FORCE-VELOCITY PROFILE

ATHLETE	DATE	TEST	BODY MASS
Example (J-B. Morin's data)	2026-10-31	jbm.csv	75.0 kg

01 SUMMARY

F0	V0	PMAX	F-V SLOPE	RFMAX
6.83 N/kg	**9.60** m/s	**16.4** W/kg	**-0.71**	**49.1** %
513 N	34.6 km/h	1,231 W	N·s/m/kg	DRF -6.5 %/(m/s)

READING

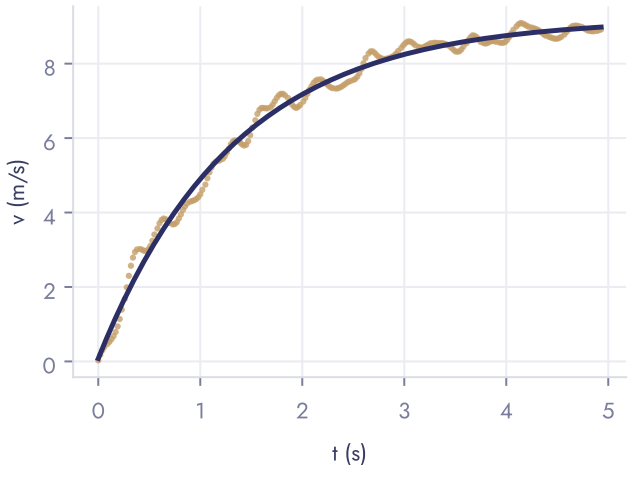
Theoretical maximal force **F0 = 6.83 N/kg**, theoretical maximal velocity **V0 = 9.60 m/s**, maximal power **16.4 W/kg**.

Compared with the optimal profile over 30 m, the profile is **markedly force-oriented** (imbalance 44 %); at equal power the optimal profile would save 0.071 s.

Goodness of fit of the model: R^2 = 0.9915.

Computed directly on the measured speed, without the model, F0 is 7.70 N/kg and V0 9.40 m/s (linearity R^2 = 0.80).

02 THE SPRINT



Measured speed (dots) and fitted model (line).

2.1 Mono-exponential model

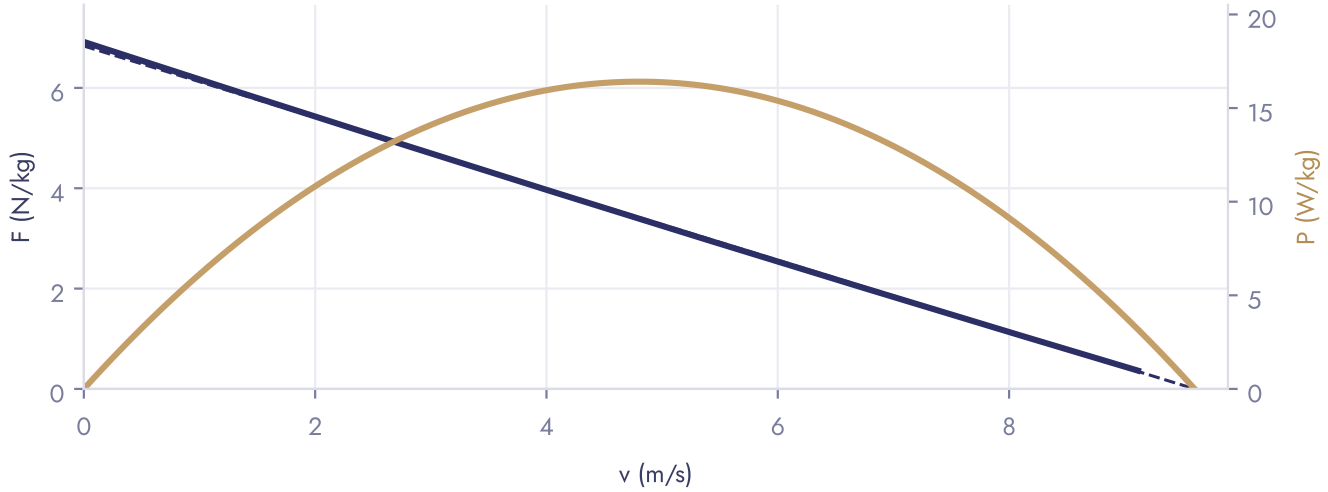
PARAMETER	VALUE
MSS (maximal speed)	9.21 m/s
MAC (maximal acceleration)	6.92 m/s²
τ	1.331 s
Time correction (s)	-0.011
R^2 · RMSE	0.9915 · 0.218

