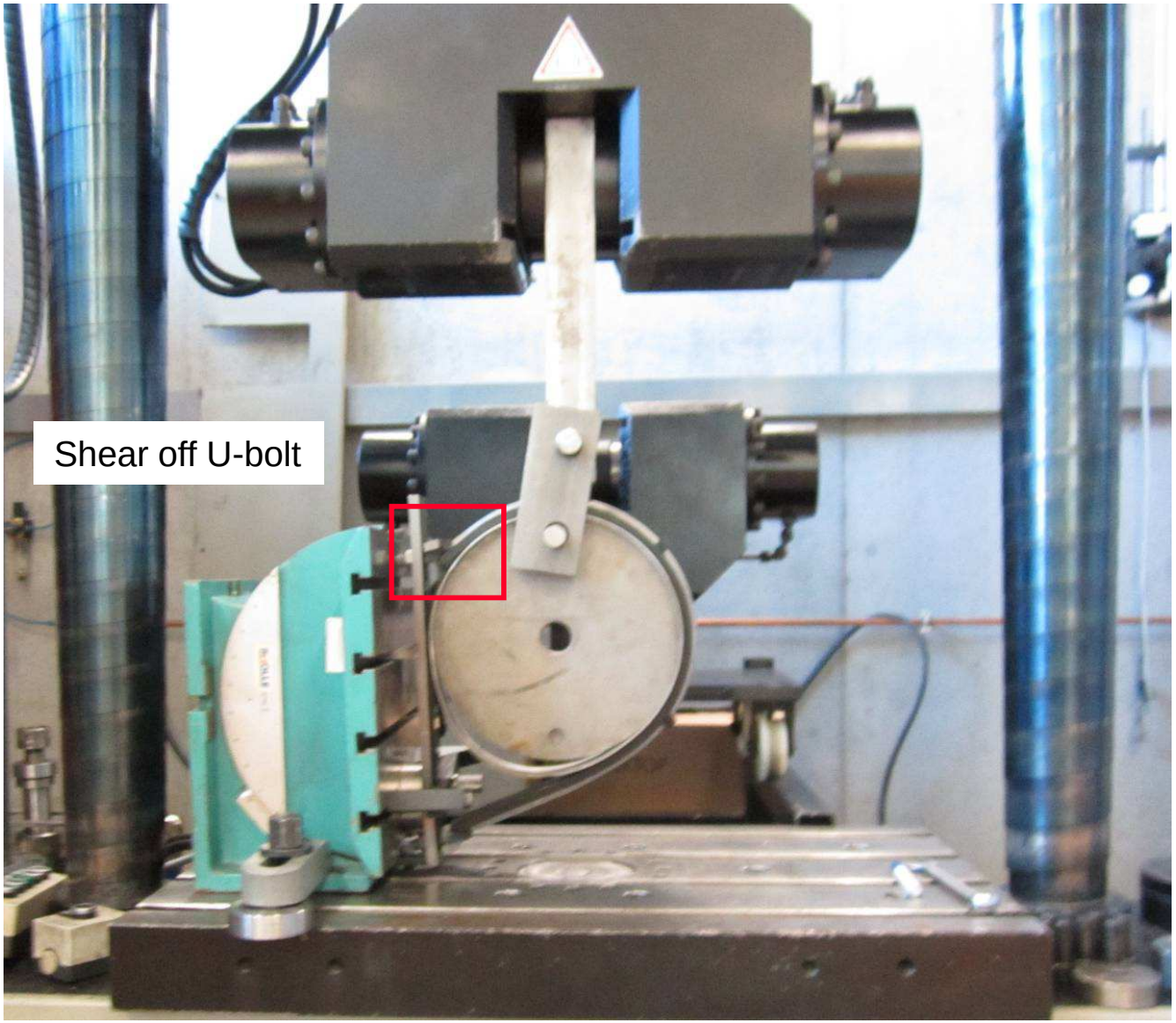
6 Damage pictures

Damage pictures in the construction state x direction



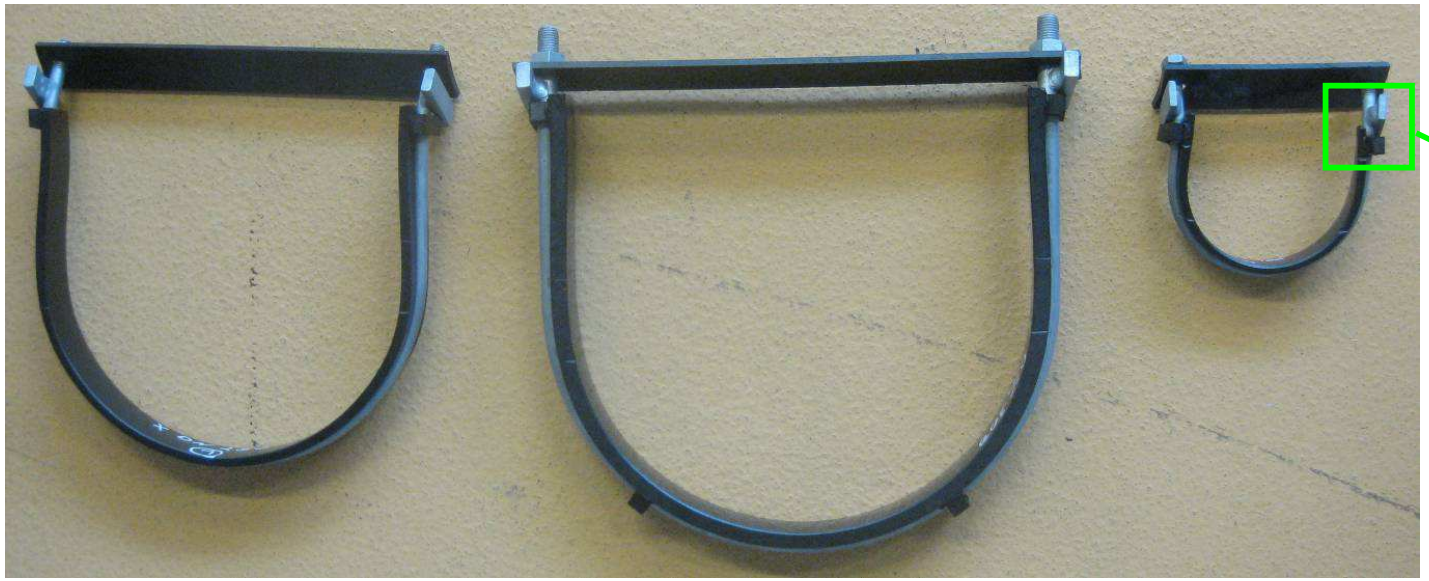
Full-sculptural state in
U-bolt (collapse)

