26) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : EXPLANATION

The field capacity in ha/10-hour day = Speed in km/h x working width in m x N.

Where N = Field Efficiency, which is measured as a decimal. The field efficiency factor allows for the time spent turning on the headlands, refueling the tractor, filling seed and fertilizer bins on a planter, *etc*. Listed in the tables which follow are average field efficiencies for a selection of different operations. In practice this figure might differ from the actual values, depending on how efficiently the operations are carried out.

EXAMPLE 1

A single-tine subsoiler is used at a speed of 5 km/hr and at a spacing of 2m. From field observations it is determined that 17 percent of the time is spent on turning at the headlands and refueling the tractor. Determine the field capacity.

Working speed	=	5km/hr
Working width =	2m	
Field efficiency	=	100 – 17
	=	83% i.e. 0.83 as a decimal
Field capacity =	5 x 2 x 0.83	
	=	8.3ha/10-hour day.

In the following tables the column “kW REQUIRED” gives an indication of the actual power required to carry out the operation at specified field capacity. It should be kept in mind that a naturally aspirated engine working under Highveld conditions can only deliver approximately 80% of its rated power as measured at sea level. A turbo-charged engine is assumed not to lose any power with an increase in altitude. Therefore, if the table indicates that 40kW is required, a tractor with an advertised rated power of 40/0.8 = 50kW has to be used. If the tractor is fitted with a turbo-charger, a 40kW turbo-charged tractor would suffice. In some places in the tables a recommended tractor size is specified. This is for certain operations where the physical size of the tractor, and not the power of the tractor, determines the field capacity for the operation. An example of such an operation is the use of a high speed planter where a smaller tractor is unstable at high speeds although sufficient power is available. The lifting capacity of a three-point hitch may also be a limiting factor in certain operations.

26) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : EXPLANATION

The field capacities listed in Table 1 can be adjusted to suit the specific requirements by interpolation between the work rates for the machines. If for instance, a 55kW tractor is available and the work rate for ploughing in a sandy soil has to be determined, it can be done as follows:

Available kW at Highveld altitude = 0.8 x 55
= 44kW

From Table 1 it can be seen that 48kW is required to plough 10Ha per day.
The field capacity with 44kW available will then be:

Field Capacity (ha/10-hour day) = (10ha/day x 44kW) ÷ 48kW
= 9.2ha/day

Table 1 usually provides for three soil types, namely sandy, sandy-loam and clay-loam. This classification is very wide and the work rates have to be modified for operating (ploughing, discing, planting, *etc*) in the specific soil, and comparing these rates with the field capacities in Table 1. The tabulated figures can then be adjusted for the specific soil type.

(By J. Pretorius and A.J. Heynes, Pr. Eng., Directorate: Agricultural Engineering.)

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement		kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
1)	**FIELD CULTIVATOR**	Sand	Firm Soil	Loose Soil			
	75 mm depth & N = 83%						
	Width 1.6m		24	28	8.0	10.0	30-35
	3.0m		36	43	8.0	20.0	45-54
	3.0m		45	54	9.2	23.0	56-68
	3.7m		48	57	9.0	28.0	60-71
	4.5m		55	64	10.0	38.0	68-80
	6.0m		70	80	10.0	50.0	88-100
	7.5m		90	100	10.0	62.0	113-125
	9.0m		117	120	10.0	75.0	146-150
2)	**LIGHT DISC HARROW**	Sand	Firm Soil	Loose Soil			
	65 mm depth & N = 83%						
	Width 1.6m		24	28	8.0	10.0	30-35
	3.0m		36	43	8.0	20.0	45-54
	3.0m		45	54	9.2	23.0	56-68
	3.7m		48	57	9.0	28.0	60-71
	4.5m		55	64	10.0	38.0	68-80
	6.0m		70	80	10.0	50.0	88-100
	7.5m		90	100	10.0	62.0	113-125
	9.0m		117	120	10.0	75.0	146-150
3)	**HEAVY DISC (OFFSET OR ONE-WAY)**	Sand	Firm Soil	Loose Soil			
	150mm depth & N = 83%						
	Width 3.0m		70	85	8.0	20.0	88-106
	3.8m		85	110	8.0	25.0	106-138
	4.6m		105	130	8.0	31.0	131-163
	5.5m		120	160	9.3	36.0	150-200
	6.5m		150	-	11.3	43.0	188-250

