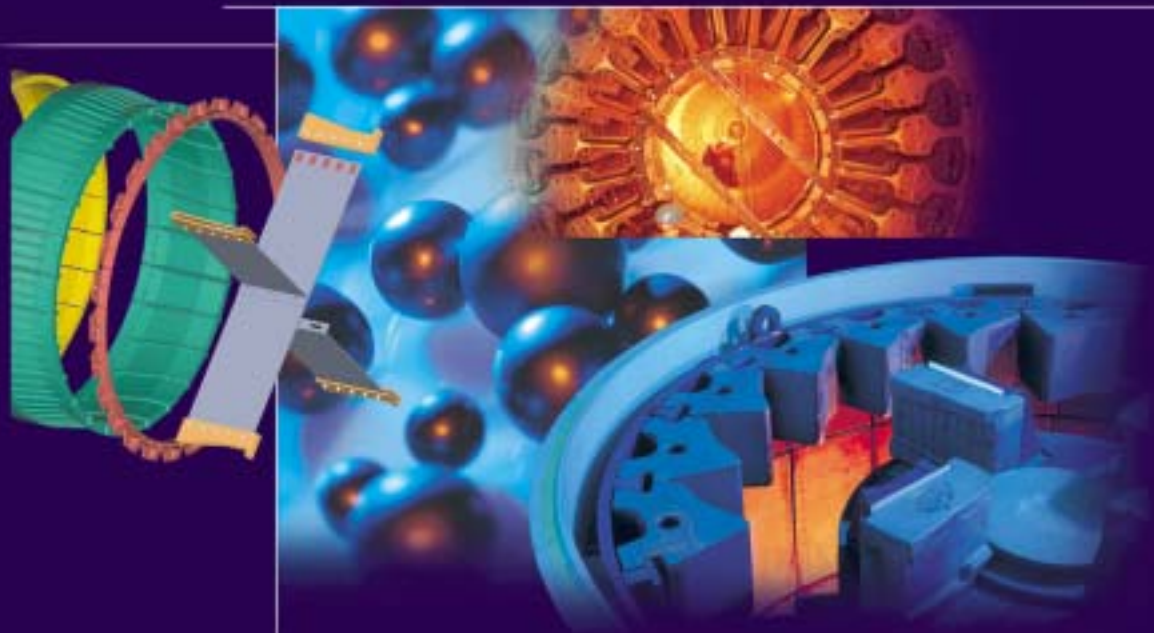




MAGOTTEAUX

SHAPING A WORLD OF PERFORMANCE





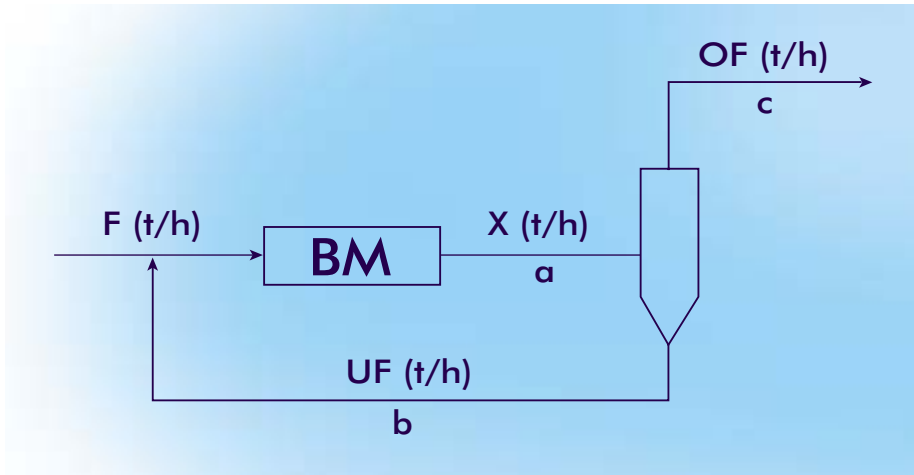
SOLID MATERIAL SPECIFIC GRAVITY

MATERIAL	SPECIFIC GRAVITY (kg/dm ³)	MATERIAL	SPECIFIC GRAVITY (kg/dm ³)	MATERIAL	SPECIFIC GRAVITY (kg/dm ³)
Aluminium	2,70	Flint	3,20 - 4,70	Sand - Dry	1,40 - 1,70
Laminated Aluminium	2,55 - 2,80	Glass	2,40 - 2,80	Sand - Wet	1,89 - 2,16
Antimony	6,68	Gold	19,29	Sandstone	1,90 - 2,50
Asbestos	2,10 - 2,80	Granite	2,60 - 2,70	Schist - Slate	2,60 - 2,90
Arsenic (Crystalline)	5,72	Graphite	2,26	Selenium	4,26 - 4,80
Barium	3,59	Grease	0,93	Silicon - Amorphous	2,00
Barytes	4,50	Gypsum	2,28 - 2,80	Silver	10,50
Basalt	2,72 - 3,20	Hornblende	3,00	Sodium	0,97
Beryllium	1,82	Ice	0,88 - 0,92	Soil	1,12
Bismuth	9,80	Iridium	22,40	Soapstone	2,60 - 2,80
Brick - Common	1,40 - 2,30	Iron - Raw	7,0 - 7,80	Snow	0,12
Brass - Cast	8,40	Iron - Pure	7,86	Snow - Compact	0,80
Brass - Laminated	8,50	Iron - Wrought	7,60 - 7,90	Sulphur -	
Cadmium	8,65	Iron - Cast	7,40 - 7,80	Amorphous -	
Calcium	1,55	Iron - Oxyde	5,10	Monoclinic -	
Carbon (Diamond)	3,51	Lead	11,33	Rhombic	1,93 - 2,07
Cement - Portland	3,10 - 3,20	Lime	0,85 - 1,0	Steel - Cast	7,80
Chalk	1,80 - 2,80	Limestone - Solid	2,10 - 2,95	Talc	2,60 - 2,80
Charcoal	0,30 - 0,60	Lithium	0,53	Tallow	0,90 - 1,00
Chromium	7,10	Magnesia	3,04	Tar	1,00 - 1,20
Chromium oxyde	5,21	Magnesium	1,74	Thorium	11,20
Clay	1,28 - 2,60	Manganese	7,20	Tungsten	19,30
Coal - Bitum - Broken	1,20 - 1,50	Marble	2,30 - 2,70	Uranium	11,28
Coal - Anthr - Broken	1,40 - 1,80	Mica	2,80 - 2,93	Tin - Cast	7,20 - 7,50
Cobalt	8,90	Molybdenum	10,20	Tin - Laminated	7,20 - 7,50
Coke - Loose	1,00 - 1,40	Mud - River	1,44 - 1,84	Vanadium	5,96
Concrete Masonry	2,20 - 2,40	Nickel	8,90	Zinc	7,14
(Cement, Stone, Sand,...)		Palladium	12,00	Zinc - Cast	6,86
Copper - Pure	8,92	Paper	0,75 - 1,15	Zinc - Laminated	7,15
Copper - Laminated	8,80 - 8,95	Paraffin	0,87 - 0,91	Wood - Oak	0,60 - 0,90
Copper - Cast	8,80 - 8,95	Platinum	21,45	Wood - Birch - Tree	0,71 - 0,72
Corundum	3,90 - 4,00	Pitch	1,07 - 1,25	Wood - Alden	0,55
Diamond	3,51	Potassium	0,86	Wood - Charm	0,72
Dolomite	2,90	Quartz	2,50 - 2,80	Wood - Maple - Tree	0,75
Earth - Dry - Loose	1,20	Radium	5,00	Wood - Pine - Tree	0,43 - 0,67
Earth - Moist - Loose	1,30	Rhodium	12,50	Wood - Larch - Tree	0,75
Feldspar	2,50 - 2,70	Rubber	0,92 - 0,96		

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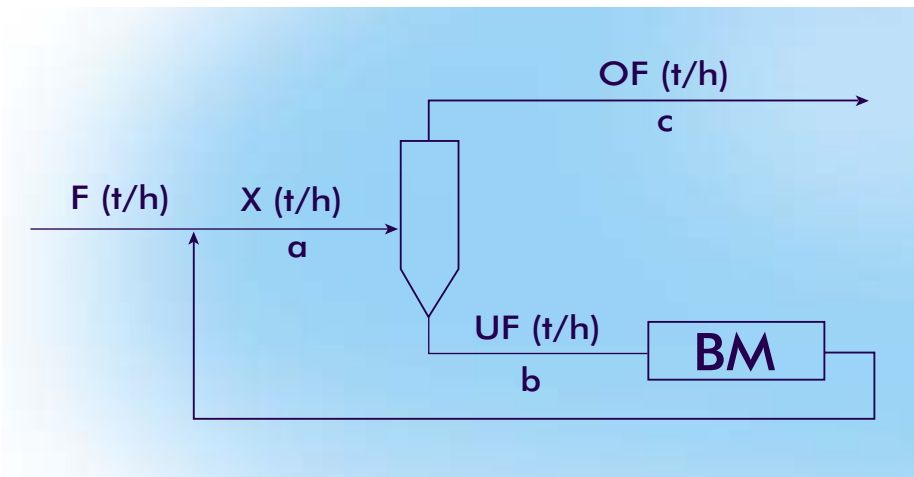


