presentation

RUHFUS

Neuss, Germany

RUHFUS

-manufacturing of custom made cylinders –

-hydraulic systems and intermediate products











RUHFUS Systemhydraulik

presentation

RUHFUS

Neuss, Germany

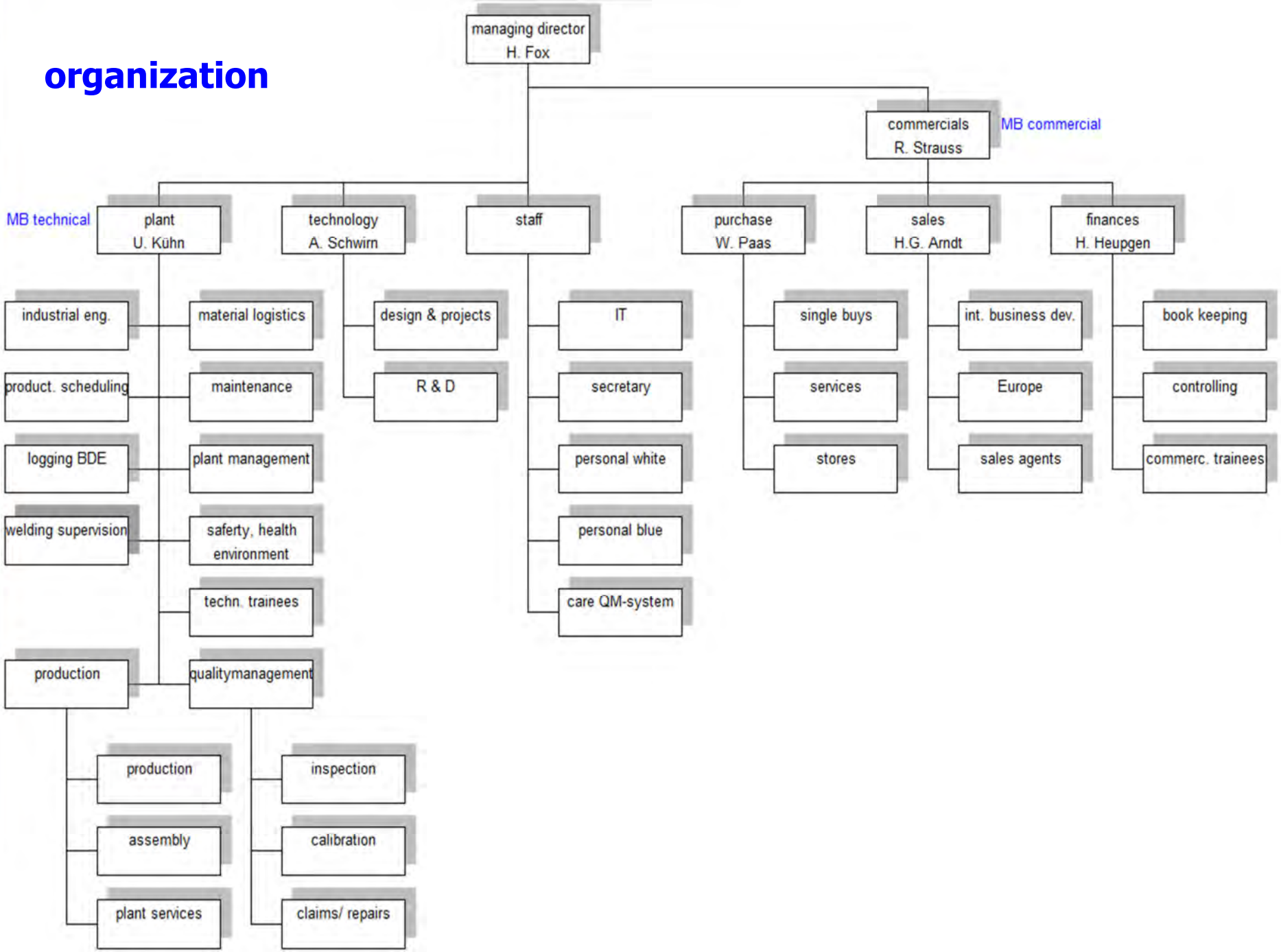
name:	**Ruhfus Systemhydraulik**
founded:	**1907**
location:	**Büdericher Str. 7, Neuss Germany**
internet:	**www.ruhfus.com**
managing director:	**Hartmut Fox**

capital:	**1.835.000 €**
turnover:	**20 Mio. EUR p.a.**
employees:	**110**
ratio of export:	**80%**

Vision

- *... TO BECOME 1 OF THE 10 MOST SOPHISTICATED SUPPLIER FOR HIGHLY DEMANDING CYLINDERS, ... BIG OR LONG*
- *... TO SUPPLY CUSTOMERS <u>WORLDWIDE</u> WITH - MADE IN GERMANY -*

organization



- certified since 1996
- semi-annually surveillance audits
- no non-conformities for the last 14 years

BUREAU VERITAS Certification

Certificate

awarded to

Ruhfus Systemhydraulik GmbH

Büdericher Strasse 7

41460 Neuss, Germany

Bureau Veritas Certification certifies that the Management System of the above organisation has been assessed and found to be in accordance with the requirements of the standards detailed below.

Standard

DIN EN ISO 9001:2008

Scope of supply

Design, manufacturing, assembly and sales of hydraulic systems, hydraulic cylinders and components thereof as well as manufacturing of comparable products regarding machining.

Original approval date: 10.05.1996

Date of the audit: 13.05.2011 Date of next recertification: 12.05.2014

Subject to the continual satisfactory operation of the organisation's Management System, this certificate is valid from

Date of certification: 08.06.2011 Valid until: 07.06.2014

To check this certificate validity you may contact Bureau Veritas Certification. Further clarifications regarding the scope of this certificate and the applicability of the Management Systems requirements may be obtained by consulting the organisation.

Local Technical Manager

Date 16.06.2011

Certificate number: **DE001785-1**

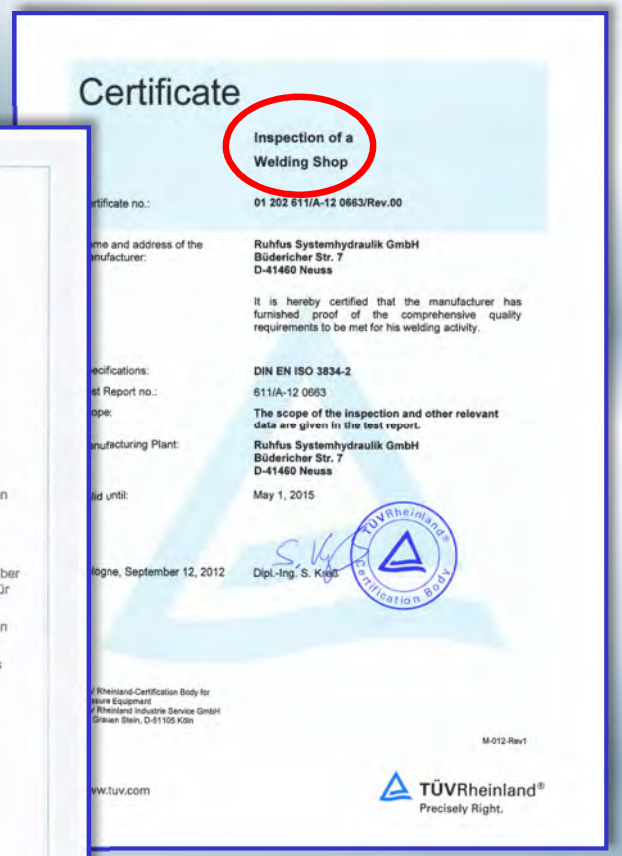
Bureau Veritas Certification Germany GmbH
Veritaskai 1, 21079 Hamburg

- **further certificates and approvals**

German railway

AD 2000

3834

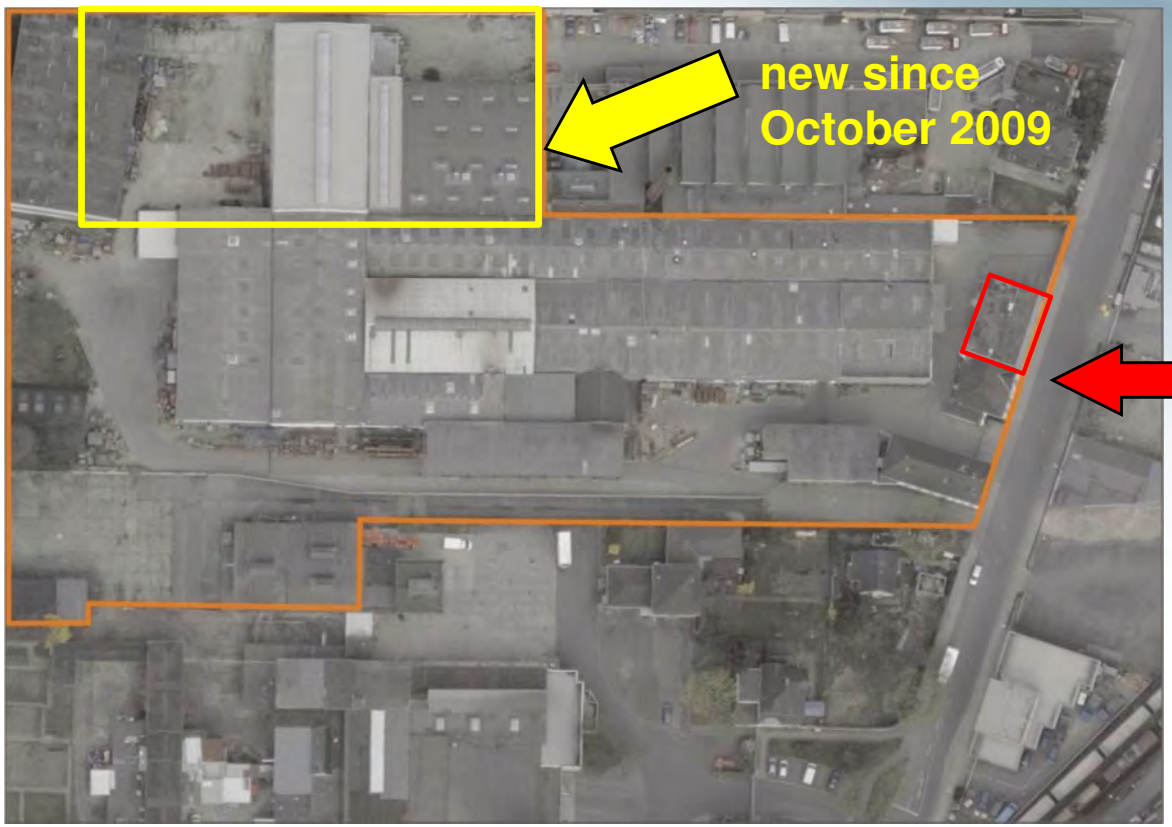


3834

Striving for certification of - Pressure Vessel Directive - in June 2013

head quarter

Ruhfus, Neuss, Germany



locations and representatives

North America
- United States

Europe
- Germany
- Austria
- Belgium
- France
- Ukraine
- The Netherlands
- Sweden
- Switzerland
- United Kingdom

East Europe
- Russia

presentation

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MADE IN GERMANY

Water Technology (ships, locks, bridges)

Steel Plants

Injection moulding / Diecasting

Concrete Conveyance

Ports/ Shipunloader

Wind Energy

Piston Accumulators

Presses (paper, wood, metal sheets, laundry)

Nutrition Industry

Coal and Ore Mining

Tunnel Drilling

Turbines

Dam and Water- Reservoirs

Know How, accumulated from many different requirements

RUHFUS Systemhydraulik

some customer references

Putzmeister
SANDVIK
SCHWING
LIEBHERR
KOMATSU
VOEST - ALPINE Materials Handling
KRAUSSMAFFEI
BÜHLER
YOUR PERFORMANCE IN MIND
Rexroth
Bosch Group

VOITH
ANDRITZ
DISA
LJM
Atlas Copco
Vestas
No. 1 in Modern Energy
LOESCHE
INNOVATIVE ENGINEERING
ALSTOM

V&M
VALLOUREC & MANNESMANN TUBES
ROLLS ROYCE
BSD
WEMHÖNER
SURFACE TECHNOLOGIES
RHEINMETALL

core competencies (1)

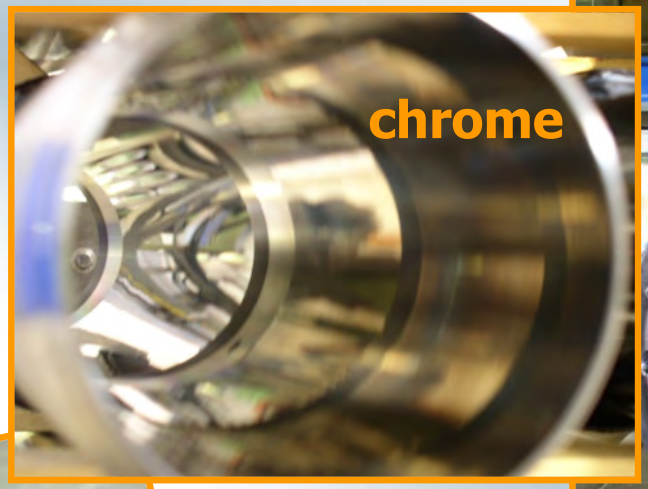
- design and assembly of special purpose hydraulic cylinder

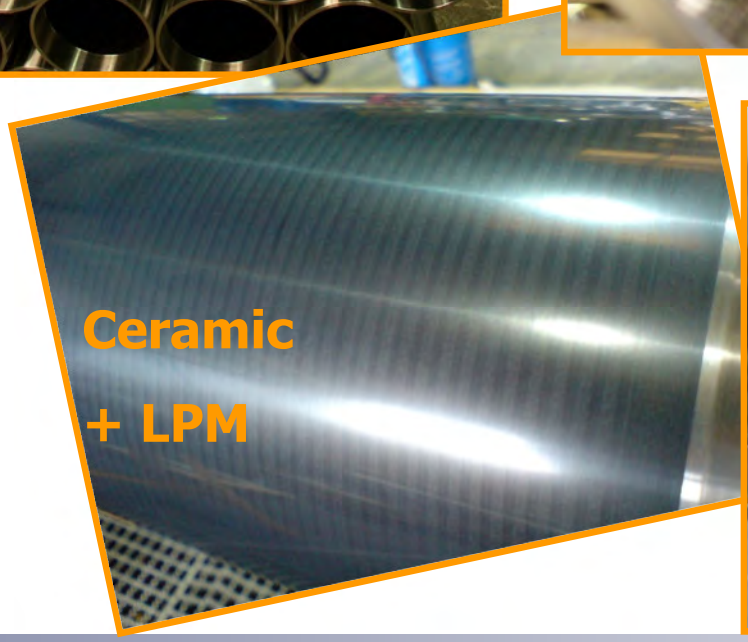
core competencies (2)

