

Hydraulic Cylinders

Technical Data 1

Bore Size Selection

Series and bore sizes

Series	Nominal pressure (MPa)	Bore size (mm)									
		20	25	32	40	50	63	80	100	125	160
CHQ	3.5	●		●	●	●	●	●	●		
CHKD	10	●	●	●	●	●	●	●	●		
CHKG	16	●	●	●	●	●	●	●	●		
CHM	3.5	●	●	●	●						
CHN	7	●	●	●	●						
CHSD	10				●	●	●	●	●		
CHSG	16			●	●	●	●	●	●		
CH2E	3.5			●	●	●	●	●	●		
CH2F	7			●	●	●	●	●	●		
CH2G	14			●	●	●	●	●	●		
CH2H	14			●	●	●	●	●	●		
CHA	3.5				●	●	●	●	●	●	●

Relationship among generated force, bore size and pressure

When a cylinder is nearly at rest, the relationship among generated force, bore size and pressure can be expressed with the following formulas.

$F_{p1} = \mu_1 \times F_{f1}$ Formula (1)	F_{p1} : Generated extension force of cylinder (N)
$F_{p2} = \mu_2 \times F_{f2}$ Formula (2)	F_{p2} : Generated retraction force of cylinder (N)
$F_{f1} = \frac{\pi}{4} D^2 \times P$ Formula (3)	F_{f1} : Theoretical extension output (N)
$F_{f2} = \frac{\pi}{4} (D^2 - d^2) \times P$ Formula (4)	F_{f2} : Theoretical retraction output (N)
	P : Operating pressure (MPa)
	D : Bore size (mm)
	d : Piston rod diameter (mm)
	μ_1 : Cylinder extension load pressure coefficient
	μ_2 : Cylinder retraction load pressure coefficient

Selection standards

A cylinder's generated force will be lower than the theoretical output due to the following factors.

- (1) Sliding resistance on the cylinder bearings and seals, etc.
- (2) Pressure loss in hydraulic equipment and piping
- (3) Frictional resistance in moving parts of machinery

It is necessary to select bore sizes considering these factors.

The ratio of the load to the theoretical output is the load factor. Select bore sizes using the values below as reference for the load factor.

Load type	Load factor
Low-speed operation (100 mm/sec or less)	60 to 80%
High-speed operation	25 to 35%

Series CHQ Theoretical Output



Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)					
				1	1.5	2	2.5	3	3.5
20	10	OUT	314	314	471	628	785	942	1099
		IN	235	235	352	470	587	705	822
32	16	OUT	804	804	1206	1608	2010	2412	2814
		IN	603	603	904	1206	1507	1809	2110
40	16	OUT	1256	1256	1884	2512	3140	3768	4396
		IN	1055	1055	1582	2110	2637	3165	3692
50	20	OUT	1963	1963	2944	3926	4907	5889	6870
		IN	1649	1649	2473	3298	4122	4947	5771
63	20	OUT	3117	3117	4675	6234	7792	9351	10909
		IN	2803	2803	4204	5606	7007	8409	9810
80	25	OUT	5026	5026	7539	10052	12565	15078	17591
		IN	4535	4535	6802	9070	11337	13605	15872
100	30	OUT	7853	7853	11779	15706	19632	23559	27485
		IN	7147	7147	10720	14294	17867	21441	25014

Theoretical output (N) = Pressure (MPa) x Piston area (mm²)

Technical Data

Series CHKD Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)		
				3.5	7	10
20	12	OUT	314	1099	2198	3140
		IN	201	704	1407	2010
25	14	OUT	490	1715	3430	4900
		IN	336	1176	2352	3360
32	18	OUT	804	2814	5628	8040
		IN	549	1922	3843	5490
40	22.4	OUT	1256	4396	8792	12560
		IN	862	3017	6034	8620
50	28	OUT	1963	6871	13741	19630
		IN	1347	4715	9429	13470
63	35.5	OUT	3117	10910	21819	31170
		IN	2127	7445	14889	21270
80	45	OUT	5026	17591	35182	50260
		IN	3436	12026	24052	34360
100	56	OUT	7853	27486	54971	78530
		IN	5390	18865	37730	53900

Theoretical output (N) = Pressure (MPa) x Piston area (mm²)

Series CHKG Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)			
				3.5	7	10	16
20	12	OUT	314	1099	2198	3140	5024
		IN	201	704	1407	2010	3216
25	14	OUT	490	1715	3430	4900	7840
		IN	336	1176	2352	3360	5376
32	18	OUT	804	2814	5628	8040	12864
		IN	549	1922	3843	5490	8784
40	22.4	OUT	1256	4396	8792	12560	20096
		IN	862	3017	6034	8620	13792
50	28	OUT	1963	6871	13741	19630	31408
		IN	1347	4715	9429	13470	21552
63	35.5	OUT	3117	10910	21819	31170	49872
		IN	2127	7445	14889	21270	34032
80	45	OUT	5026	17591	35182	50260	80416
		IN	3436	12026	24052	34360	54976
100	56	OUT	7853	27486	54971	78530	125648
		IN	5390	18865	37730	53900	86240

Series CHM Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)					
				1	1.5	2	2.5	3	3.5
20	10	OUT	314	314	471	628	785	942	1099
		IN	235	235	352	470	587	705	822
25	12	OUT	490	490	735	980	1225	1470	1715
		IN	377	377	565	754	942	1131	1319
32	16	OUT	804	804	1206	1608	2010	2412	2814
		IN	603	603	904	1206	1507	1809	2110
40	18	OUT	1256	1256	1884	2512	3140	3768	4396
		IN	1002	1002	1503	2004	2505	3006	3507

Hydraulic Cylinders: Technical Data

Series CHN Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)			
				1	3	5	7
20	10	OUT	314	314	942	1570	2198
		IN	235	235	705	1175	1645
25	12	OUT	490	490	1470	2450	3430
		IN	377	377	1131	1885	2639
32	16	OUT	804	804	2412	4020	5628
		IN	603	603	1809	3015	4221
40	18	OUT	1256	1256	3768	6280	8792
		IN	1002	1002	3006	5010	7014

Series CHSD Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)		
				3.5	7	10
40	22	OUT	1256	4396	8792	12560
		IN	876	3066	6132	8760
50	28	OUT	1963	6871	13741	19630
		IN	1347	4715	9429	13470
63	36	OUT	3117	10910	21819	31170
		IN	2099	7346	14693	20990
80	45	OUT	5026	17591	35182	50260
		IN	3436	12026	24052	34360
100	56	OUT	7853	27486	57971	78530
		IN	5390	18865	37730	53900

Theoretical output (N) = Pressure (MPa) x Piston area (mm²)

Series CHSG Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)			
				3.5	7	10	16
32	18	OUT	804	2814	5628	8040	12864
		IN	549	1922	3843	5490	8784
40	22	OUT	1256	4396	8792	12560	20096
		IN	876	3066	6132	8760	14016
50	28	OUT	1963	6871	13741	19630	31408
		IN	1347	4715	9429	13470	21552
63	36	OUT	3117	10910	21819	31170	49872
		IN	2099	7346	14693	20990	33584
80	45	OUT	5026	17591	35182	50260	80416
		IN	3436	12026	24052	34360	54976
100	56	OUT	7853	27486	54971	78530	125648
		IN	5390	18865	37730	53900	86240

Theoretical output (N) = Pressure (MPa) x Piston area (mm²)

CHQ

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Related Equipment

D-

Technical Data

Series CH2E/CH2F/CH2G/CH2H Theoretical Output

Unit: N

	Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)					
					1	3.5	5	7	10	14
B-series rod	32	18	OUT	804	804	2813	4019	5627	8038	11254
			IN	550	550	1923	2748	3847	5495	7693
	40	22.4	OUT	1256	1256	4396	6280	8792	12560	17584
			IN	862	862	3017	4311	6035	8621	12070
	50	28	OUT	1963	1963	6869	9813	13738	19625	27475
			IN	1347	1347	4715	6735	9429	13471	18859
	63	35.5	OUT	3116	3116	10905	15578	21810	31157	43619
			IN	2126	2126	7442	10632	14885	21264	29769
	80	45	OUT	5024	5024	17584	25120	35168	50240	70336
			IN	3434	3434	12020	17172	24041	34344	48081
	100	56	OUT	7850	7850	27475	39250	54950	78500	109900
			IN	5388	5388	18859	26941	37718	53882	75435
C-series rod	40	18	OUT	1256	1256	4396	6280	8792	12560	17584
			IN	1002	1002	3506	5008	7012	10017	14023
	50	22.4	OUT	1963	1963	6869	9813	13738	19625	27475
			IN	1569	1569	5490	7843	10980	15686	21961
	63	28	OUT	3116	3116	10905	15578	21810	31157	43619
			IN	2500	2500	8751	12501	17502	25002	35003
	80	35.5	OUT	5024	5024	17584	25120	35168	50240	70336
			IN	4035	4035	14121	20174	28243	40347	56486
	100	45	OUT	7850	7850	27475	39250	54950	78500	109900
			IN	6260	6260	21911	31302	43823	62604	87645