CIRCULATING LOAD



- F = new feed to circuit (tph)
- X = feed to hydrocyclone (tph)
- UF = hydrocyclone underflow (tph)
- OF = hydrocyclone overflow (tph)
- CL = circulation load (ratio) (%)
- S = sieve mesh or micron size used for evaluation

- a = % passing selected sieve size S in hydrocyclone feed
- b = % passing selected sieve size S in hydrocyclone underflow
- c = % passing selected sieve size S in hydrocyclone overflow



Circulating load is defined by :

$$C.L. = \frac{UF}{F} = \frac{c - a}{a - b}$$

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SIEVE

SIEVE

USA - A.S.T.M.E. 11.70		TYLER		BRITISH STANDARD	
Mesh	Microns		Microns		Microns
		2,5	8.000	3	5.600
3,5	5.600	3,5	5.600	4	4.000
4	4.750	5	4.000	5	3.350
5	4.000	7	2.800	6	2.800
6	3.350	9	2.000	8	2.000
7	2.800	12	1.400	10	1.700
8	2.360	18	1.000	14	1.180
		25	710	16	1.000
12	1.700	35	500	18	850
16	1.180	45	355	25	600
18	1.000	60	250	30	500
20	850	70	212	36	425
25	710	80	180	44	355
35	500	120	125	60	250
45	355	140	106	72	212
50	300	170	90	100	150
60	250	200	75	150	106
70	212	230	63	170	90
100	150	270	53	200	75
140	106	325	45	240	63
170	90	400	38	300	53
200	75			350	45
230	63			400	38
270	53			500	25
325	45				
400	38				
500	25				

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METRIC UNITS

FORCE OR WEIGHT UNITS

	N*	kN	MN	(kgf)	(dyn)
1 N	1	10 ⁻³	10 ⁻⁶	0,102	10 ⁵
1 kN	10 ³	1	10 ⁻³	0,102.10 ³	10 ⁸
1 MN	10 ⁶	10 ³	1	0,102.10 ⁶	10 ¹¹

* 1 Newton = 1 N = 1 kg m/s²

PRESSURE UNITS

	Pa	N/mm²	bar	(kgf/cm²)	(torr)
1 Pa = 1N/m²	1	10 ⁻⁶	10 ⁻⁵	1,02.10 ⁻⁵	0,0075
1 N/mm²	10 ⁶	1	10	10,2	7,5.10 ³
1 bar	10 ⁵	0,1	1	1,02	750
(1 kgf/am² = 1at)	98100	9,81.10 ⁻²	0,981	1	736
(1 torr)*	133	0,133.10 ⁻³	1,33.10 ⁻³	1,36.10 ⁻³	1

* 1 Torr = 1/760 atm
= 1,33322 mbar
 \triangleq 1 mm Hg (mm in a mercury column at t = 0°C)

ENERGY & WORK UNITS

	J	kW h	(kgf m)	(kcal)	(ch h)
1 J	1	0,278.10 ⁻⁶	0,102	0,239.10 ⁻³	0,37.10 ⁻⁶
1 kW h	3,60.10 ⁶	1	367.10 ³	860	1,36
(1 kgf m)	9,81	2,72.10 ⁻⁶	1	2,345.10 ⁻³	3,70.10 ⁻⁶
(1 kcal)	4186,8	1,16.10 ⁻³	426,9	1	1,58.10 ⁻³
(1 ch h)	2,65.10 ⁶	0,736	0,27.10 ⁶	632	1

* 1 Joule = 1 J = 1 Nm
= 1 ws

POWER UNITS

	W	kW	(kgf m/s)	(kcal/h)	(ch)
1 W*	1	10 ⁻³	0,102	0,860	1,36.10 ⁻³
1 kW	1000	1	102	860	1,36
(1 kgf m/s)	9,81	9,81.10 ⁻³	1	8,43	13,3.10 ⁻³
(1 kcal/h)	1,16	1,16.10 ⁻³	0,119	1	1,58.10 ⁻³
(1 ch)	736	0,736	75	632	1

* 1 Watt = 1 W = 1 Nm/s

VARIOUS

1 Metric carat = 1 ct = 200 mg = 0,2.10⁻³Kg = 1/5000 kg

FINENESS OF PRECIOUS METALS :

24 carats \triangleq 1000,00 % | 18 carats \triangleq 750,00 %

14 carats \triangleq 583,33 % | 8 carats \triangleq 333,33 %

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FILLING DEGREE

Percentage filling following the measurements inside the mill:

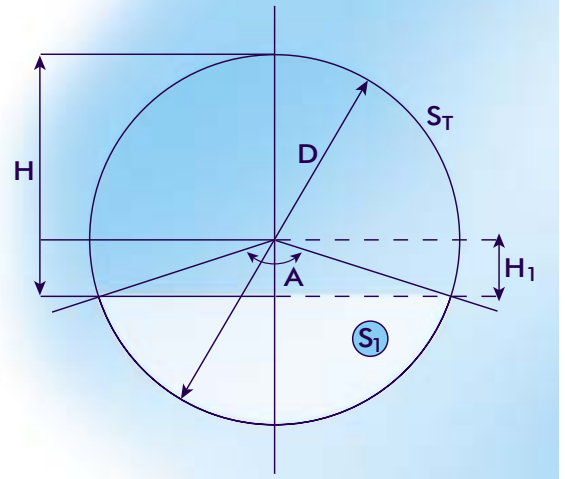
$$S_T = \pi \frac{D^2}{4} \quad \dots\dots\dots m^2$$

$$H_1 = H - \frac{D}{2} \quad \dots\dots\dots m$$

$$A = 2 \times \text{ARCOS} \left(\frac{2 \times H_1}{D} \right) \quad \dots\dots\dots ^\circ$$

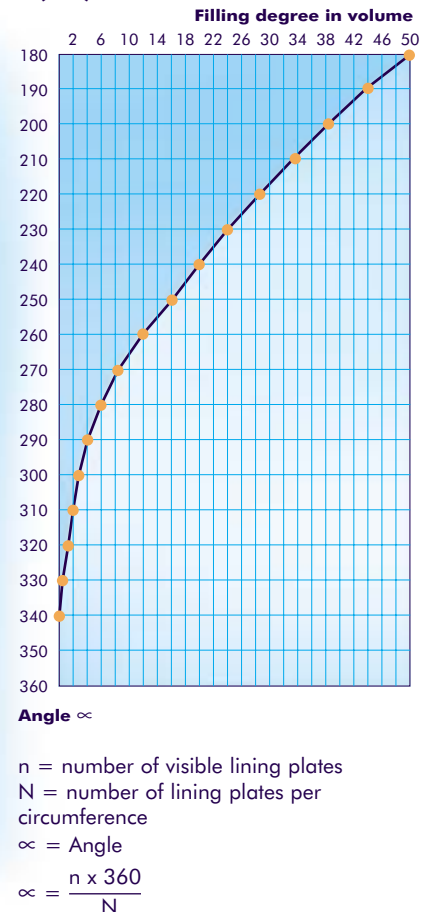
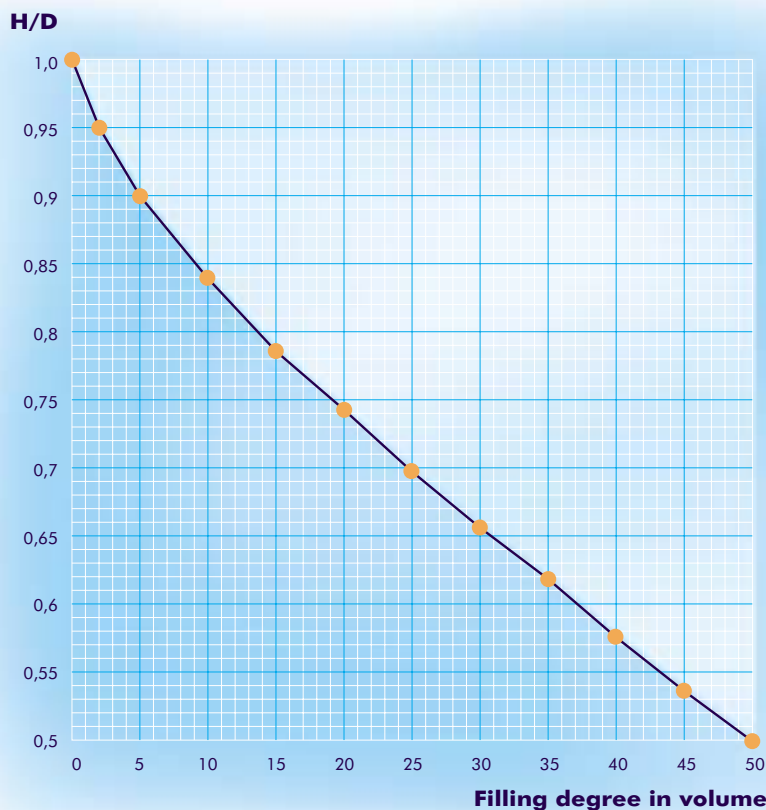
$$S_1 = \frac{D^2}{8} \times \left(\frac{\pi \times A}{180^\circ} - \sin A \right) \quad \dots\dots\dots m^2$$

$$R = \frac{S_1}{S_T} \times 100 \quad \dots\dots\dots \%$$



- H = free height above the ball load (in relation with diameter inside of liners)
- D = diameter inside of liners
- S_T = total area inside of liners
- S_1 = area of the grinding media
- R = filling degree in volume (%)