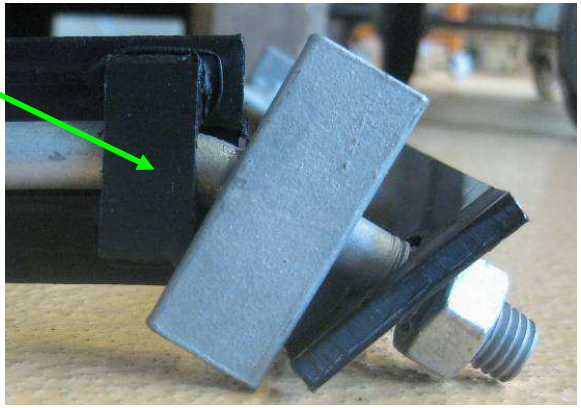
Damage pictures in the construction state y direction



Damage pictures x direction

DN 250 DN 300 DN 100

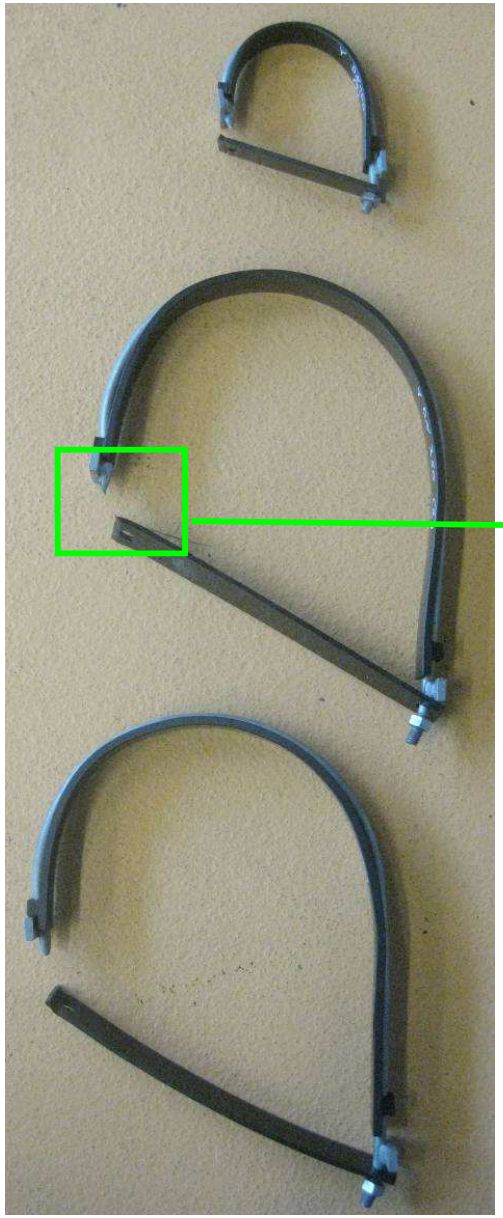




Full-sculptural state in
U-bolt (collapse)