Series CHA Theoretical Output

Unit: N

Bore size (mm)	Rod size (mm)	Operating direction	Piston area (mm ²)	Operating pressure (MPa)					
				1	1.5	2	2.5	3	3.5
40	18	OUT	1257	1257	1886	2514	3143	3771	4400
		IN	1002	1002	1503	2004	2505	3006	3507
50	20	OUT	1963	1963	2945	3926	4908	5889	6871
		IN	1649	1649	2474	3298	4123	4947	5772
63	22.4	OUT	3117	3117	4676	6234	7793	9351	10910
		IN	2723	2723	4085	5446	6808	8169	9531
80	28	OUT	5027	5027	7541	10054	12568	15081	17595
		IN	4411	4411	6617	8822	11028	13233	15439
100	35.5	OUT	7854	7854	11781	15708	19635	23562	27489
		IN	6864	6864	10296	13728	17160	20592	24024
125	35.5	OUT	12272	12272	18408	24544	30680	36816	42952
		IN	11282	11282	16923	22564	28205	33846	39487
160	45	OUT	20106	20106	30159	40212	50265	60318	70371
		IN	18516	18516	27774	37032	46290	55548	64806

Hydraulic Cylinders

Technical Data 2

Stroke Selection (maximum stroke based on buckling strength)

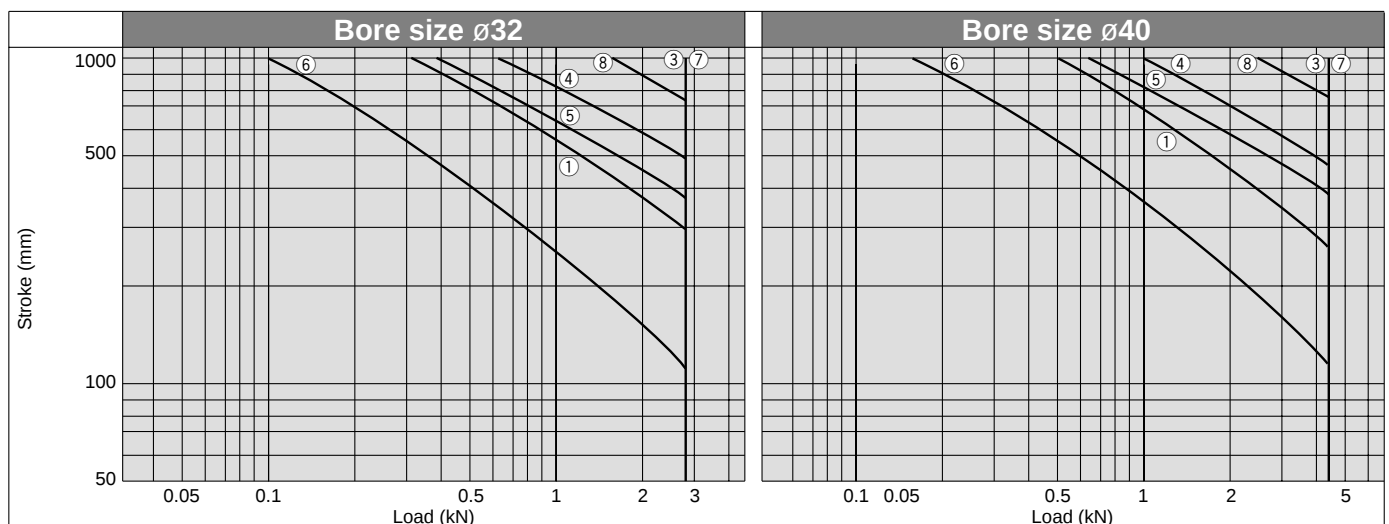
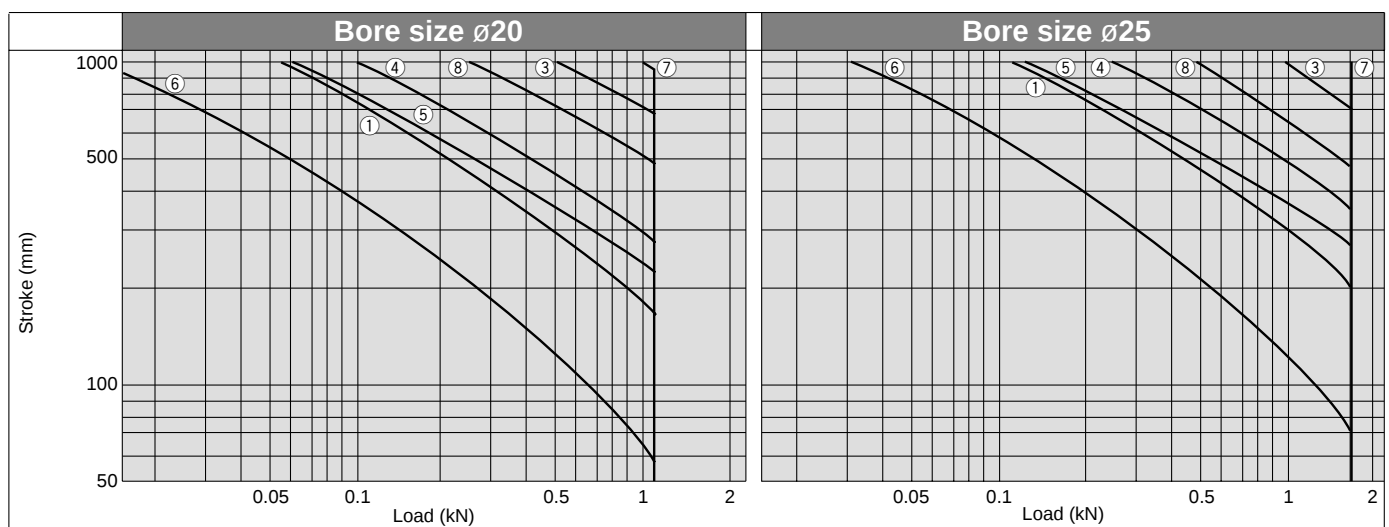
Refer to the stroke range limit charts regarding rod buckling due to load mass.

The values in these tables indicate the maximum stroke that can be used in a situation when air is being supplied while the cylinder is stopped in an intermediate position by an external force acting on the piston rod and/or by an external stopper.

Since the maximum usable stroke varies depending on the diameter of the piston rod and operating conditions, verify the applicability using the stroke range limit charts.

Series CHM Stroke range limit charts: Bore sizes $\varnothing 20$, $\varnothing 25$, $\varnothing 32$, $\varnothing 40$

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①				③		③	
④		⑤		⑤		⑥	
⑦		⑦		⑧			



CHQ

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CH2 ☐

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Related Equipment

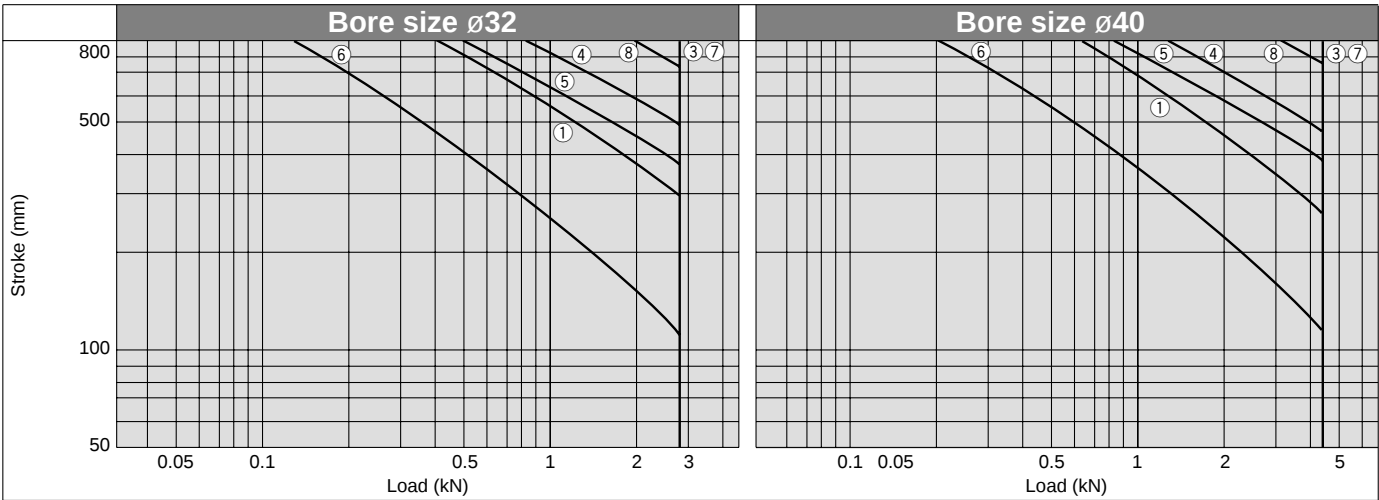
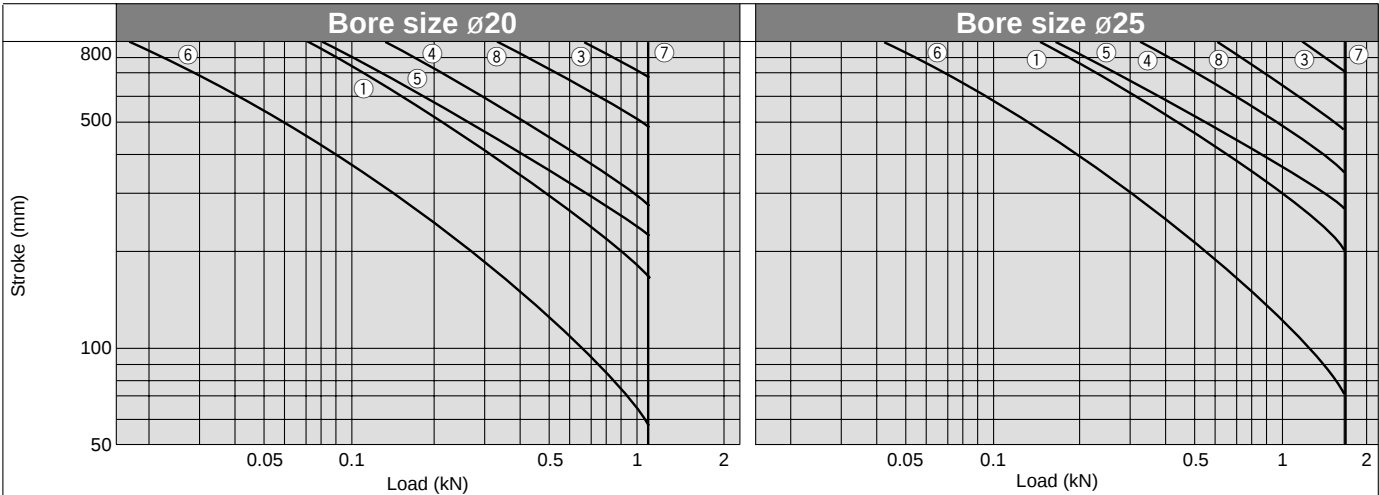
D- ☐