FILLING DEGREE IN VOLUME (%)





FILLING DEGREE

VALUES OF ANGLE A AND H/D RATIO IN RELATION TO THE FILLING DEGREE (%)

FILLING DEGREE (%)	H/D	ANGLE A	FILLING DEGREE (%)	H/D	ANGLE A	FILLING DEGREE (%)	H/D	ANGLE A
20	.7459	121.1	24.2	.7089	130.4	28.4	.6732	139.5
20.1	.745	121.3	24.3	.708	130.8	28.5	.6723	139.7
20.2	.7441	121.5	24.4	.7072	131	28.6	.6715	139.9
20.3	.7432	121.8	24.5	.7063	131.3	28.7	.6707	140.1
20.4	.7423	122	24.6	.7054	131.5	28.8	.6698	140.3
20.5	.7414	122.3	24.7	.7046	131.7	28.9	.669	140.5
20.6	.7405	122.5	24.8	.7037	131.9	29	.6682	140.7
20.7	.7396	122.7	24.9	.7028	132.1	29.1	.6673	140.9
20.8	.7387	123	25	.702	132.3	29.2	.6665	141.1
20.9	.7379	123.2	25.1	.7011	132.6	29.3	.6657	141.3
21	.737	123.4	25.2	.7003	132.8	29.4	.6648	141.5
21.1	.7361	123.7	25.3	.6994	133	29.5	.664	141.7
21.2	.7352	123.9	25.4	.6986	133.2	29.6	.6632	141.9
21.3	.7343	124.1	25.5	.6977	133.4	29.7	.6623	142.1
21.4	.7334	124.3	25.6	.6968	133.6	29.8	.6615	142.3
21.5	.7325	124.6	25.7	.696	133.8	29.9	.6607	142.5
21.6	.7316	124.8	25.8	.6951	134.1	30	.6598	142.7
21.7	.7307	125	25.9	.6943	134.3	30.1	.659	142.9
21.8	.7299	125.3	26	.6934	134.5	30.2	.6582	143.1
21.9	.729	125.5	26.1	.6926	134.7	30.3	.6574	143.3
22	.7281	125.7	26.2	.6917	134.9	30.4	.6565	143.5
22.1	.7272	125.9	26.3	.6909	135.1	30.5	.6557	143.7
22.2	.7263	126.2	26.4	.69	135.3	30.6	.6549	143.9
22.3	.7254	126.4	26.5	.6892	135.5	30.7	.6541	144.1
22.4	.7246	126.6	26.6	.6883	135.7	30.8	.6532	144.3
22.5	.7237	126.8	26.7	.6875	136	30.9	.6524	144.5
22.6	.7228	127.1	26.8	.6866	136.2	31	.6516	144.7
22.7	.7219	127.3	26.9	.6858	136.4	31.1	.6508	144.9
22.8	.7211	127.5	27	.685	136.6	31.2	.6499	145.1
22.9	.7202	127.7	27.1	.6841	136.8	31.3	.6491	145.3
23	.7193	128	27.2	.6833	137	31.4	.6483	145.5
23.1	.7184	128.2	27.3	.6824	137.2	31.5	.6475	145.7
23.2	.7176	128.4	27.4	.6816	137.4	31.6	.6466	145.9
23.3	.7167	128.6	27.5	.6807	137.6	31.7	.6458	146.1
23.4	.7158	128.9	27.6	.6799	137.8	31.8	.645	146.3
23.5	.7149	129.1	27.7	.679	138	31.9	.6442	146.5
23.6	.7141	129.3	27.8	.6782	138.2	32	.6434	146.7
23.7	.7132	129.5	27.9	.6774	138.4	32.1	.6425	146.9
23.8	.7123	129.7	28	.6765	138.7	32.2	.6417	147.1
23.9	.7115	130	28.1	.6757	138.9	32.3	.6409	147.3
24	.7106	130.2	28.2	.6748	139.1	32.4	.6401	147.5
24.1	.7097	130.6	28.3	.674	139.3	32.5	.6393	147.7



VALUES OF ANGLE A AND H/D RATIO IN RELATION TO THE FILLING DEGREE (%)

FILLING DEGREE (%)	H/D	ANGLE A	FILLING DEGREE (%)	H/D	ANGLE A	FILLING DEGREE (%)	H/D	ANGLE A
32.6	.6384	147.8	36.8	.6044	155.9	41	.5709	163.7
32.7	.6376	148	36.9	.3036	156.1	41.1	.5701	163.9
32.8	.6368	148.2	37	.6028	156.3	41.2	.5693	164.1
32.9	.636	148.4	37.1	.602	156.5	41.3	.5685	164.2
33	.6352	148.6	37.2	.6012	156.6	41.4	.5678	164.4
33.1	.6344	148.8	37.3	.6004	156.8	41.5	.567	164.6
33.2	.6336	149	37.4	.5996	157	41.6	.5662	164.8
33.3	.6327	149.2	37.5	.5988	157.2	41.7	.5654	165
33.4	.6319	149.4	37.6	.598	157.4	41.8	.5646	165.2
33.5	.6311	149.6	37.7	.5972	157.6	41.9	.5638	165.3
33.6	.6303	149.8	37.8	.5964	157.8	42	.563	165.5
33.7	.6295	150	37.9	.5956	157.9	42.1	.5622	165.7
33.8	.6287	150.2	38	.5948	158.1	42.2	.5614	165.9
33.9	.6279	150.4	38.1	.594	158.3	42.3	.5606	166.1
34	.627	150.6	38.2	.5932	158.5	42.4	.5598	166.3
34.1	.6262	150.8	38.3	.5924	158.7	42.5	.559	166.4
34.2	.6254	150.9	38.4	.5916	158.9	42.6	.5583	166.6
34.3	.6246	151.1	38.5	.5908	159.1	42.7	.5575	166.8
34.4	.6238	151.3	38.6	.59	159.3	42.8	.5567	167
34.5	.623	151.5	38.7	.5892	159.4	42.9	.5559	167.2
34.6	.6222	151.7	38.8	.5884	159.6	43	.5551	167.3
34.7	.6214	151.9	38.9	.5876	159.8	43.1	.5543	167.5
34.8	.6206	152.1	39	.5868	160	43.2	.5535	167.7
34.9	.6197	152.3	39.1	.586	160.2	43.3	.5527	167.9
35	.6189	152.5	39.2	.5852	160.4	43.4	.5519	168.1
35.1	.6181	152.7	39.3	.5844	160.6	43.5	.5511	168.3
35.2	.6173	152.9	39.4	.5836	160.7	43.6	.5504	168.4
35.3	.6165	153	39.5	.5828	160.9	43.7	.5496	168.6
35.4	.6157	153.2	39.6	.5821	161.1	43.8	.5488	168.8
35.5	.6149	153.4	39.7	.5813	161.3	43.9	.548	169
35.6	.6141	153.6	39.8	.5805	161.5	44	.5472	169.2
35.7	.6133	153.8	39.9	.5797	161.7	44.1	.5464	169.3
35.8	.6125	154	40	.5789	161.8	44.2	.5456	169.5
35.9	.6117	154.2	40.1	.5781	162	44.3	.5448	169.7
36	.6109	154.4	40.2	.5773	162.2	44.4	.544	169.9
36.1	.6101	154.6	40.3	.5765	162.4	44.5	.5433	170.1
36.2	.6093	154.8	40.4	.5757	162.6	44.6	.5425	170.3
36.3	.6085	154.9	40.5	.5749	162.8	44.7	.5417	170.4
36.4	.6077	155.1	40.6	.5741	163	44.8	.5409	170.6
36.5	.6068	155.3	40.7	.5733	163.1	44.9	.5401	170.8
36.6	.606	155.5	40.8	.5725	163.3	45	.5393	171
36.7	.6052	155.7	40.9	.5717	163.5	45.1	.5385	171.2