- manufacturing of long, highly precise cylinder tubes and piston rods

core competencies (3)

- manufacturing and treatment of super finished rotational component





presentation

RUHFUS

Neuss, Germany

product portfolio

50% complete cylinders, power packs, control cabinets

35% cylinder components (ready for assembly)

15% processing of customer material

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MADE IN GERMANY

RUHFUS Systemhydraulik

presentation

RUHFUS

Neuss, Germany

machine park

machine park at RUHFUS

RUHFUS Systemhydraulik

key facts of facilities and capacities

production plant in Neuss, Germany

total available area	24.000 m²
total production area	15.500 m²
crane capacities	25 to
under beam height	8,5 m

- up to 670 mm/ 1.200 mm bore diameter
- up to 1.500 mm outer diameter
- up to 15.000 mm in tube length
- up to 17.000 mm in rod length

key facts to facilities and capacities

deep hole drilling:	⌀	20 – 680 mm
6 machine tools	length	– 10.000 mm
honing:	⌀	20 – 600 mm
6 machine tools	length	– 16.000 mm
roller burnishing:	⌀	0 – 350 mm
5 machine tools	length	– 10.000 mm
turning/ milling:	CNC, NC, conventional	
16 machine tools		
	outer ⌀	– 1.500 mm
	length	– 10.000 mm
welding:	robotics, semi automatic, manually MAG, WIG, UP tests: magnetic particles, ultra sonic	
assembly:	performed tests: 600 bar testing pressure, function	
details:	on www.RUHFUS.com, *„production options"*	

key facts of facilities and capacities

recent investments

Deephole drilling machine 10 m	2004	740 T Euro
CNC turning center (rotation tools) 2 m/ 650 mm	2004	250 T Euro
CNC turning center (rotation tools) 6 m/ 840 mm	2005	705 T Euro
Conventional lathe 10 m/ 1300 mm	2006	380 T Euro
CNC honing machine 3 m/ 250 mm	2007	160 T Euro
CNC milling center 15000 x 960 mm x 1000 mm	2008	540 T Euro
Paint shop 16.000 mm x 1.500 mm	2009	250 T Euro
Welding plant UP & WIG 15.000 mm x 1.500 mm	09/ 2009	300 T Euro
NC lathe 4,5 m/ 1.200 mm	10/ 2009	450 T Euro

facilities and capacities

Fräsbearbeitung - CNC milling -

Axa VHS 50 - XTS

5 Achsen-Hochgeschwindigkeits-Fahrständer-Bearbeitungszentrum

Bearbeitungsfenster:	4000 x 1.000 x 1.000 mm
Aufnahmen:	2 x 30 Werkzeugplätze
Steuerung:	Heidenhain iTNC 530
Antriebsleistung:	57 kW

Besonderheiten:

Achsschwenkkopf stufenlos positionierbar

integrierter **Rundtisch**, horizontal und vertikal zu verwenden

verstärkte **Auflagetische**

Pendelbetrieb vorgesehen

facilities and capacities

Drehbearbeitung - CNC turning -

Heynumat 24 LK-2/6000

Spitzenweite:	6.000 mm
Bearbeitungsdurchmesser:	770 mm
Lünetten:	170 – 460 mm
Umlaufdurchmesser:	890 mm
Steuerung:	CNC Sinumerik 840 D Shopturn

Besonderheiten:

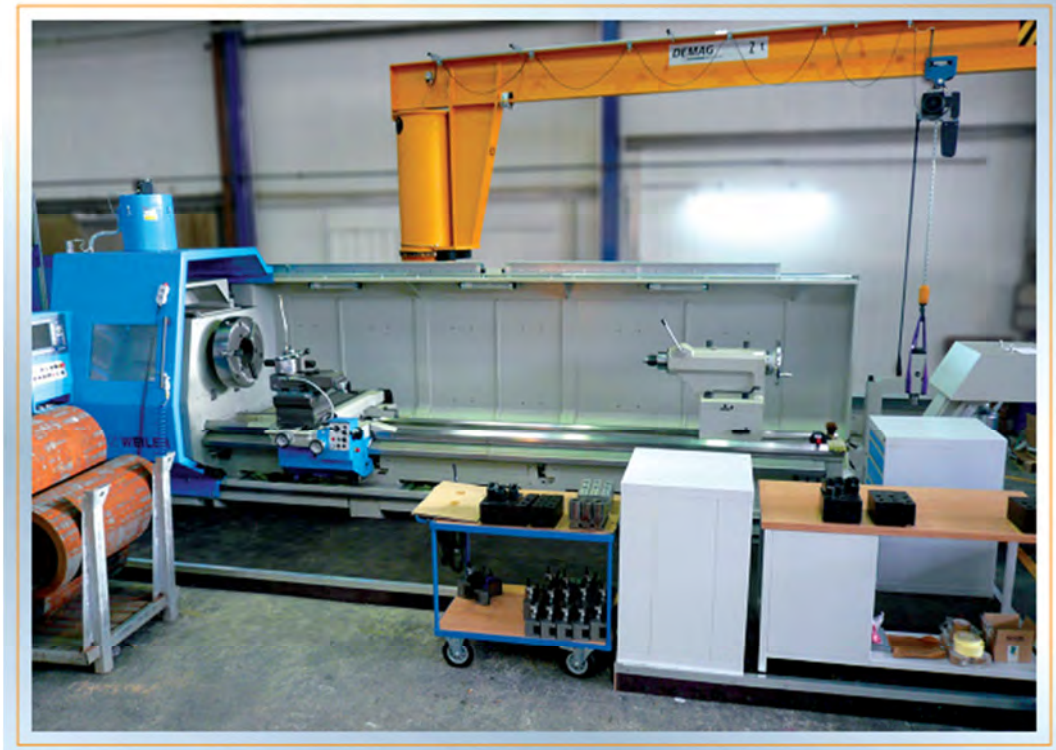
angetriebene Werkzeuge

Bohrstangenarbeit möglich

zwei Supporte
beidseitige, gleichzeitige Bearbeitung von Rohren möglich

facilities and capacities

Drehbearbeitung - NC turning -



Weiler E120-4500/ D3

Spitzenweite:	4.500 mm
Bearbeitungsdurchmesser:	830 mm
Lünetten:	300 - 600 mm 580 – 900 mm
Umlaufdurchmesser:	1.200 mm
Steuerung:	CNC Weiler Siemens D3
Antriebsleistung:	45 kW
Besonderheiten:	**angetriebene Zentrierwerkzeuge** **Bohrstangenarbeit** möglich

facilities and capacities

Drehbearbeitung - conventional turning -

Poreba 10 m

Spitzenweite:	10.000 mm
Spitzenhöhe ü. S.:	500 mm
Lünetten:	2 x 60 – 450 mm 400 – 800 mm
Umlaufdurchmesser:	1.350 mm
Steuerung:	konventionell
Antriebsleistung:	50 kW
Besonderheiten:	**keine**

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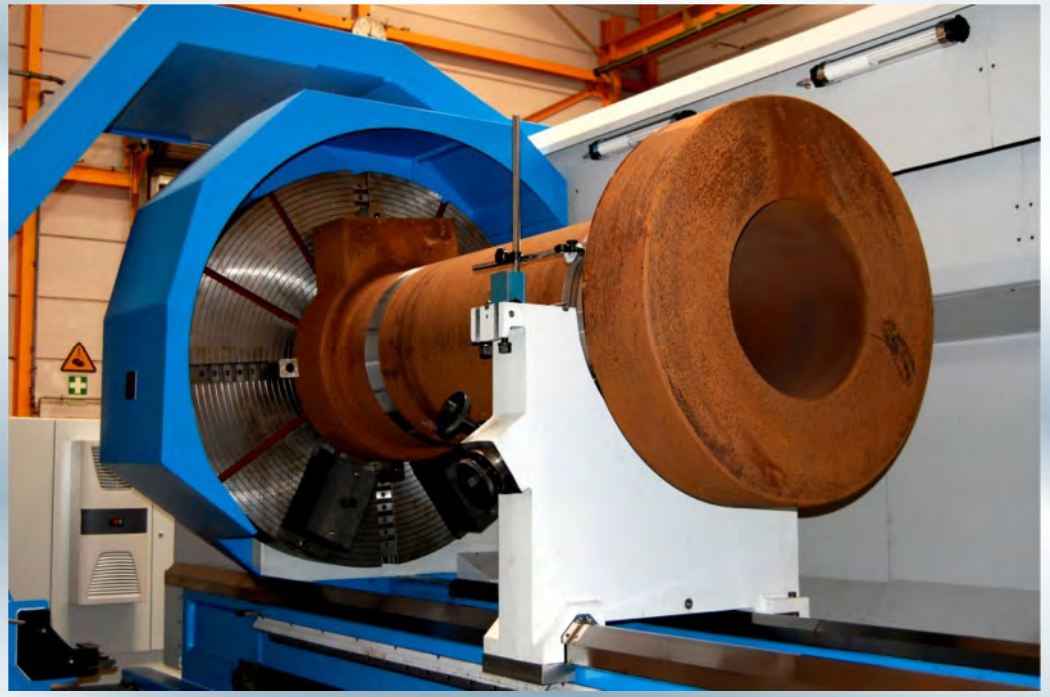
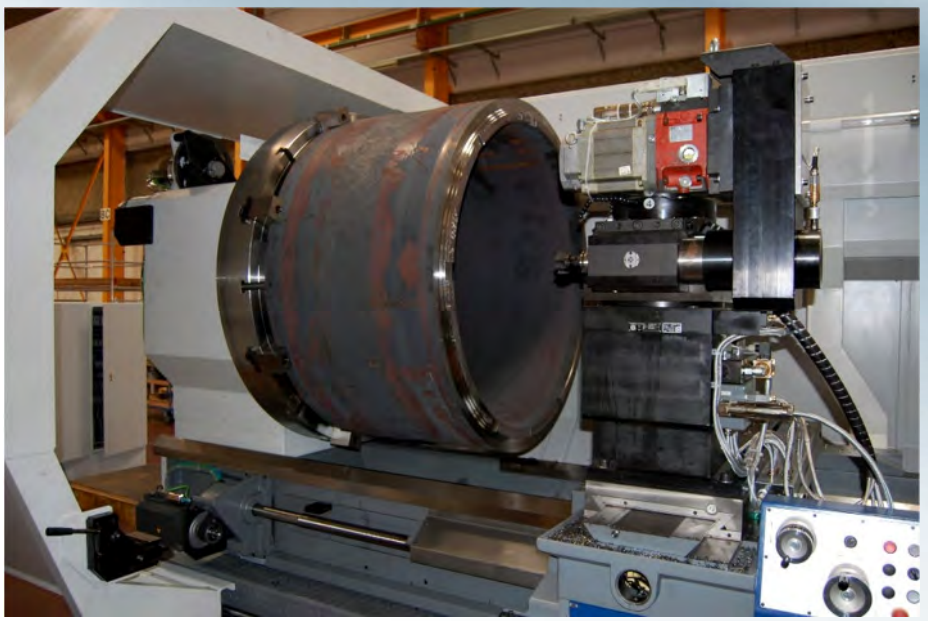
Neuss, Germany

facilities and capacities

Weiler 200 since Dec. 2012

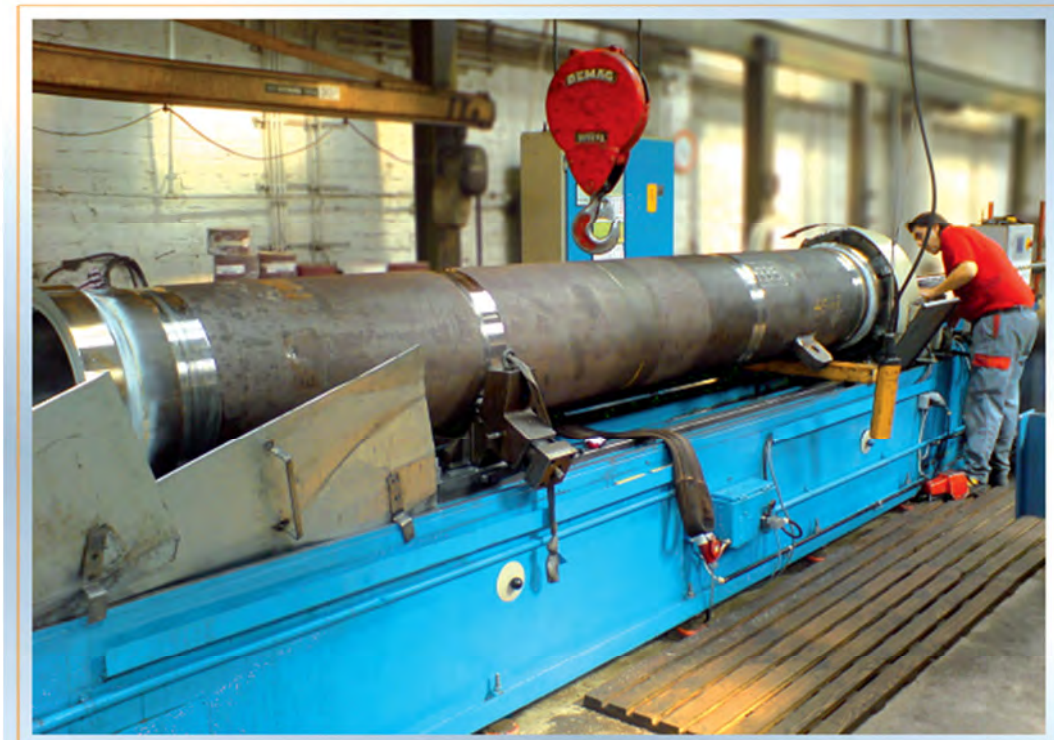
2.000 x 6.000 mm





facilities and capacities

Honen - honing -



Gehring 8,8m horizontal

Bearbeitungslänge:	8.800 mm alternativ ca. 16.000 mm auf Umschlag
Hondurchmesser:	600 mm
Rohraußendurchmesser:	720 mm
Umlaufdurchmesser:	920 mm
Steuerung:	CNC, selbstentwickelt
Antriebsleistung:	50 kW
Besonderheiten:	**Gegendrehantrieb** bis 8.800 mm

facilities and capacities

- deep hole drilling, skiving & roller burnishing -

Tiefbohren, Schälen & Glattwalzen

Tacchi FT 430

Bohrlänge:	9.700 mm
Bohrdurchmesser:	150 - 600 mm
S & G Länge:	10.000 mm
S & G Durchmesser:	150 - 320 mm
Rohraußendurchmesser:	720 mm
Umlaufdurchmesser:	960 mm
Steuerung:	CNC Sinumerik 840 D
Antriebsleistung:	120 kW + 60 kW
Besonderheiten:	**keine**

facilities and capacities

Schweißen - welding -

Schweißanlage
(Eigenentwicklung)

