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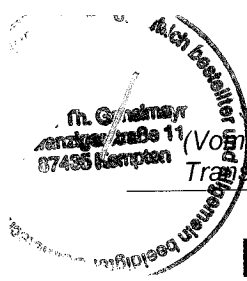
German Technical Approval PFEIFER Cable Tension Members made of stainless steels Z-14.7-411



validity to 30 April 2010

PFEIFER
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GMBH

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CERTIFIED TRANSLATION FROM THE GERMAN LANGUAGE

(Von Deutschem Institut für Bautechnik nicht geprüfte Übersetzung der deutschen Originalfassung – Translation of the German original not verified by the German Institute for Construction Engineering)

DEUTSCHES INSTITUT FÜR BAUTECHNIK
(German Institute for Construction Engineering)

Anstalt des öffentlichen Rechts
(German statutory body)

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Ref. No.: I 3-1.14.7-46/05

German Technical Approval

Approval number:

Z-14.7-411

Applicant:

Pfeifer Seil- und Hebetchnik GmbH & Co. KG
Dr.-Karl-Lenz-Straße 66
D-87700 Memmingen

Generic type of construction product:

PFEIFER Cable Tension Members made of rustproof steels

Validity to:

30 April 2010

The above-mentioned object of approval is herewith technically approved.*

The original of the German Technical Approval contains six (6) pages and ten (10) appendices.

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tion Engineering)*

* This German Technical Approval replaces the German Technical Approval number Z-14.7-411 dated 31 March 2000, extended by notification of 30 March 2005.

I. GENERAL CONDITIONS

- 1 This German Technical Approval is granted as proof of the fitness for an intended use or application of the construction product within the meaning of the building regulations of the German Länder.
- 2 This German Technical Approval does not replace the permissions, approvals and certificates that are prescribed by law for the execution of construction projects.
- 3 This German Technical Approval is granted without prejudice to the rights of third parties and especially to private property rights.
- 4 Without prejudice to any further regulations stipulated in the "Specific Conditions" below the manufacturer and the suppliers of the construction product are obliged to provide photocopies of this German Technical Approval to the user or applier of the construction product, respectively, and to point out to them that the German Technical Approval has to be available at the site of use or application. Photocopies of this German Technical Approval have to be provided to the authorities involved upon request.
- 5 This German Technical Approval may only be reproduced in full. Any partial reproduction requires the prior consent of the Deutsches Institut für Bautechnik (German Institute for Construction Engineering). Texts and drawings of advertising brochures shall not contradict this German Technical Approval. Translations of this German Technical Approval have to be designated as "Vom Deutschen Institut für Bautechnik nicht geprüfte Übersetzung der deutschen Originalfassung" ("Translation of the German original not verified by the German Institute for Construction Engineering").
- 6 This German Technical Approval may be withdrawn at any time. The conditions of this German Technical Approval can be supplemented and amended subsequently especially if required by new technical findings.

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II. SPECIAL CONDITIONS

1 Definition of product and intended use

The product is prefabricated high-strength cable tension members made of rustproof steels (cf. Appendix 1) consisting of spiral strands or strand ropes as well as the corresponding swaged final anchorings, connection constructions, deflection bearings, clamps and straps.

This German Technical Approval regulates and governs manufacturing, design and use of the prefabricated high-strength cable tension members. Furthermore, unless otherwise provided in this German Technical Approval, the regulations stipulated in German standard DIN 18800-1:1990-11, in the German Anpassungsrichtlinie Stahlbau (Adaptation Guideline structural steel engineering), in the pertinent application standards as well as in the German Technical Approval number Z-30.3-6 shall apply.

2 Characteristics of the construction products

2.1 Properties and composition

2.1.1 Cables

The specifications made in DIN EN 10264-4:2002-11 as well as in the standards of series DIN 12385 shall apply to the cables mentioned in section 1 above. In addition the specifications made in Section 2.1.2 below as well as the specifications in Appendices 2.1 to 8 have to be observed.

2.1.2 Swaged fittings (open swaged fittings, closed swaged fittings and swaged fittings with thread)

For the mechanical properties of the open swaged fittings, closed swaged fittings and swaged fittings with thread the specifications listed in Appendices 2.1 and 3 to 8 shall apply.

The dimensions have to correspond to the specifications made in Appendices 3 to 8. The swaged fittings with thread shown in Appendices 5 and 8 have to be provided with metric ISO screw threads pursuant to German standards of the series DIN 13. The specifications pertinent German standards of series DIN 13 shall apply to the tolerances of the screw threads.

