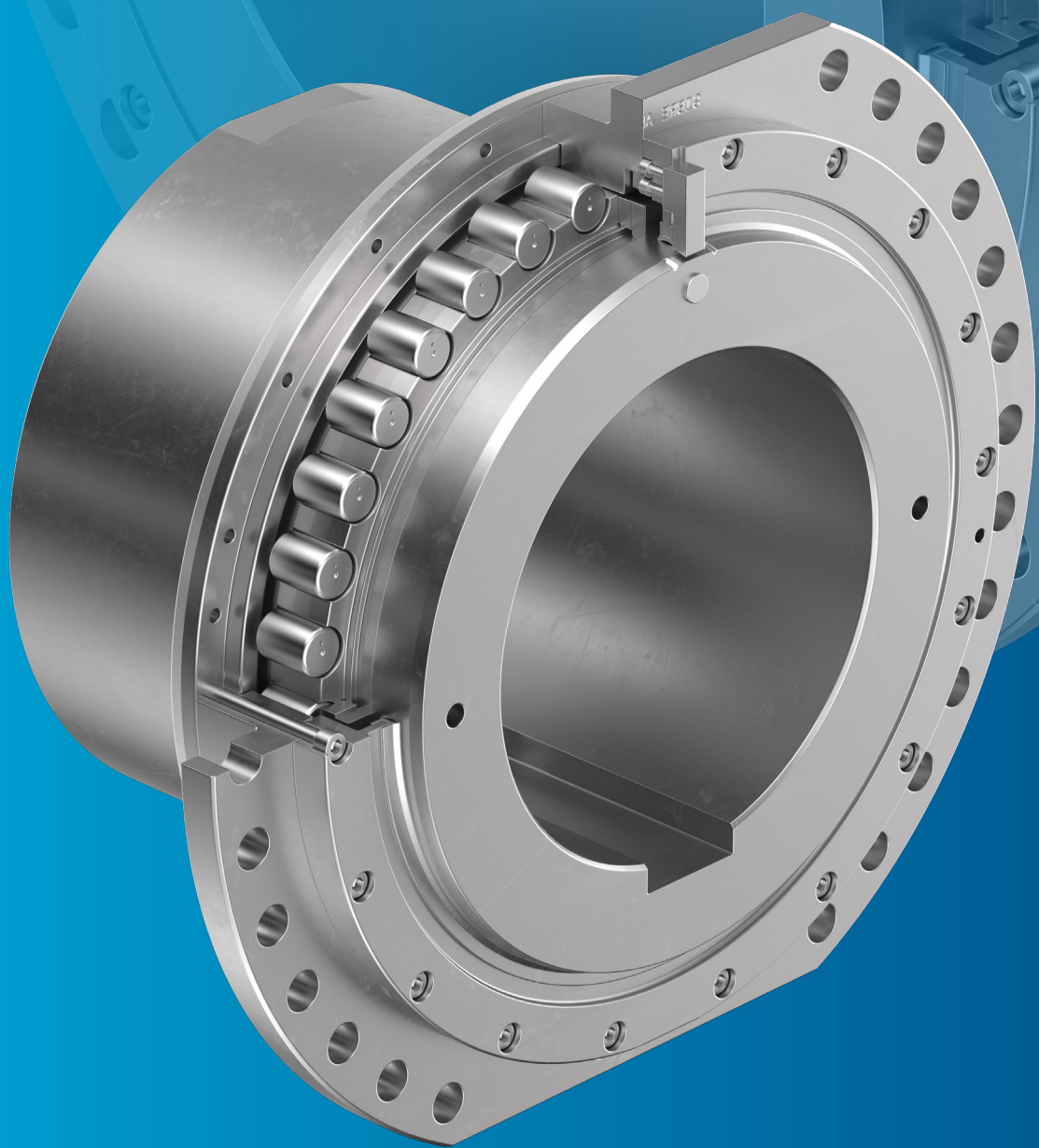




DRUM COUPLING

DRUM COUPLING

ABC-V

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APPLICATION

The Sibre ABC-V drum coupling of the series is especially designed for the use in rope drum drives.

It is used for the transfer of medium and high torques as rope drum couplings in crane hoisting gear, conveyance, stackers, ship unloaders, container cranes as well as in heavy, rough smelting works.

Torques of up to 1025 kNm and radial loads of up to 550 kN can be transferred with a maximum coupling diameter of 1025 mm.

The design of the SIBRE drum coupling is performed on the basis of the steel-iron-guidelines (Stahl-Eisen-Betriebsblatt) SEB 666 212.

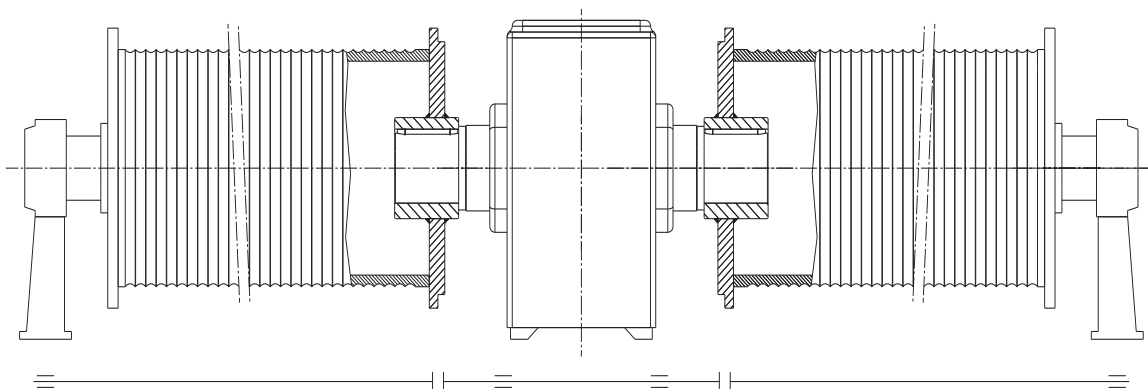
The exchangeability regarding connection dimensions with series on the market is ensured.

The following drawings 1 and 2 show the typical arrangement of a rope drum drive in a crane installation.

Drawing 1 shows the direct displacement of the rope drum over a rigid hub on the drive output shaft. This un-recommended construction leads to a structurally undefined suspension.

In practice such a connection requires a difficult to achieve precision in assembly and alignment.

Misalignment during assembly or dending of the foundation with this hub causes significant additional loads in the drive shaft, which in turn leads to damage in the drive gearing or in the bearings, or to fatigue failure on the shaft.



Drawing 1: Double drum drive with quadruple supported shaft (structurally undefined case).