Damage pictures y direction

DN 100



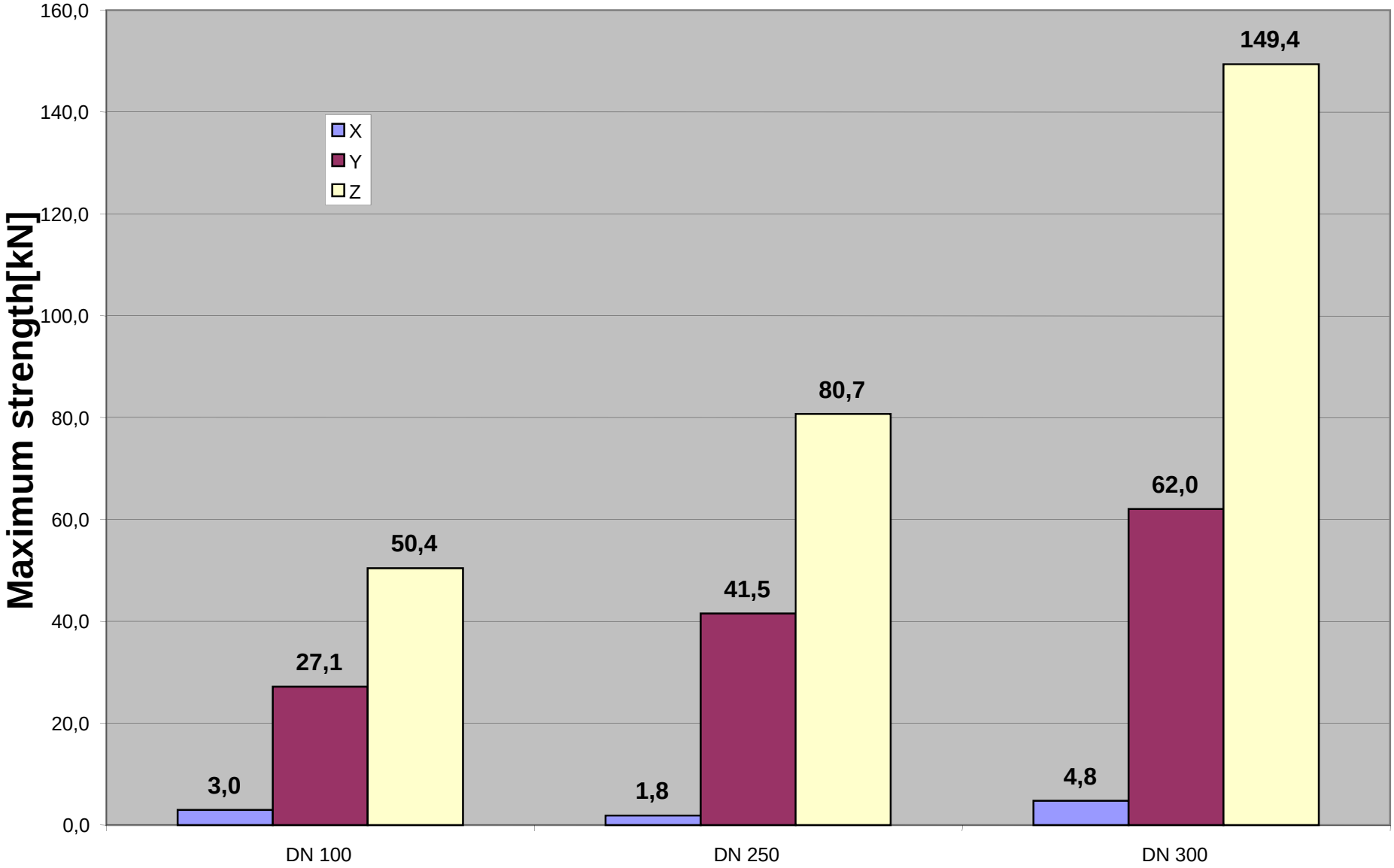
Shear off U-bolt

Damage pictures z direction

Abschälen des Gewindes

7 Summary

Summary of the test results

Summary Maximum strength F_{max} [kN]			
Load direction			
	x	**y**	**z**
DN 100	3,0	27,1	50,4
DN 250	1,8	41,5	80,7
DN 300	4,8	62,0	149,4

Summary maximum forces