Spitzenweite:	15.000 mm
Spitzenhöhe:	600 mm
Lünetten:	bis 800 mm
Steuerung:	CNC Lincoln

Besonderheiten:

Fügen und Verschweißen von Rohren

Rundschweißen

Längstschweißen

WIG/ UP/ MAG (vorbereitet)

Wurzeldurchhang max. 0,3 mm

gesteuerte Pulvertrocknung

facilities and capacities

Lackieren - painting -

Lutro Super 50

kombinierte Reinigungs-, Farbspritz- und Trocknungskabine

Kabinenlänge:	16.000 mm
Kabinenbreite:	4.000 mm
Luftleistung:	2 x 28.000 m³ / h
Heizleistung:	2 x 186 kW (max. + 90° C) (mit Wärmerückgewinnung)
Steuerung:	SPC, Siemens

Besonderheiten: **Wand- und Bodenabsaugung**

Mittige Teilung der Kabinen

Kabinen separat steuerbar

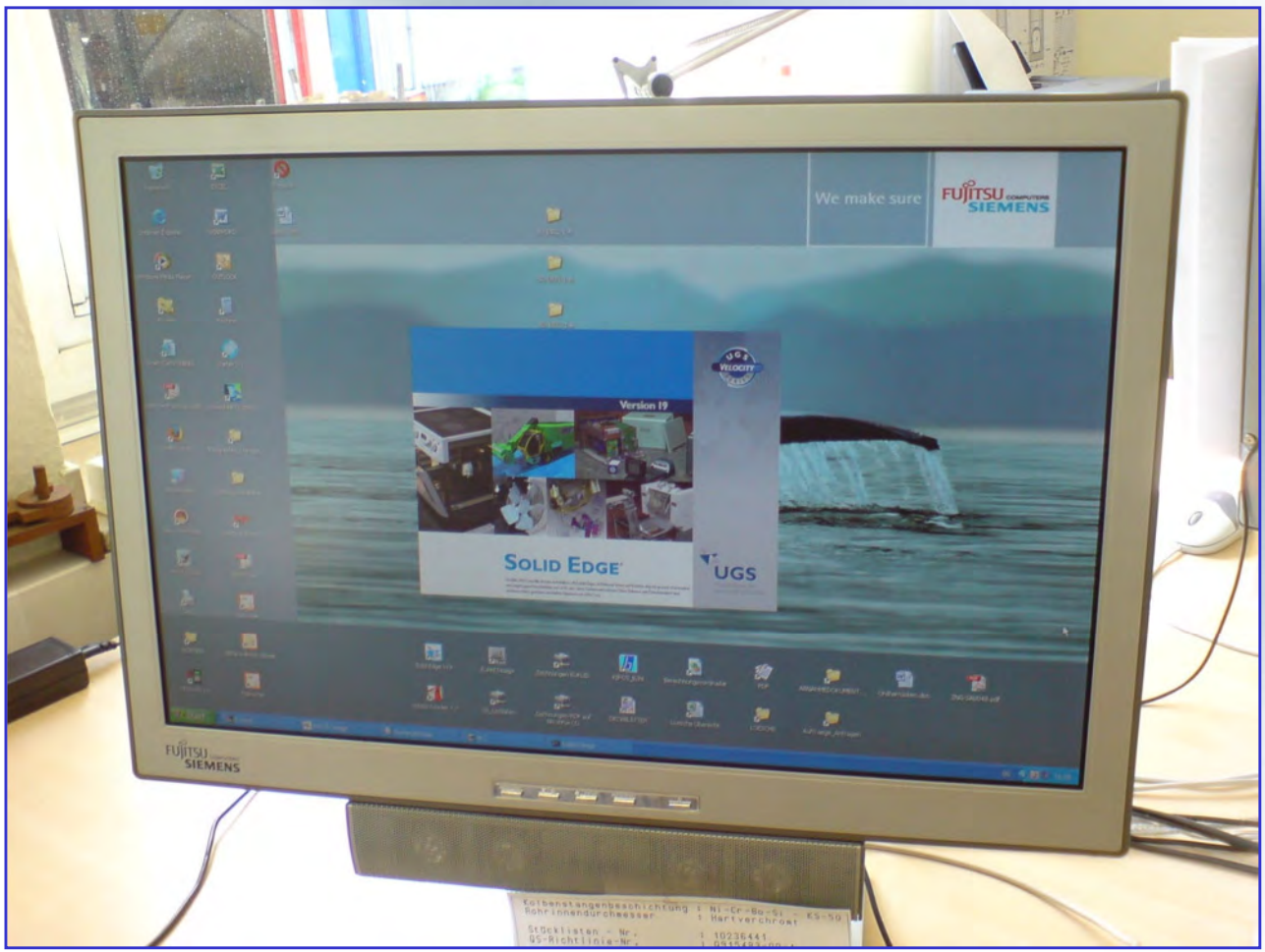
facilities and capacities

- assembly -

crane capacity	25 tons
area	800 m²
test pressure	max. 600 bar

key facts of facilities and capacities

3 – D System Solid Edge



design facilities

key facts of facilities and capacities

design facilities

designer

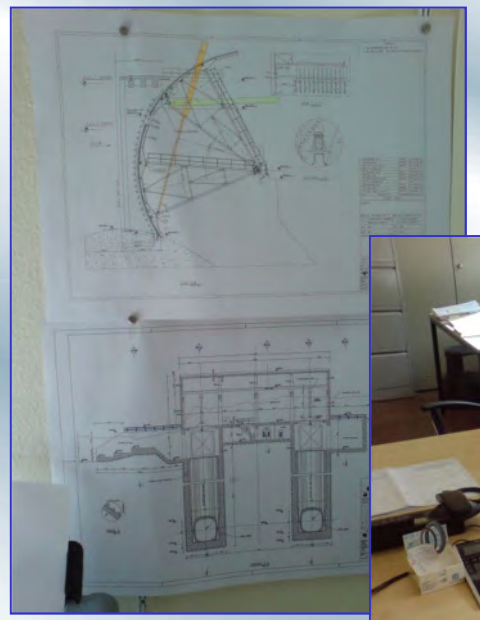
4 engineers (mechanical)

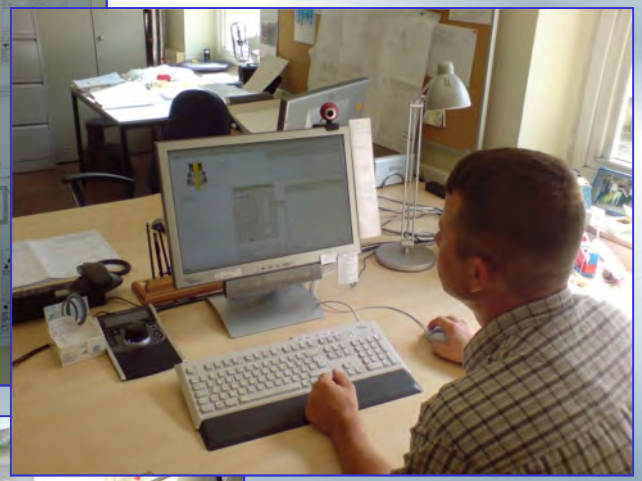
experience: **32 years**

8 years

5 years

3 years





documentation

1 engineer (electronics)

experience: **7 years**

presentation

RUHFUS

Neuss, Germany

cylinder dimensionizing

wall thickness, rod, piston, pressure

Only an essence out of many various calculation schemes!!

cylinder calculation

RUHFUS Systemhydraulik

Hydraulik Zylinder Kalkulation
Hydraulic Cylinder Calculation
ohne Knickung - without buckling

Projekt-Nr. : Project-no.	50426
Erstellt : Construct	A.S.
Datum : Date	28.01.2013

5.4 Berechnung der Wandstärke von Stahlrohren gegen Innendruck in Anlehnung an DIN 19704-1:1998-05

Calculation of the required wallthickness of the cylindertube against internal pressure at service condition according to DIN 19704-1 : 1998

- DIN 2413 : 2005-04 " Nahtlose Stahlrohre für schwellende Beanspruchung , Berechnungsgrundlage für Rohre und Rohrbögen "
" Calculation of wall thickness of steel tubes subjected to internal pressure " Design rules for pipes and elbows

- Rohrwandberechnung ; Spannung in der Zylinderrohrwand ; Formulas for stress & strain (Roark/Young)
- Tube sheet computation tension in the cylinder barrel wall ; Formulas for stress & strain (Roark/Young)

- Geltungsbereich I "Vorwiegend ruhend beansprucht bis -10°C bis +120°C"
- Area of application I "mostly static loaded -10°C to +120°C"

- Die angegebenen Formeln gelten für Rohre mit Kreisquerschnitt ohne Ausschnitte bis zu einem Durchmesserverhältnis von u = Da / Di = 2
- the formulas apply for pipes with a circular cross-section without extracts up to a diameter ratio of $u = D_a / D_i = 2$

Rohrwerkstoff / Norm Tube material / Rules		:	E355+AR EN 10297-1	
Streckgrenze Yield strength tube material	R_{eH}	:	335	N/mm²
Zugfestigkeit Tensile strength tube material	R_m	:	490	N/mm²
Dehnung Elongation tube material	A	:	20	%
Sicherheitsfaktor Safety factor	S	:	1,6	
Erhöhungsfaktor nach DIN 19704-1 ; Abschnitt 10.2.2 Increase factor to DIN 19704-1 ; Section 10.2.2	E	:	40	%
Rohr Innen-ϕ Tube inside diameter	D_i	:	600	mm
Auslegungs Druck Design pressure	p	:	215	bar
Prüfdruck Test pressure	p_p	:	325	bar
Schweißnahtfaktor bei nahtlosen Rohren Weld factor seamless tube	v_N	:	1	
Zuschlag zum Ausgleich der zul. Wanddicken-Unterschreitung Allowance for minus thickness tolerance	c_1	:	0	mm
Zuschlag zur Berücksichtigung von Korrosion & Abnutzung Wastage allowance	c_2	:	2	mm
Durchmesserverhältnis Dia ratio	u	:	2	

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RUHFUS Systemhydraulik

presentation

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Neuss, Germany

cylinder dimensionizing

deflection of slender cylinder

according to DIN 19704

designed, programmed and approved

for RUHFUS by

University Linz, Austria (2005)

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RUHFUS Systemhydraulik
ruhfus.com
MADE IN GERMANY

cylinder calculation

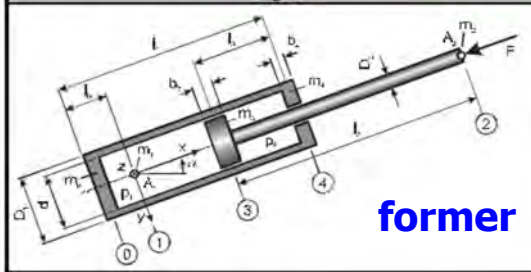
former

Berechnungsdatenblatt
schlanker Hydraulikzylinder nach DIN 19704-1

RUHFUS Systemhydraulik

Projektdaten			
Kunde			
Projekt	ZaHung	Datum	20. Dezember 2007
Projekt-Nr.	111665-1	Sachbearbeiter	A.Schwarn
Abmessung	D 265/140x6630		

Eingabe

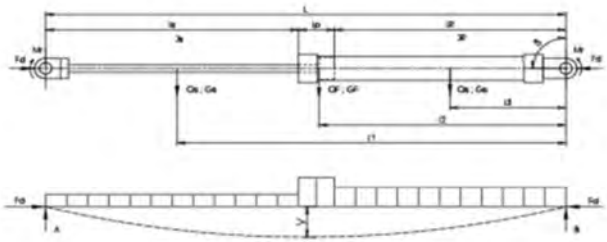


Geometrische Abmessungen			Äussere Kräfte		
Rotationsfreiheitsgrad	f_x	x	Normalkraft	F	2000000 N
Winkel	α	60 °	Masse Zylinderdeckel	m_5	225 kg
Lager - Zylinderb. Abst.	l_0	280 mm	Masse Lager A_1	m_1	350 kg
Zylinderlänge	l_1	4270 mm	Masse Lager A_2	m_2	480 kg
Kolbenstangenlänge	l_2	4640 mm	Masse Kolben	m_3	350 kg
Restlänge	l_3	370 mm	Masse Zylinderkopf	m_4	225 kg
Buchsenlänge Kolben	b_3	350 mm			
Buchsenlänge Zylinder	b_4	380 mm	**Sicherheitsfaktoren**		
Zylinderinnend.	d_1	400 mm			
Zylinderaussend.	D_1	470 mm	Teilsicherheitsbeiwert	$\gamma_{F,S}$	1,35
Stangendurchmesser	D_2	250 mm	Teilsicherheitsbeiwert	$\gamma_{F,F}$	1,35
Gelenkkopfd. A1	d_{k1}	200 mm	Kombinationsbeiwert	ψ	1,00
Gelenkkopfd. A2	d_{k2}	200 mm	Teilsicherheitsbeiwert	γ_M	1,50
Werkstoffe			**Drücke und Reibzahlen**		
Zylinderrohr	E355+AR od.		max. Druck	$p_{1,max}$	250 bar
DIN EN 10297-1, Rohre aus unlegierte					
Kolbenstange	42CrMo4+QT		Reibzahl Lager A1	μ_1	0,15
DIN EN 10083-1, Vergütungsstähle - E			Reibzahl Lager A2	μ_2	0,15
Buchsen	C360				
Führungsring aus Hartgewebe / Busak					

actual version

RUHFUS Systemhydraulik	Hydraulik Zylinder Kalkulation Hydraulic Cylinder Calculation mit Knickung - with buckling	Projekt-Nr. / Project-no.	114461
		Erstellt / Construct	V. Sept
		Datum / Date	20.12.2011

5.18 Berechnung der Spannungen in der Kolbenstange im ausgefahrenen Zustand mit Schrägstellung unter Druckspannung (Theorie II. Ordnung)
Calculation of the stress in the piston rod, with extended pulling cylinder and inclined installation attitude ; under pushing force (Theorie II. Ordnung)



Eingabewerte
Input value

Druck kolbenseitig Pressure piston side	p	:	7	bar
Rohraußen-Ø Tube outside dia.	D_a	:	495,00	mm
Kolben-Ø Diameter of piston	D_k	:	420	mm
Kolbenstangen-Ø Diameter of piston rod	d_s	:	240	mm
Neigungswinkel des Zylinders (zur Vertikalen, Zyl. ausgefahren) Angle of inclination , to vertical ; rod extendet	β	:	40,5	°
Länge der ausgef. Kolbenstange Lenght extendest piston rod	l_s	:	11.887	mm
Führungslänge der Kolbenstange Bearing lenght piston rod	l_b	:	663	mm
Länge Zylinderrohr Lenght cylinder tube	l_R	:	11.500	mm
Reibungszahl Gelenklager Friction coefficient spherical bearing	μ	:	0,05	
Gelenklager-Ø Spherical bearing - Ø	d_G	:	200	mm
Kugel-Ø Gelenklager Ball -Ø spherical bearing	d_K	:	250	mm
Dichte von Stahl Density steel	p	:	7,85	kg/m³
Dichte von Oel Density oil	$p_{Öl}$	:	0,90	kg/m³
Sicherheitsfaktor Safety grade	υ_k	:	2,50	