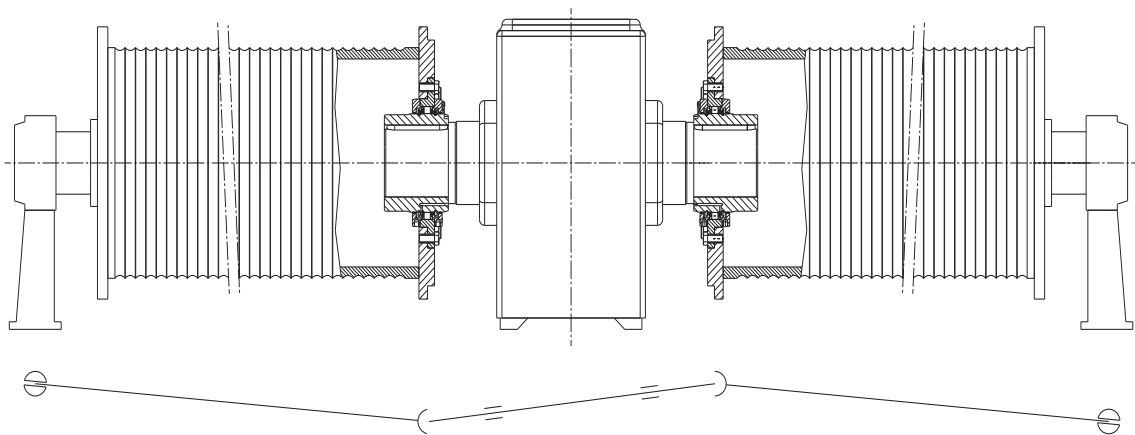
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Drawing 2 shows the standard support of a rope drum via a drum coupling on the gearbox output shaft. The drum coupling is working as a joint, that also allows

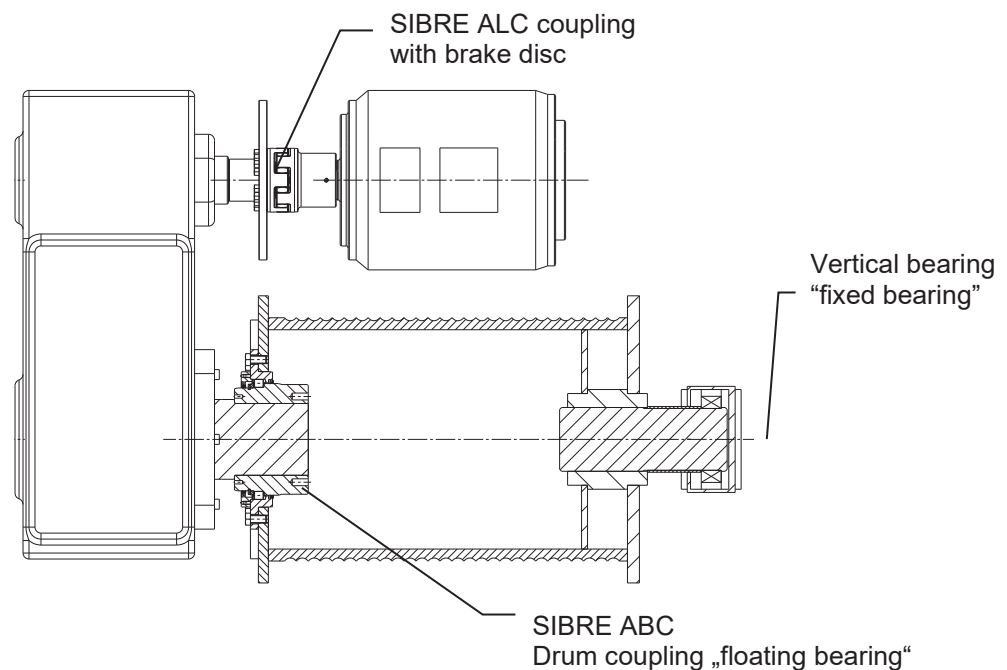
limited axial displacements. As a result, the connection is structurally defined and the side load on the drive shaft is significantly reduced.



Drawing 2: Double drum drive with drum couplings. The driven shaft and the rope drum are supported in a structurally defined way.

Drawing 3 shows the use of a drum coupling in a single drum drive. The drum coupling is designed as a loose bearing with length compensation. The axial forces accrued due to the inertial forces and rope flow have to be

absorbed by the oppositely lying vertical bearing of the rope drum. The vertical bearing is usually constructed with a spherical roller bearing as a "fixed bearing".