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
4) CHISEL PLOUGH	Sand	Firm Soil	Loose Soil			
200mm depth, 300mm, spacing & N = 83%						
Width 2.2m	38	48	60	5.5	10.0	48-75
3.0m	47	60	74	5.5	14.0	59-92
3.4m	60	71	108	7.0	20.0	75-135
4.0m	70	82	125	7.0	23.0	88-156
4.5m	86	105	150	7.6	29.0	108-188
4.9m	93	120	170	7.6	31.0	116-212
5.4m	108	140	198	8.0	36.0	135-248
6.1m	150	194	274	9.8	50.0	188-343
5) RIPPER PLOUGH						
380mm depth, 500mm, spacing & N = 83%						
2 - t = 1.0m	40	45	60	6.5	5.5	50-75
3 - t = 1.5m	48	60	78	7.0	9.0	60-98
5 - t = 2.5m	60	75	100	6.8	14.0	75-125
7 - t = 3.5m	70	100	120	6.8	20.0	88-150
9 - t = 4.5m	100	130	170	7.2	28.0	125-212
11 - t = 5.5m	120	150	195	4.0	33.0	150-244

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
6) MOULDBOARD PLOUGH	Sand	Firm Soil	Loose Soil			
250mm depth & N = 83%						
2 x 508mm = 1.02m	24	-	-	5.0	4.5	30
3 x 508mm = 1.52m	40	-	-	5.8	7.5	50
4 x 508mm = 2.03m	48	-	-	5.9	10.0	60
5 x 508mm = 2.54m	60	-	-	6.1	13.0	75
5 x 508mm = 2.54m	72	-	-	7.3	15.5	90
6 x 508mm = 3.05m	100	-	-	8.1	21.0	125
8 x 406mm = 3.25m	113	-	-	8.2	22.5	141
8 x 457mm = 3.66m	138	-	-	8.8	27.0	173
3 x 406mm = 1.22m	-	40	-	5.0	5.0	50
4 x 406mm = 1.63m	-	48	-	5.0	7.0	60
5 x 406mm = 2.03m	-	60	-	5.5	9.0	90
5 x 406mm = 2.03m	-	72	-	7.0	12.0	125
6 x 406mm = 2.44m	-	100	-	7.9	16.0	150
7 x 406mm = 2.85m	-	120	-	8.0	19.0	175
8 x 406mm = 3.25m	-	140	-	8.2	22.0	200
8 x 457mm = 3.66m	-	160	-	8.2	25.0	50
3 x 406mm = 1.22m	-	-	40	3.3	3.5	60
4 x 406mm = 1.63m	-	-	48	3.6	5.0	90
5 x 406mm = 2.03m	-	-	63	4.2	7.0	79
5 x 406mm = 2.03m	-	-	73	5.6	9.5	91
6 x 406mm = 2.44m	-	-	100	6.6	13.5	125
7 x 406mm = 2.85m	-	-	143	7.8	18.5	179
8 x 406mm = 3.25m	-	-	163	7.9	21.0	204
8 x 457mm = 3.66m	-	-	200	6.6	26.0	250

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
7) HEAVY SPIKE-TOOTH HARROW		Sandy Loam				
150mm depth and N = 83%						
5-section = 5.5m		30		8.7	40.0	38
8-section = 7.3m		45		9.0	55.0	56
12-section = 11.0m		65		9.3	85.0	81
16-section = 14.6m		95		9.9	120.0	120
8) SPREADER (LIME OR FERTILIZER)		Sandy Loam				
N = 60%						
Width 3m		15		8.0	14.0	30
4m		18		8.0	19.0	30
6m		24		8.0	29.0	40
8m		27		8.0	38.0	50
10m		34		8.0	48.0	75
12m		42		8.0	58.0	75
14m		47		8.0	67.0	90
16m		54		8.0	77.0	110
18m		60		8.0	86.0	130
9) MAIZE PLANTER	Sand	Firm Soil	Loose Soil			
Full Fertilizer & N = 60%						
2 x 0.91 m = 1.82m (Mounted)	21	20	19	8.0	9.0	35
2 x 0.91 m = 1.82m (Mounted)	25	23	22	12.0	13.0	35
4 x 0.91 m = 3.64m (Mounted)	25	23	22	6.0	13.0	40
4 x 0.91 m = 3.64m (Mounted)	33	40	29	8.0	18.0	40
4 x 0.91 m = 3.64m (Mounted)	43	39	37	10.0	22.0	50
4 x 0.91 m = 3.64m (Trailed)	50	46	44	12.0	26.0	55
6 x 0.91 m = 5.46m (Mounted)	38	34	33	6.0	20.0	50
6 x 0.91 m = 5.46m (Trailed)	50	46	44	8.0	26.0	60
6 x 0.91 m = 5.46m (Trailed)	60	56	54	10.0	33.0	70
6 x 0.91 m = 5.46m (Trailed)	74	68	65	12.0	39.0	75