Technical Data

Series CHN

Stroke range limit charts: Bore sizes $\varnothing 20$, $\varnothing 25$, $\varnothing 32$, $\varnothing 40$

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①				③		③	
④				⑤		⑤	
⑦		⑦		⑧			

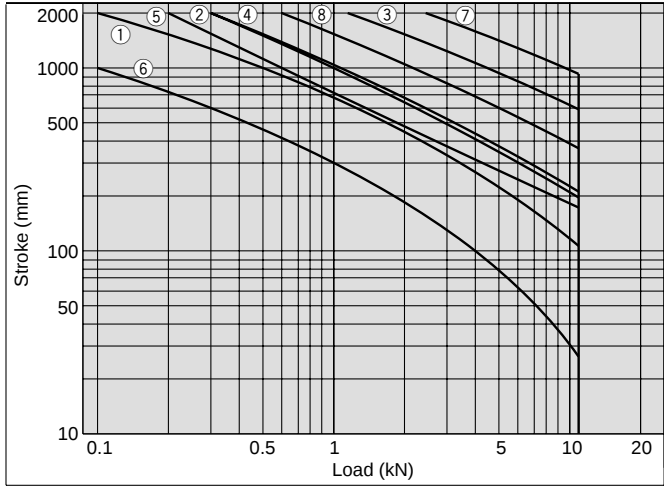


Hydraulic Cylinders: Technical Data

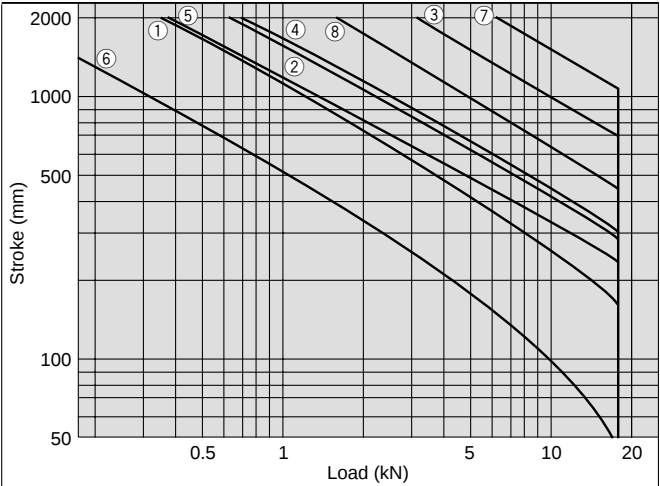
Series CHS **Stroke range limit charts: Bore sizes $\varnothing 32$, $\varnothing 40$**

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①		②		③		③	
④		⑤		⑤		⑥	
⑦		⑦		⑧			