The swaged fittings shown in Appendices 3 to 8 may be used for spiral strands and strand ropes with diameters from 3 mm to 36 mm and from 6.1 mm to 36.6 mm, respectively (also see Appendix 2.2 and Appendices 3 to 8).

2.1.3 Pins for open swaged fittings

The specifications made in Appendices 2.1, 3 and 6 shall apply.

2.1.4 Connection constructions, deflection bearings, clamps and straps

The connection constructions, deflection bearings, clamps and straps for the cables mentioned in sections 1 and 2.1.1 above regulated and governed by this German Technical Approval are made of rustproof steel with the material number 1.4462 in property class S460.

2.1.5 Manufacturing of the cable tension members

Specifications for manufacturing of the cable tension members have been deposited with the Deutsches Institut für Bautechnik (German Institute for Construction Engineering).

2.1.6 Corrosion resistance classes

The specifications made in Appendix 2.1 shall apply (also cf. German Technical Approval number Z-30.3-6).

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2.2 CE Marking

The manufacturer has to mark each packaging of the cable tension members with the conformity sign (CE sign) pursuant to the Ordinances on the Conformity Sign of the German Länder. CE marking may only take place if the requirements of Section 2.3 are fulfilled.

In addition, marking must identify the manufacturing plant, the manufacturing year, the designation of the construction product and the material of the individual components.

Cable tension members of different strengths have to be marked such that they cannot be mixed up.

2.3 Proof of conformity

2.3.1 General information

Conformity of the cable tension members with the conditions of this German Technical Approval has to be confirmed and attested for each manufacturing plant with a certificate of conformity issued on the strength of both the factory production control and the continuous outside surveillance at regular intervals including initial type-testing of the cable tension members in accordance with the following provisions.

The manufacturer of the cable tension members has to involve an approved certification body and an approved inspection body for granting of the conformity certificate and execution of continuous outside surveillance including the necessary product tests to be carried out.

A photocopy of the conformity certificate granted by the certification body shall be submitted to the Deutsches Institut für Bautechnik (German Institute for Construction Engineering) for information purposes.

2.3.2 Factory production control

The manufacturer has to establish a factory production control system and exercise factory production control in each manufacturing plant. Factory production control is taken to mean the continuous control of production to be exercised by the manufacturer so as to ensure that the construction products manufactured by him are in conformity with this German Technical Approval.

Factory production control shall at least encompass the following measures and steps:

- **Cables**

The dimensions required in Section 2.1 above have to be checked for each delivery. Proof of the material properties required in Section 2.1 above has to be furnished by means of an inspection certificate "3.1" pursuant to German standard DIN EN 10204:2005-01. The technical delivery conditions according to German standards DIN 10264-4:2002-11 and of the standards of series DIN 12385 have to be observed.

- **Open swaged fittings, closed swaged fittings and swaged fittings with thread as well as connection constructions, deflection bearings, clamps, straps and pins**

The dimensions and tolerances required in Section 2.1 above have to be checked for each production lot. Proof of the material properties required in Section 2.1 above has to be furnished by means of an inspection certificate "3.1" pursuant to German standard DIN EN 10204:2005-01.

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- Verification of the k_e value (loss factor, cf. Appendix 2.2) of prefabricated cable tension members

The k_e values stated in Appendix 2.2 and thus the breaking loads have to be checked at regular intervals by tension tests of prefabricated cable tension members. On the occasion of the initial type-testing of the product (cf. Section 2.3.3 below) nature, extent and frequency of said tests have to be agreed with the inspection body involved in continuous outside surveillance and the Deutsches Institut für Bautechnik (German Institute for Construction Engineering).

The results of factory production control have to be recorded and evaluated. The records have to include at least the following information:

- designation of the construction product or the basic material and the components;
- type of control or testing;
- date of manufacture of the construction product and date of testing of the construction product and the basic material or the components, respectively;
- result of control and testing and comparison with the requirements;
- signature of the person responsible for factory production control.

The records have to be kept for at least five (5) years and they have to be presented to the inspection body involved in continuous outside surveillance. They have to be presented to the Deutsches Institut für Bautechnik (German Institute for Construction Engineering) and the competent Highest Building Inspectorate upon request.

Should the test result be unsatisfactory, the manufacturer shall immediately take the necessary steps so as to remedy the defect. Construction products which fail to meet the requirements have to be handled such that confusion with construction products that are in conformity with requirements is excluded. After the defect has been remedied, the test concerned has to be repeated immediately – provided that this is technically feasible and necessary so as to furnish proof of the removal of defects.