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Hardness conversion table

HB	HRc	HB	HRc	HB	HRc	HB	HRc	HB	HRc
160	7.40	161	7.60	162	7.80	163	8.00	164	8.20
165	8.40	166	8.60	167	8.70	168	8.90	169	9.10
170	9.30	171	9.50	172	9.70	173	9.90	174	10.00
175	10.20	176	10.40	177	10.60	178	10.80	179	11.00
180	11.10	181	11.30	182	11.50	183	11.70	184	11.90
185	12.00	186	12.20	187	12.40	188	12.60	189	12.80
190	12.90	191	13.10	192	13.30	193	13.50	194	13.60
195	13.80	196	14.00	197	14.20	198	14.30	199	14.50
200	14.70	201	14.90	202	15.00	203	15.20	204	15.40
205	15.60	206	15.70	207	15.90	208	16.10	209	16.20
210	16.40	211	16.60	212	16.70	213	16.90	214	17.10
215	17.20	216	17.40	217	17.60	218	17.80	219	17.90
220	18.10	221	18.20	222	18.40	223	18.60	224	18.70
225	18.90	226	19.10	227	19.20	228	19.40	229	19.50
230	19.70	231	19.90	232	20.00	233	20.20	234	20.40
235	20.50	236	20.70	237	20.80	238	21.00	239	21.20
240	21.30	241	21.50	242	21.60	243	21.80	244	22.00
245	22.10	246	22.30	247	22.40	248	22.50	249	22.70
250	22.90	251	23.00	252	23.20	253	23.30	254	23.50
255	23.70	256	23.80	257	24.00	258	24.10	259	24.30
260	24.40	261	24.50	262	24.70	263	24.90	264	25.00
265	25.20	266	25.30	267	25.50	268	25.60	269	25.70
270	25.90	271	26.00	272	26.20	273	26.30	274	26.50
275	26.60	276	26.80	277	26.90	278	27.10	279	27.20
280	27.30	281	27.50	282	27.60	283	27.80	284	27.90
285	28.10	286	28.20	287	28.30	288	28.50	289	28.60
290	28.80	291	28.90	292	29.00	293	29.20	294	29.30
295	29.40	296	29.60	297	29.70	298	29.90	299	30.00
300	30.10	301	30.30	302	30.40	303	30.50	304	30.70
305	30.80	306	30.90	307	31.10	308	31.20	309	31.30
310	31.50	311	31.60	312	31.70	313	31.80	314	32.00
315	32.10	316	32.20	317	32.40	318	32.50	319	32.50
320	32.70	321	32.90	322	33.00	323	33.10	324	33.30
325	33.40	326	33.50	327	33.60	328	33.80	329	33.90
330	34.00	331	34.10	332	34.20	333	34.40	334	34.50
335	34.60	336	34.70	337	34.90	338	35.00	339	35.10
340	35.20	341	35.30	342	35.50	343	35.60	344	35.70
345	35.80	346	35.90	347	36.00	348	36.20	349	36.30
350	36.40	351	36.50	352	36.60	353	36.70	354	36.90
355	37.00	356	37.10	357	37.20	358	37.30	359	37.40
360	37.50	361	37.60	362	37.80	363	37.90	364	38.00
365	38.10	366	38.20	367	38.30	368	38.40	369	38.50
370	38.60	371	38.70	372	38.90	373	39.00	374	39.10
375	39.20	376	39.30	377	39.40	378	39.50	379	39.60
380	39.70	381	39.80	382	39.90	383	40.00	384	40.10
385	40.20	386	40.30	387	40.40	388	40.50	389	40.60
390	40.70	391	40.80	392	40.90	393	41.00	394	41.10
395	41.20	396	41.30	397	41.40	398	41.50	399	41.60
400	41.70	401	41.80	402	41.90	403	42.00	404	42.10
405	42.20	406	42.30	407	42.40	408	42.50	409	42.60
410	42.70	411	42.70	412	42.80	413	42.90	414	43.00
415	43.10	416	43.20	417	43.30	418	43.40	419	43.50
420	43.60	421	43.70	422	43.70	423	43.80	424	43.90
425	44.00	426	44.10	427	44.20	428	44.30	429	44.40
430	44.40	431	44.50	432	44.60	433	44.70	434	44.80
435	44.90	436	44.90	437	45.00	438	45.10	439	45.20
440	45.30	441	45.30	442	45.40	443	45.50	444	45.60
445	45.70	446	45.70	447	45.80	448	45.90	449	46.00
450	46.10								

Euronorm 8 (Technical note Quality Group n°06 02/92)

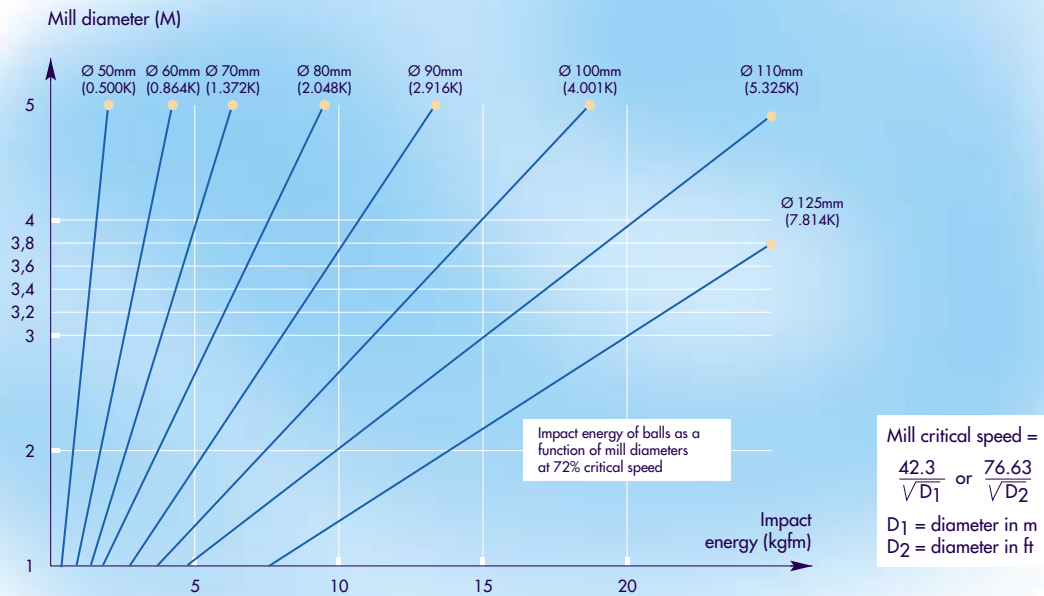
HB	HRc	HB	HRc	HB	HRc	HB	HRc	HB	HRc
455	47.00	520	52.60	585	-	650	-	720	64.60
460	47.70	525	-	590	56.30	655	61.00	725	65.00
465	48.40	530	53.10	595	-	660	-	730	-
470	48.70	535	-	600	56.80	665	-	735	-
475	49.10	540	53.80	605	-	670	62.00	740	65.70
480	49.50	545	54.00	610	57.40	675	-	745	-
485	49.80	550	-	615	-	680	62.50	750	-
490	50.10	555	54.50	620	58.00	685	-	755	66.40
495	50.40	560	-	625	-	690	63.00	760	-
500	51.20	565	55.00	630	59.00	695	-	765	-
505	-	570	55.20	635	-	700	-	770	67.00
510	51.90	575	-	640	-	705	63.80		
515	-	580	55.70	645	60.00	710	-		

"MAGOTTEAUX GROUP's table" for the conversion of the HB values > 450 in Rc values (Technical note Quality Group n°06 02/92)

References: several extrapolations, among them DIN until 620 HB.