Bore size $\varnothing 32$



Bore size $\varnothing 40$



CHQ

CHK ☐

CHN

CHM

CHS ☐

CH2 ☐

CHA

Related Equipment

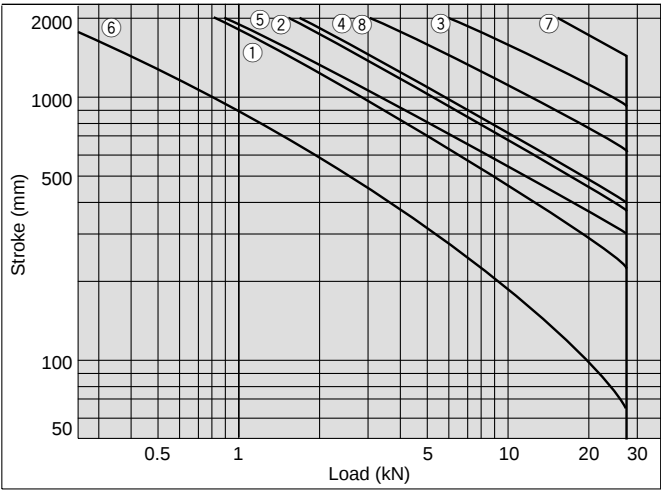
D- ☐

Technical Data

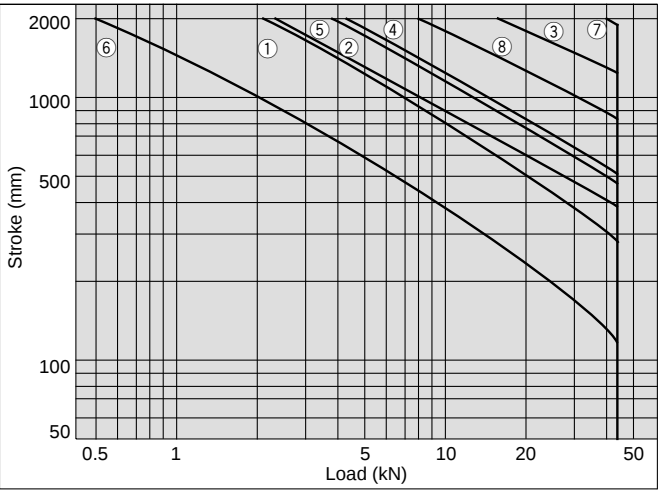
Series CHS

Stroke range limit charts: Bore sizes ø50, ø63, ø80, ø100

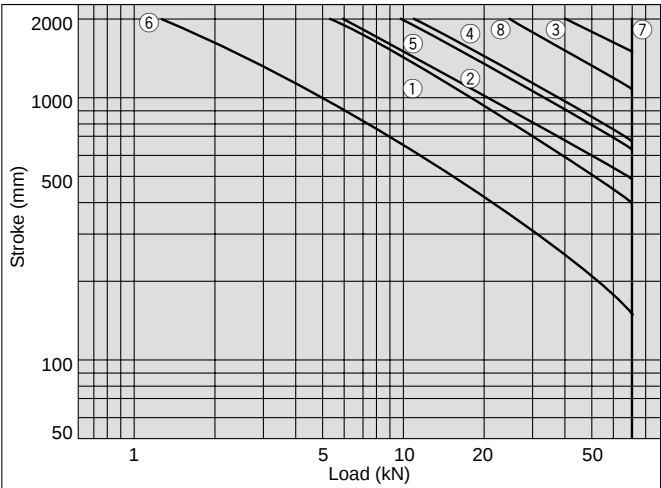
Bore size ø50



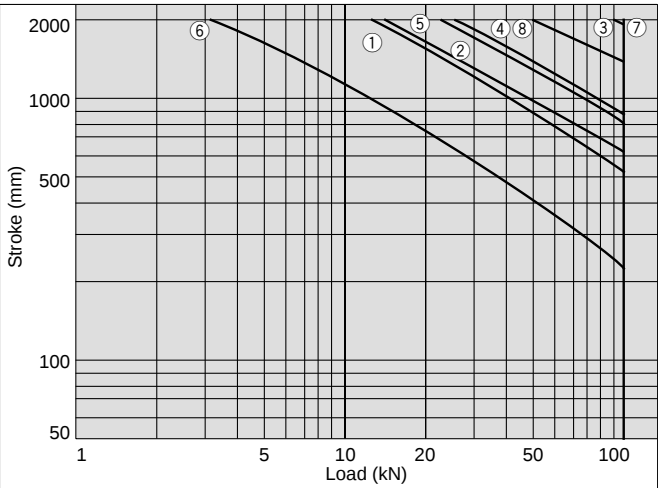
Bore size ø63



Bore size ø80



Bore size ø100

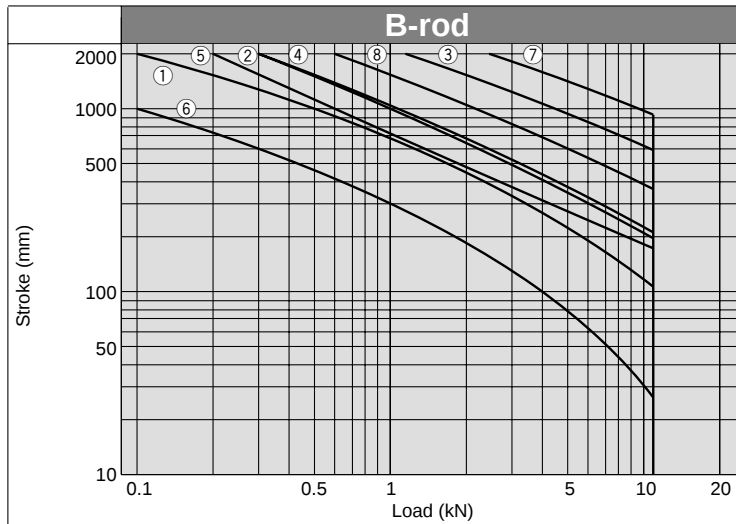


Hydraulic Cylinders: Technical Data

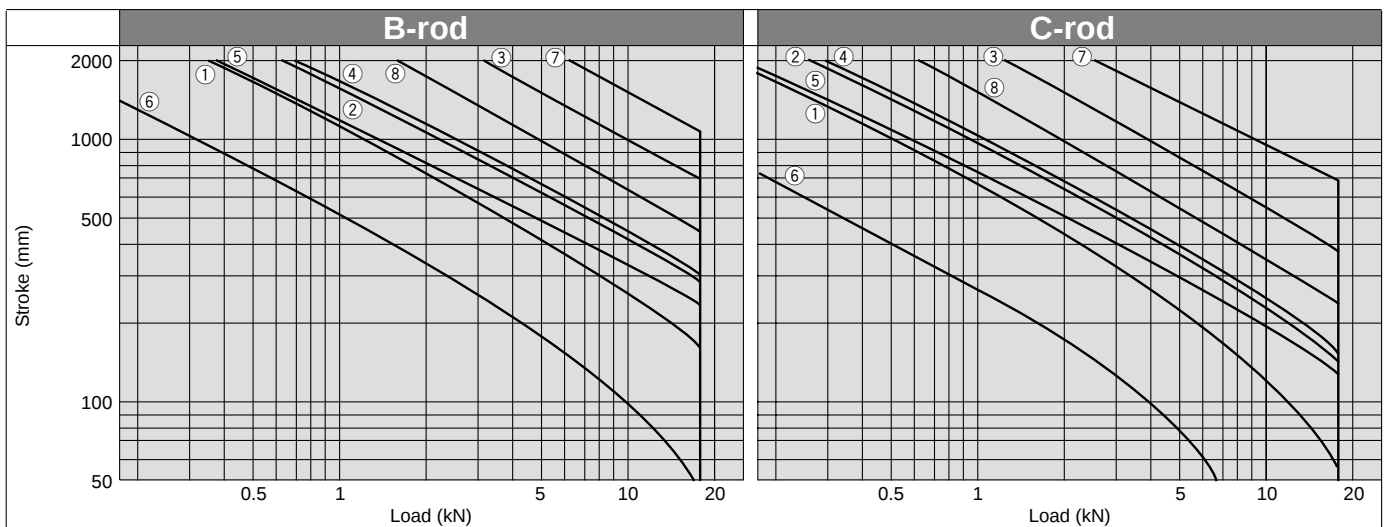
Series CH2E, CH2F, CH2G, CH2H Stroke range limit charts: Bore sizes $\varnothing 32$, $\varnothing 40$

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①		②		③		③	
④		⑤		⑤		⑥	
⑦		⑦		⑧			

Bore size $\varnothing 32$



Bore size $\varnothing 40$



CHQ

CHK ☐

CHN

CHM

CHS ☐

CH2 ☐

CHA

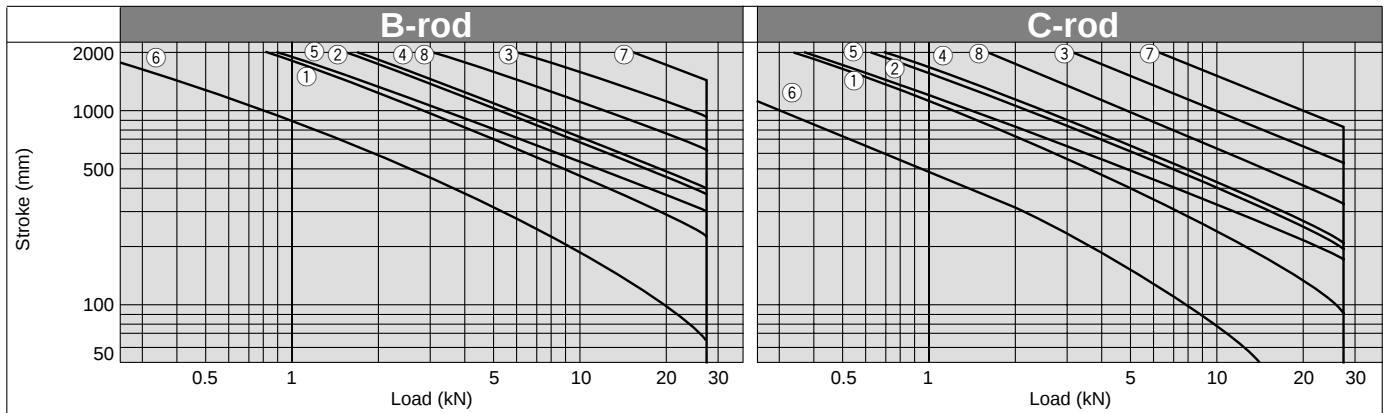
Related
Equipment

D- ☐

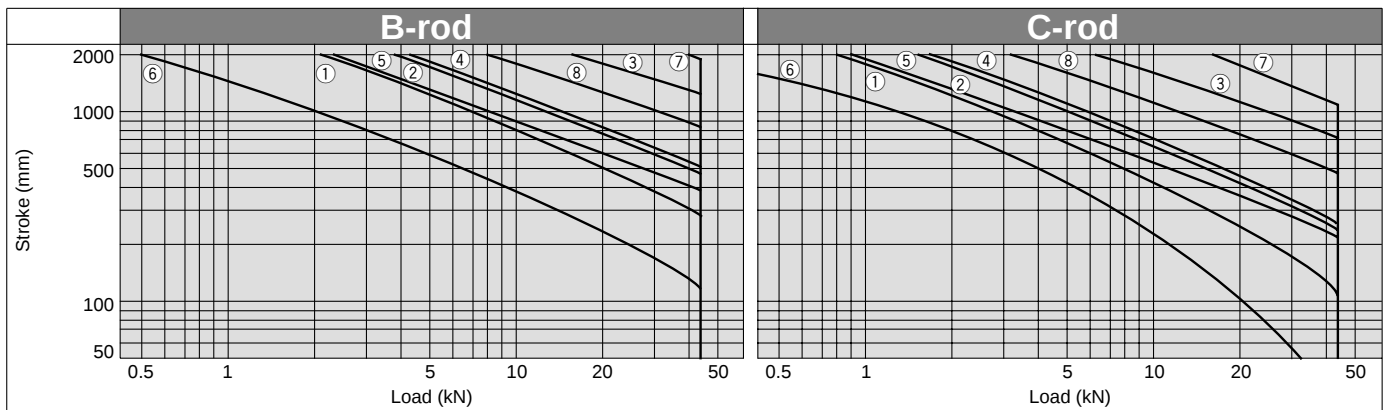
Technical Data

Series CH2E, CH2F, CH2G, CH2H Stroke range limit charts: Bore sizes $\varnothing 50$, $\varnothing 63$, $\varnothing 80$, $\varnothing 100$