2.3.3 Continuous outside surveillance

In each manufacturing plant factory production control has to be checked by continuous outside surveillance carried out at regular intervals but at least twice a year.

In the scope of continuous outside surveillance initial type-testing of the construction product has to be carried out and sample tests of the properties of the cable tension members required in Section 2.1 above have to be carried out. The competent approved body is responsible for taking of samples and execution of the tests. Statistical evaluation of the values obtained during continuous outside surveillance has to prove that the respective requirements are met in each case.

The records of certification and continuous outside surveillance have to be kept for at least five (5) years. They have to be presented by the certification body or the inspection body, respectively, to the Deutsches Institut für Bautechnik (German Institute for Construction Engineering) and the competent Highest Building-Supervisory Authority upon request.

3 Conditions for construction and design

3.1 General information

For verification of load-bearing capacity of the cable tension members the proof concept stated in German standard DIN 18800-1:1990-11 shall apply. Verification of load-bearing capacity shall be construed to have been furnished if the stress of the cable tension members does not exceed loading according to Sections 3.2 and 3.3, respectively. In each case the smaller value shall be decisive. The characteristic values of resistance quantities necessary for the establishment of loading shall be taken from Appendix 2.1.

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The linear thermal expansion coefficient α_T and the creep ε_K as well as reference values for the modulus of elasticity E_Q following German standard DIN 18800-1:1990-11, element 426 with annotation 2, have to be taken from Appendix 2.3.

Creep ε_K has to be taken into consideration for design if stress caused by constant actions, calculated with characteristic values multiplied by a factor of 1.0, exceeds 40% of the calculated breaking load established pursuant to German standard DIN 18800-1:1990-11, element 905.

3.2 Limit of the tensile force of the cable tension members

The limit of the tensile force of the cable tension members is always the limit of tensile force pursuant to German standard DIN 18800-1:1990-11, element 903 in connection with element 905. The k_e value (loss factor) and the k_s value (stranding factor) necessary to establish the calculated breaking load shall be taken from Appendix 2.2. The value of the limit of the tensile force shall apply to the cable including the swaged fitting.

3.3 Loading of the connection constructions provided for the swaged fittings

The connection constructions for the swaged fittings shown in Appendices 3 to 8 (connecting plates, pins, turnbuckles, etc.) have to be proven in each case. Loading shall be established according to German standard DIN 18800-1:1990-11. In the case of open swaged fittings, loading of the pin is already covered by the limit of the tensile force according to Section 3.2 above, provided that the thickness of the connecting plate corresponds to the specifications listed in Appendices 3 and 6, respectively.

4 Conditions for installation

The manufacturer has to draw up implementing instructions for installation of the prefabricated cable tension members and to hand these instructions over to the firm executing the works.

Prior to installation all individual components of the cable tension members have to be checked as to their complete flawlessness. Damaged parts must not be used.

The swaged fittings with thread have to be screwed into the connection constructions according to Appendices 5 and 8, respectively.

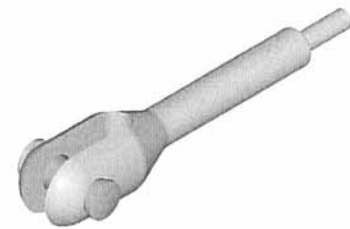
The person responsible for installation has to put down in writing that all connections were checked as to adherence to minimum thread reaches.

Conformity of the connection constructions and of the installation of the prefabricated cable tension members with the provisions of this German Technical Approval has to be certified and attested by the firm executing the works.

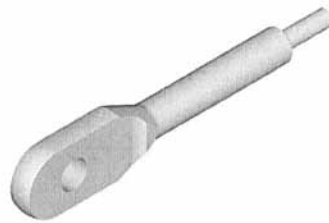
Breitschaft

Certified
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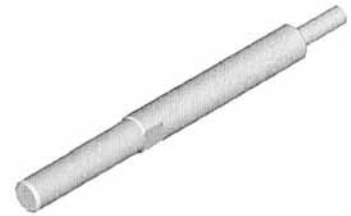
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**Open Swaged Fitting
Type 961**



**Closed Swaged Fitting
Type 963**



**Swaged Fitting with Thread
Type 969**

PE



**Open Swaged Fitting
Type 981**



**Closed Swaged Fitting
Type 983**



**Swaged Fitting with Thread
Type 989**

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Cable Systems
End Terminations
Examples