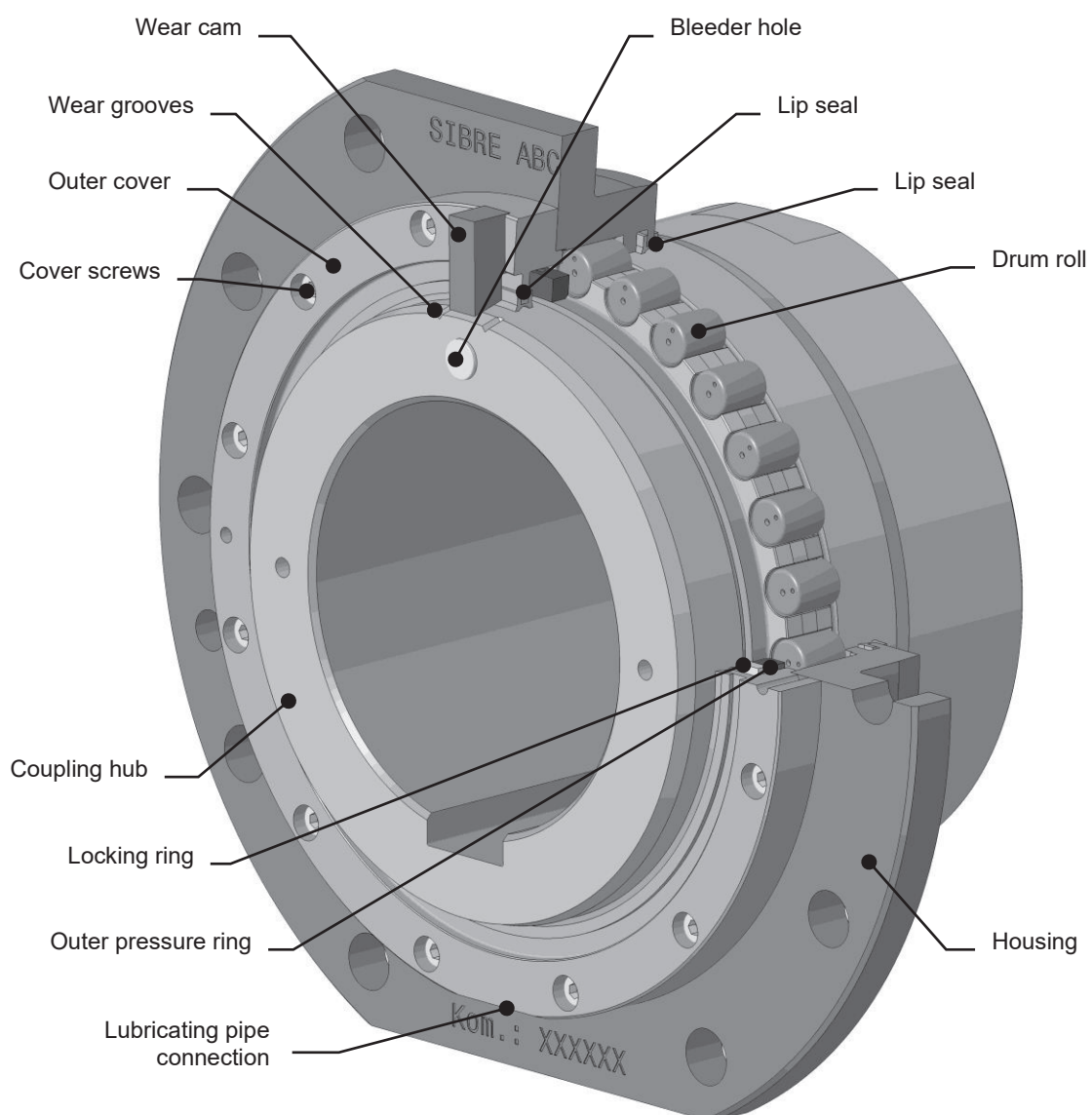
Drawing 3: Single drum drive

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DESCRIPTION AND CHARACTERISTICS



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The drum coupling largely consists of a hub part and a housing part, fitted above each other axially. Drill holes are arranged in the parting plane throughout the diameter of both parts. The power transmission of the hub part onto the housing part occurs with positive locking. Hardened barrel rollers are fit into the drill holes, which are formed from the two circular gearings, as power transmission elements. The sealing of the coupling is achieved through double-sided covers with lip seals. This prevents escape of lubricant from the coupling, as well as intrusion of dirt from outside. The semicircular gearing of the hub over the outer diameter is crowned. Together with the arched drum roll it is possible for the hub to oscillate relative to the housing part, therefore angular and axial displacement can be compensated. The coupling housing has an attachment flange which is fixed to the front flange of the drum. The transmission between the coupling and the drum roll occurs partially by friction torque, and partially by positive locking by the oppositely lying camming surfaces on the housing. Grade 10.9 high-tension bolts are to be used as connection bolts.

The coupling is built with visual wear and position display. Using a wear cam on the housing part and wear grooves on the hub part, the wear on the coupling gearing can be easily checked from the side of the coupling.

The wear cam also can be used for checking the axial position of the coupling housing to the coupling hub.

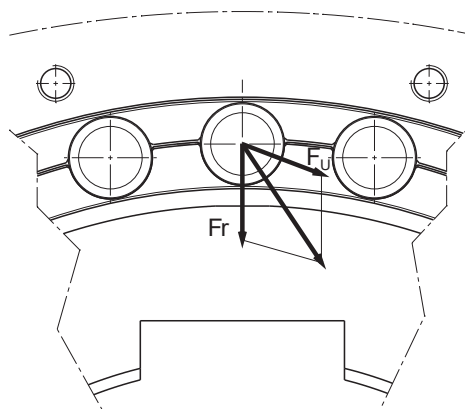
The drum couplings of the ABC-V series, that transfers high radial loads in addition to high torques, are characterized by the following features:

- Compensation of angular displacement up to $\pm 1^\circ$
- Depending on the size of the coupling axial shifting from up to $\pm 4\text{mm}$ up to $\pm 10\text{mm}$.

The max. angular displacement and max. axial shifting must not be fully exploited simultaneously (see information in the OM).

The standard drum coupling is not suitable for transfer of axial loads.

- Due to the adjustability of the arched drum roll the sliding within the gearing at an angular displacement is limited, which significantly reduces wear due to relative movements.
- A high overload safety is the result of the robust design.
- The power transmission between the coupling hub, the drum roll, and the coupling housing additionally leads to smoothed tooth flanks. There is a strain hardening of the material structure which improves the wear resistance.
- Due to the convex and concave fit of the drum rolls to the coupling hub and the coupling's housing, the forces are spread across a large contact surface which leads to favourable compressive stresses (drawing 4).



Drawing 4

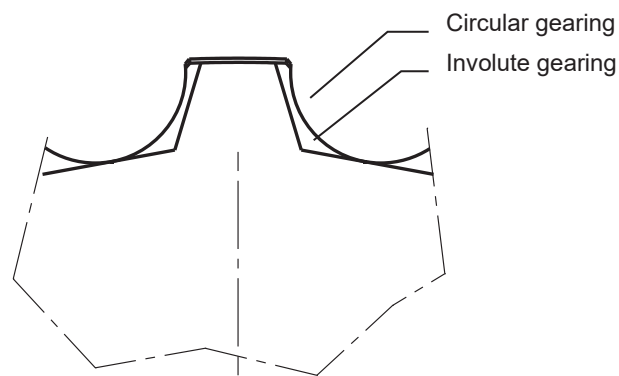
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The circular gearings of the drum coupling have a much more favourable tooth flow load compared to the involute gearing of a tooth coupling. Due to the wide tooth

base of the drum coupling the tooth flow bending stress is much lower than a comparable tooth coupling (see drawing 5).