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RUHFUS Systemhydraulik

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cylinder dimensionizing

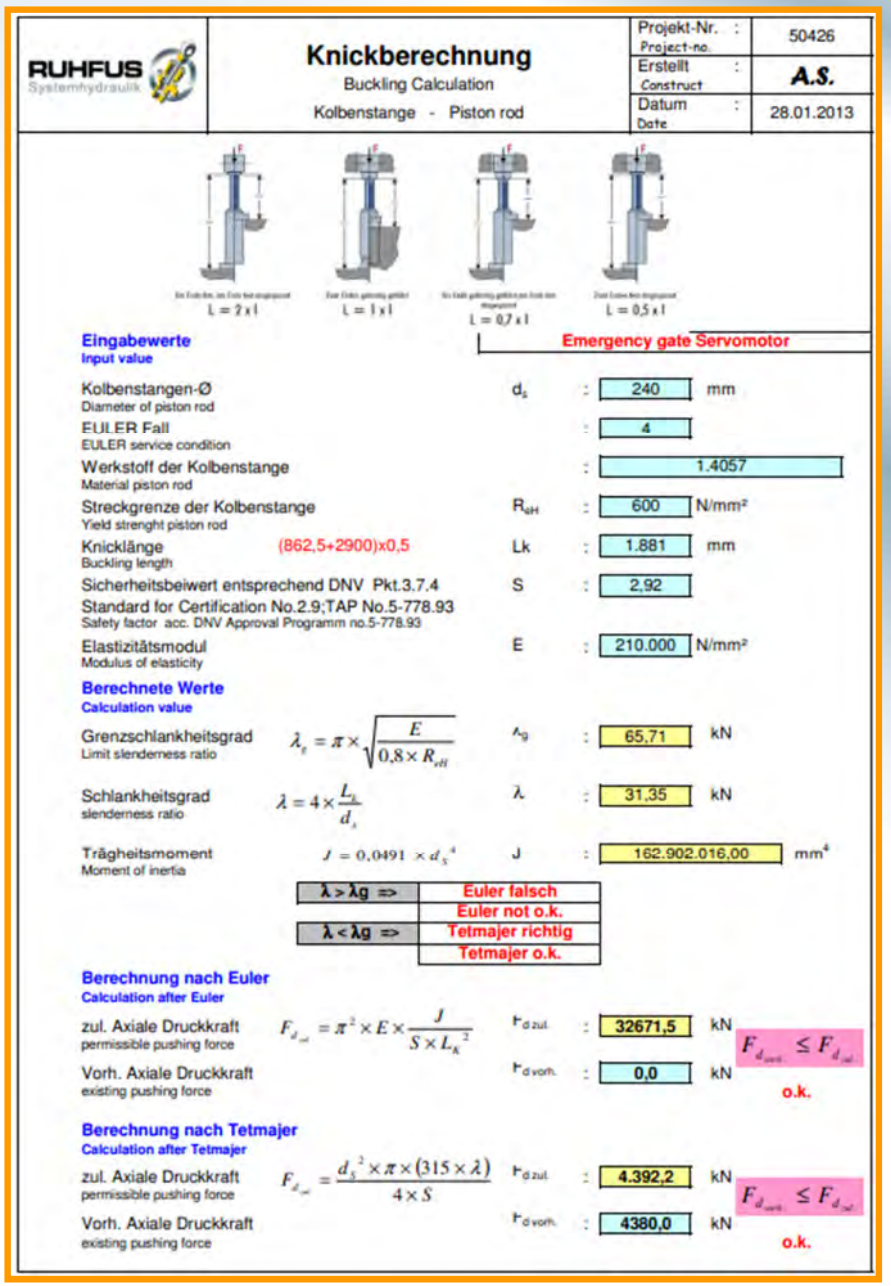
buckling of slender cylinder

designed, programmed and approved by

RUHFUS

cylinder calculation

(buckling)



RUHFUS Systemhydraulik

Knickberechnung
Buckling Calculation
Kolbenstange - Piston rod

Projekt-Nr. / Project-no.	50426
Erstellt / Construct	A.S.
Datum / Date	28.01.2013

L = 2 x l | L = 1 x l | L = 0,7 x l | L = 0,5 x l

Eingabewerte / Input value — Emergency gate Servomotor

Kolbenstangen-Ø Diameter of piston rod	d_s	:	240	mm
EULER Fall EULER service condition		:	4	
Werkstoff der Kolbenstange Material piston rod		:	1.4057	
Streckgrenze der Kolbenstange Yield strenght piston rod	R_{eH}	:	600	N/mm²
Knicklänge (862,5+2900)x0,5 Buckling length	Lk	:	1.881	mm
Sicherheitsbeiwert entsprechend DNV Pkt.3.7.4 Standard for Certification No.2.9;TAP No.5-778.93 Safety factor acc. DNV Approval Programm no.5-778.93	S	:	2,92	
Elastizitätsmodul Modulus of elasticity	E	:	210.000	N/mm²

Berechnete Werte / Calculation value

Grenzschlankheitsgrad Limit slenderness ratio	$\lambda_g = \pi \times \sqrt{\frac{E}{0{,}8 \times R_{eH}}}$	λ_g	:	65,71	kN
Schlankheitsgrad slenderness ratio	$\lambda = 4 \times \frac{L_k}{d_s}$	λ	:	31,35	kN
Trägheitsmoment Moment of inertia	$J = 0{,}0491 \times d_s^4$	J	:	162.902.016,00	mm⁴

λ > λg =>	Euler falsch Euler not o.k.
λ < λg =>	Tetmajer richtig Tetmajer o.k.

Berechnung nach Euler / Calculation after Euler

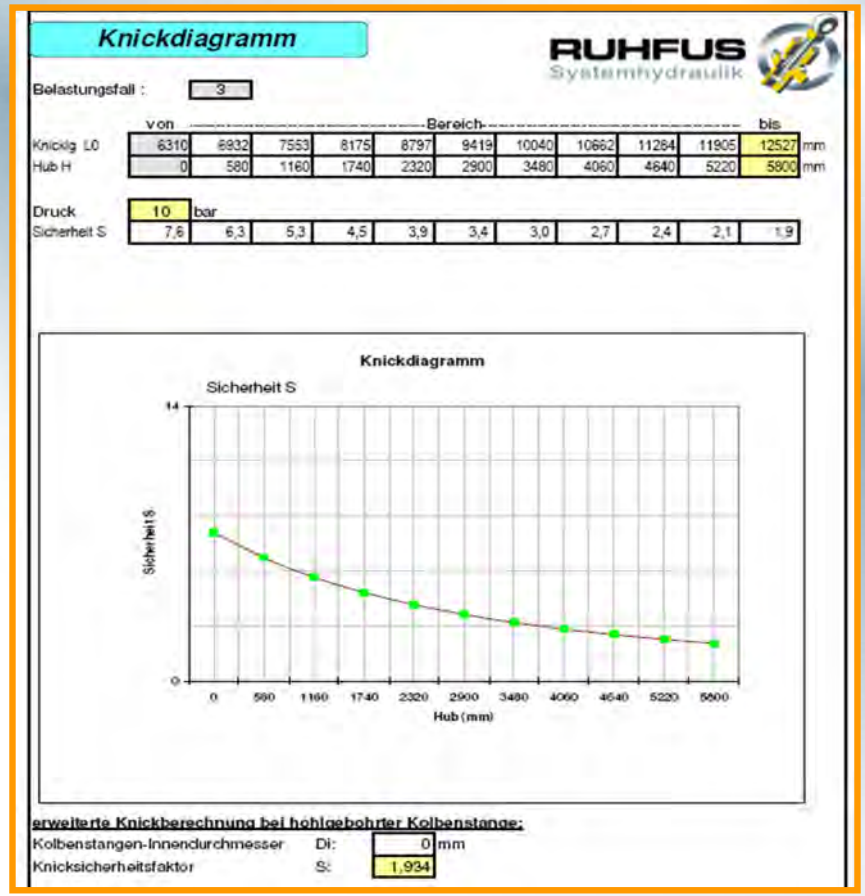
zul. Axiale Druckkraft permissible pushing force	$F_{d\,zul} = \pi^2 \times E \times \frac{J}{S \times L_k^2}$	$F_{d\,zul}$	:	32671,5	kN
Vorh. Axiale Druckkraft existing pushing force		$F_{d\,vorh}$	:	0,0	kN

$F_{d\,vorh} \le F_{d\,zul}$ o.k.

Berechnung nach Tetmajer / Calculation after Tetmajer

zul. Axiale Druckkraft permissible pushing force	$F_{d\,zul} = \frac{d_s^2 \times \pi \times (315 \times \lambda)}{4 \times S}$	$F_{d\,zul}$	:	4.392,2	kN
Vorh. Axiale Druckkraft existing pushing force		$F_{d\,vorh}$	:	4380,0	kN

$F_{d\,vorh} \le F_{d\,zul}$ o.k.



Knickdiagramm

RUHFUS Systemhydraulik

Belastungsfall : 3

	von	Bereich								bis	
Knickl. L0	6310	6932	7553	8175	8797	9419	10040	10662	11284	11905	12527	mm
Hub H	0	580	1160	1740	2320	2900	3480	4060	4640	5220	5800	mm
Druck	10	bar										
Sicherheit S	7,6	6,3	5,3	4,5	3,9	3,4	3,0	2,7	2,4	2,1	1,9	

erweiterte Knickberechnung bei hohlgebohrter Kolbenstange:

Kolbenstangen-Innendurchmesser	Di:	0	mm
Knicksicherheitsfaktor	S:	1,934	

presentation

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cylinder dimensionizing

safety factor & stress

cylinder calculation

Seite10von25

RUHFUS	Radial gate cylinder Computation -Calculation	Quotation-No. : 9115 / 9116
		Design : A.S.
		Date : 14.10.2008
		Current status : 11-01-2007

Input values

Safety factor increase	S_E	:	2,24	
allowable stress	δ_{zul}	:	154,02	N/mm²
calculated wall thickness	s_r	:	34,55	mm
requisite wall thickness	s	:	34,55	mm
requisite tube outside dia.	d_e	:	519	mm
tube outside dia. specify acc. DIN / EN	D_a	:	521	mm
calculated wall thickness	s_{bar}	:	35,50	mm
dia ratio	u	:	1,16	

It is to be proven that the dia ratio Da / Di =< 2

Requirements o.k. !

calculated wall thickness	s_{rech}	:	34,67	mm
requisite wall thickness	s_{vorh}	:	34,67	mm

It is to be proven that the nominal wall thickness is thicker than the required wallthickness

Requirements o.k. !

The specified limits according to DIN 19704 : 2005

Computation safety factor S by test pressure

push factor ψ	:	1,1	
safety S	:	1,49	

The work test pressure may not be regarded as increased operating pressure!!

Expansion cylinder barrel/change of diameter with test pressure

Δ_d	:	0,462	

Existing tensile states with internal positive pressure

Tangential tension	δ_{t1}	:	140,93	N/mm²
	δ_{t2}	:	120,43	N/mm²
Radial stress	δ_r	:	-20,5	N/mm²
Tensile stress	δ_z	:	60,21	N/mm²
Stress intensity (after criterion guest)	δ_i	:	161,43	N/mm²
Safety factor	S	:	2,14	N/mm²

Seite11von25

RUHFUS	Radial gate cylinder Computation -Calculation	Quotation-No. : 9115 / 9116
		Design : A.S.
		Date : 14.10.2008
		Current status : 11-01-2007

6.2 Calculation of the required wallthickness of the cylinder front head with opening and with no additional peripheral moment according to AD-Instruction sheet B5

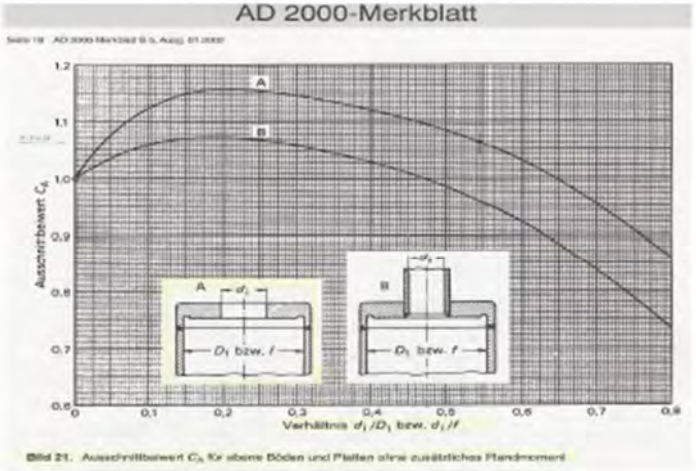

Bild 21. Ausschnittbeiwert C_1 für ebene Böden und Platten ohne zusätzliches Randmoment

Input values

Inside -Ø cylinder head	d_i	:	222	mm
Computation factor (Tafel 1 - d)	C	:	0,35	
Material			S355J2G3	DIN EN 10025
Yield strenght material	R_{eH}	:	275	N/mm²
Partial safety factor	γ_F	:	1,35	
Partial safety factor	γ_M	:	1,5	
Allowance for minus thickn. Tolera. (no allowance forwalls thicker than 25 mm)	C_1	:	0	mm
Wastage allowance (no allowance forwalls thicker than 30 mm)	C_2	:	0	mm
Flange thickness available	s	:	120	mm
Flange thickness available	s_R	:	90	mm

presentation

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cylinder dimensionizing

tension and force calculation

„spherical eye – trunnion"