Appendix 1

German technical approval

No.: Z-14.7-411

from: **13. April 2006**

Table 1 – Steel Quality, Mechanical Properties (Minimum Value)											
Members	Steel Quality					Mechanical Properties (Minimum Value)					
	Contraction	Material-No.	Structure	Property Class	Yield Strength $R_{p0,2}$ in N/mm ²	Tensile Strength R_m in N/mm ²	Elongation in %			Thermal Expansion Coefficient α_k in K ⁻¹	Corrosion Resistance Class
Cable	X4CrNiMo 17-13-3	1.4436	A	S1100	1100	1450	A ₅	A ₁₀	A _{GL}	16x10 ⁻⁶	III*
	X5CrNiMo 17-12-2	1.4401	A	S1100	1100	1450	-	6	2	16x10 ⁻⁶	II
Pin	X2CrNiMoN 22-5-3	1.4462	FA	S460	460	600	10	-	-	13x10 ⁻⁶	III
				S690	690	800	12	-	-	13x10 ⁻⁶	
Type 961,963,969 Type 981,983,989	X2CrNiMoN 22-5-3	1.4462	FA	S460	460	600	10	-	-	13x10 ⁻⁶	III

* Accessible construction with moderate chloride and sulphur loading

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Table 1

Steel Quality

Mechanical Properties (Minimum Value)

Appendix 2.1

German technical approval

No.: Z-14.7-411

from: 13. April 2006

Table 2 – Loss Factor k_e , Stranding Factor k_s

Spiral Strand

End Termination Type 961, Type 963 and Type 969

Cable Construction	1 x 19	1 x 37	1 x 61	1 x 91
Stranding Factor k_s	0,88	0,87	0,87	0,87
Loss Factor k_e	Swaged Fittings	0,9		

End Terminations PE Type 981, PE Type 983 and PE Type 989

Cable Construction	1 x 19	1 x 37	1 x 61	1 x 91
Stranding Factor k_s	0,88			
Loss Factor k_e	Swaged Fittings	0,95		

Strand Ropes

End Terminations Type 961, Type 963 and Type 969

Cable Construction	6x7 SE	6x19 SE	6x19 WS / SE	6x36 WS / SE
Stranding Factor k_s	0,84	0,80	0,80	0,78
Loss Factor k_e	Swaged Fittings	0,9		

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Table 2

Loss Factor k_e

Stranding Factor k_s

Appendix 2.2

German technical approval
No.: Z-14.7-411
 from: **13. April 2006**

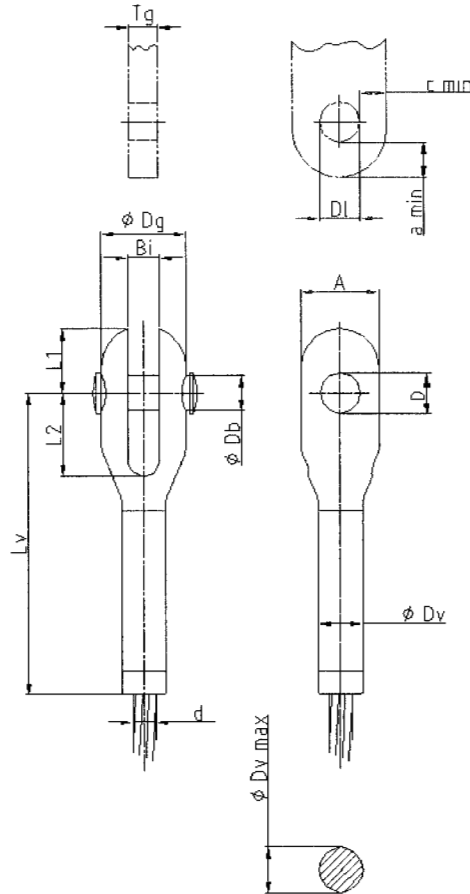
Tabelle 3 – Reference Value for Modulus of Elasticity E_Q

Cable Type	E_Q in N/mm ²
Spiral Strand	0,13 x 10⁶
Strand Rope	0,10 x 10⁶

Tabelle 4 – Creep ϵ_K

Temperature in °C	ϵ_K in %
20	2,5 x 10⁻²
40	3,0 x 10⁻²
70	3,5 x 10⁻²

PFEIFER PFEIFER Seil- und Hebeteknik GmbH Dr.-Karl-Lenz-Str.66 87700 Memmingen Tel.: 08331/937 – 0 Fax: 08331/937 – 350 E-Mail: cablestructures@pfeifer.de	Table 3 Reference Value for Modulus of Elasticity E_Q	Appendix 2.3 German technical approval
	Table 4 creep ϵ_K	No.: Z-14.7-411 from: 13. April 2006