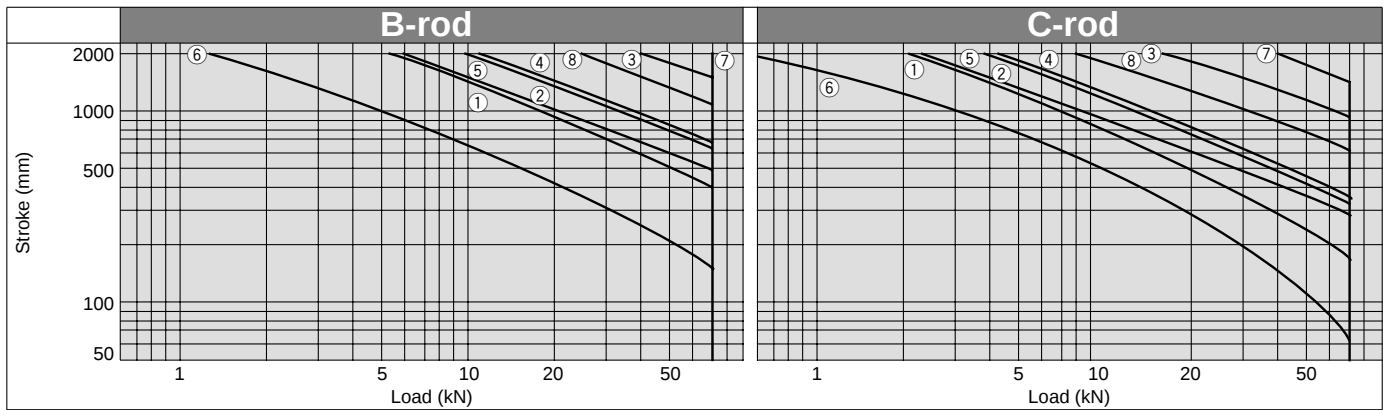
Bore size $\varnothing 50$



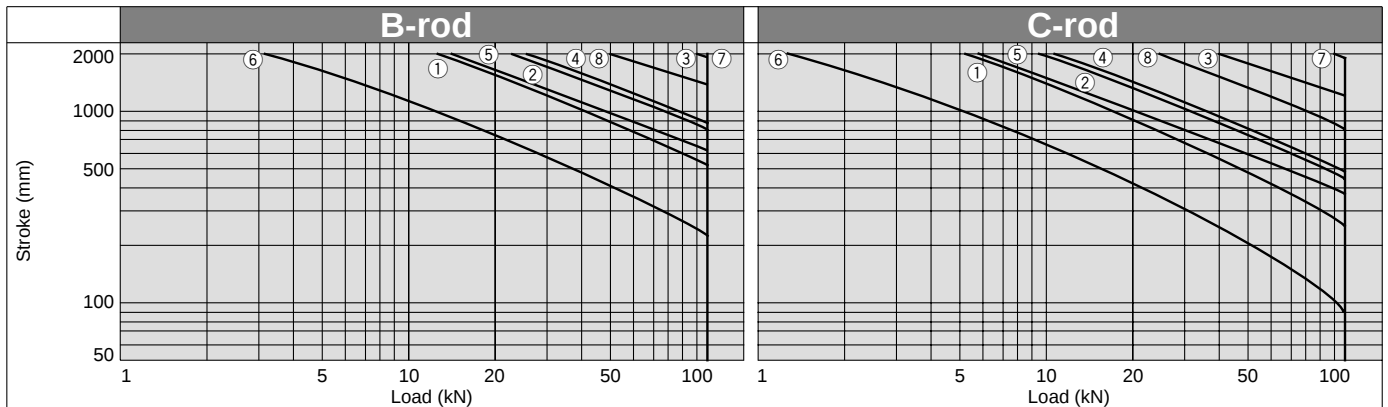
Bore size $\varnothing 63$



Bore size $\varnothing 80$



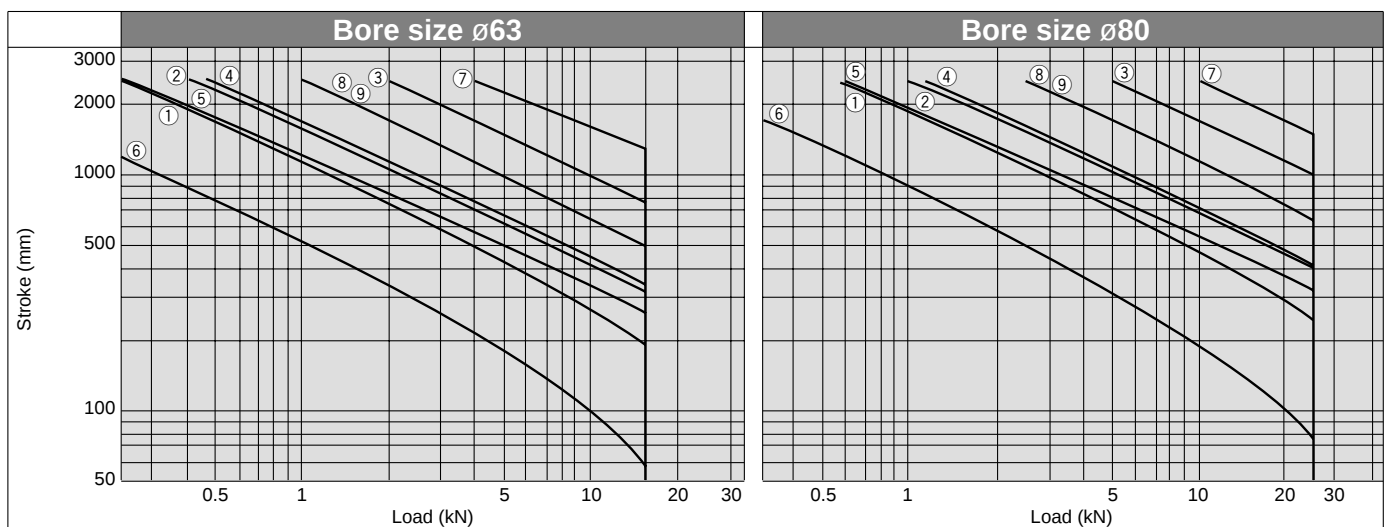
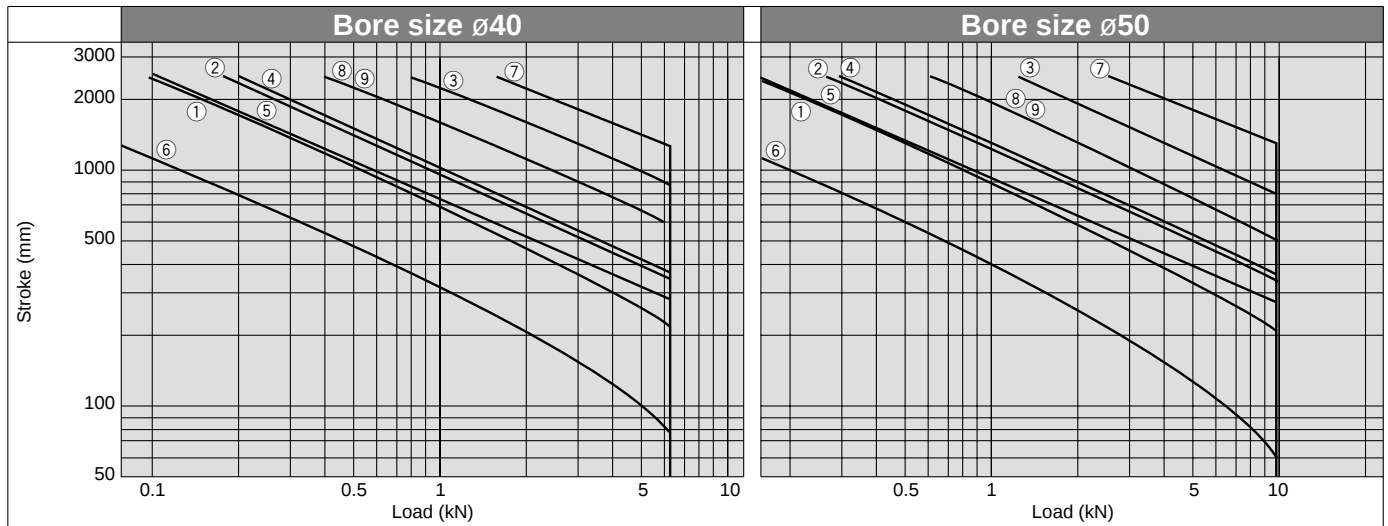
Bore size $\varnothing 100$



Hydraulic Cylinders: Technical Data

Series CHA Stroke range limit charts: Bore sizes $\varnothing 40$, $\varnothing 50$, $\varnothing 63$, $\varnothing 80$

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①		②		③		③	
④		⑤		⑤		⑥	
⑦		⑦		⑧		⑨	