IMPACT ENERGY OF BALLS



MINERAL HARDNESS AND CHEMICAL COMPOSITION

Minerals	Mohs	Mineral composition
Galena	2 - 3	PbS
Cuprite	3.5 - 4	Cu ₂ O
Chalcosine	2.5 - 3	Cu ₂ S
Calcite	3	CaCO ₃
Bornite	3	Cu ₃ FeS ₄
Chalcopyrite	3 - 4	CuFeS ₂
Blende	3 - 4	ZnS
Pyrrhotite	4	FeS
Dolomite	3.4 - 4	(Ca, Mg) (CO ₃) ₂
Malachite	3.5 - 4	CuCO ₃ .Cu(OH) ₂
Magnetite	5.5 - 6	Fe ₃ O ₄
Amphibole	5.5 - 6	(MgO, FeO).SiO ₂
Pyroxenes	5.5 - 6	Fe ₂ O ₃
Hematite	5.5 - 6	(FeMg) ₂ SiO ₄
Olivine	6.5 - 7	Ca ₂ (Al, Fe) ₃ Si ₃ O ₁₂ (OH)
Epidotes	6.5	K(AlSi ₃)O ₈
Feldspath	6 - 6.5	FeS ₂
Pyrite	6 - 6.5	FeO.Cr ₂ O ₃
Chromite	5.5	X ₃ Y ₂ Si ₃ O ₁₂
Garnets	6.5 - 7.5	SiO ₂
Quartz	7	
Ferrite		100 - 200 HV
Pearlite		300 - 500 HV
Bainite		600 - 700 HV
Martensite		800 - 1000 HV
Iron carbides		1100 HV
Cr Carbides		1500 - 2000 HV

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UNITS CONVERSION

HANDY MULTIPLIERS

Multiply	By	To obtain	Multiply	By	To obtain
Acres	43,560	Square feet	Feet	30.48	Centimeters
Acres	4047	Square meters	Feet	12	Inches
Acres	1.562x10 ³	Square miles	Feet	0.3048	Meters
Atmospheres	76.0	Cms. of mercury	Feet of water	0.02950	Atmospheres
Atmospheres	29.92	Inches of mercury	Feet of water	0.8826	Inches of mercury
Atmospheres	33.90	Feet of water	Feet of water	304.8	Kgs./sq. meter
Atmospheres	10,333	Kgs./sq. meter	Feet of water	62.43	Lbs./sq. ft.
Atmospheres	14.70	Lbs./sq. Inch	Feet of water	0.4335	Lbs./sq. inch
Atmospheres	1.058	Tons/sq. ft.	Gallons	3785	Cubic centimeters
British Thermal Units	0.2520	Kilogram-calories	Gallons	0.1337	Cubis feet
British Thermal Units	3.927x10 ⁴	Horsepower-hrs	Gallons	231	Cubic inches
British Thermal Units	107.5	Kilogram-meters	Gallons	3.785x10 ³	Cubic meters
British Thermal Units	2.928x10 ⁴	Kilowatt-hrs	Gallons	3.785	Liters
B.T.U.	1.055056	Kilojoule	Gallons-Imperial	1.20095	U.S. Gallons
B.T.U./min	0.02356	Horsepower	Gallons-U.S.	0.83267	Imperial Gallons
B.T.U./min	0.01757	Kilowatts	Grams	980.7	Dynes
B.T.U./min	17.57	Watts	Grams	10 ³	Milligrams
Centares (Centiares)	1	Square meters	Grams	0.03527	Ounces
Centigrams	0.01	Grams	Grams	0.03215	Ounces (troy)
Centiliters	0.01	Liters	Grams	2.205x10 ³	Pounds
Centimeters	0.3937	Inches	Grams/liter	1000	Parts/million
Centimeters	0.1	Meters	Hectares	2.471	Acres
Centimeters	10	Milimeters	Hectares	1.076x10 ⁵	Square feet
Centimeters of mercury	0.01316	Atmospheres	Hectograms	100	Grams
Centimeters of mercury	0.4461	Feet of water	Hectoliters	100	Liters
Centimeters of mercury	136.0	Kgs./sq. meter	Hectometers	100	Meters
Centimeters of mercury	27.85	Lbs./sq. ft.	Hectowatts	100	Watts
Centimeters of mercury	0.1934	Lbs./sq. inch	Horsepower	42.44	B.T.U./min.
Centimeters/sec.	1.969	Feet/min.	Horsepower	1.014	Horsepower (metric)
Centimeters/sec.	0.03281	Feet/sec.	Horsepower	10.70	Kg-calories/min.
Centimeters/sec.	0.036	Kilometers/hr.	Horsepower	0.7457	Kilowatts
Centimeters/sec.	0.6	Meters/min.	Horsepower	745.7	Watts
Centimeters/sec.	0.02237	Miles/hr.	Horsepower-hours	2547	B.T.U.
Centimeters/sec.	3.728x10 ⁴	Miles/min.	Horsepower-hours	641.7	Kilogram-calories
Cubic centimeters	3.531x10 ³	Cubic feet	Horsepower-hours	2.737x10 ⁵	Kilogram-meters
Cubic centimeters	6.102x10 ²	Cubic inches	Horsepower-hours	0.7457	Kilowatt-hours
Cubic centimeters	10 ⁶	Cubic meters	Inches	2.540	Centimeters
Cubic centimeters	2.642x10 ⁴	Gallons	Inches of mercury	0.03342	Atmospheres
Cubic centimeters	10 ³	Liters	Inches of mercury	1.133	Feet of water
Cubic feet	2.832x10 ⁴	Cubic cms.	Inches of water	0.07355	Inches of mercury
Cubic feet	1728	Cubic inches	Inches of water	25.40	Kgs./sq. meter
Cubic feet	0.02832	Cubic meters	Inches of water	5.202	Lbs./sq. foot
Cubic feet	7.48052	Gallons	Inches of water	0.03613	Lbs./sq. inch
Cubic feet	28.32	Liters	Kilograms	980.665	Dynes
Cubic feet/min.	472.0	Cubic cms./sec.	Kilograms	2.205	Lbs.
Cubic feet/min.	0.1247	Gallons/sec.	Kilograms	1.102x10 ³	Tons (short)
Cubic feet/min.	0.4720	Liters/sec.	Kilograms	10 ³	Grams
Cubic feet/sec.	448.831	Gallons/min.	Kilograms-calories	3.968	B.T.U.
Cubic inches	16.39	Cubic centimeters	Kilograms-calories	3086	Foot-pounds
Cubic inches	5.787x10 ⁴	Cubic feet	Kilograms-calories	1.558x10 ³	Horsepower-hrs.
Cubic inches	1.639x10 ³	Cubic meters	Kilograms-calories	1.162x10 ³	Kilowatt-hours
Cubic inches	4.329x10 ³	Gallons	Kilograms-calories	4.1868	Kilojoule
Cubic inches	1.639x10 ²	Liters	Kilograms-cal./min.	0.09351	Horsepower
Cubic meters	10 ⁶	Cubic centimeters	Kilograms-cal./min.	0.06972	Kilowatts
Cubic meters	35.31	Cubic feet	Kgs./sq. meter	9.678x10 ⁵	Atmospheres
Cubic meters	61.023	Cubic inches	Kgs./sq. meter	3.281x10 ³	Feet of water
Cubic meters	264.2	Gallons	Kgs./sq. meter	2.896x10 ³	Inches of mercury
Cubic meters	10 ³	Liters	Kiloliters	10 ³	Liters
Decigrams	0.1	Grams	Kilometers	10 ⁵	Centimeters
Deciliters	0.1	Liters	Kilometers	3281	Feet
Decimeters	0.1	Meters	Kilometers	10 ³	Meters
Degrees (angle)	60	Minutes	Kilometers	0.6214	Miles
Degrees (angle)	0.01745	Radians	Kilometers	1094	Yards
Degrees (angle)	3600	Seconds	Kilometers/hr.	27.78	Cms./sec.
Degrees/sec.	0.01745	Radians/sec.	Kilometers/hr.	54.68	Feet/min.
Degrees/sec.	0.1667	Revolutions/min.	Kilometers/hr.	0.9113	Feet/sec.
Degrees/sec.	0.002778	Revolutions/sec.	Kilometers/hr.	0.6214	Miles/hr.
Dekagrams	10	Grams	Kilowatts	56.92	B.T.U./min.
Dekaliters	10	Liters	Kilowatts	1.341	Horsepower
Dekameters	10	Meters	Kilowatts	14.34	Kg-calories/min.