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
9) MAIZE PLANTER (cont)	Sand	Firm Soil	Loose Soil			
Full Fertilizer & N = 60%						
8 x 0.91 m = 7.28m (Trailed)	49	45	43	6.0	26.0	70
8 x 0.91 m = 7.28m (Trailed)	66	60	58	8.0	35.0	80
8 x 0.91 m = 7.28m (Trailed)	83	76	73	10.0	44.0	90
8 x 0.91 m = 7.28m (Trailed)	98	90	86	12.0	52.0	100
12 x 0.91 m = 10.92m (Trailed)	75	68	65	6.0	39.0	90
12 x 0.91 m = 10.92m (Trailed)	98	90	86	8.0	52.0	100
12 x 0.91 m = 10.92m (Trailed)	120	110	105	10.0	65.0	120
12 x 0.91 m = 10.92m (Trailed)	142	130	125	12.0	78.0	150
2 x 2.29m = 4.58m (Mounted)	18	17	16	6.0	16.5	40
2 x 2.29m = 4.58m (Mounted)	24	22	21	8.0	22.0	50
2 x 2.29m = 4.58m (Mounted)	29	27	26	10.0	27.0	55
2 x 2.29m = 4.58m (Mounted)	36	33	32	12.0	33.0	55
3 x 2.29m = 5.87m (Mounted)	27	25	24	6.0	25.0	55
3 x 2.29m = 5.87m (Trailed)	36	33	32	8.0	33.0	60
3 x 2.29m = 5.87m (Trailed)	46	42	40	10.0	41.0	70
3 x 2.29m = 5.87m (Trailed)	55	50	48	12.0	49.0	75
4 x 2.29m = 9.16m (Trailed)	36	33	32	6.0	33.0	90
4 x 2.29m = 9.16m (Trailed)	49	45	43	8.0	44.0	90
4 x 2.29m = 9.16m (Trailed)	60	55	53	10.0	55.0	100
4 x 2.29m = 9.16m (Trailed)	74	68	65	12.0	66.0	110
Starter fertilizer and N = 70%						
2 x 0.91 m = 1.82m (Mounted)	21	20	19	6.0	8.0	35
2 x 0.91 m = 1.82m (Mounted)	25	23	22	12.0	15.0	35
4 x 0.91 m = 3.64m (Mounted)	22	21	20	6.0	15.0	35
4 x 0.91 m = 3.64m (Mounted)	25	24	23	8.0	20.0	35
4 x 0.91 m = 3.64m (Mounted)	27	26	25	10.0	25.0	45
4 x 0.91 m = 3.64m (Trailed)	33	31	30	12.0	30.0	50