CHQ

CHK ☐

CHN

CHM

CHS ☐

CH2 ☐

CHA

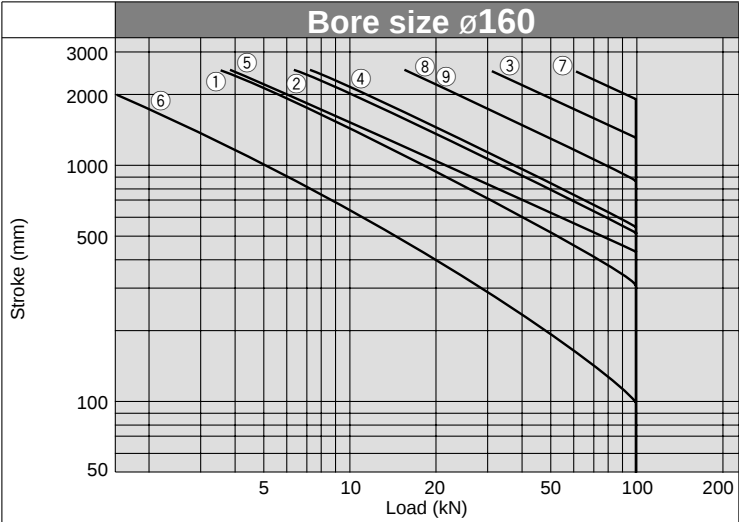
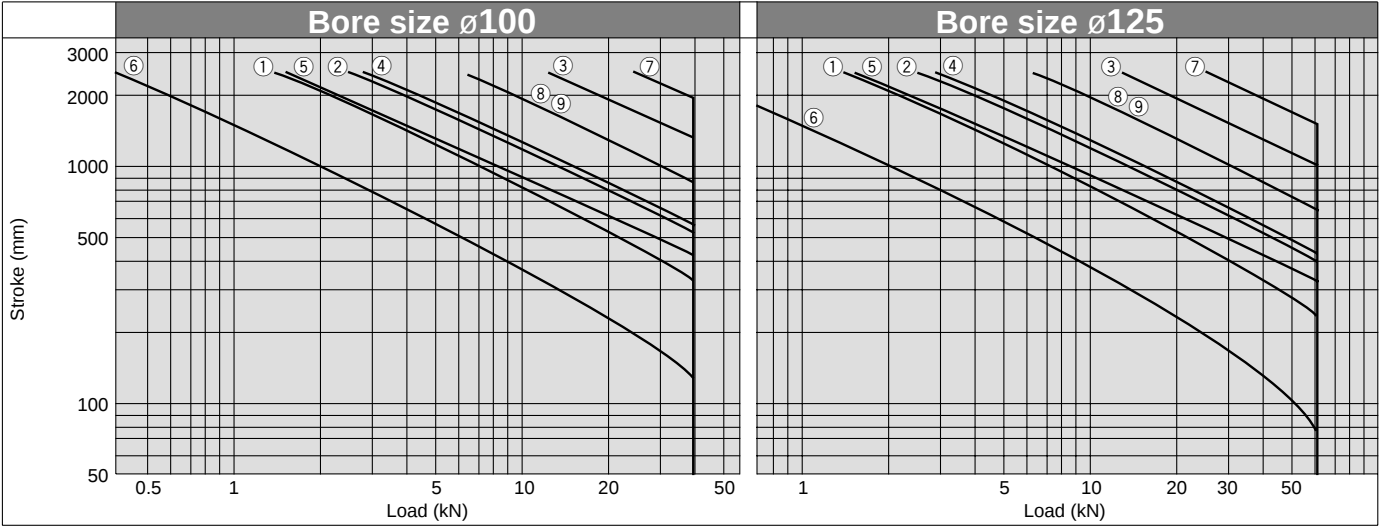
Related
Equipment

D- ☐

Technical Data

Series CHA **Stroke range limit charts: Bore sizes $\varnothing 100$, $\varnothing 125$, $\varnothing 160$**

Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation	Symbol	Mounting orientation
①		②		③		③	
④		⑤		⑤		⑥	
⑦		⑦		⑧		⑨	



Hydraulic Cylinders

Technical Data 3

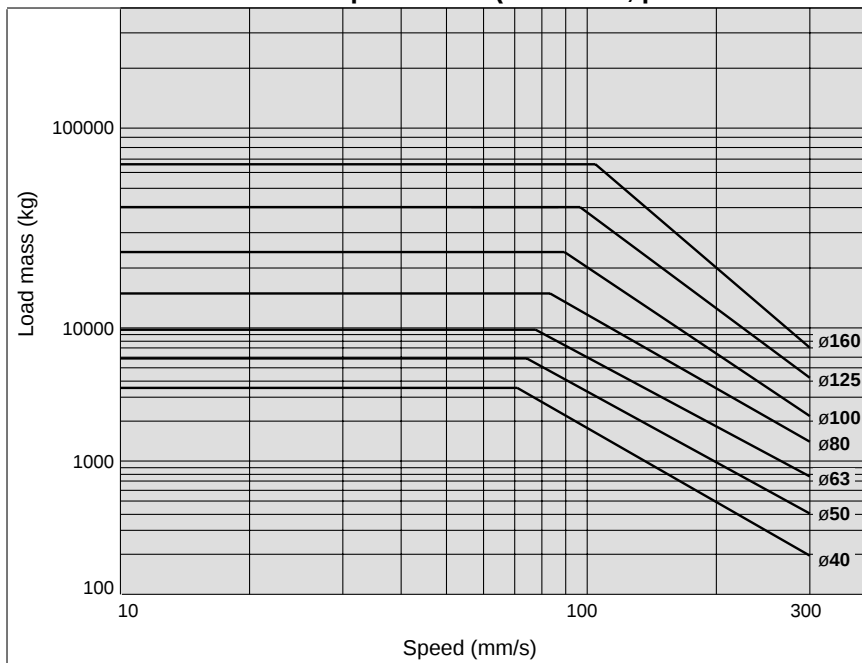
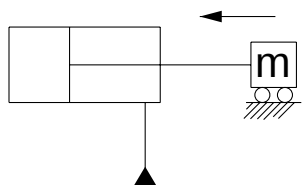
Relationship Between Load Mass and Speed

Load mass in light of cushion performance characteristics — Speed charts

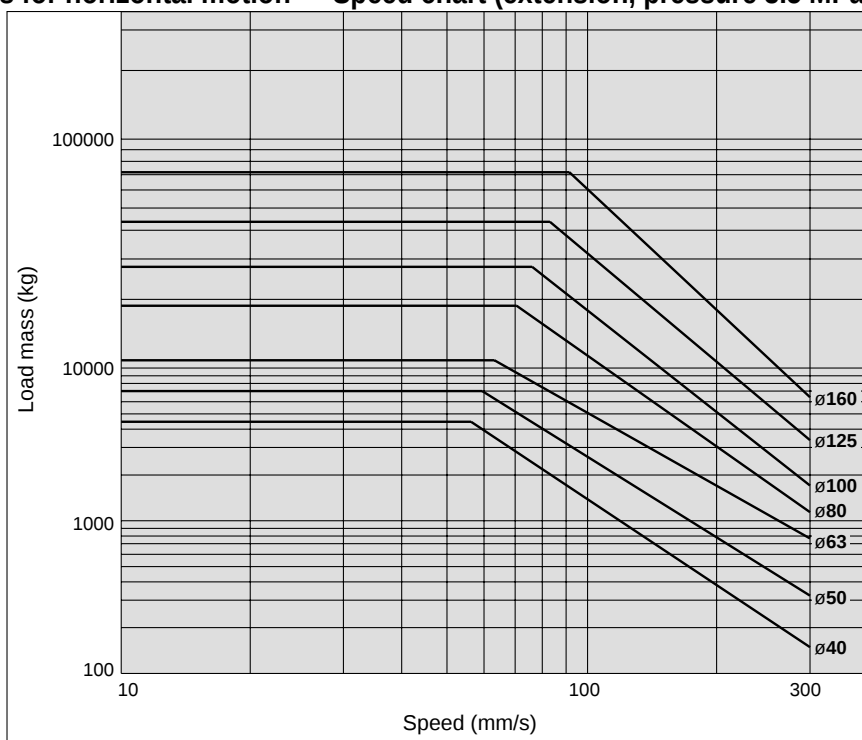
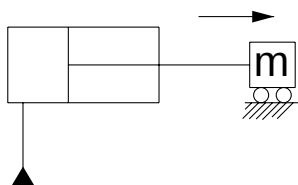
Set up the inertial force that can be absorbed by the cylinder cushion within the values shown in the graphs.

* In case of vertical motion, since surge pressure is generated by the gravitational force, adjust the load mass and speed below the maximum allowable pressure.

Series CHA (aluminum tube): Load mass for horizontal motion — Speed chart (retraction, pressure 3.5 MPa)



Series CHA (aluminum tube): Load mass for horizontal motion — Speed chart (extension, pressure 3.5 MPa)



CHQ

CHK

CHN

CHM

CHS

CH2

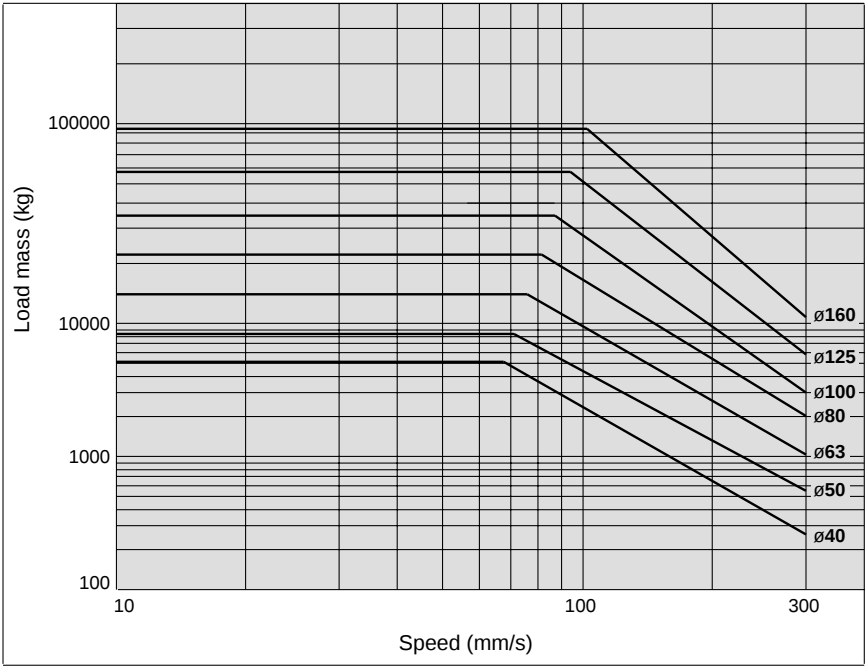
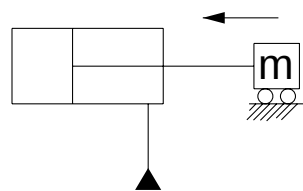
CHA