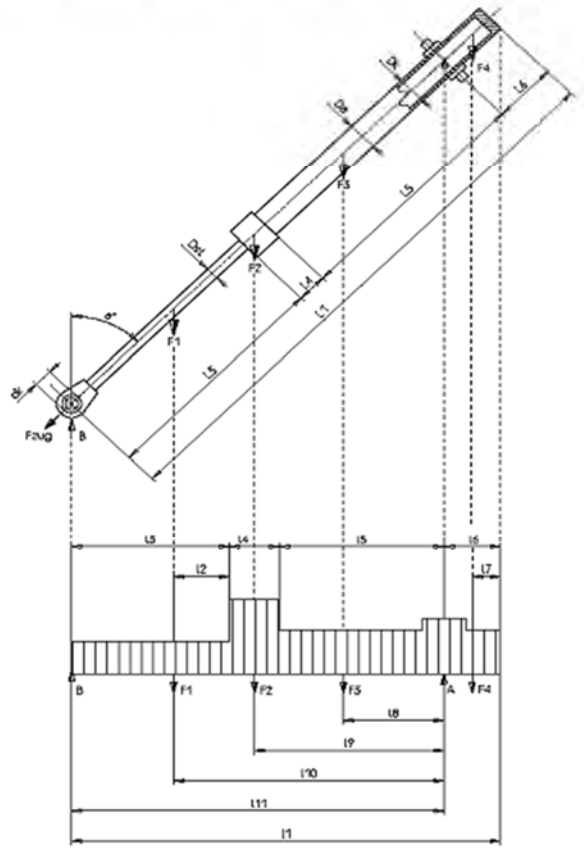
cylinder calculation

RUHFUS Systemhydraulik

Hydraulikzylinder
Berechnung - Kalkulation
Befestigung : Auge- Schwenkzapfen

Angebots-Nr.	:	xx
Erstellt	:	A.S.
Datum	:	xx
Stand : 13-09-2009		

5.15 Berechnung der Spannungen in der Kolbenstange im ausgefahrenen Zustand mit Schrägstellung in Anlehnung an DIN 19704-1 : 1998



RUHFUS Systemhydraulik

Hydraulikzylinder
Berechnung - Kalkulation
Befestigung : Auge- Schwenkzapfen

Angebots-Nr.	:	xx
Erstellt	:	A.S.
Datum	:	xx
Stand : 13-09-2009		

Eingabewerte

Neigungswinkel des Zylinders (zur Vertikalen ; Zylinder ausgefahren)	α	:	26	°
Zylinderlänge ausgefahren	L_1	:	23.840	mm
Länge der ausgef. Kolbenstange	L_2	:	11.920	mm
Führungslänge der Kolbenstange	L_4	:	620	mm
Länge Kopf bis Mitte Schwenkzapfen	L_5	:	9.483	mm
Mitte Schwenkzapfen bis Boden	L_6	:	1.817	mm
Reibungszahl Gelenklager	μ	:	0,15	
Gelenklager-Ø	d_G	:	200	mm
Kugel-Ø Gelenklager	d_K	:	250	mm
Werkstoff Kolbenstange		:	25CrMo4+QT	DIN EN 10083
Streckgrenze Kolbenstangenmaterial	R_{eH}	:	400	N/mm²

Berechnung

Berechnung der Längen l_1 - l_{10}

$l_1 = \sin\alpha \times L_1$	l_1	:	10.451	mm
$l_3 = \sin\alpha \times L_3$	l_3	:	5.225	mm
$l_2 = \frac{l_3}{2}$	l_2	:	2.613	mm
$l_4 = \sin\alpha \times L_4$	l_4	:	272	mm
$l_5 = \sin\alpha \times L_5$	l_5	:	4.157	mm
$l_6 = \sin\alpha \times L_6$	l_6	:	796,5	mm
$l_7 = \frac{L_6}{2}$	l_7	:	398,26	mm
$l_8 = \sin\alpha \times \frac{L_5}{2}$	l_8	:	2.079	mm
$l_9 = \sin\alpha \times \left(L_5 + \frac{L_4}{2}\right)$	l_9	:	4.293	mm
$l_{10} = \sin\alpha \times \left(L_5 + L_4 + \frac{L_3}{2}\right)$	l_{10}	:	7.042	mm
$l_{11} = \sin\alpha \times (L_3 + L_4 + L_5)$	l_{11}	:	9.654	mm
Querschnitt Kolbenstange	A_{St}	:	39.761	mm²

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cylinder calculation

(damping)

Auslegung Endlagendämpfung

RUHFUS Systemhydraulik

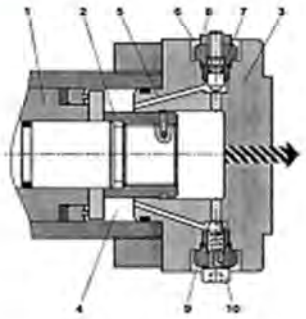
Normen / Vorschriften

Kunde : Tarvand Tadbir
Projekt : Karun 4, Ø420/170x5500

	Eingabewerte
	Ausgabewerte

1. Endlagendämpfung

Der Kolben (1) wird mit einer Dämpfungsbuchse (2) auf der Kolbenstange befestigt.
Durch das einfahren der Dämpfungsbuchse in die Bohrung des Zylinderbodens (3) verringert sich der Querschnitt der abfließenden Druckflüssigkeit aus dem Kolbenraum (4). Die Druckflüssigkeit kann nur noch über die Bohrung (5) und das einstellbare Drosselventil (6) abfließen. Am Drosselventil (6) wird die Wirkung der Dämpfung eingestellt.
Je kleiner der Volumenstromquerschnitt um so größer ist die Wirkung der Endlagendämpfung.



Pos.(7) = Drosselschraube
Pos.(8) = Kontermutter
Pos.(9) = Rückschlagventil
Pos.(10)= Entlüftungsschraube

2. Technische Daten

Kolbendurchmesser in mm	420	
Stangendurchmesser in mm	170	
Betriebsdruck pB in N/cm² ausf.	750	75 bar
Betriebsdruck pB in N/cm² einf.	2000	200 bar
$v_{max.}$ ausfahren in m/s.	0,0050	
$v_{max.}$ einfahren in m/s.	0,0050	
bewegte Masse in kg	105.600	
Dämpfungslänge Kolben in m	0,000	
Dämpfungsdurchm. Kolben in cm	0,000	
Dämpfungslänge Stange in m	0,098	
Dämpfungsdurchm. Stange in cm	19,495	

Legende

FB = Bremskraft in N
m = bewegte Masse in kg
a = Verzögerung in m/s²
v = Hubgeschwindigkeit in m/s
s = Dämpfungslänge in m
a = Verzögerung in m/s²
dK = Kolbendurchmesser in cm
AK = Kolbenfläche in cm²
dS = Stangendurchmesser in cm
AR = Ringfläche in cm²
pB = Systemdruck in N/cm²
(1 bar = 10 N/cm²)
dDK = Dämpfungsdurchmesser Kolben in cm
ADK = Dämpfungsfläche in cm² (Kolbenraum)
dDR = Dämpfungsdurchmesser Stange in cm
ADR = Dämpfungsfläche in cm² (Ringraum)
pD = mittl. Dämpfungsdruck in N/cm²

3. Berechnung der Bremskraft

Kolbenfläche : $A_K = d^2 * 0{,}785$
1384,74 cm²

Ringfläche : $A_R = (d_K^2 - d_S^2) * 0{,}785$
1.157,88 cm²

Verzögerung ausfahren : $a_{ausf} = v^2 / 2 * s$
0,00 m/s²

Verzögerung einfahren : $a_{einf} = v^2 / 2 * s$
#DIV/0! m/s²

cylinder dimensionizing

damping

designed, programmed and

approved by RUHFUS

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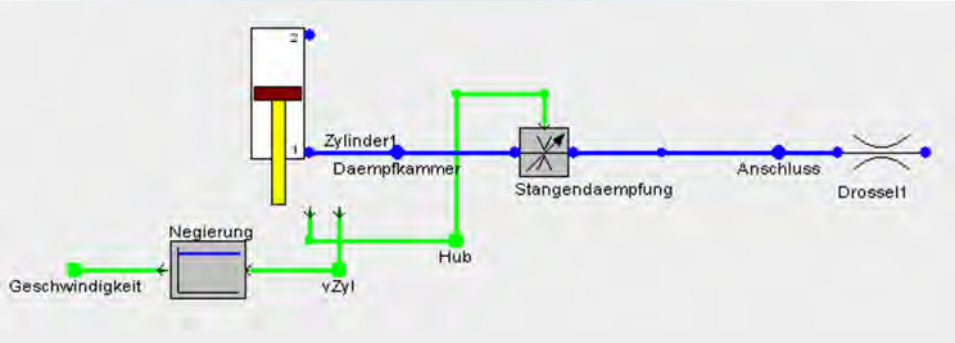
modelling of cylinder concept and damping scheme



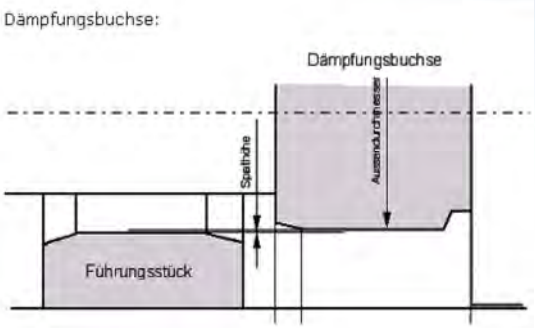
cylinder dimensionizing

damping

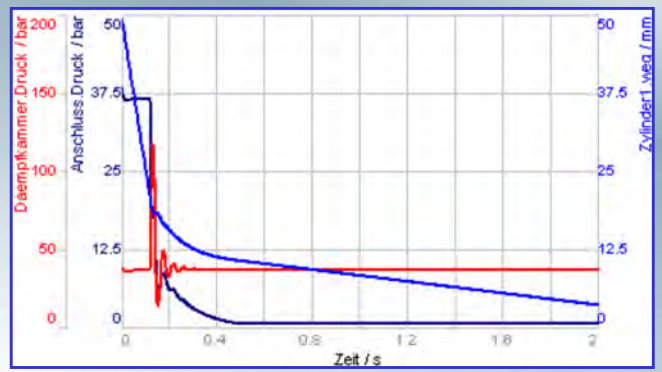
designed, programmed and approved for RUHFUS by

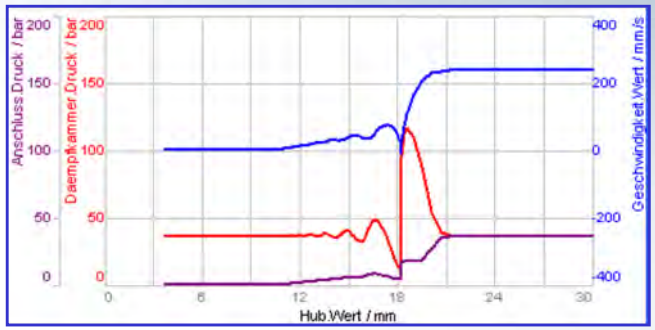
FLUIDON associated with THH University Aachen, Germany (2006)

parameterising for damping calculation



results





cylinder calculation

(damping)

DESIGNED FOR A LIFETIME
RUHFUS Systemhydraulik
ruhfus.com
MADE IN GERMANY

RUHFUS Systemhydraulik

Our prefered partner

TOPCOAT® ceramic coating and LPM® displacement transducer by

VLAMSPUITTECHNIEK
GEBR. GRIEKSPOOR BV

KS-InductiveCoat *and* **KS-VacuumCoat**,
KS-SuperCoat *and* **KS-HardCoat** *by*

Karl Schumacher
Maschinenbau und Metallspritzwerk

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Our partner

for .... ceramic coating

The *ceramic coating* was launched under its own brand name, TOPCOAT® and is used in the hydraulic and civil-engineering world since 1990 as an excellent protection against (salt-water)-corrosion, corrosive substances and general wear and tear.

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TECHNICAL SPECIFICATIONS

Technical specifications (according to NBD 10300)

Specification	Value according to NBD-standard	Griekspoor average
Connection strength	≥ 15 N/mm2	approx. 40 N/mm2
Max. service temperature	540 oC	
Porosity	< 4%, *without* open connections	< 3%, *without* open connections
Macro-hardness	> 60 HRc	approx. 62 HRc
MicroOhardness	850 HV 300G	1000 HV 300G
Dialectic force	> 100 mΩ	
Surface roughness (Ra)	≤ 0,4 µm	approx. 0.3 µm
Surface roughness (Ry)	≤ 5 µm	approx. 4 µm
Bearing part	≥ 80% depth 1,5 µm	≥ 90% depth 1,5 µm
Corrosion resistance	≥ 1000 hours	DIN50021-155 (35±1oC, 5%±1 weight % NaCl, pH 3.1-3.3, rel. moisture ≥ 95%)
Wear-resistance	Equal or better than hardened chrome, depending on the situation	

TOPCOAT®

Application and composition

Application	○ In (contaminated) salt and/or fresh water, chemically corrosive environment; ○ Exposure to cavitation, abrasive and erosive wear; ○ Combines toughness with great hardness and good wear resistance.
Examples	○ Plunger rods of hydraulic cylinders, moving parts of bridges and ship locks. ○ Protection against acids and bases in food and nonfood.

	Composition		Layer thickness [mm]		
First coating	NiCr 80/20	Optimum	0.2	Maximum	0.6
Top layer	Al_2O_3-TiO_2 87/13	Optimum	0.2	Maximum	0.6

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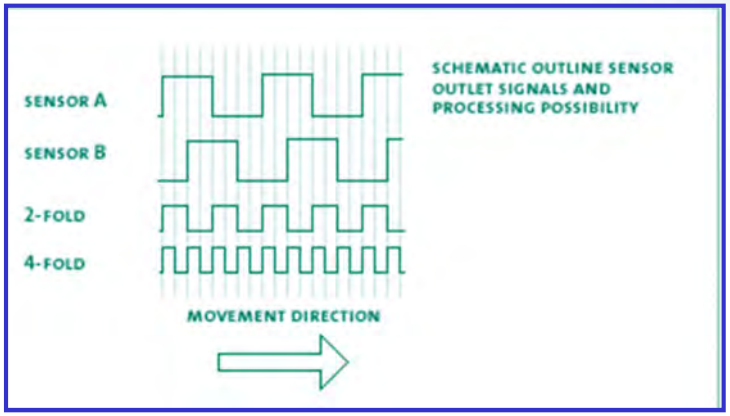
Our partner

for .... ceramic coating

Additional with the ceramic coating an electrical **L**inear **P**ositioning **M**easuring system *LPM®* ,
a, low maintenance and interference, displacement transducer for piston rod has been developed

The concept is that a profile is placed underneath the ceramic on the piston rod, over which the *TOPCOAT®* is applied. Using special recorders (IP67 Class) the profile is read out without a direct contact and converted into a counter signal (digital, 4-20 mA or RSS 422). The measuring accuracy is 1 mm. The repetition accuracy is 0.1 mm.



Our partner

for .... ceramic coating

The system allows to monitor the travelling distance of the cylinder rod contactless. The *Lineare Position Measurement System* (LPM®) consists of 1 or 2 sensor that scan the profile of the rod during ist movements.

The profile is located underneath the protective TOPCOAT®. The signal is passed on and processed in the control electronics of your installation.