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required			Speed (Km/Hr)	Ha/Day	Tractor size (kW)
9) MAIZE PLANTER (cont)	Sand	Firm Soil	Loose Soil			
Starter fertilizer and N = 70%						
6 x 0.91 m = 5.46m (Mounted)	26	25	24	6.0	23.0	45
6 x 0.91 m = 5.46m (Trailed)	33	31	30	8.0	30.0	55
6 x 0.91 m = 5.46m (Trailed)	42	40	38	10.0	38.0	60
6 x 0.91 m = 5.46m (Trailed)	50	48	46	12.0	46.0	70
8 x 0.91 m = 7.28m (Trailed)	35	34	32	6.0	31.0	65
8 x 0.91 m = 7.28m (Trailed)	44	42	40	8.0	41.0	70
8 x 0.91 m = 7.28m (Trailed)	55	53	50	10.0	51.0	80
8 x 0.91 m = 7.28m (Trailed)	66	64	60	12.0	61.0	90
12 x 0.91 m = 10.92m (Trailed)	51	48	46	6.0	46.0	80
12 x 0.91 m = 10.92m (Trailed)	68	65	62	8.0	61.0	90
12 x 0.91 m = 10.92m (Trailed)	83	80	76	10.0	76.0	100
12 x 0.91 m = 10.92m (Trailed)	100	98	92	12.0	92.0	110
2 x 2.29m = 4.58m (*M)	15	15	14	6.0	19.0	35
2 x 2.29m = 4.58m (*M)	21	20	19	8.0	25.0	45
2 x 2.29m = 4.58m (*M)	25	24	23	10.0	32.0	55
2 x 2.29m = 4.58m (*M)	30	28	27	12.0	38.0	55
3 x 2.29m = 5.87m (*M)	24	23	22	6.0	29.0	50
3 x 2.29m = 5.87m (**T)	30	28	27	8.0	38.0	55
3 x 2.29m = 5.87m (**T)	37	36	34	10.0	48.0	60
3 x 2.29m = 5.87m (**T)	44	42	40	12.0	58.0	70
4 x 2.29m = 9.16m (**T)	30	28	27	6.0	38.0	80
4 x 2.29m = 9.16m (**T)	40	38	36	8.0	51.0	80
4 x 2.29m = 9.16m (**T)	50	48	45	10.0	64.0	90
4 x 2.29m = 9.16m (**T)	59	58	54	12.0	77.0	100

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement		kW Required	Speed (Km/Hr)	Ha/Day	Tractor size (kW)
10)	**WHEAT DRILL**	Firm Soil			
	350mm rows & N = 60%				
	7-row = 2.45m	15	7.0	10.0	40
	9-row = 3.15m	20	7.0	13.0	45
	14-row = 4.90m	39	9.0	26.0	70
	18-row = 6.30m	51	9.0	34.0	80
	21-row = 7.35m	60	9.0	40.0	90
	27-row = 9.45m	76	9.0	51.0	100
11)	**CULTIVATOR**	Firm Soil			
	N = 83%				
	4 x 0.91m = 3.64m	17	4.0	12.0	25
	4 x 0.91m = 3.64m	26	6.0	18.0	35
	4 x 0.91m = 3.64m	34	8.0	24.0	50
	4 x 0.91m = 3.64m	43	10.0	30.0	55
	6 x 0.91m = 5.45m	26	4.0	18.0	40
	6 x 0.91m = 5.45m	39	6.0	27.0	50
	6 x 0.91m = 5.45m	52	8.0	36.0	65
	6 x 0.91m = 5.45m	65	10.0	45.0	80
	8 x 0.91m = 7.28m	34	4.0	24.0	60
	8 x 0.91m = 7.28m	52	6.0	36.0	70
	8 x 0.91m = 7.28m	69	8.0	48.0	85
	8 x 0.91m = 7.28m	86	10.0	60.0	100
	2 x 2.29m = 4.58m	22	4.0	15.0	35
	2 x 2.29m = 4.58m	33	6.0	23.0	50
	2 x 2.29m = 4.58m	43	8.0	30.0	60
	2 x 2.29m = 4.58m	54	10.0	38.0	70
	3 x 2.29m = 6.87m	33	4.0	23.0	50
	3 x 2.29m = 6.87m	49	6.0	34.0	60
	3 x 2.29m = 6.87m	65	8.0	45.0	80
	3 x 2.29m = 6.87m	82	10.0	57.0	100

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	kW Required		Speed (Km/Hr)	Ha/Day	Tractor size (kW)
11) CULTIVATOR (cont.)					
N = 83%		Firm Soil			
		4			
4 x 2.29m = 9.16m		3	4.0	30.0	80
		6			
4 x 2.29m = 9.16m		5	6.0	45.0	100
		8			
4 x 2.29m = 9.16m		8	8.0	61.0	110
		1			
4 x 2.29m = 9.16m		09	10.0	76.0	120