Open Swaged Fitting Type 961											Pin		Connecting Plate			
Size	d	D	A	Bi	Dg	Dv	Dvmax	L1	L2	~Lv	Db	Tg	a min	c min	DI	
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm						mm
030	3	6	11	7	13	6	7	10	14	48	5	1.4462 - S690	5	6	4	6
040	4	7	14	7	15	7	9	11	16	58	6		5	7	5	7
050	5	8	16	8	18	8	10	13	19	68	7		6	8	6	8
060	6	10	20	10	22	11	13	16	23	79	9		8	10	7	10
080	8	13	25	12	28	13	15	21	30	108	12		10	13	9	13
100	10	16	31	14	34	17	20	27	36	134	15		12	16	11	16
120	12	20	37	17	41	19	22	32	44	159	19		15	20	13	20
140	14	23	44	20	48	22	26	37	51	193	22		18	23	15	23
160	16	27	50	22	55	26	30	43	59	215	25		20	27	18	27
180	18	30	58	28	64	30	34	48	67	239	28		25	29	19	30
200	20	32	62	28	68	34	39	53	73	271	30	1.4462 - S460	25	32	21	32
220	22	35	66	28	72	38	43	57	77	287	33		25	36	24	35
240	24	35	70	28	75	38	43	60	80	321	33		25	38	27	35
260	26	38	76	33	83	44	50	65	88	342	36		30	40	27	38
280	28	42	83	33	89	44	50	70	93	367	40		30	45	31	42
300	30	47	90	38	98	48	55	77	103	403	45		35	48	32	47
320	32	50	97	43	106	52	59	82	113	426	48		40	50	33	50
340	34	54	103	43	112	56	64	88	118	458	52		40	55	37	54
360	36	57	109	48	119	58	66	92	126	482	55		45	57	38	57

*) after swaging

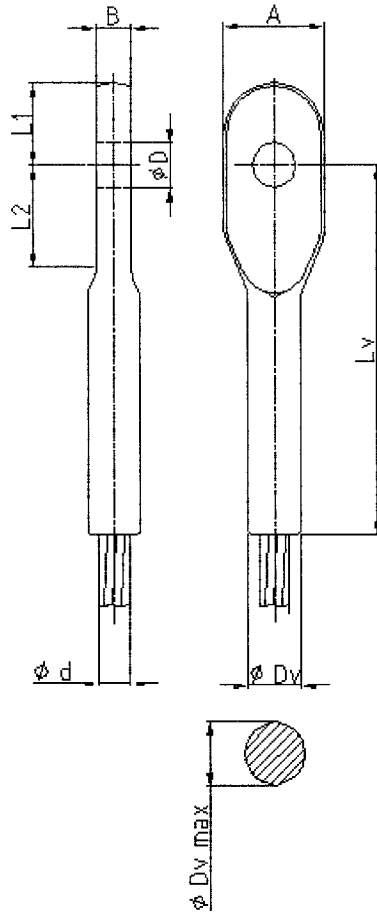
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Type 961
 Open Swaged Fitting
 Pin
 Connecting Plate

Appendix 3

German technical approval
 No.: Z-14.7-411
 from: 13. April 2006



Closed Swaged Fitting Type 963										
Size	d	A	B	D	Dv	Dvmax *	L1	L2	~Lv max	1.4462 - S460
	mm	mm	mm	mm	mm	mm	mm	mm	mm	
030	3	13	5	6	6	7	11	14	48	
040	4	15	5	7	7	9	12	15	58	
050	5	18	6	8	8	10	14	18	69	
060	6	22	8	10	11	13	17	22	79	
080	8	28	10	13	13	15	23	29	108	
100	10	34	12	16	17	20	28	35	134	
120	12	41	15	20	19	22	34	42	159	
140	14	48	18	23	22	26	39	49	193	
160	16	55	20	27	26	30	46	57	215	
180	18	64	25	30	30	34	52	66	239	
200	20	68	25	32	34	39	56	70	269	
220	22	72	25	35	38	43	60	74	287	
240	24	75	25	35	38	43	63	77	321	
260	26	83	30	38	44	50	68	85	342	
280	28	89	30	42	44	50	74	90	367	
300	30	98	35	47	48	55	81	100	403	
320	32	106	40	50	52	59	87	108	426	
340	34	112	40	54	56	64	92	114	458	
360	36	119	45	57	58	66	97	121	482	