Drawing 5

CALCULATORY BASES / DIMENSIONING

Required design parameters:

- max. drive torque $T_{A \max}$ [Nm]
- max. radial load $F_{R \max}$ [N]
- Dimensions of the gear box output shaft

MAX. DRIVE TORQUE $T_{A \max}$

The determined torque $T_{A \max}$, intended to be transferred by the coupling due to the installed or used power must be less than the max. torque $T_{k \max}$ of the drum coupling (according to the dimension sheet).

$$(1) \quad T_{A \max} = \frac{P_i \cdot 9550}{n_{Tr}} \cdot C_{erf} \leq T_{k \max}$$

or

$$(2) \quad T_{A \max} = \frac{P_e \cdot 9550}{n_{Tr}} \cdot C_{erf} \leq T_{k \max}$$

or

$$(3) \quad T_{A \max} = S_{Tr} \cdot \frac{D_{Tr}}{2} \cdot C_{erf} \leq T_{k \max}$$

P_i = max. installed drive power [kW]

P_e = max. used power [kW]

S_{Tr} = rope tensile force at the rope drum (including load of the suspension elements) [N]

n_{Tr} = rotation speed of the rope drum [1/min]

D_{Tr} = diameter to the drum roll in respect of the midpoint of the rope [m]

C_{erf} = required operating coefficient for engine groups by operating time group and load collective [-]

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Table 1 operating coefficient C_{erf}

Engine group		$C_{\text{erf}}^{*)}$
DIN 15020	FEM 1.001	
1Bm	M1; M2; M3	1.25
1Am	M4	1.25
2m	M5	1.40
3m	M6	1.60
4m	M7	1.80
5m	M8	2.00

*) To increase the lifetime of the coupling concerning the wear especially at crane systems with high lift heights and high speeds, e.g. cable cranes but also production

cranes working in three shifts it is recommended to raise the operating coefficient C_{erf} seen in table 1 by 20% up to 40%.

$$(4) \quad P_e = \frac{S_{\text{Tr}} \cdot V_{\text{Tr}}}{60000}$$

V_{Tr} = rope speed at the drum roll in respect to the midpoint of the rope [m/min]

$$(5) \quad V_{\text{Tr}} = D_{\text{Tr}} \cdot \pi \cdot n_{\text{Tr}}$$

MAX. RADIAL LOAD $F_{\text{R MAX}}$

The support of the rope drum occurs by the vertical bearing (fixed bearing) on one side, and by the drum coupling (floating bearing) on the other side.

The radial load $F_{\text{R max}}$ is the proportion of the rope ten-

sile force that has to be absorbed by the drum coupling. The rope tensile force in turn includes the max. payload as well as the load of the suspension elements.

$$(6) \quad S_{\text{Tr}} = \frac{(m_1 + m_2) \cdot 9.81}{i_{\text{F}} \cdot \eta_{\text{F}}}$$

m_1 = max. payload

[kg]

m_2 = dead weight of the suspension elements

[kg]

i_{F} = ratio of reeving

$$i_{\text{F}} = \frac{\text{Number of load bearing rope lines}}{\text{Number of rope lines arriving on the drum}}$$

η_{F} = efficiency of reeving (table 2)

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Table 2 efficiency η_F

iF	Efficiency η_F	
	Slide bearing	Roller bearing
2	0.92	0.97
3	0.90	0.96
4	0.88	0.95
5	0.86	0.94
6	0.84	0.93
7	0.83	0.92
8	0.81	0.91

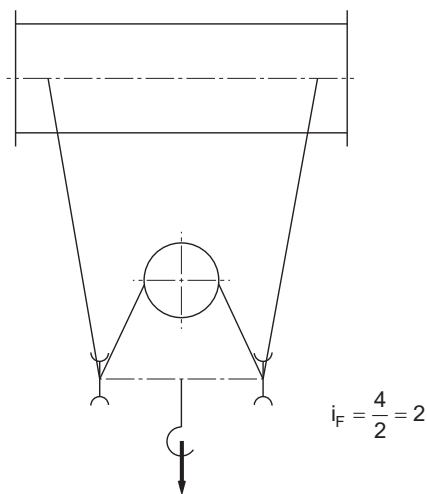
CALCULATION OF RADIAL LOAD $F_{R \text{ MAX}}$ WITH MULTIPLE ROPE LINES TO THE ROPE DRUM

$$(7) \quad F_{R \text{ max}} = \frac{S_{Tr}}{2} + \frac{m_{Tr} \cdot 9.81}{2}$$

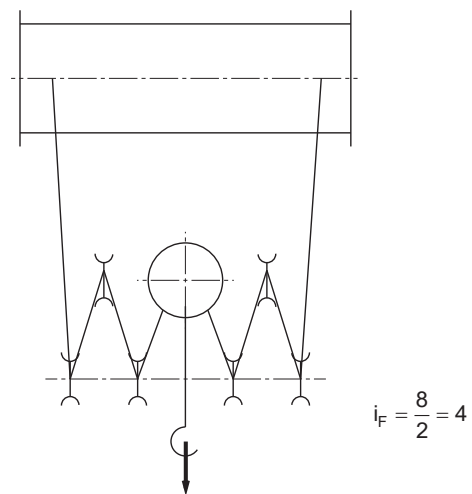
S_{Tr} = rope tensile force at the rope drum [N]
(including load of the suspension elements)

m_{Tr} = dead weight of the rope drum [kg]

Case study drawing 6:
4 load bearing rope lines
2 rope lines arriving on the drum



Case study drawing 7:
8 load bearing rope lines
2 rope lines arriving on the drum



CALCULATION OF RADIAL LOAD $F_{R \text{ MAX}}$ WITH ONE ROPE LINE TO THE ROPE DRUM

$$(8) \quad F_{R \text{ max}} = \left[S_{Tr} \cdot \left(1 - \frac{b}{l} \right) \right] + \frac{m_{Tr} \cdot 9.81}{2}$$

S_{Tr} = rope tensile force at the rope drum [N]
(including load of the suspension elements)

m_{Tr} = dead weight of the rope drum [kg]

b = minimum distance from rope to middle of drum roll [mm]

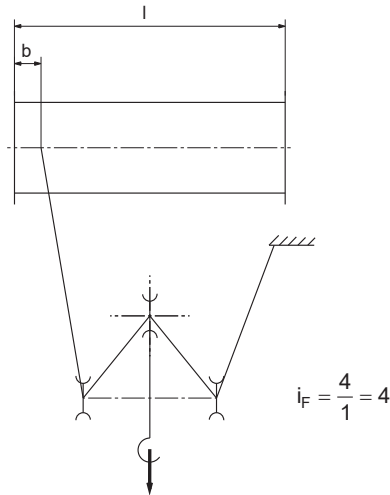
l = distance between middle of fixed bearing to middle of drum roll [mm]

DRUM COUPLING

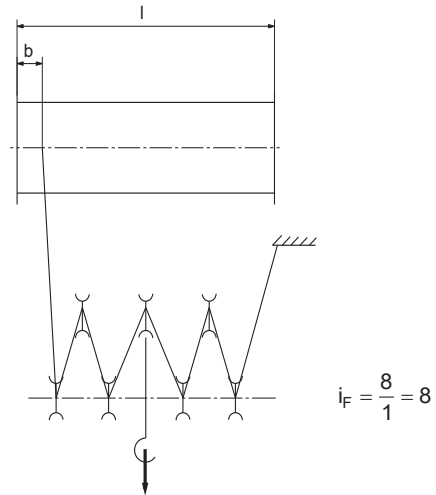
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Case study drawing 8:
4 load bearing rope lines
1 rope line arriving on the drum



Case study drawing 9:
8 load bearing rope lines
1 rope lines arriving on the drum



The max. radial load $F_{R \max}$ must be less than than the max. approved coupling radial load $F_{r \max}$ given in the dimension sheet of the drum coupling.