Implement	Tractor size kW	ha/day at a yield of				
		2t/ha	3t/ha	4t/ha	5t/ha	6t/ha
12) TRAILED COMBINE FOR MAIZE						
with unloading wagon & N = 80%						
1-row	38	12	8	6	5	4
2 x 0.91m	42	14	10	7	6	5
without unloading wagon & N = 65%						
1-row	38	10	7	5	4	3
2 x 0.91m	42	12	8	6	5	4
13) SELF-PROPELLED COMBINE FOR MAIZE						
with unloading wagon & N = 80%						
4 x 0.91m = 3.64m	38	24	16	12	10	8
4 x 0.91m = 3.64m	48	38	26	19	15	13
6 x 0.91m = 5.46m	68	58	38	29	23	19
6 x 0.91m = 5.46m	95	80	54	40	32	26
2 x 2.29m = 4.58m	38	24	16	12	-	-
2 x 2.29m = 4.58m	48	38	26	19	-	-
3 x 2.29m = 6.87m	68	58	38	29	-	-
3 x 2.29m = 6.87m	95	80	54	40	-	-

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement	Tractor size kW	Ha/Day at a yield of				
		2t/ha	3t/ha	4t/ha	5t/ha	6t/ha
13) SELF-PROPELLED COMBINE FOR MAIZE						
without unloading wagon & N = 65%						
4 x 0.91m = 3.64m	38	20	13	10	8	7
4 x 0.91m = 3.64m	48	31	21	16	12	10
6 x 0.91m = 5.46m	68	47	31	23	19	16
6 x 0.91m = 5.46m	95	65	44	33	26	21
2 x 2.29m = 4.58m	38	20	13	10	-	-
2 x 2.29m = 4.58m	48	31	21	16	-	-
3 x 2.29m = 6.87m	68	47	31	23	-	-
3 x 2.29m = 6.87m	95	65	44	33	-	-
14) SELF-PROPELLED COMBINE FOR WHEAT						
With unloading wagon & N = 80%						
2.70m	38		34	17	11	9
3.66m	48		48	24	16	12
4.57m	68		77	38	26	19
6.71m	95		115	58	38	29
Without unloading wagon & N = 65%						
2.70m	38		27	14	9	7
3.66m	48		39	20	13	10
4.57m	68		62	31	21	16
6.71m	95		94	47	31	25

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement		kW Required	Speed (Km/Hr)	Ha/Day	Tractor size (kW)
15)	**BOOM SPRAYER**				
	N = 60%				
	Band 4 x 0.91m	15	6.0	13.0	30
	6 x 0.91m	15	6.0	30.0	30
	8 x 0.91m	15	6.0	26.0	30
	2 x 2.29m	15	6.0	16.5	30
	3 x 2.29m	15	6.0	25.0	30
	4 x 2.29m	20	6.0	33.0	40
	6m Boom	20	6.0	22.0	40
	8m Boom	25	6.0	29.0	50
	12m Boom	25	6.0	43.0	50
16)	**CUTTER-BAR MOWER**				
	N = 80%				
	1.8m knife	10		9.0	35
17)	**DISC MOWER**				
	N = 80%				
	1.6m	30		10.0	38
	1.8m	30		12.0	38
	2.0m	35		13.0	44
	2.4m	46		15.0	58
	2.8m	46		18.0	58

27) FIELD CAPACITIES OF AGRICULTURAL MACHINERY : TABLE

Implement		kW Required						Speed (Km/Hr)	Ha/Day	Tractor size (kW)
18)	**PICK-UP BALER**									
	Hay and N = 50%	35		25	1	7	13	10	8	7
19)	**ROUND BALER**									
	Hay and N = 50%									
	Small	45	56	30	2	0	15	12	10	8
	Medium	48	60	40	2	7	20	16	13	11
	Large	52	65	45	3	0	23	18	15	13
20)	**HAY RAKE**			**Brittle Crops (ha/day)**				**Other Crops (ha/day)**		
	N = 80%									
	2.0m	16	35	11				15		
	2.4m	18	35	13				18		
	3.0m	20	35	17				23		
	6.0m	26	35	33				46		

28) TRANSPORT

No measurements have been made of the required power.
For a tractor and trailer the following can be used to calculate approximate fuel consumption.

Terrain	Fuel consumption/ litre per ton-km
Flat	0.05
Undulating	0.10
Hilly	0.15