Technical specification	Standard	Special
Supply voltage	18-30 VDC	18-28 VDC
Power consumption	20mA	20mA
Maximum output current	30mA	100mA
Maximum switch frequency	1-20kHz	1-20kHz
Voltage loss	<7VDC (I_A=30mA)	<3VDC
Short-circuit resistant	Yes	Yes
Resistant against reversal of polarity	-	Yes
Control possibility	LED	LED
Temperature range	-25°C... +75°C	-40°C... +120°C
Material	Brass (nickel-plated)	Chrome Nickel Steel (1.4305)
Protection class tracer surface	-	IP68 / 20 bar
Protection class sensor	IP67	IP67

presentation

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***Ruhfus*, ... partner in power packs and control units**

power packs

&

control units

RUHFUS Systemhydraulik

presentation

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***Ruhfus*, ... partner in power packs and control units**

power packs

&

control units

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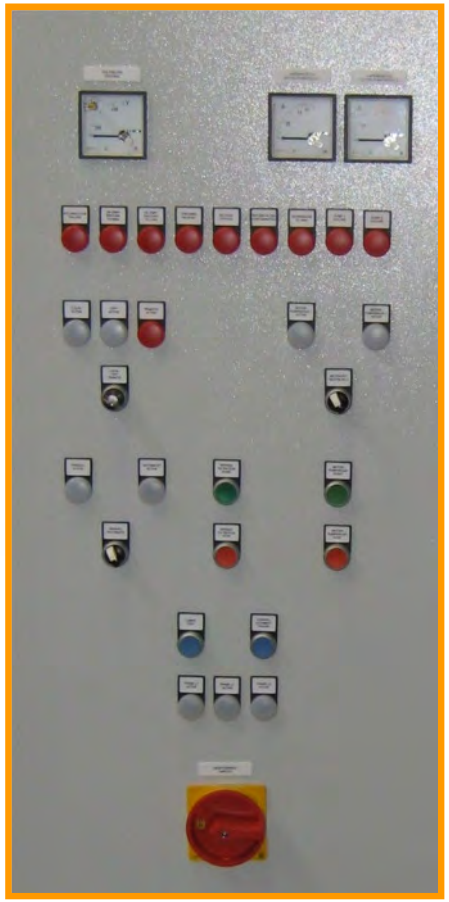
power packs

&

control units



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presentation

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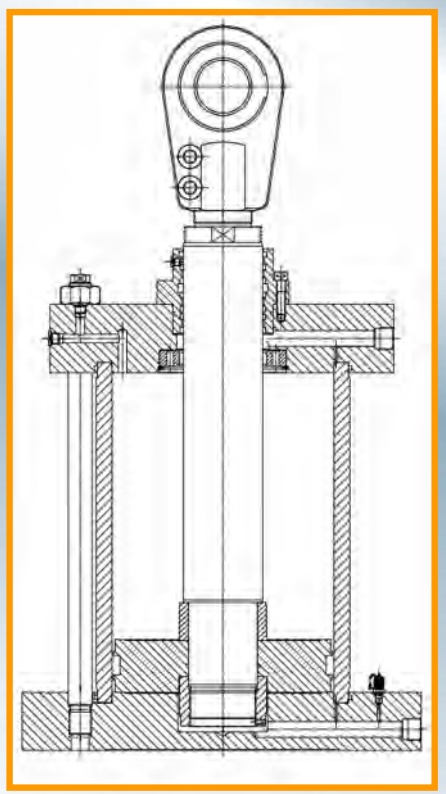
RUHFUS

- supplier of various branches -

Manantali (Senegal - Westafrika) 2000

5 Kaplan Turbines each 40 MW

10 x servomotors for distributor of water turbine 420/ 150; stroke 505 mm

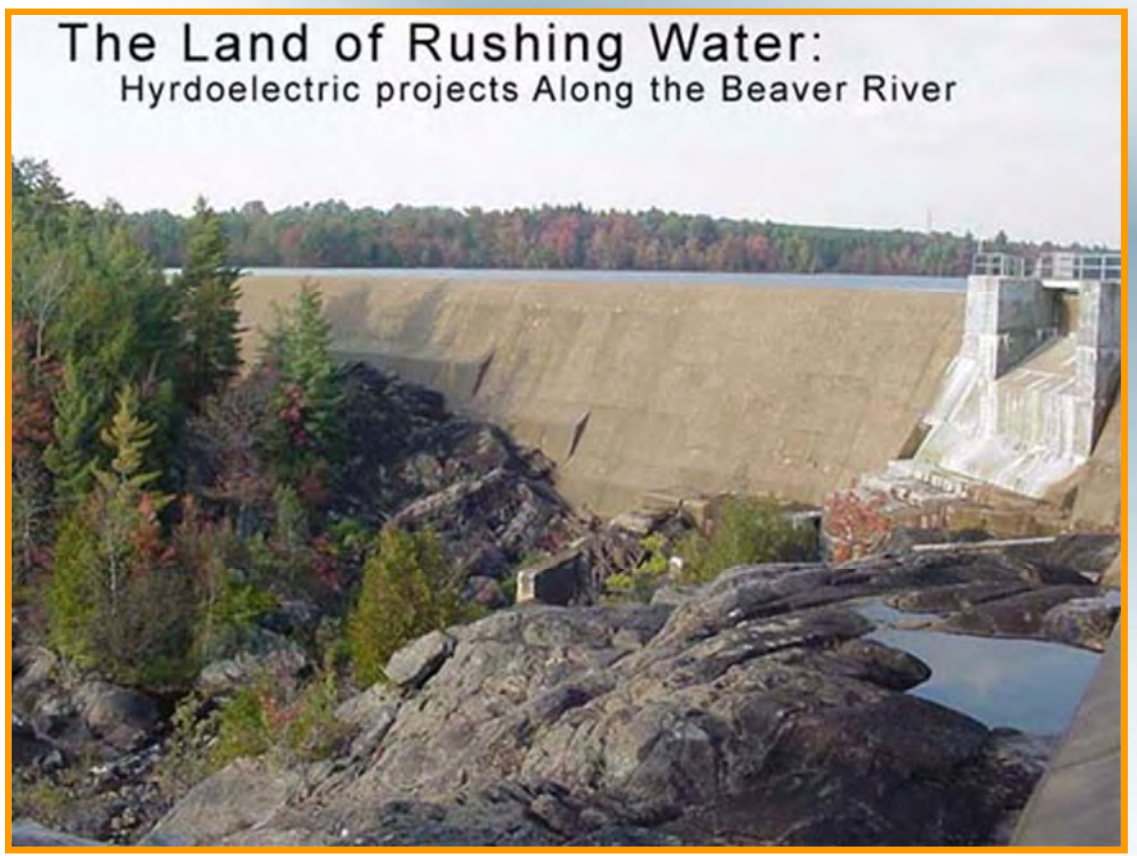


600m long und 65m high dam of Manantali at river **Bafing**

High Falls (USA / Canada) 2001

8 x servomotors for distributor of water turbine 420 / 160; stroke 535 mm

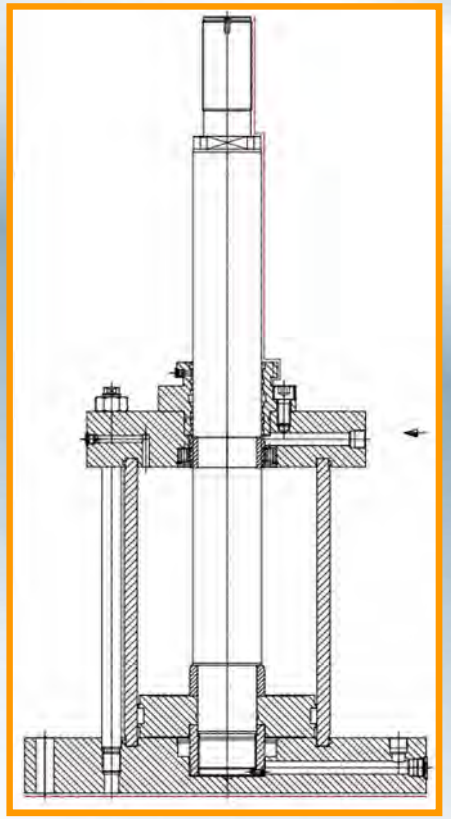
8 x locking cylinders for distributor of water turbine 110/ 95; stroke 45 mm



Walter F. George Lock & Dam (Georgia, USA) 2001

4 x servomotors for distributor of water turbine 260/ 150; stroke 265 mm

4 x locking cylinders for distributor of water turbine 110/ 95; stroke 40 mm



Walter F. George Lock & Dam

Ekbatan (Iran) 2006

2 x servomotors for gate operation
200/ 125; stroke 1400 mm
280/ 125; stroke 1550 mm

1 x power pack 500 l +
control unit (local)

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Vanyar Storage dam (Iran) 2007

2 x servomotors for gate operation 380/ 140; stroke 3.300 mm

1 x power pack 1.500 l + control unit (local and remote)

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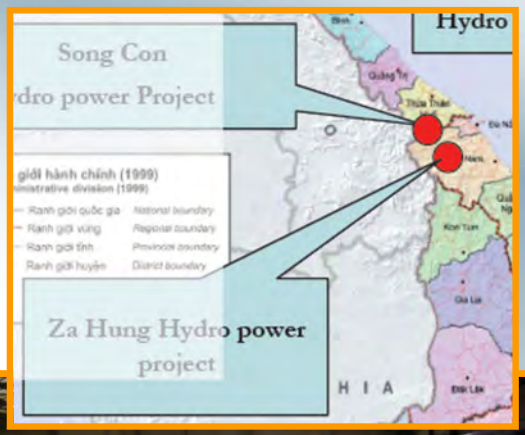
Za Hung Hydro Power Plant (Vietnam) 2008

4 x servomotors for gate operation 280/ 140; stroke 6.630 mm, ceramic & LPM

1 x servomotors for gate operation 280/ 140; stroke 4.800 mm, ceramic & LPM



presentation

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Sang Tuda II Hydro Power Plant (Tajikistan) 2009

10 x servomotors for gate operation,
320/ 140; stroke 6.800 mm, ceramic & LPM

3 x power packs and control cabinets

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presentation

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Karacham Wangtoo Hydro Power Plant (India) 2009

Optimized high pressure francise turbine 4 x 300 MW

10 x servomotors for turbine vane adjustement, 400/ 200; stroke 330 mm,

6 x servomotors for turbine vane adjustement, 350/ 200; stroke 2.051 mm,

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presentation

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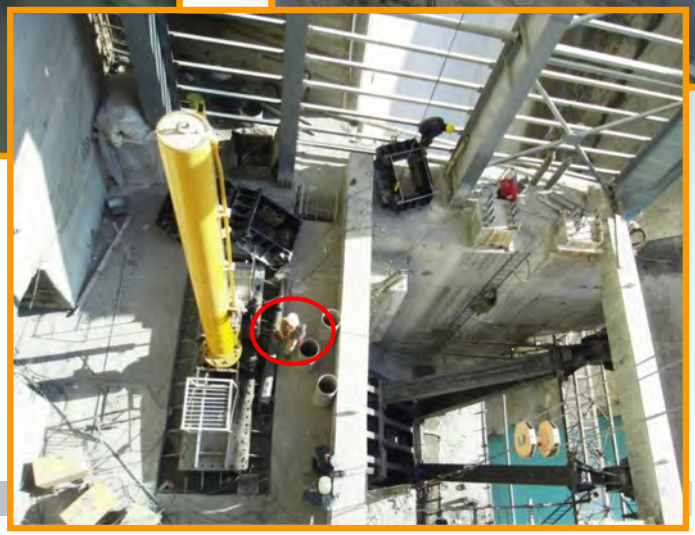
Karun IV Hydro Power Plant dam (Iran) 2009

2 x servomotors for intake gate operation, 330/ 125; stroke 9.500 mm,
2 x servomotors for emergency gate operation, 420/ 170; stroke 5.500 mm,
2 x servomotors for service gate operation, 480/ 220; stroke 4.050 mm,

2 x power pack 3000 Liter, Q = 52 l/min. / motor = 22 kW / p= 200 bar



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Gotvand Power Plant dam (Iran) 2009

4 x cylinder for power intake gate operation, 550/ 200; stroke 11.600 mm

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Sogomosa HPP (Columbia) 2011

18 x servomotors, 240/ 125, stroke 1.002 mm
➔ ring gate

6 x servomotors, 360/ 190, stroke 370 mm
➔ vane adjustment with locking device

presentation

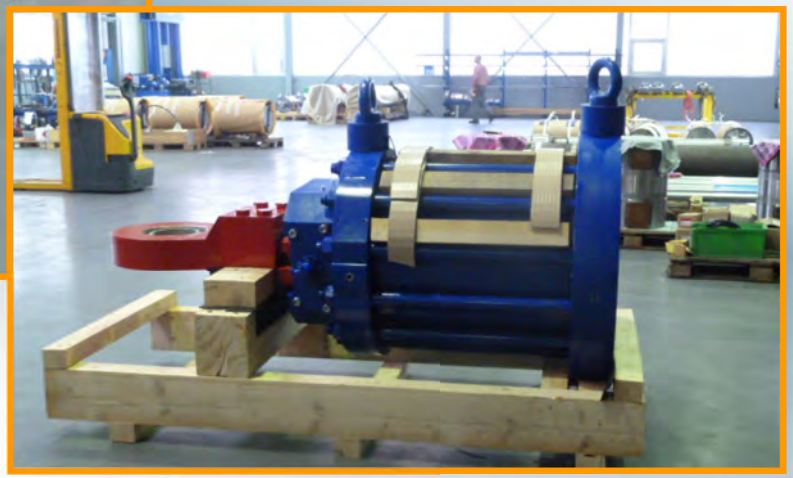
RUHFUS

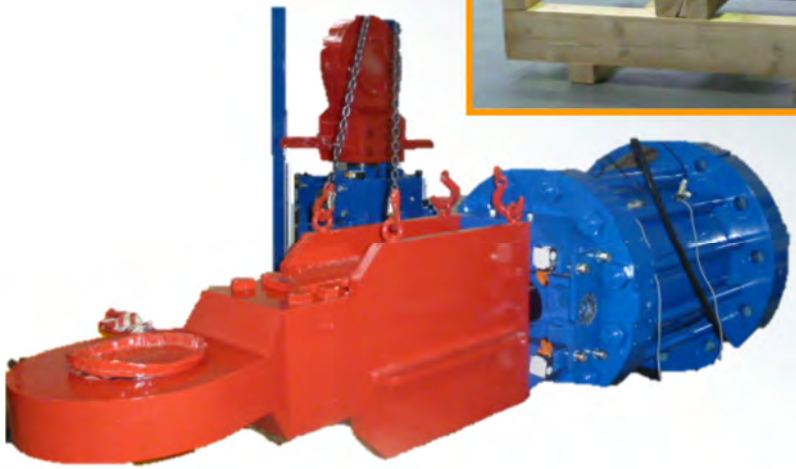
Neuss, Germany

Bemposta HPP (Portugal) 2012

2 x servomotors, 550/ 220, stroke 598mm

➔ vane adjustment with locking device





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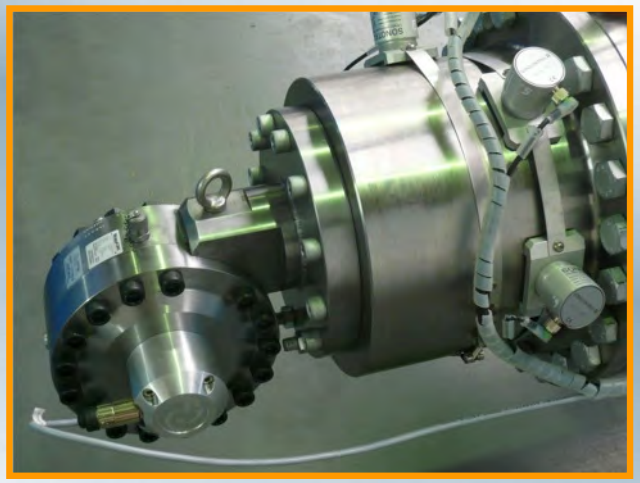
Frades II dam (Portugal) 2012