(9) $F_{R \max} \leq F_{r \max}$

CORRECTED RADIAL LOAD $F_{K \text{KORR}}$

A correction/increase of the max. approved radial load $F_{r \max}$ can occur if the max. drive torque T_A is lower than $T_{k \max}$ of the selected coupling.

The unused torque can be converted to increase the max. approved radial load $F_{r \max}$ as follows:

(10) $F_{K \text{KORR}} = \frac{(T_{k \max} - T_{A \max})}{C_{\text{erf}}} + F_{r \max}$

If not all radial load is used, a correction of the max. approved torque is not permitted!

DIMENSIONS OF THE GEAR BOX OUTPUT SHAFT

- Confirming that the diameter of the shaft of the gear-box output shaft is less than the max. approved drilling diameter according to the dimensions sheet of the chosen drum coupling.
- Confirming that the shaft/hub connection is dimensioned sufficiently for the transmitted torque.

DRUM COUPLING

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CALCULATION EXAMPLES

A.) Closed Winch Grab Unloader

- Installed motor power : P_i = 515 kW
- Rated motor speed : n_M = 1230 min⁻¹
- Gear ratio : i_G = 31.5
- Radial load that acts on the drum coupling : $F_{R \max}$ = 145000 N
- Engine group : FEM 1.001 = M8
- Operating coefficient : C_{erf} = 2.0

Rotation speed of the rope drum

$$n_{\text{Tr}} = \frac{n_M}{i_G} = \frac{1230 \text{ min}^{-1}}{31,5} = \underline{\underline{39 \text{ min}^{-1}}}$$

Max. output torque

$$T_{A \max} = \frac{P_i \cdot 9550}{n_{\text{Tr}}} \cdot C_{\text{erf}} = \frac{515 \cdot 9550}{39} \cdot 2 = \underline{\underline{252200 \text{ Nm}}}$$

Chosen drum coupling

ABC-V-545

$T_{k \max}$ = 320000 Nm
 $F_{r \max}$ = 260000 N

$$T_{A \max} = 252200 \text{ Nm} \leq T_{k \max} 320000 \text{ Nm}$$

$$F_{R \max} = 145000 \text{ N} \leq F_{r \max} 260000 \text{ N}$$

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B.) Main Hoist

• Max. payload	:	m_1	= 20000 kg
• Dead weight of the suspension elements	:	m_2	= 7000 kg
• Dead weight of the rope drum	:	m_{Tr}	= 3000 kg
• Installed motor power	:	P_i	= 450 kW
• Rated motor speed	:	n_M	= 900 min ⁻¹
• Gear ratio	:	i_G	= 20
• Rope drum diameter	:	D_{Tr}	= 1.4 m
• Lifting speed	:	v_H	= 90 m/min
• Ratio of reeving	:	i_F	= 2 (see drawing 6)
• Efficiency of reeving	:	η_F	= 0.97
• Engine group	:	FEM 1.001	= M7
• Operating coefficient	:	C_{erf}	= 1.8

Rotation speed of the rope drum

$$n_{Tr} = \frac{n_M}{i_G} = \frac{900 \text{ min}^{-1}}{20} = \underline{\underline{45 \text{ min}^{-1}}}$$

Max. drive torque based on installed power

$$T_{A \max} = \frac{P_i \cdot 9550}{n_{Tr}} \cdot C_{erf} = \frac{450 \cdot 9550}{45} \cdot 1,8 = \underline{\underline{171900 \text{ Nm}}}$$

Max. drive torque based on used power

$$T'_{A \max} = \frac{P_e \cdot 9550}{n_{Tr}} \cdot C_{erf}$$

$$P_e = \frac{S_{Tr} \cdot V_{Tr}}{60000}$$

$$S_{Tr} = \frac{(m_1 + m_2) \cdot 9,81}{i_F \cdot \eta_F} = \frac{(20000 + 7000) \cdot 9,81}{2 \cdot 0,97} = \underline{\underline{136500 \text{ N}}}$$

$$v_{Tr} = v_H \cdot i_F = 90 \frac{\text{m}}{\text{min}} \cdot 2 = \underline{\underline{180 \text{ m/min}}}$$

$$P_e = \frac{136500 \cdot 180}{60000} = \underline{\underline{410 \text{ kW}}}$$

$$T'_{A \max} = \frac{410 \cdot 9550}{45} \cdot 1,8 = \underline{\underline{156600 \text{ Nm}}}$$

Chosen drum coupling

ABC-V-450

$T_{kmax} = 180000 \text{ Nm}$
 $F_{rmax} = 150000 \text{ N}$

Max. radial load

$$F_{R \max} = \frac{S_{Tr}}{2} + \frac{m_{Tr} \cdot 9,81}{2} = \frac{136500}{2} + \frac{3000 \cdot 9,81}{2} = \underline{\underline{83000 \text{ N}}}$$