Related Equipment

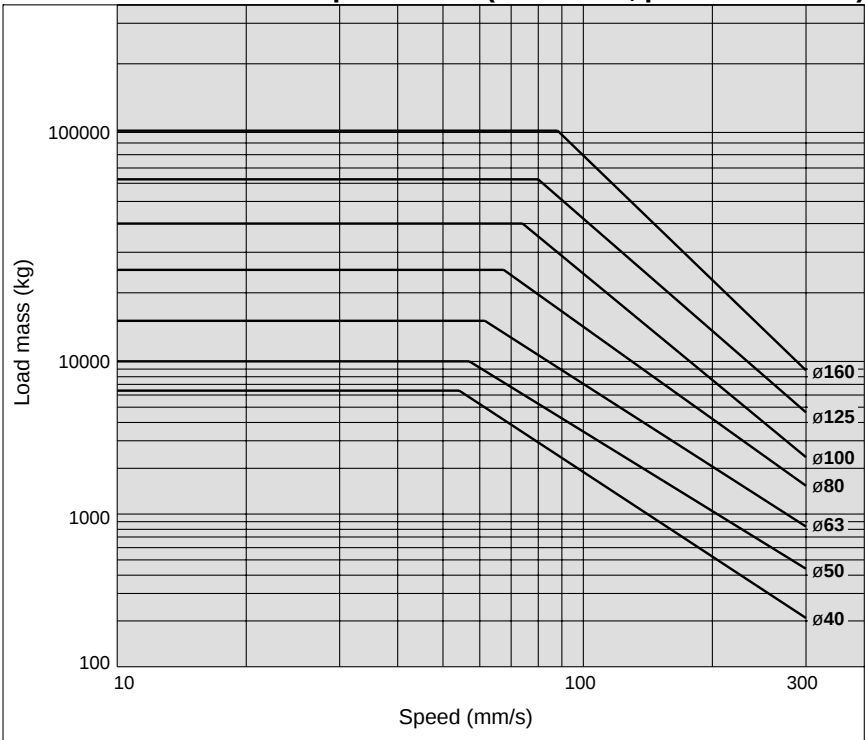
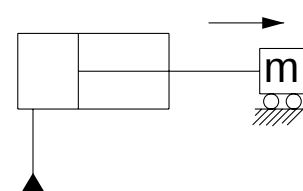
D-

Technical Data

Series CHA (steel tube): Load mass for horizontal motion — Speed chart (retraction, pressure 5 MPa)

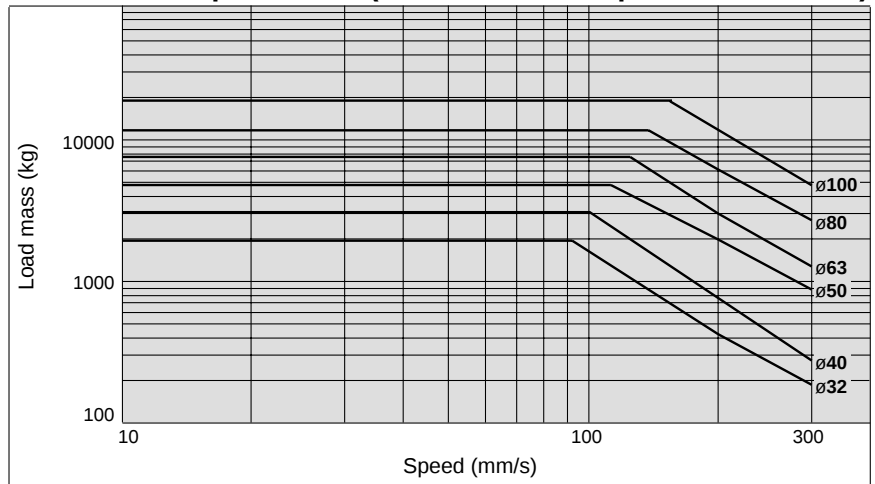
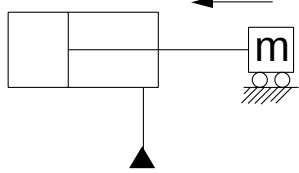


Series CHA (steel tube): Load mass for horizontal motion — Speed chart (extension, pressure 5 MPa)

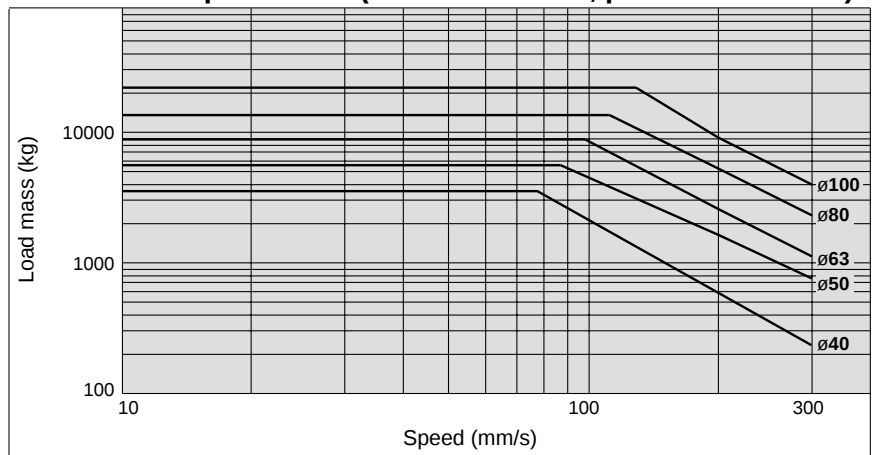
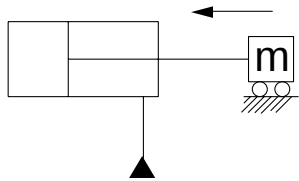


Hydraulic Cylinders: Technical Data

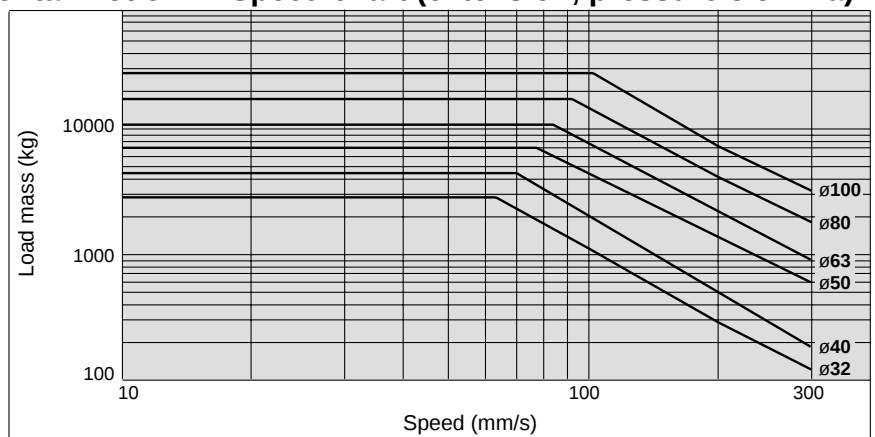
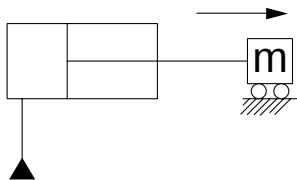
Series CH2E: Load mass for horizontal motion — Speed chart (B-rod retraction, pressure 3.5 MPa)



Series CH2E: Load mass for horizontal motion — Speed chart (C-rod retraction, pressure 3.5 MPa)



Series CH2E: Load mass for horizontal motion — Speed chart (extension, pressure 3.5 MPa)