1 x cylinder, 290/ 140, stroke 8.500 mm

➔ *power intake gate operation*



presentation

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Sluice gates,
Waterways,
Bridges,
Ship unloader,
Marine application

Grab Type Shipunloader (No. 3) Luka Koper, (Slowenia)

2 x hydraulic cylinders

double acting 280 x 125, stroke 1614 mm

demands: highly corrosive environment

longelivity

presentation

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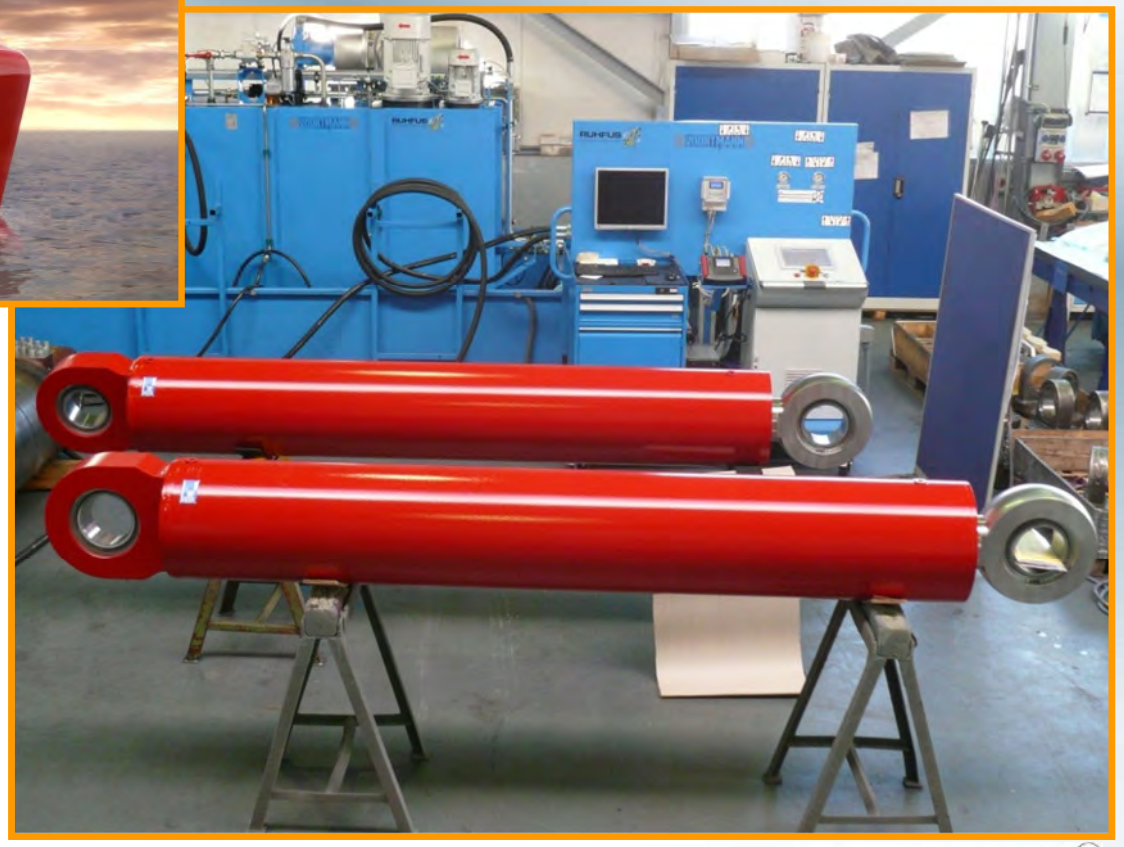
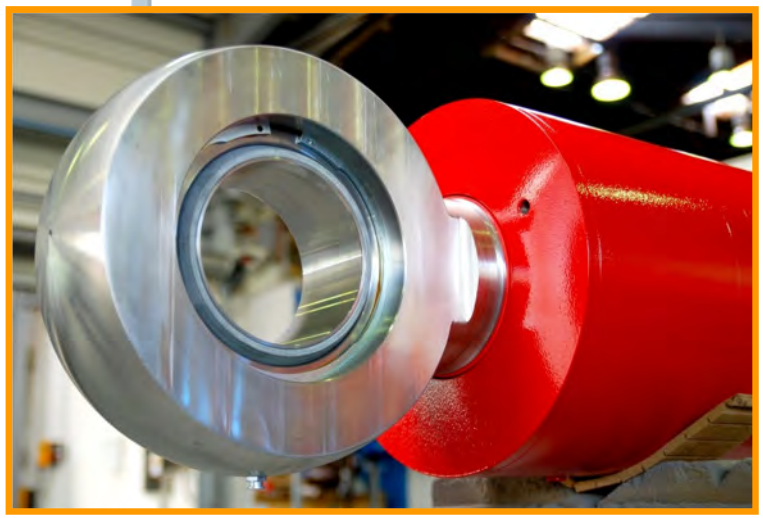
Crane lifting application, onboard, (Brazil), 2012

DNV design approval

2 x hydraulic cylinders,320x 180, stroke 1614 mm





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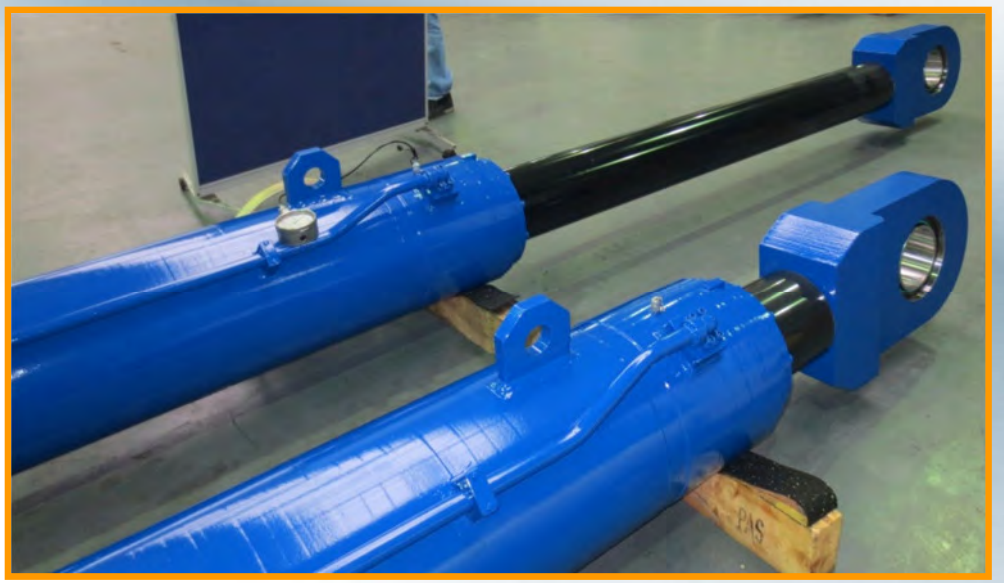
Flood gate Oder/ Neiße (Poland) 2013

2 x hydraulic cylinders 360 x 250, stroke 2.200 mm (blue)
➔ *gate operation*

Port crane Gdansk (Poland) 2013

2 x hydraulic cylinders 400 x 250, stroke 2.600 mm *(yellow)*



presentation

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references

Mining & Reclaiming

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Mining, shield support

550 x cylinder tubes 442/ 51 x 1.788 mm

550 x cylinder tubes 362/ 66 x 1.540 mm for coal mining,

project in 2004

BOOM LUFFING (Stacker), Hsinta (Taiwan) 2003

4 x hydraulic cylinders 250 / 160; stroke 2220 mm

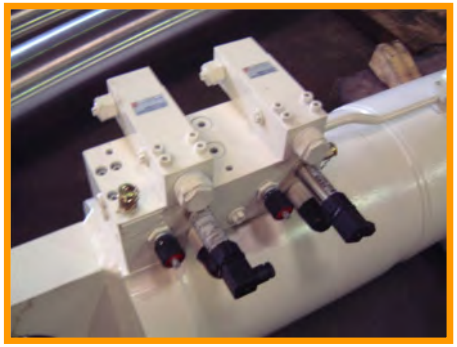
demands: very dusty and abbrasive environment

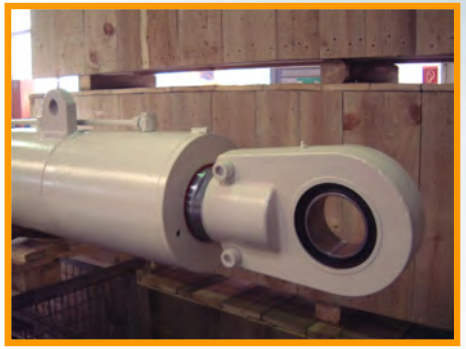
highly corrosive

24 hrs in operation

BOOM LUFFING (Stacker), HO-Ping (China) 2003

1 x hydraulic cylinder 250 / 160; stroke 2220 mm





BOOM LUFFING (Stacker),TianJin Port (China) 2003

piston rod with TOPCOAT® CERAMIC coated

2 x hydraulic cylinders 280 / 180; stroke 2019 mm

2 x hydraulic cylinders 480 / 180; stroke 3980 mm

2 x hydraulic cylinders 360 / 250; stroke 3209 mm

BOOM LUFFING (Stacker),Quinhuangdao (China) 2004

piston rod TOPCOAT® CERAMIC coated

12 hydraulic cylinders 280 / 180 ; stroke 2019 mm

6 cabine adjustment cylinders 80 / 45 ; stroke 375 mm

BOOM LUFFING (Stacker), Tianjin Shenua (China) 2004

piston rod with TOPCOAT® CERAMIC coated

6 x hydraulic cylinders	360 / 250; stroke 3309 mm
6 x hydraulic cylinders	280 / 220; stroke 3309 mm
8 x hydraulic cylinders	280 / 180; stroke 2077 mm

cylinders in assembly before primering and coating

presentation

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Stacker Clermont (New Caledonia), 2012

1 x hydraulic cylinders 560/ 240, stroke 5.400 mm
➔ boom hosting
1 x hydraulic cylinders 560/ 240, stroke 6.800 mm
➔ boom luffing

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Stacker Port of Sacomar (Angola), 2012

1 x hydraulic cylinders 450/ 320, stroke 3.900 mm ➔boom luffing
1 x hydraulic cylinders 360/ 160, stroke 1.650 mm ➔discharge boom
1 x hydraulic cylinders 280/ 180, stroke 2.150 mm ➔boom luffing
1 x hydraulic cylinders 100/ 60, stroke 1.670 mm ➔deflector plate
1 x hydraulic cylinders 100/ 60, stroke 500 mm ➔cabin luffing

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hydraulic cylinders for transport crawler, Senegal (Africa) 2003

4 hydraulic cylinders 240 / 180; stroke 2.600 mm

hydraulic cylinders for giant excavator, (permanent 4 pieces per month)

480/ 280; stroke 3.400 mm

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references

Steel manufacturing

demands: very dirty environment

constant heat radiation

24 hrs in operation

no maintenance possible

Projects

retro fit (rehabilitation) of steel mill, Kosice, Czech Republic, 1992

electric furnace of steel mill, Hangzhou, P.R.China, 1998

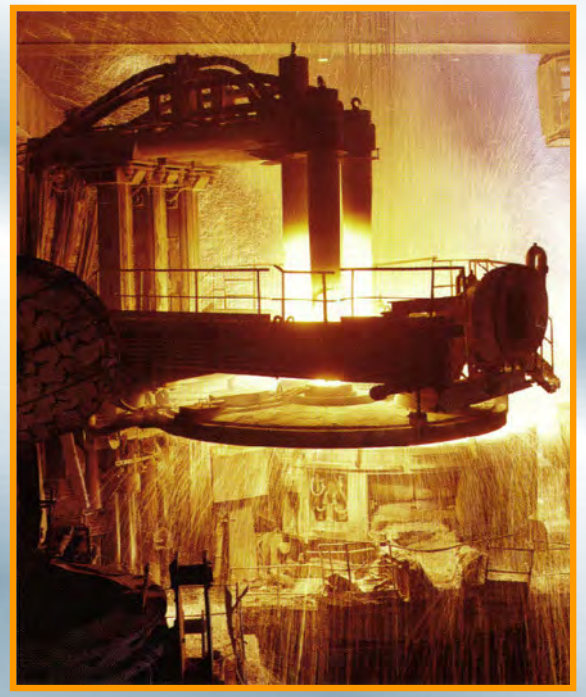
steel mill, Slobom ,Russia, 1998

steel processing, cold drawn metal sheet, Rasbeitz,Germany, 1999

steel processing Perkasa, Indonesia, 1999

steel processing Alfahot, Algeria, 2000

steel processing, stainless cold drawn metal sheet, Krecoil,Germany, 2002



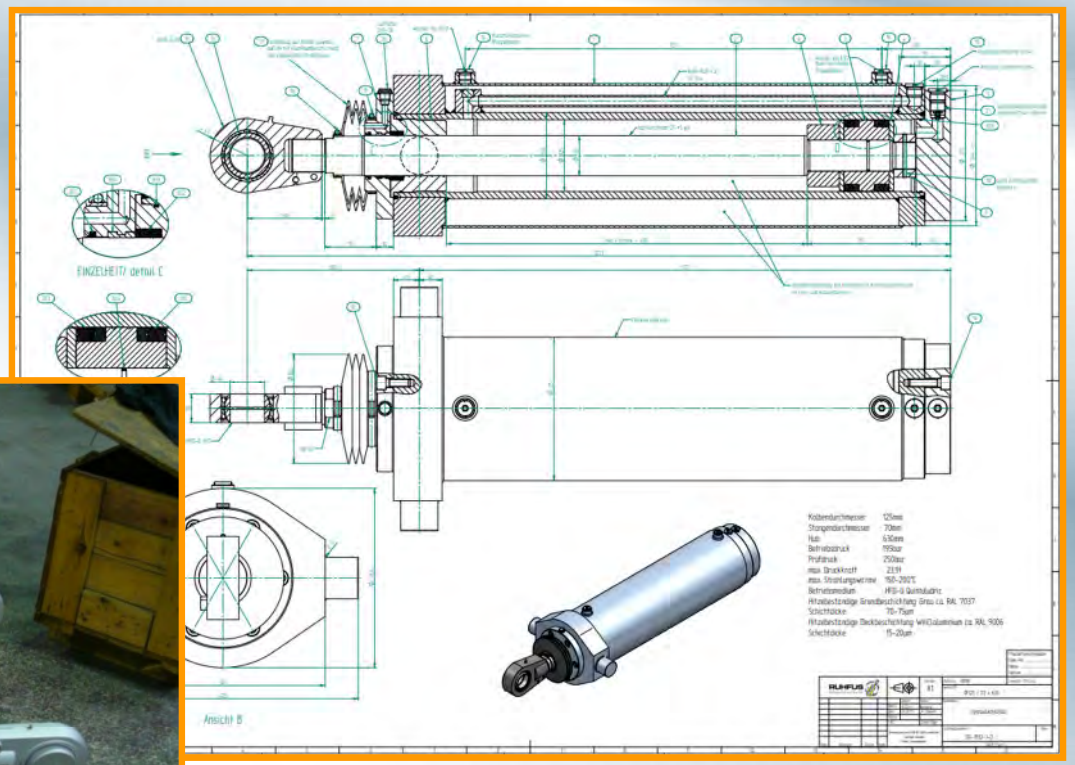
hydraulic cylinders for steel plants

*replacements for **SMS** (Germany), 2012*

19 x hydraulic cylinders with water cooling shell

125/ 70 stroke 630 mm

➔ *application not known*



hydraulic cylinders for steel plants

*hydraulic cylinders for **Vallourec & Mannesmann**, Germany*
OPTIMIZED REPLACEMENTS for steel plant in Germany

