Tillage Implement Draft and Tractor Power

Draft of a plough or other tillage implement from soil specific resistance, width and depth, the drawbar power at a speed and the engine power needed.

Method: Implement draft from specific soil resistance

Input parameters

Unit system: SI

Parameter	Value	Unit
Specific soil resistance (draft per unit furrow area)	60.000	kPa
Working width	1.2000	m
Working depth	200.00	mm
Travel speed	5.0000	km/h
Tractive efficiency	70.000	%
Transmission efficiency	90.000	%
Engine reserve (share of rated power kept in hand)	20.000	%

Calculated results

Parameter	Value	Unit
Draft	14.400	kN
Drawbar power	20.000	kW
Engine power needed	39.683	kW
Engine power in horsepower	53.215	hp

Notes for this case

• Draft is the soil's specific resistance times the furrow cross-section: about 20–40 kPa (2–4 N/cm²) for light soils, 40–70 kPa for medium loams and over 70 kPa for heavy clays with a mouldboard plough; it rises with speed. Drawbar power is draft × speed; the engine must also cover wheel slip and rolling resistance (tractive efficiency) and the transmission, and keep a reserve for hard patches.

Formula and method

$$D = k\,w\,d, \quad P_{db} = D\,v, \quad P_e = \frac{P_{db}}{\eta_t \eta_{tr} (1 - f_r)}$$

Variables

k	Specific soil resistance (draft per unit furrow area)	Pa
w	Working width	m
d	Working depth	m
v	Travel speed	m/s
η_t	Tractive efficiency	-
η_{tr}	Transmission efficiency	-
f_r	Engine reserve (share of rated power kept in hand)	-
D	Draft	N
P_{db}	Drawbar power	W
P_e	Engine power needed	W
P_{hp}	Engine power in horsepower	W

Method and standards

Tillage draft.

Assumptions and limits

- Constant soil resistance and depth.

References

Implement draft from specific soil resistance

Report details

Report reference	FCC-F9SK-HZKC (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/irrigation-farm/tillage-draft-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.