MAGOTTEAUX

SHAPING A WORLD OF PERFORMANCE

Multiply	By	To obtain	Multiply	By	To obtain
Kilowatts	10 ³	Watts	Radians/sec./sec.	573.0	Revs./min./min.
Kilowatt-hours	3415	B.T.U.	Radians/sec./sec.	0.1592	Revs./sec./sec.
Kilowatt-hours	1.341	Horsepower-hrs.	Revolutions	360	Degrees
Kilowatt-hours	860.5	Kilogram-calories	Revolutions	4	Quadrants
Kilowatt-hours	3.671x10 ⁵	Kilogram-meters	Revolutions	6.283	Radians
Liters	10 ³	Cubic centimeters	Revolutions/min.	6	Degrees/sec.
Liters	0.03531	Cubic feet	Revolutions/min.	0.1047	Radians/sec.
Liters	61.02	Cubic inches	Revolutions/min.	0.01667	Revolutions/sec.
Liters	10 ⁻³	Cubic meters	Revolutions/min./min.	1.745x10 ⁻³	Rads/sec./sec.
Liters	0.2642	Gallons	Revolutions/min./min.	2.778x10 ⁻⁴	Revs/sec./sec.
Meters	100	Centimeters	Revolutions/sec.	360	Degrees/sec.
Meters	3.281	Feet	Revolutions/sec.	6.283	Radians/sec.
Meters	39.37	Inches	Revolutions/sec.	60	Revolution/min.
Meters	10 ⁻³	Kilometers	Revolutions/sec./sec.	6.283	Radians/sec./sec.
Meters	10 ³	Millimeters	Revolutions/sec./sec.	3600	Revs./min./min.
Meters	1.094	Yards	Seconds (angle)	4.848x10 ⁻⁶	Radians
Meters/min.	1.667	Centimeters/sec.	Square centimeters	1.076x10 ⁻⁴	Square feet
Meters/min.	3.281	Feet/min.	Square centimeters	0.1550	Square inches
Meters/min.	0.05468	Feet/sec.	Square centimeters	10 ⁻⁴	Square meters
Meters/min.	0.06	Kilometers/hr.	Square centimeters	100	Square millimeters
Meters/min.	0.03728	Miles/hr.	Square feet	2.296x10 ⁻⁵	Acres
Meters/sec.	196.8	feet/min.	Square feet	929.0	Square centimeters
Meters/sec.	3.281	Feet/sec.	Square feet	144	Square inches
Meters/sec.	3.6	Kilometers/hr.	Square feet	0.09290	Square meters
Meters/sec.	0.06	Kilometers/min.	Square inches	6.452	Square centimeters
Meters/sec.	2.237	Miles/hr.	Square inches	6.944x10 ⁻³	Square feet
Meters/sec.	0.03728	Miles/min.	Square inches	645.2	Square millimeters
Microns	10 ⁻⁶	Meters	Square kilometers	247.1	Acres
Miles	1.609x10 ³	Centimeters	Square kilometers	10.76x10 ⁶	Square feet
Miles	5280	Feet	Square kilometers	10 ⁶	Square meters
Miles	1.609	Kilometers	Square kilometers	0.3861	Square miles
Miles	1760	Yards	Square meters	2.471x10 ⁻⁴	Acres
Miles/hr.	1.609	Kilometers/hr.	Square meters	10.76	Square feet
Milliers	10 ³	Kilograms	Square meters	3.861x10 ⁻⁷	Square miles
Milligrams	10 ⁻³	Grams	Square miles	640	Acres
Milliliters	10 ⁻³	Liters	Square miles	27.88x10 ⁶	Square feet
Millimeters	0.1	Centimeters	Square miles	2.590	Square kilometers
Millimeters	0.03937	Inches	Square millimeters	0.01	Square centimeters
Milligrams/liter	1	Parts/million	Square millimeters	1.550x10 ⁻³	Square inches
Minutes (angle)	2.909x10 ⁻⁴	Radians	Temp.(°C.) + 273	1	Abs. Temp. (°C.)
Ounces	0.0625	Pounds	Temp.(°C.) + 17.78	1.8	Temp. (°F)
Ounces	28.349527	Grams	Temp.(°F) + 460	1	Abs. Temp. (°F)
Ounces	0.9115	Ounces (troy)	Temp.(°F) - 32	5/9	Temp. (°C.)
Ounces	2.790x10 ⁻⁵	Tons (long)		1016	Kilograms
Ounces	2.835x10 ⁻⁵	Tons (metric)		2240	Pounds
Ounces (troy)	0.08333	Pounds (troy)		1.12000	Tons (short)
Ounces (troy)	31.103481	Grams		10 ³	Kilograms
Parts/millions (by weight)	8.345	Lbs./million gal.		2205	Pounds
Pounds	16	Ounces		2000	Pounds
Pounds	0.0005	Tons (short)		32,000	Ounces
Pounds	453.5924	Grams		907.18486	Kilograms
Pounds	1.21528	Pounds (troy)		2430.56	Pounds (troy)
Pounds	14.5833	Ounces (troy)		0.89287	Tons (long)
Pounds (troy)	12	Ounces (troy)		29166.66	Ounces (troy)
Pounds (troy)	373.24177	Grams		0.90718	Tons (metric)
Pounds (troy)	3.6735x10 ⁻⁴	Tons (long)		0.05692	B.T.U./min.
Pounds (troy)	4.1143x10 ⁻⁴	Tons (short)		1.341x10 ⁻³	Horsepower
Pounds (troy)	3.7324x10 ⁻⁴	Tons (metric)		0.01434	Kg.-calories/min.
Quadrants (angle)	90	Degrees		10 ⁻³	Kilowatts
Quadrants (angle)	5400	Minutes		3.415	B.T.U.
Quadrants (angle)	1.571	Radians		1.341x10 ⁻³	Horsepower-hrs.
Radians	57.30	Degrees		0.8605	Kilogram-calories
Radians	3438	Minutes		367.1	Kilogram-meters
Radians	0.637	Quadrants		10 ³	Kilowatt-hours
Radians/sec.	57.30	Degrees/sec.		91.44	Centimeters
Radians/sec.	0.1592	Revolutions/sec.		3	Feet
Radians/sec.	9.549	Revolutions/min.		36	Inches
				0.9144	Meters

Remarks:

-English Measures-are those used in the U.S.A., unless otherwise designated.
 -Properties of water - the calculations in the multipliers are based on water at 39,2°F in a Vacuum, Weighing 1000,08 grams/Cu.Cm. The water freezes at 32°F (0°), and is at its maximum density at 39.2°F (4°C).

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UNITS CONVERSION

COMPARISON OF METRIC UNITS AND GB-USA UNITS

LENGHT UNITS

	in	ft	yd	mm	m	km
1 in	1	0,08333	0,02778	25,4	0,0254	-
1 ft	12	1	0,3333	304,8	0,3048	-
1 yd	36	3	1	914,4	0,9144	-
1 mm	0,03937	3281.10 ⁻⁶	1094.10 ⁻⁶	1	0,001	10 ⁻⁶
1 m	39,37	3,281	1,094	1000	1	0,001
1 km	39370	3281	1094	10 ⁶	1000	1

SURFACE UNITS

	sq in	sq ft	sq yd	cm ²	dm ²	m ²
1 sq in	1	6,944.10 ⁻³	0,772.10 ⁻³	6,452	0,06452	64,5.10 ⁻⁵
1 sq ft	144	1	0,1111	929	9,29	0,0929
1 sq yd	1296	9	1	8361	83,61	0,8361
1 cm ²	0,155	1,076.10 ⁻³	1,197.10 ⁻³	1	0,01	0,0001
1 dm ²	15,5	0,1076	0,01196	100	1	0,001
1 m ²	1550	10,76	1,196	10000	100	1

VOLUME UNITS

	cu in	cu ft	cu yd	cm ³	dm ³	m ³
1 cu in	1	5,786.10 ⁻⁴	2,144.10 ⁻⁵	16,39	0,01639	1,64.10 ⁻⁵
1 cu ft	1728	1	0,037	28316	28,32	0,0283
1 cu yd	46656	27	1	764555	764,55	0,7646
1 cm ³	0,06102	3532.10 ⁻⁸	1,31.10 ⁻⁶	1	0,001	10 ⁻⁶
1 dm ³	61,02	0,03532	0,00131	1000	1	0,001
1 m ³	61023	35,32	1,307	10 ⁶	1000	1

MASS UNITS

	dram	oz	ib	g	kg	mg
1 dram	1	0,0625	0,003906	1,772	0,00177	1,77.10 ⁻⁶
1 oz	16	1	0,0625	28,35	0,02832	28,3.10 ⁻⁶
1 ib	256	16	1	453,6	0,4531	4,53.10 ⁻⁴
1 g	0,5643	0,03527	0,002205	1	0,001	10 ⁻⁶
1 kg	564,3	35,27	2,205	1000	1	0,001
1 mg	564,3.10 ³	35270	2205	10 ⁶	1000	1



ENERGY & WORK UNITS

	ft lb	kgf m	J = W s	kW h	kcal	Btu
1 ft lb	1	0,1383	1,356	$376,8 \cdot 10^{-9}$	$324 \cdot 10^{-6}$	$1,286 \cdot 10^{-3}$
1 kgf m	7,233	1	9,807	$2,725 \cdot 10^{-6}$	$2,344 \cdot 10^{-3}$	$9,301 \cdot 10^{-3}$
1 J = W s	0,7376	0,102	1	$277,8 \cdot 10^{-9}$	$239 \cdot 10^{-6}$	$948,4 \cdot 10^{-6}$
1 kW h	$2,655 \cdot 10^6$	$367,1 \cdot 10^3$	$3,6 \cdot 10^6$	1	860	3413
1 kcal	$3,087 \cdot 10^3$	426,9	4187	$1,163 \cdot 10^{-3}$	1	3,968
1 Btu	778,6	107,6	1055	$293 \cdot 10^{-6}$	0,252	1