CHQ

CHK ☐

CHN

CHM

CHS ☐

CH2 ☐

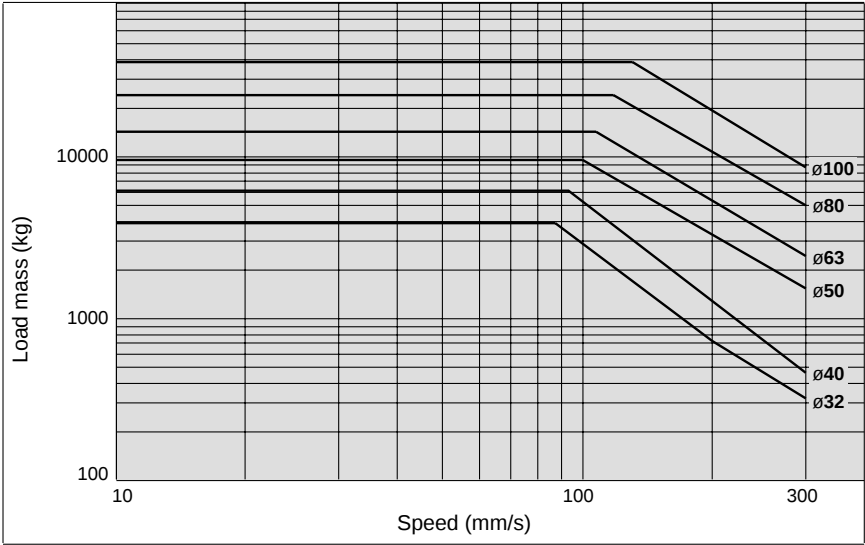
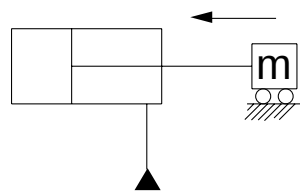
CHA

Related Equipment

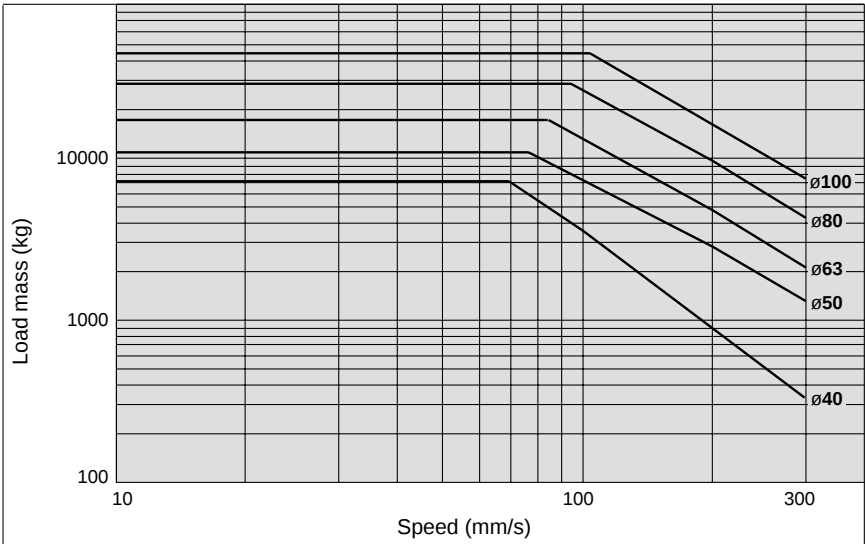
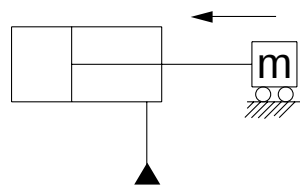
D- ☐

Technical Data

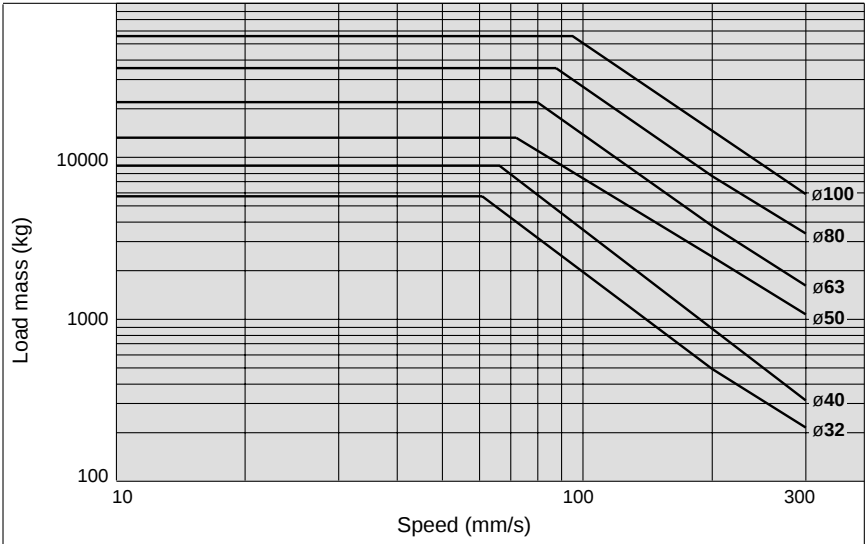
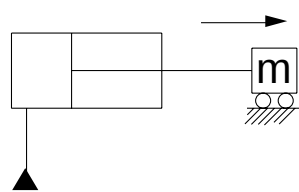
Series CH2F: Load mass for horizontal motion — Speed chart (B-rod retraction, pressure 7 MPa)



Series CH2F: Load mass for horizontal motion — Speed chart (C-rod retraction, pressure 7 MPa)

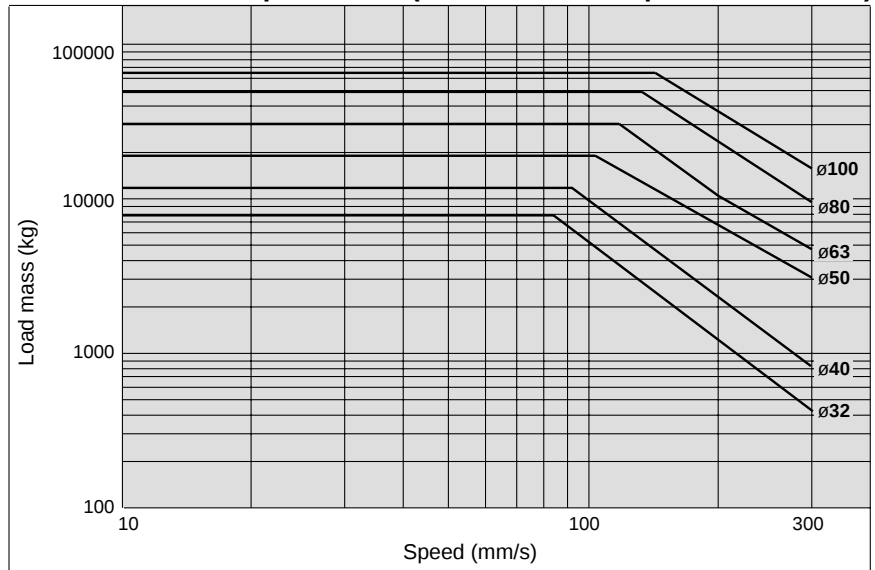
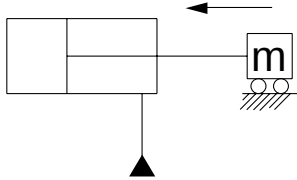


Series CH2F: Load mass for horizontal motion — Speed chart (extension, pressure 7 MPa)

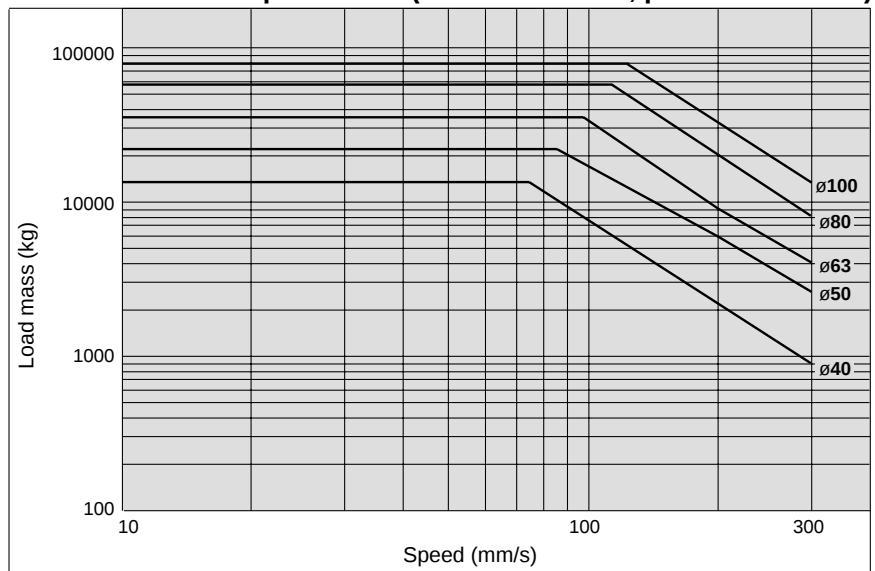
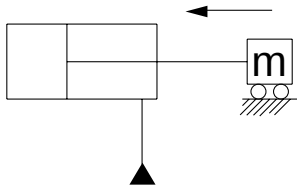


Hydraulic Cylinders: Technical Data

Series CH2G, CH2H: Load mass for horizontal motion — Speed chart (B-rod retraction, pressure 14 MPa)



Series CH2G, CH2H: Load mass for horizontal motion — Speed chart (C-rod retraction, pressure 14 MPa)



CHQ

CHK ☐

CHN

CHM

CHS ☐

CH2 ☐

CHA

Related Equipment

D- ☐

Series CH2G, CH2H: Load mass for horizontal motion — Speed chart (extension, pressure 14 MPa)