2.2 Modelled split times

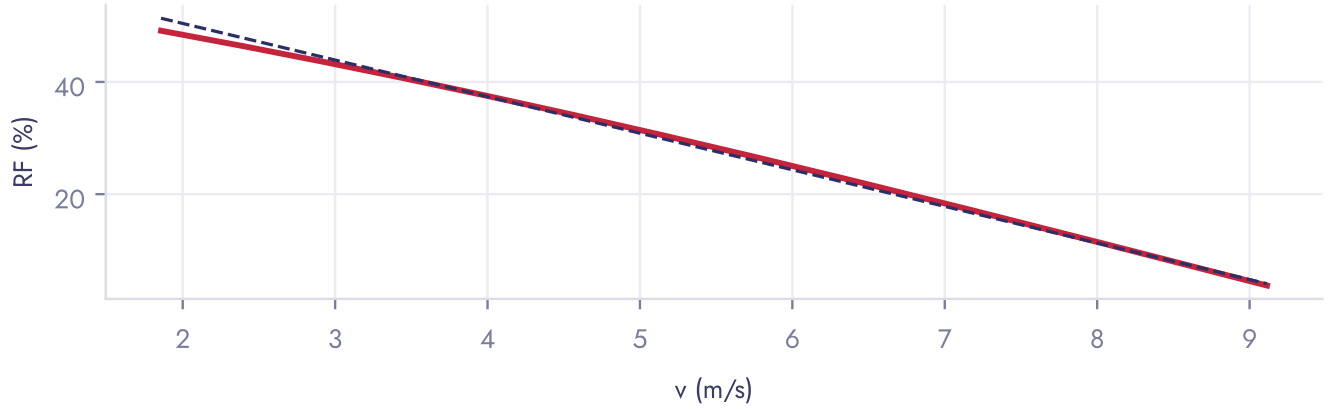
DISTANCE	TIME	SPEED
5 m	1.41 s	6.02 m/s
10 m	2.15 s	7.38 m/s
20 m	3.40 s	8.49 m/s
30 m	4.55 s	8.90 m/s
40 m	5.66 s	9.08 m/s

03 FORCE, POWER, ORIENTATION

Net horizontal force decreases almost linearly with velocity: its intercept is F0, its velocity intercept V0, and maximal power is F0·V0/4. The ratio of forces (RF) is the share of the total force oriented forward.

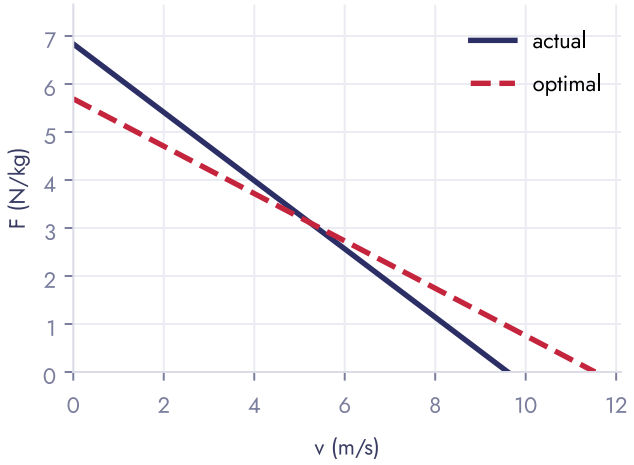


Horizontal force (blue) and power (gold) against velocity; F-v line dashed.



Ratio of forces against velocity: its slope is the DRF index.

04 ▸ OPTIMAL PROFILE



44 %
FV IMBALANCE
markedly force-oriented

0.071 s
POTENTIAL GAIN
over 30 m

	ACTUAL	OPTIMAL
F-v slope	-0.71	-0.49
F0 (N/kg)	6.83	5.69
V0 (m/s)	9.60	11.53
Time 30 m	4.542 s	4.472 s

Actual and optimal profiles at the same maximal power.

05 ▸ METHOD

The mono-exponential model $v(t) = MSS \cdot (1 - e^{-t/\tau})$ is fitted by least squares to a continuous speed measurement (radar, laser or positioning system). Net horizontal force is $F_H = m \cdot a + k \cdot v^2$, with an aerodynamic coefficient k from body mass and height (Arsac & Locatelli 2002).

F0, V0 and Pmax come from the linear regression of F_H on v (Samozino et al. 2016). The ratio of forces $RF = F_H / \sqrt{(F_H^2 + (m \cdot g)^2)}$ is computed from 0.3 s; DRF is the slope of RF against velocity.

The optimal profile minimises the time over the distance at equal maximal power, by numerical simulation (Samozino et al. 2022). Reading thresholds for the imbalance: ±10 % balanced, beyond ±25 % markedly oriented (indicative, configurable).

- Samozino P. et al. (2016). A simple method for measuring power, force, velocity properties, and mechanical effectiveness in sprint running. Scand J Med Sci Sports 26, 648–658.
- Samozino P. et al. (2022). Optimal mechanical force-velocity profile for sprint acceleration performance. Scand J Med Sci Sports 32, 559–575.
- Morin J-B. & Samozino P. (2016). Interpreting power-force-velocity profiles for individualized and specific training. Int J Sports Physiol Perform 11, 267–272.
- Arsac L. & Locatelli E. (2002). Modeling the energetics of 100-m running by using speed curves of world champions. J Appl Physiol 92, 1781–1788.

Report generated by sprintfv 0.1.0. Values depend on measurement quality; read them with the athlete's context in mind.