POWER UNITS

	hp	kgf m/s	J/s = W	kW	kcal/s	Btu/s
1 hp	1	76,04	745,7	0,7457	0,1782	0,7073
1 kgf m/s	$13,15 \cdot 10^{-3}$	1	9,807	$9,807 \cdot 10^{-3}$	$2,344 \cdot 10^{-3}$	$9,296 \cdot 10^{-3}$
1 J/s = W	$1,341 \cdot 10^{-3}$	0,102	1	10^{-3}	$239 \cdot 10^{-6}$	$948,4 \cdot 10^{-6}$
1 kW	1,341	102	1000	1	0,239	0,9484
1 kcal/s	5,614	426,9	4187	4,187	1	3,968
1 Btu/s	1,415	107,6	1055	1,055	0,252	1

OTHER UNITS

1 Btu/cu ft	9,547 kcal/m ³	39 964 Nm/m ³
1 Btu/lb	0,556 kcal/kg	2 327 Nm/kg
1 lb/sq ft	4,882 kgf/m ²	47,8924 N/m ²
1 lb/sq in (= 1 psi)	0,0703 kgf/cm ²	0,6896 N/cm ²

1 stone (GB) = 14 lb = 14 English Pounds	6,35 kg
1 short quarter (USA)	11,34 kg
1 long quarter (GB, USA)	12,70 kg
1 short cwt (USA) = 4 short quarter	45,36 kg
1 long cwt (GB, USA) = long quarter	50,80 kg
1 short ton (USA)	0,9072 Mg
1 long ton (GB, USA)	1,0160 Mg

1 Mil = 10 ⁻³ in	0,0254 mm
1 sq mil = 10 ⁻⁶ sq in	645,2 μm ²
1 statute mile (English mile)	1609 m
1 international nautical mile	1852 m
1 geographical mile	7420 m
1 rod, pole or perch = 5,5 yd	5,092 m
1 sq chain = 16 sq rods	404,7 m ²
1 imperial gallon (English)	4,546 dm ³
1 gallon USA	3,785 dm ³

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MAGOTTEAUX

SHAPING A WORLD OF PERFORMANCE

GRINDING MEDIA CHARACTERISTICS

Composition and surface of MAGOTTEAUX ball charges at equilibrium

Calculation made for 100 metric ton charges

Diameter (mm)	Weight (gr)	Surface (cm ²)	125 (kg)	110 (kg)	100 (kg)	90 (kg)	80 (kg)	70 (kg)	60 (kg)	50 (kg)	40 (kg)	30 (kg)	25 (kg)
125	7977	491	7 987										
120	7057	452	14 133										
115	6211	415	12 439										
110	5436	380	10 886	9 072									
105	4728	346	9 468	15 781									
100	4084	314	8 179	13 632	9 975								
95	3502	284	7 012	11 688	17 105								
90	2977	254	5 962	9 938	14 544	11 077							
85	2508	227	5 023	8 372	12 252	18 664							
80	2091	201	4 188	6 980	10 215	15 560	12 452						
75	1723	177	3 451	5 751	8 417	12 821	20 520						
70	1401	154	2 805	4 676	6 843	10 424	16 684	14 215					
65	1122	133	2 246	3 744	5 479	8 346	13 358	22 762					
60	882	113	1 767	2 945	4 309	6 564	10 506	17 903	16 555				
55	679	95	1 361	2 268	3 319	5 056	8 093	13 790	25 503				
50	511	79	1 022	1 704	2 494	3 799	6 080	10 361	19 161	19 810			
45	372	64	745	1 242	1 818	2 769	4 432	7 553	13 968	28 883			
40	261	50	523	872	1 277	1 945	3 113	5 305	9 810	20 285	24 639		
35	175	38	351	584	855	1 303	2 085	3 554	6 572	13 590	33 013		
30	110	28	221	368	539	821	1 313	2 238	4 139	8 558	20 789	32 530	
25	64	20	128	213	312	475	760	1 295	2 395	4 952	12 031	37 651	38 700
20	33	13	65	109	160	243	389	663	1 226	2 536	6 160	19 277	39 628
15	14	7	28	46	67	103	164	280	517	1 070	2 599	8 133	16 718
10	4	3	8	14	20	30	49	83	153	317	770	2 410	4 954
Charge in metric tons (mt)			100	100	100	100	100	100	100	100	100	100	100
Quantity of balls of each diameter			2 003	3 338	4 885	7 441	11 910	20 295	37 533	77 608	188 530	590 009	1 212 898
Total surface calculated with 5 mm step			820	931	1 024	1 137	1 279	1 460	1 701	2 036	2 532	3 336	3 953
Total surface calculated by integral (m²)			820	932	1 025	1 138	1 280	1 462	1 703	2 038	2 534	3 333	3 941

Diameter (inch)	Weight (gr)	Surface (cm ²)	5" to ± 3/8"	4" to ± 3/8"	3 1/2" to ± 3/8"	3" to ± 3/8"	2 1/2" to ± 3/8"	2" to ± 3/8"	1 1/2" to ± 3/8"	1 1/4" to ± 3/8"	1" to ± 3/8"	7/8" to ± 3/8"	3/4" to ± 3/8"	5/8" to ± 3/8"
5"	8,195.894	506.707	43.069											
4"	4,196.298	324.293	22.052	38.736										
3 1/2"	2,811.192	248.287	14.773	25.950	42.356									
3"	1,770.313	182.415	9.303	16.342	26.673	46.272								
2 1/2"	1,024.487	126.677	5.384	9.457	15.436	26.778	49.841							
2"	524.537	81.073	2.756	4.842	7.903	13.710	25.519	50.876						
1 1/2"	221.289	45.604	1.163	2.043	3.334	5.784	10.766	21.463	43.693					
1 1/4"	128.061	31.669	0.673	1.182	1.929	3.347	6.230	12.421	25.285	44.906				
1"	65.567	20.268	0.344	0.605	0.988	1.714	3.190	6.359	12.946	22.992	41.732			
7/8"	43.895	15.511	0.231	0.405	0.661	1.147	2.135	4.258	8.667	15.392	27.938	47.947		
3/4"	27.661	11.401	0.145	0.255	0.417	0.723	1.346	2.683	5.462	9.700	17.605	30.214	58.046	
5/8"	15.992	7.917	0.084	0.148	0.241	0.418	0.778	1.551	3.158	5.608	10.178	17.468	33.559	79.988
±3/8"	4.001	3.142	0.021	0.037	0.060	0.105	0.195	0.388	0.790	1.403	2.547	4.370	8.396	20.012
Charge in metric tons (mt)			100	100	100	100	100	100	100	100	100	100	100	100
Quantity of balls of each diameter			5,255	9,231	15,067	26,138	48,650	96,993	197,447	350,660	636,473	1,092,311	2,098,460	5,001,751
Total surface calculated with existing ball diameter (m²)			843.41	1,013.80	1,166.13	1,374.01	1,669.97	2,100.72	2,675.64	3,152.71	3,706.70	4,147.61	4,713.14	5,531.44
Total surface calculated by integral (m²)			823.06	1,028.40	1,174.84	1,374.68	1,641.43	2,045.94	2,707.98	3,222.51	3,961.06	4,460.33	5,081.29	5,865.57



Unit weight and specific surface of MAGOTTEAUX grinding media

BALLS

Diameter		Weight (gr)	Surface (cm ²)	Number of balls per metric ton	Specific surface (m ² /mt)
mm	inch				
150.00	±6"	13,503.892	706.858	74	5.231
125.00	±5"	7,814.752	490.874	128	6.283
110.00		5,325.535	380.133	188	7.147
100.00	±4"	4,001.153	314.159	250	7.854
90.00	±3 1/2"	2,916.841	254.469	343	8.728
80.00		2,048.590	201.062	488	9.812
77.00	±3"	1,826.658	186.265	548	10.207
70.00		1,372.396	153.938	729	11.222
64.00	±2 1/2"	1,048.878	128.680	954	12.276
60.00		864.249	113.097	1,157	13.085
50.00	±2"	500.144	78.540	2,000	15.708
40.00		256.074	50.265	3,905	19.628
38.00	±1 1/2"	219.551	45.365	4,555	20.664
35.00		171.549	38.485	5,830	22.437
31.75	= 1 1/4"	128.061	31.669	7,809	24.730
30.00		108.031	28.274	9,257	26.173
25.00	±1"	62.518	19.635	15,996	31.408
23.00		48.682	16.619	20,542	34.139
22.22	= 7/8"	43.895	15.511	22,782	35.337
20.00	±3/4"	32.009	12.566	31,242	39.259
17.00	±5/8"	19.658	9.079	50,870	46.185
15.00		13.504	7.069	74,052	52.347
10.00		4.001	3.142	249,938	78.531

$$\text{Ball diameter (mm)} = \sqrt[3]{250P}$$

(P=weight in gr)

$$\text{Specific surface of balls of diameter} = \frac{785 \text{ m}^2/\text{mt}}{d}$$