$$T'_{A \max} = 156600 \text{ Nm} \leq T_{kmax} 180000 \text{ Nm}$$

$$T'_{A \max} = 156600 \text{ Nm} \leq T_{kmax} 180000 \text{ Nm}$$

DRUM COUPLING ABC-V

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Dimension sheet ABC-V

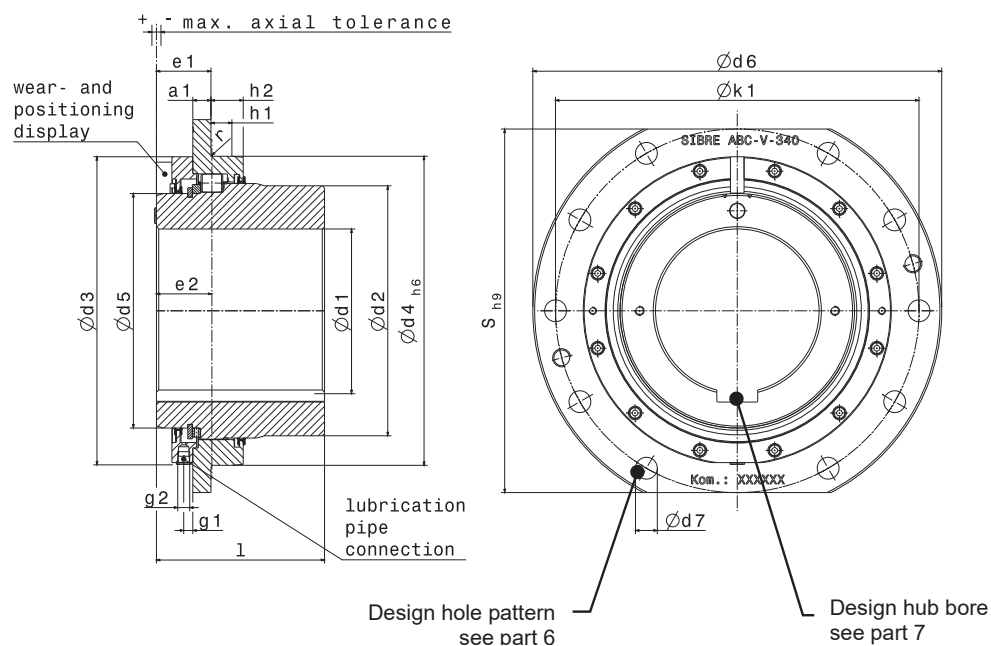


Table 3

Size		260	280	310	340	400	420	450	530	545	560	600	670	730	800	860	950	1030
Torque ⁽¹⁾ T _{k max}	[Nm]	27000	35000	45000	55000	80000	120000	180000	250000	320000	410000	500000	600000	770000	950000	1025000	1400000	1700000
Radial load F _{r max}	[N]	41000	45000	55000	75000	115000	130000	150000	200000	260000	315000	340000	400000	475000	525000	550000	650000	72500
Weight ⁽³⁾	[kg]	37	44	54	71	108	135	164	260	294	329	415	549	697	960	1097	1350	1620
MOI ⁽³⁾	[kgm ²]	0,43	0,54	0,82	1,35	2,67	3,7	5,2	11,0	13,2	15,6	22,3	36,3	56,2	105,5	118,4	190,93	269,64
Finish bore ⁽²⁾	Ø d1 _{min} ^{H7}	[mm]	80	100	100	100	120	140	160	160	170	200	230	260	290	330	380	405
	Ø d1 _{max} ^{H7}	[mm]	125	140	155	180	210	245	290	300	310	330	370	420	450	470	560	610
Ø d2	[mm]	195	215	235	275	315	330	370	430	450	465	500	560	620	680	715	820	900
Ø d3	[mm]	259	279	309	339	399	419	449	529	544	558	598	668	728	798	835	940	1020
Ø d4 _{h6}	[mm]	260	280	310	340	400	420	450	530	545	560	600	670	730	800	860	950	1030
Ø d5	[mm]	180	198	218	258	298	310	350	410	430	440	470	530	590	650	680	775	855
Ø d6	[mm]	380	400	420	450	510	550	580	650	665	680	710	780	850	940	1025	1120	1200
Ø d7	[mm]	19	19	19	24	24	24	24	24	24	24	28	28	28	28	34	34	34
a1	[mm]	15	15	15	20	20	20	20	25	25	25	35	35	35	40	40	45	45
e1	[mm]	45	45	45	60	60	60	60	65	65	65	81	81	81	86	86	100	100
e2	[mm]	48	48	50	61	61	65	67	69	78	78	88	88	90	92	92	110	110
g1	[mm]	7.5	7.5	7.5	10	10	10	10	10	10	10	10	10	10	10	10	15	15
g2	[In]	G1/8	G1/8	G1/8	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G3/8	G3/8
h1	[mm]	27,5	27,5	27	23	24,5	30	32	35	45	45	40	40	50	50	50	65	65
h2	[mm]	34,5	34,5	37	35,5	37	45	47	50	60	65	60	60	70	70	70	85	85
S _{h9}	[mm]	340	360	380	400	460	500	530	580	590	600	640	700	760	830	900	1000	1080
Ø k1	[mm]	340	360	380	400	460	500	530	600	615	630	660	730	800	875	945	1040	1120
l	[mm]	145	170	175	185	220	240	260	315	330	350	380	410	450	500	500	500	500
r	[mm]	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4	4	4	4	4	4	4	4	4
Axial tol. max +/-	[mm]	4	4	4	5	6	6	6	6	6	6	8	8	8	10	10	15	15

(1) The given torques do not refer to the shaft-hub connection. These must be checked if necessary.

(2) Other tolerances possible by arrangement.

(3) With respect to max. finish bore Ød1.

DRUM COUPLING

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CONNECTION COUPLING ROPE DRUM

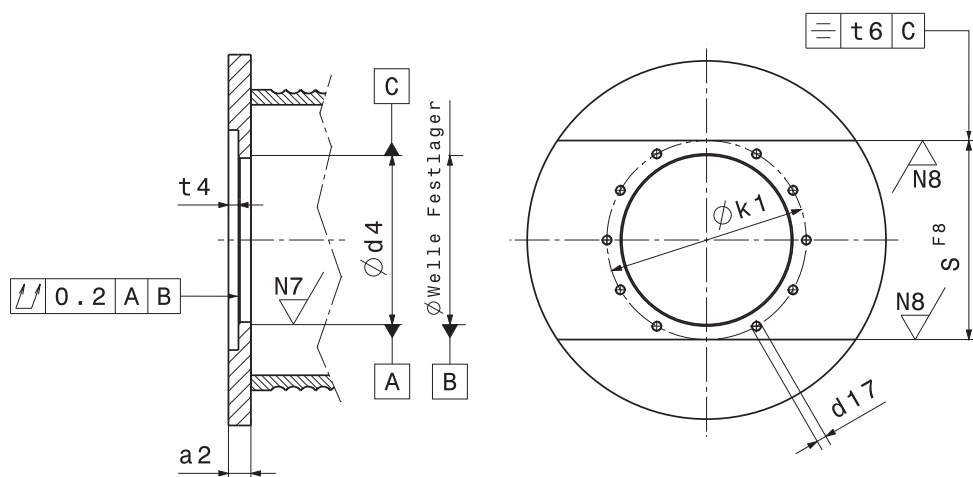
The material of the drum flange should have a min. yield strength of 320 N/mm².

We recommend the use of screws in accordance with DIN931, 933 with strength class 10.9 with washers in accordance with DIN125-300HV or screws in accordance

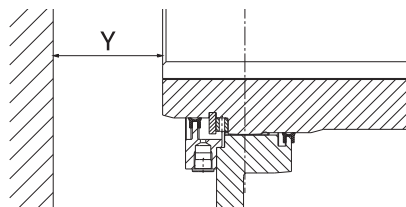
with DIN6914 with high tensile washers in accordance with DIN6916 for attaching the SIBRE drum coupling to the rope drum. Screws in accordance with DIN912 with strength class 8.8 are to be used as cover screws.

