

Table 13.1 Motor speeds in vivo and in vitro

Motor	Speed ^a in vivo (nm/s)	Speed ^b in vitro (nm/s)	In vitro ATPase ^c (s ⁻¹)	Function
Myosins				
1. Myosin IB	ND ^d	200	6	Amoeboid motility, hair cell adaptation
2. Myosin II	6000	8000	20	Fast skeletal muscle
3. Myosin II	200	250	1.2	Smooth muscle contraction
4. Myosin V	200	350	5	Vesicle transport
5. Myosin VI	ND	-58	0.8	Vesicle transport?
6. Myosin XI	60,000	60,000	ND	Cytoplasmic streaming in algae
Dyneins				
7. Axonemal	-7000	-4500	10	Sperm and ciliary motility
8. Cytoplasmic	-1100	-1250	2	Retrograde axonal transport, mitosis, transport in flagella
Kinesins				
9. Conventional	1800	840	44	Anterograde axonal transport
10. Nkin	800	1800	78	Secretory vesicle transport
11. Unc104/KIF	690	1200	110	Transport of synaptic vesicle precursors and mitochondria
12. Fla10/KinII	2000	400	ND	Transport in flagella, axons, melanocytes
13. BimC/Eg5	18	60	2	Mitosis and meiosis
14. Ncd	ND	-90	1	Meiosis and mitosis

^a*In vivo* speed in cells or extracts applies to motion of the motor relative to the filament without external load. A positive speed denotes motion towards the plus (rapidly polymerizing) end of the filament. A negative speed denotes motion toward the minus end.

^b*In vitro* speed of purified motors at high ATP concentration.

^cATPase is the maximum filament-activated rate of hydrolysis per head per second measured in solution at high ATP and filament concentrations.

^dND = not determined.

Notes

Speed: Zot et al. (1992). ATPase: Ostap and Pollard (1996).

In vivo speed: glycerinated rabbit psoas fibers at 25°C; Pate et al. (1994); Cooke et al. (1988). See Appendix 13.1. In vitro speed and ATPase: rabbit psoas HMM at 30°C; Toyoshima et al. (1987).

In vivo speed: chicken gizzard at 20°C; Siemankowski et al., 1985. The speed was calculated using a "sarcomere" length of 2.5 μm (see Appendix 13.1). In vitro speed and ATPase: phosphorylated turkey gizzard myosin at 22°C and 37°C, respectively; Warshaw et al. (1990).

In vivo speed: yeast Myo2 at 37°C; Govindan et al. (1995). With functional Myo2, a mother cell is able to transport 1 vesicle per 17 s, over $\sim 4 \mu\text{m}$ to the tip of the bud. In vitro speed and ATPase: native chicken brain myosin V at 24°C and 37°C; Cheney (1993).

Recombinant truncated pig protein at 25°C; Wells et al. (1999).

Nitella myosin; Rivolta et al. (1995). *Chara* myosin at 23°C; Higashi-Fujime et al. (1995); Morimatsu et al. (2000).

In vivo speed: reactivated sea urchin sperm at 25°C using parameters from Brennen and Winet (1977) (see Appendix 13.2). In vitro speed and ATPase: native sea urchin outer-arm dynein; 25°C; Yokota and Mabuchi (1994). Outer-arm dynein determines the speed.

In vivo speed: retrograde transport in squid axoplasm at room temperature; Brady et al. (1990). In vitro speed: native bovine brain cytoplasmic dynein at 30°C; Paschal et al. (1987). ATPase: native bovine brain cytoplasmic dynein at 37°C; Shpetner et al. (1988).

In vivo speed: anterograde transport in squid axoplasm at room temperature; Brady et al. (1990). In vitro speed and ATPase: recombinant *Drosophila* full-length conventional kinesin tetramer; single-motor assays at 25°C; Coy et al. (1999).

In vivo speed: This corresponds to an elongation rate of *Neurospora* hyphae of 68 mm/day at 25°C; Seiler et al. (1997, 2000). In vivo speed and ATPase: recombinant *Neurospora* dimer at 24°C; Crevel et al. (1999).

In vivo speed: Mouse KIF1A (Okada et al. [1995]; Yonekawa et al. [1998]) is thought to move synaptotagmin-containing vesicles; Nakata et al. (1998). In vitro speed: recombinant full-length KIF1A; Okada et al. (1995). ATPase: recombinant truncated KIF1A; Okada and Hirokawa (1999).

In vitro speed: base-to-tip movement of "rafts" in *Chlamydomonas* flagella mediated by Fla10 at room temperature; Kozminski et al. (1993, 1995). In vitro: sea urchin egg Kin II; Cole et al. (1993).

In vivo speed: yeast spindle elongation during mitosis at 20–24°C; Yeh et al. (1995). This is attributed to the action of the related Kip1 and Cin8 kinesins; Saunders and Hoyt (1992). In vitro speed and ATPase: recombinant *Xenopus* Eg5 dimer at 20°C; Lockhart and Cross (1996).

Recombinant *Drosophila* Ncd dimer (GST-MC5) at room temperature; Chandra et al. (1993).

Key:

Motors operate in large arrays (10^4 to 10^9)
Motors operate in small arrays (10 to 1000)
Motors operate alone or in small numbers (<10)
Unknown