1 x 360/ 250; stroke 3.100 mm, 2009, *ejector cylinder*
1 x 280/ 160; stroke 1.800 mm, 2009, *manipulator cylinder for positioning press*
1 x 380/ 290; stroke 1.825 mm, 2011, *cylinder for 4000 to perforating press*
1 x 220/ 160; stroke 1.500 mm, 2012, *application not known*

*hydraulic cylinders for **Danielli Fröhling**, Germany*
for steel plant in China

2 x 240/ 200; stroke 50 mm, 2011, *roll adjustment cylinder*

*hydraulic cylinders for **Voest Steel**, Austria*
OPTIMIZED REPLACEMENTS for steel plant in Austria

2 x 200/ 160; stroke 3.220 mm, 2011, *lifting cylinder*
1 x 420/ 380; stroke 800 mm, 2013, *jack ram cylinder for horizontal press with power quick traverse*

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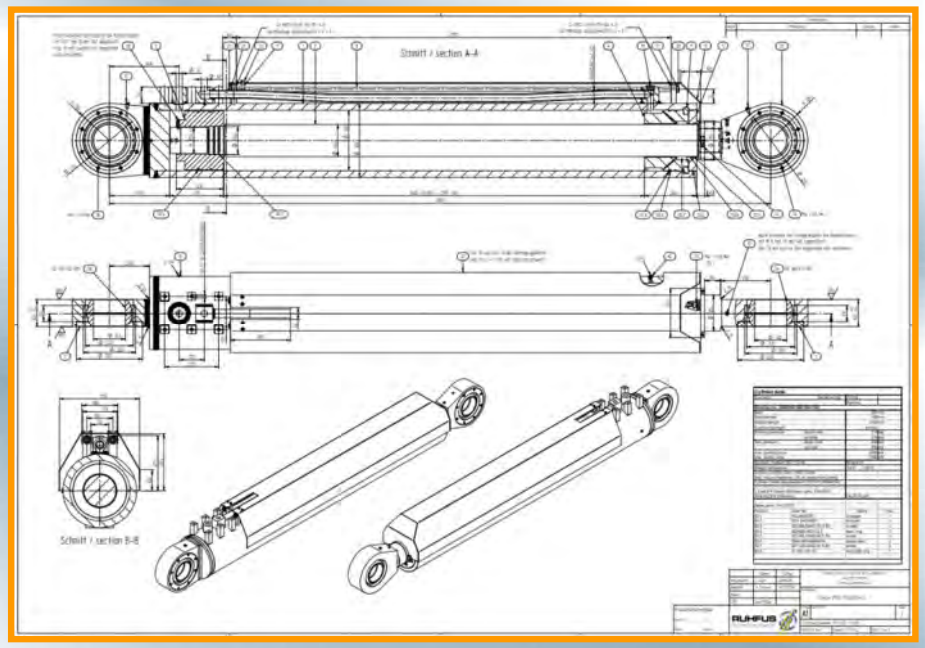
hydraulic cylinders for steel plants

hydraulic cylinders with
heat protection shield for
Changsha Kairui Zhonggong Machinery
P.R. of China, 2009

2 x 300/ 160 stroke 2.100 mm

➔ *ejector cylinder for mill train*



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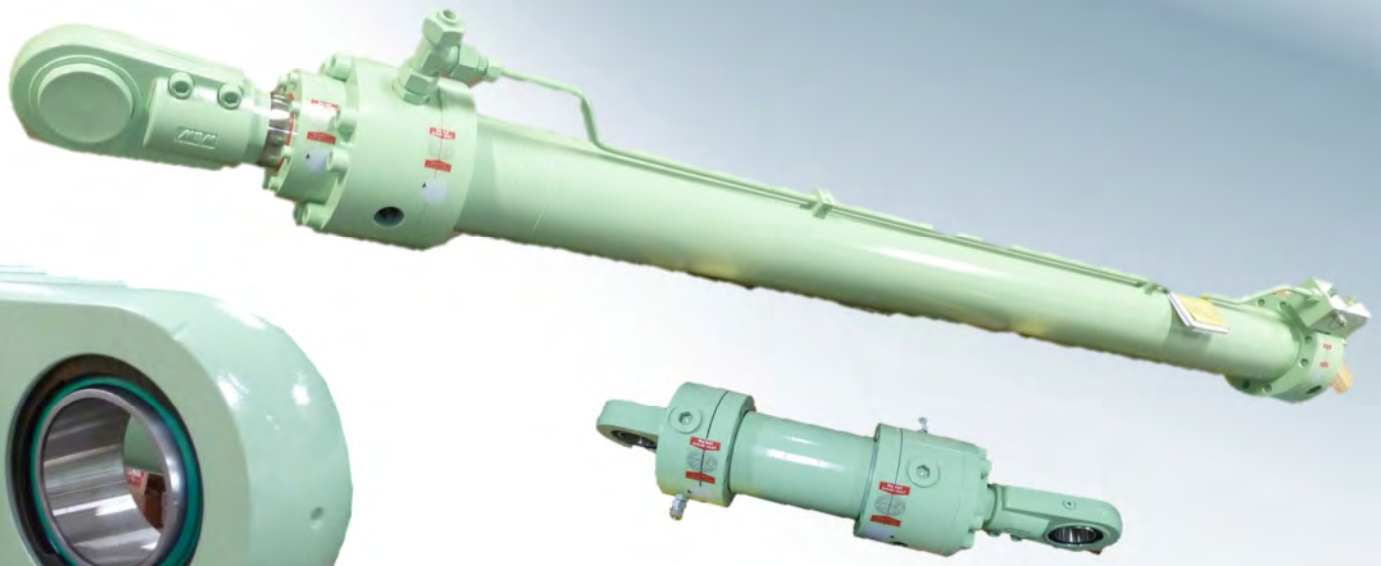
hydraulic cylinders for steel plants

*hydraulic cylinders for **SMS Mevac**, Germany for 250 ton aluminium melting furnace in Taiwan, 2012*
lifting, tilting, holding

4 x 100/ 56; stroke 150 mm
8 x 160/ 100; stroke 850 mm
2 x 160/ 110; stroke 2.300mm
4 x 202/ 180; stroke 4.000mm



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references

Grinding mills

demands: very dusty and abbrasive environment

highly corrosive

24 hrs in operation

fast, short movements (50 – 60 Herz)

presentation

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grinding mills

(coal, cement, clinker)

tension and suspension cylinders, approx. 450 – 500 pcs. per year

references

Special projects

demands: time to design and manufacture the cylinders

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DESIGNED FOR A LIFETIME
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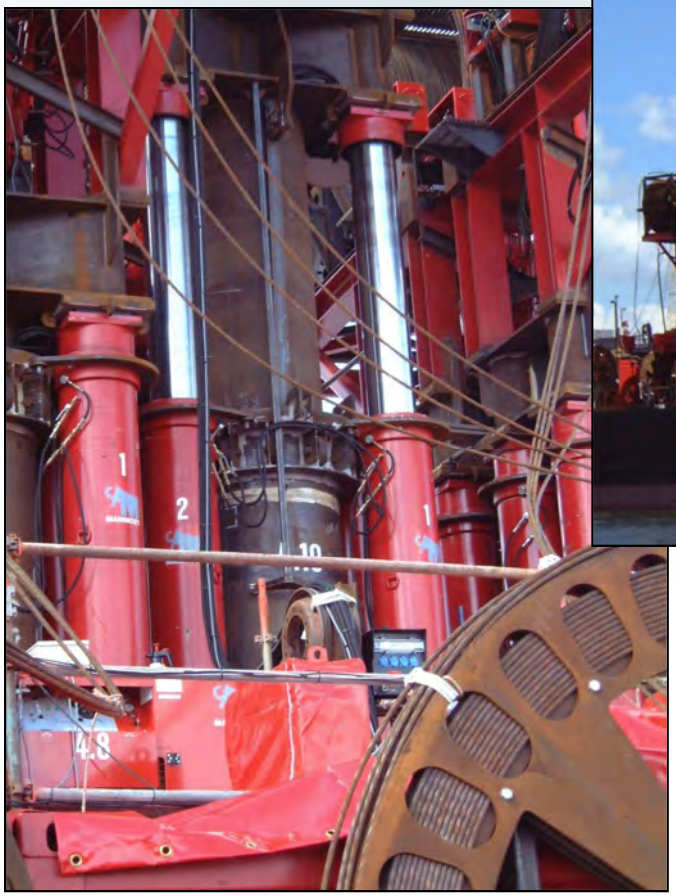
ruhfus.com
MADE IN GERMANY

salvages



lifting of submarine KURSK,

Mammoet, Netherlands, 2001

107 cylinders in 10 weeks

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references

Accumulators

demands: always ready, long stand by periods without movements

no leakage at all allowed, although filled with nitrogen

temperatur -50^{0}C – 80^{0}C

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accumulators

approx. 6.000 – 6.500 m
of accumulator tubes p.a.

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references

Heavy Duty

Presses

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laminate presses (wood processing industry)

between 250 – 300 plunger cylinder year
Ø 350, Ø 400, Ø 420, Ø 450,
stroke 260 – 350 mm
***hard chrome** or **NiCrBoSi** plated*

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debris presses (environmental industry)

recycling

compacting

moulding and forming presses (consumer industry)

plastic/ injection moulding

forming

sand ingot casting (automotive)

die casting

references

Wind energy

presentation

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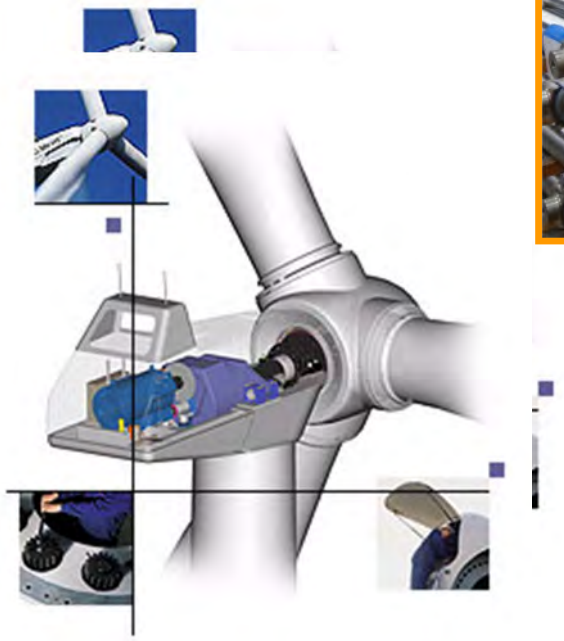
adjustment of rotor blades, approx. 7.000-8.000 cylinder tubes per year

wind energy



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references

civil engineering

demands: very dusty and abbrasive environment

forces difficult to control
(high velocities and power peaks)

no maintenance

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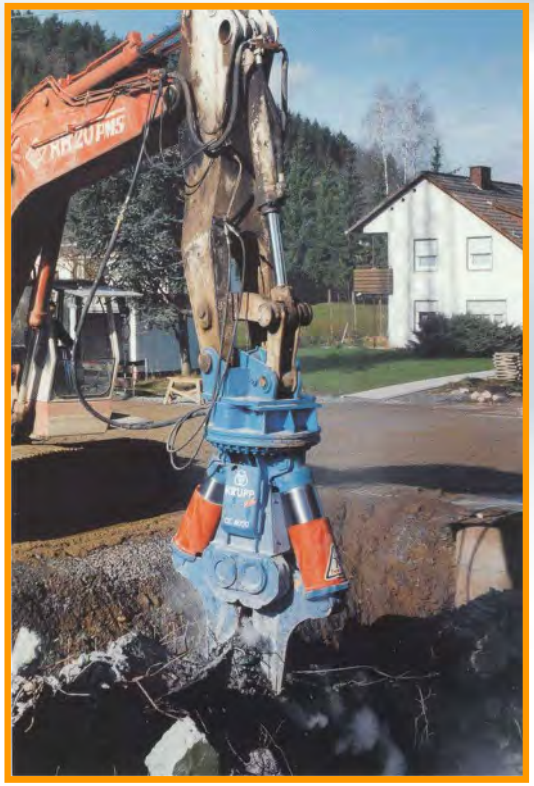
building machinery



demolition tongues, approx. 400 cylinder per year

worldwide largest excavator at this time, O&K, 1997

excavators, main cylinder, approx. 1.700 cylinder tubes per year

main cylinder for larger excavator (4 cylinder per months)

presentation

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concrete & sludge pumping

concrete & sludge pumps and tilting cylinders, approx. 2.500 – 3.000 tubes and 100 cylinder per year

presentation

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tunnel drilling

coal and ore mining

brown coal reclaimer,

tunnel drilling device for Metro in Paris,

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Thank you for

your attention !!!