Table 4

Size	S F8/h9	a2 min.	Ø d4 F8	Ø d17		Ø k1	t4 min.	t6	y min.
	[mm]	[mm]	[mm]	Thread	Quantity	[mm]	[mm]	[mm]	[mm]
280	360	30	280	M16	10	360	15	0.10	60
310	380	30	310	M16	10	380	15	0.10	60
340	400	40	340	M20	10	400	20	0.10	70
400	460	40	400	M20	10	460	20	0.10	70
420	500	40	420	M20	10	500	20	0.15	80
450	530	40	450	M20	14	530	20	0.15	80
530	580	50	530	M20	14	600	25	0.20	80
545	590	50	545	M20	26	615	25	0.20	100
560	600	50	560	M20	26	630	25	0.20	100
600	640	60	600	M24	26	660	35	0.20	120
670	700	60	670	M24	26	730	35	0.20	120
730	760	60	730	M24	26	800	35	0.20	120
800	830	70	800	M24	32	875	40	0.20	120
860	900	70	860	M30	32	945	40	0.20	120
950	1000	75	950	M30	32	1040	45	0.20	120
1030	1080	75	1030	M30	32	1120	45	0.20	120



Drawing 6



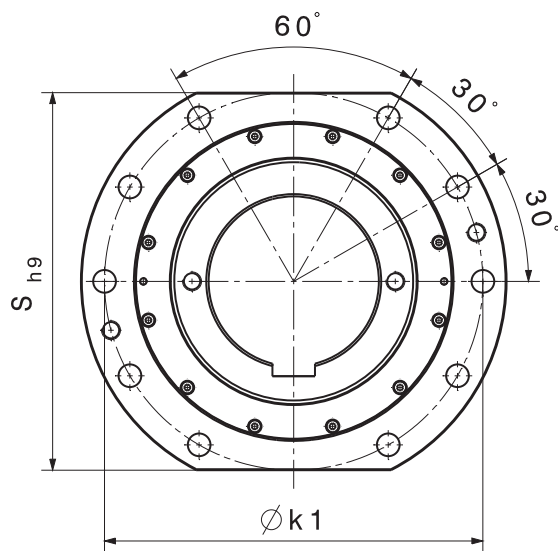
Drawing 7



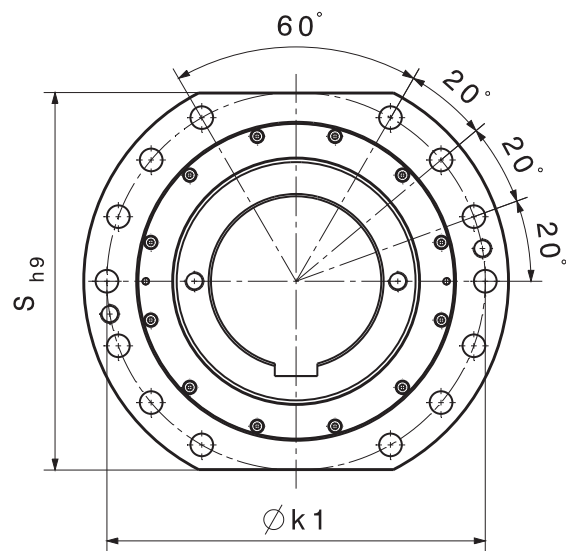
DRUM COUPLING

ABC-V

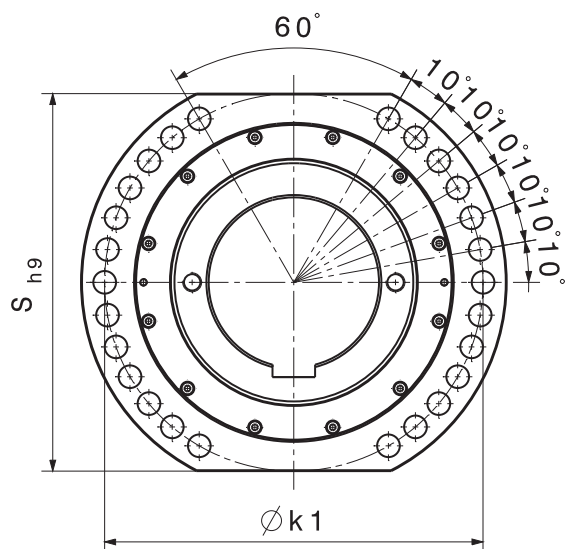
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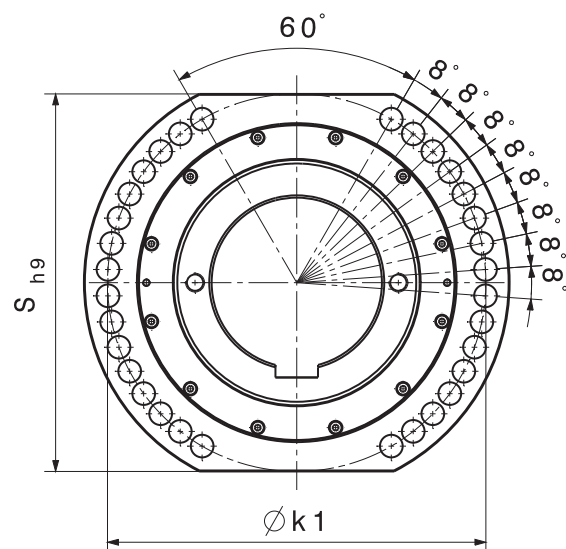
Hole pattern size 280-420



Hole pattern size 450-530



Hole pattern size 545-730



Hole pattern size 800-1030

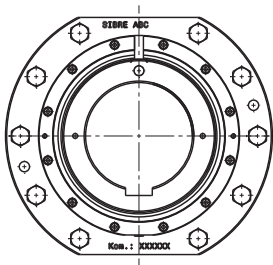
Drawing 8

DRUM COUPLING

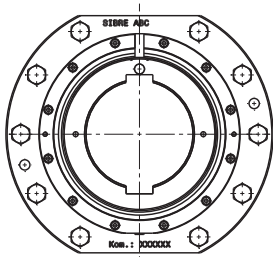
ABC-V

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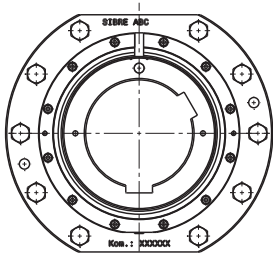
KEY WAY CONNECTION



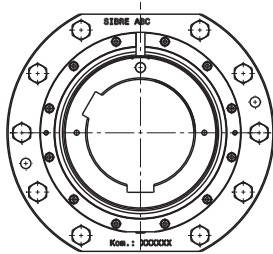
1 Key way



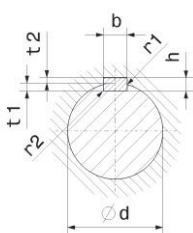
2x key way 180°



2x key way 120° right



2x key way 120° left



Drawing 9

The given values are valid for drillings in accordance with DIN6885-1. In principle every feather key connection must be checked for surface pressure.