*) after swaging

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Type 963

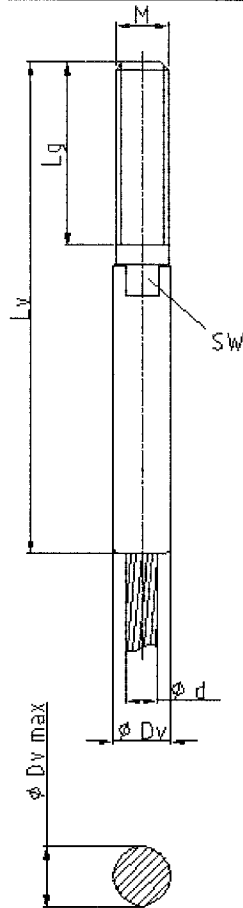
Closed Swaged Fitting

Appendix 4

German technical approval

No.: Z-14.7-411

from: **13. April 2006**



Swaged Fitting with Thread Type 969								
Size	d	M	Lg	~Lv max	Dv	Dvmax *	SW	Minimal Thread Reach
	mm	mm	mm	mm	mm	mm	mm	mm
030	3	5	22	60	6	7	5	5
040	4	6	27	73	7	9	6	6
050	5	8	33	85	8	10	6	8
060	6	10	36	98	11	13	9	10
080	8	12	51	134	13	15	11	12
100	10	14	63	164	17	20	13	14
120	12	16	73	196	19	22	17	16
140	14	20	93	240	22	26	19	20
160	16	22	101	262	26	30	22	22
180	18	24	108	284	30	34	22	24
200	20	27	126	333	34	39	27	27
220	22	30	136	355	38	43	30	30
240	24	33	158	409	38	43	32	33
260	26	36	166	431	44	50	32	36
280	28	39	179	458	44	50	36	39
300	30	42	197	507	48	55	43	42
320	32	45	205	529	52	59	46	45
340	34	48	224	573	56	64	46	48
360	36	48	231	595	58	66	46	48

1.4462 - S460

*) after swaging

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Type 969

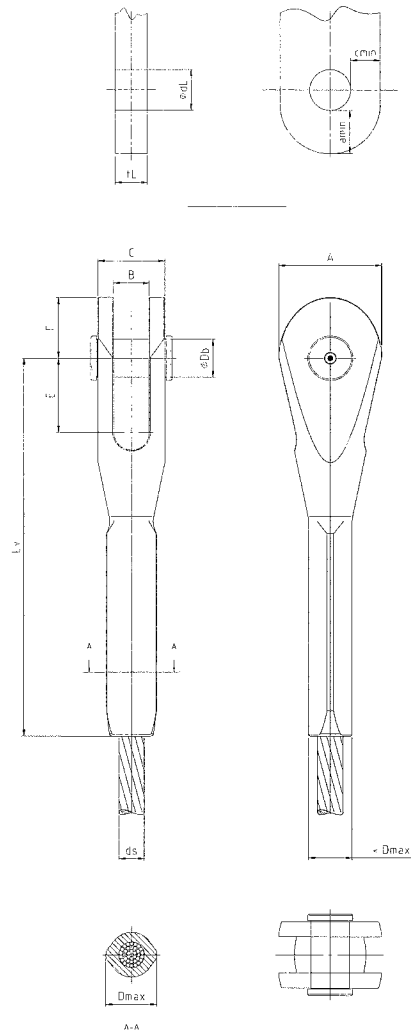
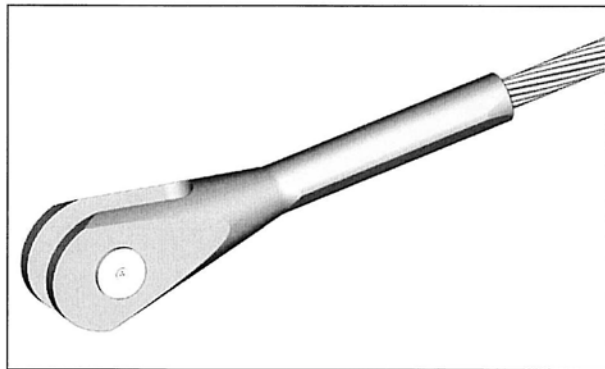
Swaged Fitting with Thread