(d=diameter in mm)

CYLPEBS

Diameter x Length (mm)	Weight (gr)	Surface (cm ²)	Number of cylpebs per metric ton	Specific surface (m ² /mt)
43 x 43	565.00	90.16	1,770	15.960
34 x 43	417.00	75.34	2,398	18.066
35 x 40	328.00	64.87	3,049	19.770
30 x 30	180.00	43.64	5,556	24.246
28 x 28	149.00	38.05	6,711	25.535
25 x 25	105.00	30.32	9,524	28.877
22 x 22	74.00	23.62	13,514	31.920
19 x 19	48.00	17.85	20,833	37.187
16 x 16	27.00	12.56	37,037	46.518
13 x 13	13.42	8.18	74,516	60.954
10 x 15	8.40	7.14	119,048	85.000
10 x 13	6.40	6.34	156,250	99.062
8 x 13	4.64	4.89	204,499	100.000
8 x 10	3.23	3.93	309,598	121.672

Charge density: mt/M³

- Balls4.65
- Cylpebs4.70
- Cubes5.50
- Rods6.20
- Ceramic Balls2.05

BOULPEBS

Diameter x Length (mm)	Weight (gr)	Surface (cm ²)	Number of boulpebs per metric ton	Specific surface (m ² /mt)
25 x 32	101	27.78	9,901	27.505
22 x 28	65	21.37	15,385	32.877
19 x 24	41	15.79	24,390	38.512
16 x 20	26	11.06	38,462	42.539
13 x 16	13	7.16	76,923	55.077

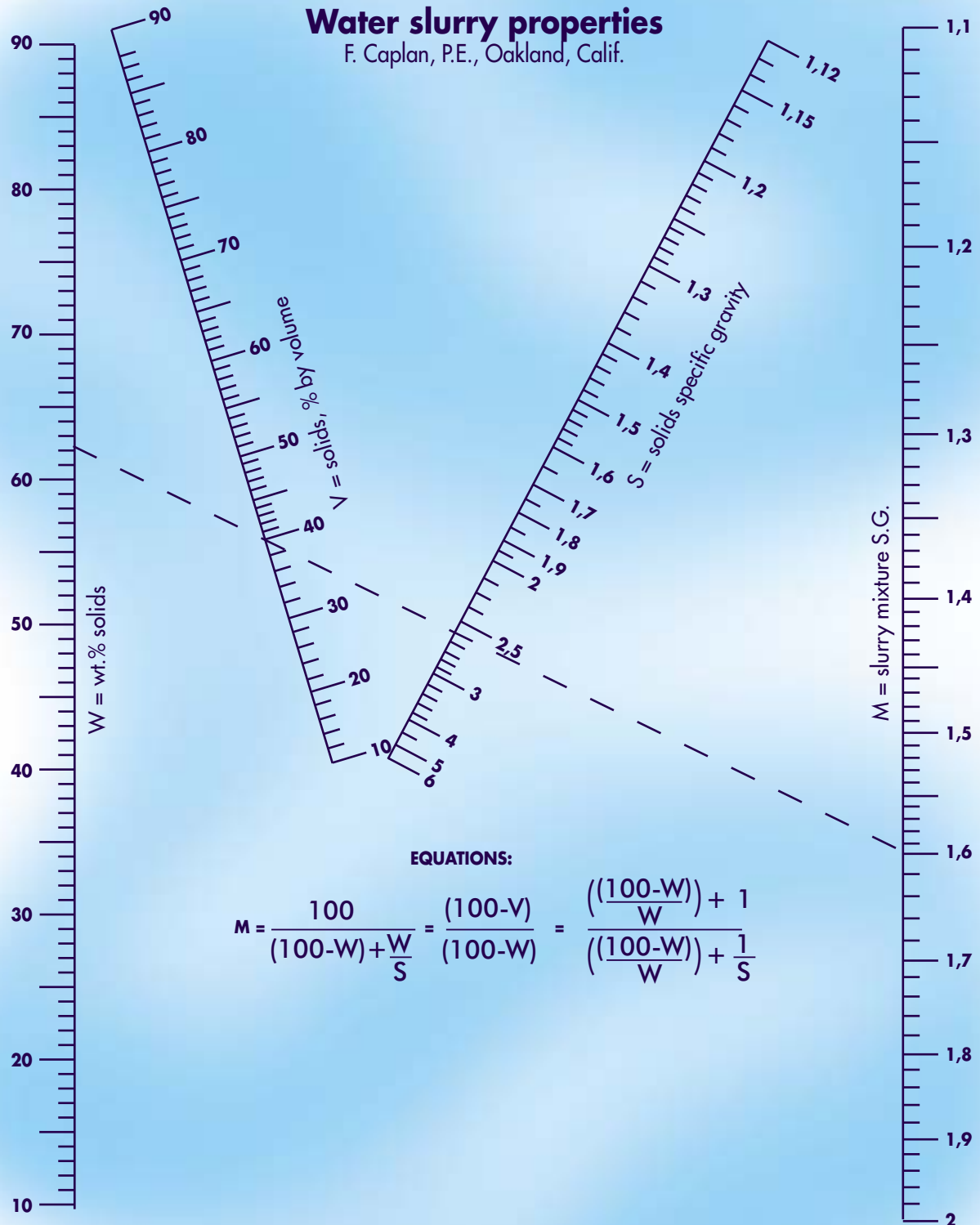
The information and data are accurate to the best of our knowledge and belief, but are intended for general information only. Applications suggested for the materials are described only to help readers make their own evaluations and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications.



WATER SLURRY PROPERTIES

THOSE WORKING WITH WATER SLURRIES are interested in the solids specific gravity (S), the percent solids by weight (W), the specific gravity of the slurry mixture (M), and the percent solids by volume (V). The relationships are shown on the nomograph here, prepared by F. Caplan, a

professional engineer, of Oakland, Calif. If any two properties are known, the other two are fixed. The nomograph gives a rapid simultaneous solution to the equations. Example: What are M and V if S = 2.5 and W = 62.5%? Align the S and W values and read M = 1.60 and V = 40%.





SLURRIES SPECIFIC GRAVITY

Calculation of the pulp density:

$$\frac{\left(\frac{\% \text{ water}}{1 - \% \text{ water}} + 1 \right)}{\frac{\% \text{ water}}{1 - \% \text{ water}} + \frac{1}{\text{spec. gravity}}} = \text{gr/l}$$

SPECIFY GRAVITY OF PULP

WATER SOLID RATIO

SPECIFIC GRAVITY OF THE DRY SOLIDS IN THE PULP

% Solids by Weight	1.4	2.2	2.6	2.7	2.8	2.9	3.0	3.2	3.4	3.8	4.2	5.0
5	1.02	1.03	1.03	1.03	1.03	1.03	1.03	1.04	1.04	1.04	1.04	1.04
10	1.03	1.06	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	1.08	1.09
15	1.05	1.09	1.10	1.10	1.11	1.11	1.11	1.12	1.12	1.12	1.13	1.14
20	1.06	1.12	1.14	1.14	1.15	1.15	1.15	1.16	1.16	1.17	1.18	1.19
25	1.08	1.16	1.18	1.19	1.19	1.20	1.20	1.21	1.21	1.23	1.24	1.25
30	1.09	1.20	1.23	1.23	1.24	1.25	1.25	1.26	1.27	1.28	1.30	1.32
35	1.11	1.24	1.27	1.28	1.29	1.30	1.30	1.32	1.33	1.35	1.36	1.39
40	1.13	1.28	1.33	1.34	1.35	1.36	1.36	1.38	1.39	1.42	1.44	1.47
45	1.15	1.33	1.38	1.40	1.41	1.42	1.43	1.45	1.47	1.50	1.52	1.56
50	1.17	1.38	1.44	1.46	1.47	1.49	1.50	1.52	1.55	1.58	1.62	1.67
55	1.19	1.43	1.51	1.53	1.55	1.57	1.58	1.61	1.63	1.68	1.73	1.79
60	1.21	1.49	1.59	1.61	1.63	1.65	1.67	1.70	1.74	1.79	1.84	1.92
65	1.23	1.55	1.67	1.70	1.72	1.74	1.76	1.81	1.85	1.92	1.99	2.08
70	1.25	1.62	1.76	1.79	1.82	1.85	1.88	1.93	1.98	2.07	2.14	2.27

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