Feather keyways in accordance with BS 46, ANSI B17.1 or other standards are also possible.

We request consultation for other connection methods such as involute splines in accordance with DIN5480

Table 5 key ways in accordance with DIN 6885 part 1

Drill hole $\varnothing d1$	across	44	50	58	65	75	85	95	110	130
	up to	50	58	65	75	85	95	110	130	150
Key	Width b:	14	16	18	20	22	25	28	32	36
	Height h:	9	10	11	12	14	14	16	18	20
Shaft key way	Width b:	14	16	18	20	22	25	28	32	36
	Depth t1	5.5	6	7	7.5	9	9	10	11	12
	Tolerance	+0.2								+0.3
Hub key way	Width b:	14	16	18	20	22	25	28	32	36
	Depth t2	3.8	4.3	4.4	4.9	5.4	5.4	6.4	7.4	8.4
	Tolerance	+0.2								+0.3
r2	max.	0.4				0.6				1
	min.	0.25				0.4				0.7

Drill hole $\varnothing d1$	across	150	170	200	230	260	290	330	380	440
	up to	170	200	230	260	290	330	380	440	500
Key	Width b:	40	45	50	56	63	70	80	90	100
	Height h:	22	25	28	32	32	36	40	45	50
Shaft key way	Width b:	40	45	50	56	63	70	80	90	100
	Depth t1	13	15	17	20	20	22	25	28	31
	Tolerance	+0.3								+0.3
Hub key way	Width b:	40	45	50	56	63	70	80	90	100
	Depth t2	9.4	10.4	11.4	12.4	12.4	14.4	15.4	17.4	19.5
	Tolerance	+0.3								
r2	max.	1				1.6				2.5
	min.	0.7				1.2				2

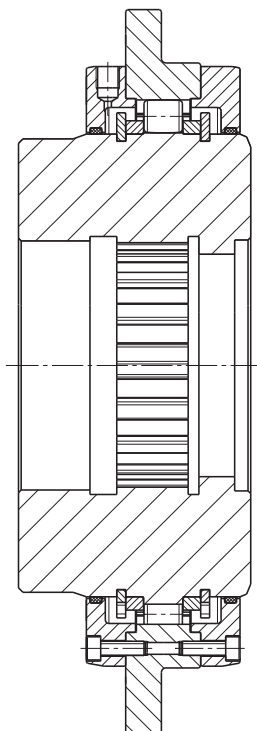
DRUM COUPLING

ABC-V

B06 20 246 E-EN

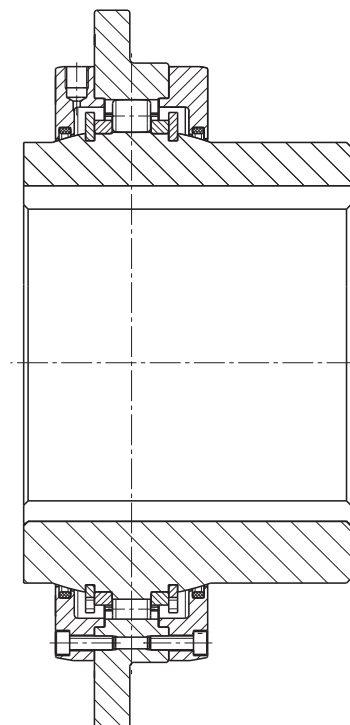
SPECIAL MODELS

ABC-AZ



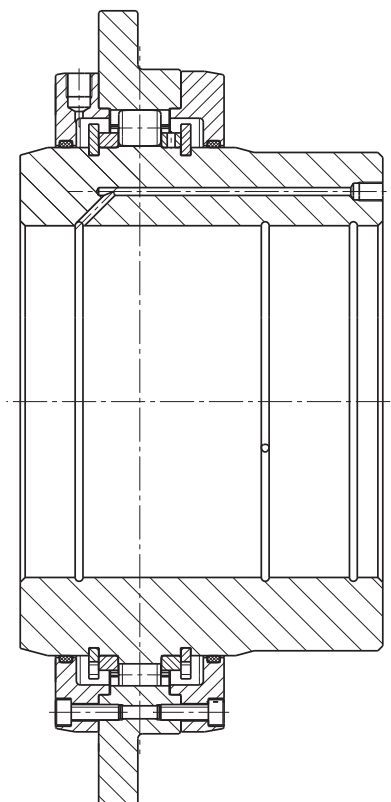
Drawing 10

ABC-B



Drawing 12

ABC-AS



Drawing 11

DRUM COUPLING

ABC-V

B06 20 246 E-EN

WEAR DISPLAY

The wear display serves to detect the wear at the gearing. With increasing wear the wear cam will cover the wear groove more and more caused by the torsion of the coupling hub in relation to the housing. If the wear cam is centrally covered, the max. wear is reached and the drum coupling has to be replaced.

The layout of the wear display simplifies a lateral check.

The max. permitted wear is shown in Table 6. In applications with two load directions the max. permitted wear has to be halved. This must be indicated during ordering so that the appropriate wear grooves are produced.

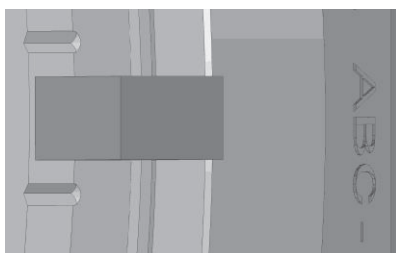
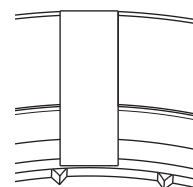
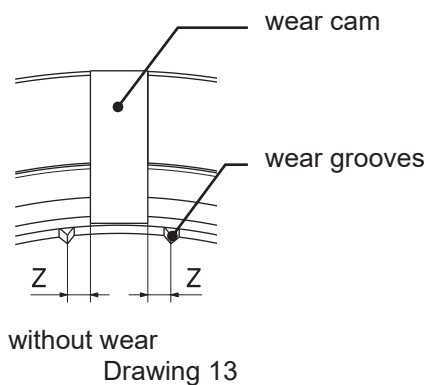


Table 6 coupling wear

Coupling size	Max. permitted wear
280-400	6 mm
420-860	8 mm
950-1030	10 mm