Appendix 5

German technical approval

No.: Z-14.7-411

from: **13. April 2006**



Open Swaged Fitting Type 981										Pin		Connecting Plate			
Size	A	B	C	E	F	G	Dmax *	-Lv *	ds	Db	dL	tL	amin	cmin	
	mm	mm	mm	mm	mm	mm	mm	mm	mm						mm
PE 3	25	10,5	18	18	15	27	13	101	6,1	9	10	8	11	7	
PE 5	32	12,5	23	24	20	32	15	129	8,1	12	13	10	14	10	
PE 7	40	14,5	27	29	24	36	20	156	10,1	15	16	12	17	12	
PE 10	50	17,5	33	35	30	39	22	190	11,9	19	20	15	22	15	
PE 15	57	20,5	38	41	35	50	26	223	14,1	22	23	18	25	17	
PE 20	67	22,5	43	48	41	55	30	258	16,6	25	27	20	29	20	
PE 30	80	28	52	59	48	64	39	310	20,5	30	32	25	34	24	
PE 45	96	28	58	66	57	73	44	383	24,1	33	35	25	41	30	
PE 60	110	33	68	77	67	83	51	424	28,6	40	42	30	48	34	
PE 75	117	38	76	84	71	95	60	466	32,1	45	47	35	51	36	
PE 100	142	49	92	102	86	111	66	547	36,6	55	57	45	63	44	

*) after swaging

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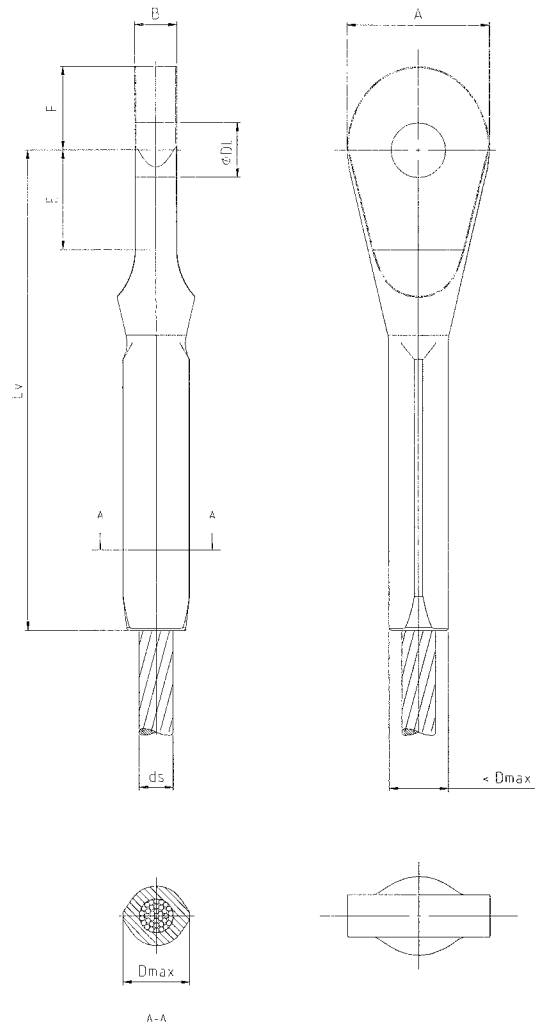
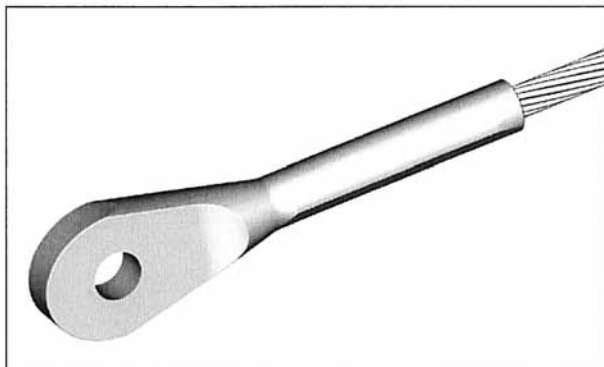
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PE Type 981

Open Swaged Fitting
 Pin
 Connecting Plate

Appendix 6

German technical approval
No.: Z-14.7-411
 from: **13. April 2006**



Closed Swaged Fitting Type 983								
Size	A	B	Dmax	DL	E	F	~Lv	ds
	mm	mm	mm	mm	mm	mm	mm	mm
PE 3	25	8	13	10	18	15	86	6,1
PE 5	32	10	15	13	24	20	115	8,1
PE 7	40	12	20	16	29	24	145	10,1
PE 10	50	15	22	20	35	30	176	11,9
PE 15	57	18	26	23	41	35	206	14,1
PE 20	67	20	30	27	48	41	235	16,6
PE 30	80	25	39	32	59	48	290	20,5
PE 45	96	25	44	35	66	57	344	24,1
PE 60	110	30	51	42	77	67	400	28,6
PE 75	117	35	60	47	84	71	447	32,1
PE 100	142	45	66	57	102	86	504	36,6

1.4462 - S460

*) after swaging

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PE Type 983

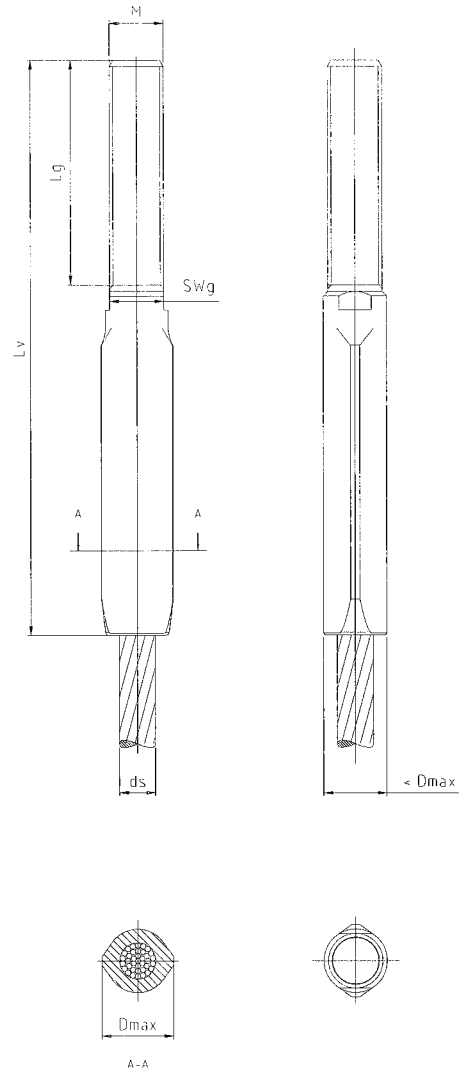
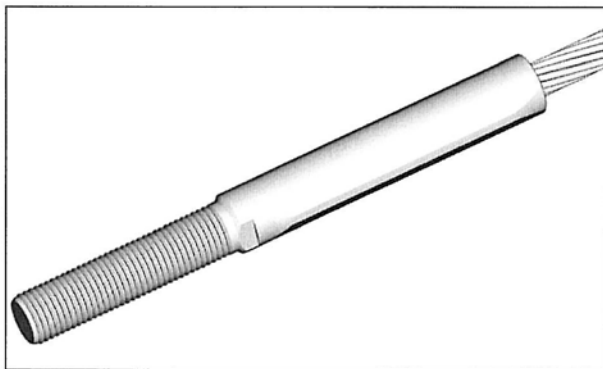
Closed Swaged Fitting

Appendix 7

German technical approval

No.: Z-14.7-411

from: **13. April 2006**



Swaged Fitting with Thread Type 989							
Size	M	D _{max} [*]	L _g	~Lv [*]	SWg	ds	Minimal Thread Reach
	mm	mm	mm	mm	mm	mm	mm
PE 3	10	13	40	104	9	6,1	9
PE 5	14	15	56	140	12	8,1	13
PE 7	16	20	64	169	15	10,1	14
PE 10	20	22	80	205	17	11,9	18
PE 15	24	26	96	243	20	14,1	22
PE 20	27	30	108	274	24	16,6	24
PE 30	30	39	120	329	30	20,5	27
PE 45	36	44	144	393	32	24,1	32
PE 60	42	51	168	456	36	28,6	38
PE 75	48	60	192	523	45	32,1	43
PE 100	56	66	224	594	50	36,6	50

*) after swaging

1.4462 - S460

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PE Type 989

Swaged Fitting with Thread

Appendix 8

German technical approval

No.: Z-14.7-411

from: **13. April 2006**

BEGLAUBIGUNGSVERMERK
(ATTESTATION CLAUSE)

Als in Bayern öffentlich bestellter und allgemein beeidigter Dolmetscher und Übersetzer für die englische Sprache bestätige ich: Vorstehende Übersetzung der mir im Original vorgelegten, in deutscher Sprache abgefassten Urkunde ist richtig und vollständig.

I, the undersigned translator duly sworn in Bavaria do hereby certify that the foregoing is a true and correct translation of a document in German that was presented to me in original.

IN WITNESS WHEREOF I have hereunder set my hand and seal
at Kempten, Germany this **22 May 2006**.

Kempten, Montag, 22. Mai 2006



[Handwritten signature]

Ganslmayr

officially appointed and sworn
translator and interpreter



PFEIFER