International Association of Public Transport
Union Internationale des Transports Publics
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Unión Internacional de Transporte Público

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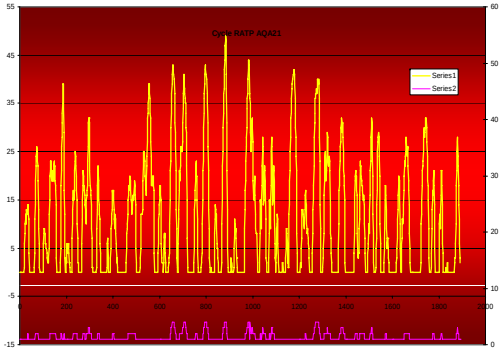
UITP's Standardised On-Road Test (SORT) cycles for measuring fuel consumption

Better mobility for people worldwide

The energy issue

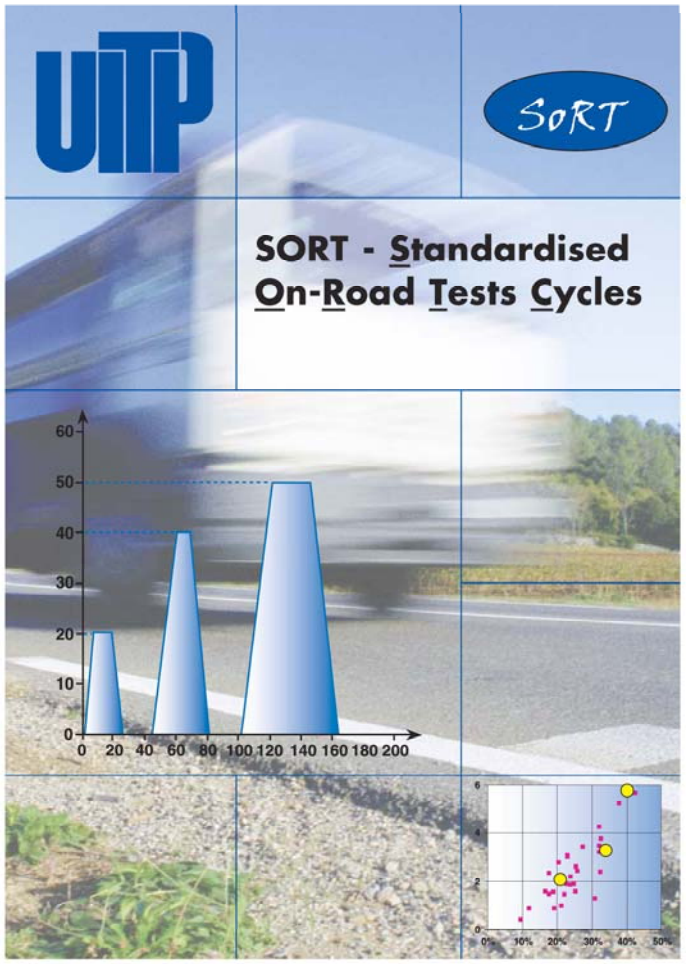
- **Fuel costs represents in average 10 to 20% (but can reach up to 50%) of all operational expenses**
- **Fuel costs increase with oil price increase**
- **Fuel costs represent 1.5 times the acquisition cost of a bus (LCC of 14 years)**
- **Severe emissions norms**

Why "Standardised On-Road Test Cycles (SORT)"?



- Test bench standards for engine approval validate engine, fuel quality and conformity to emissions standards
- But these tests allow comparison between engines (g/kWh) and not between vehicles (g/km or l/km)

What is SORT?

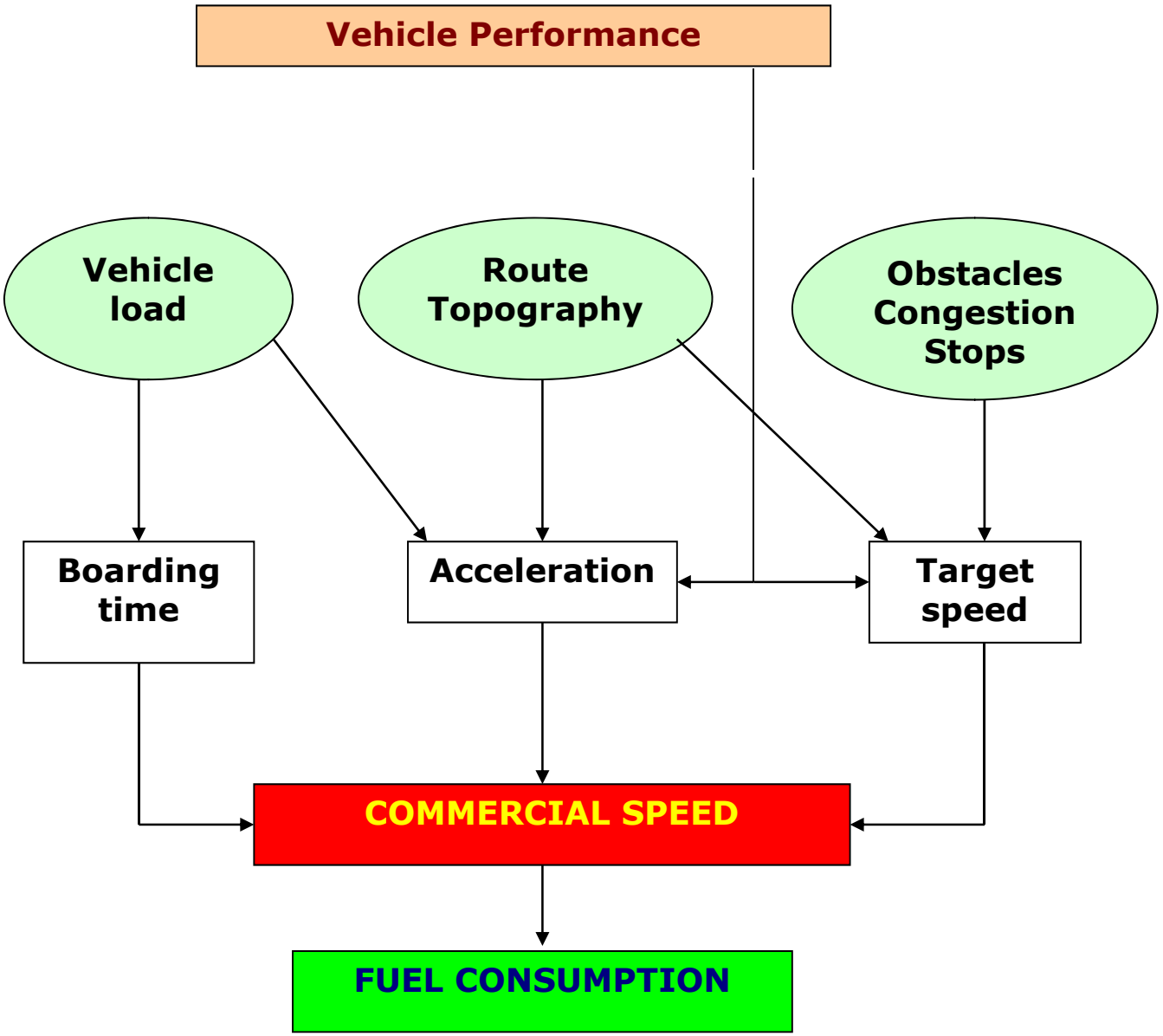


- **SORT is a methodology for the measurement of fuel consumption of buses using standardised on-road test cycles, with the aim of consumer (operator) protection and information**
- **SORT allows to compare between buses based on their fuel consumption in real operational conditions**

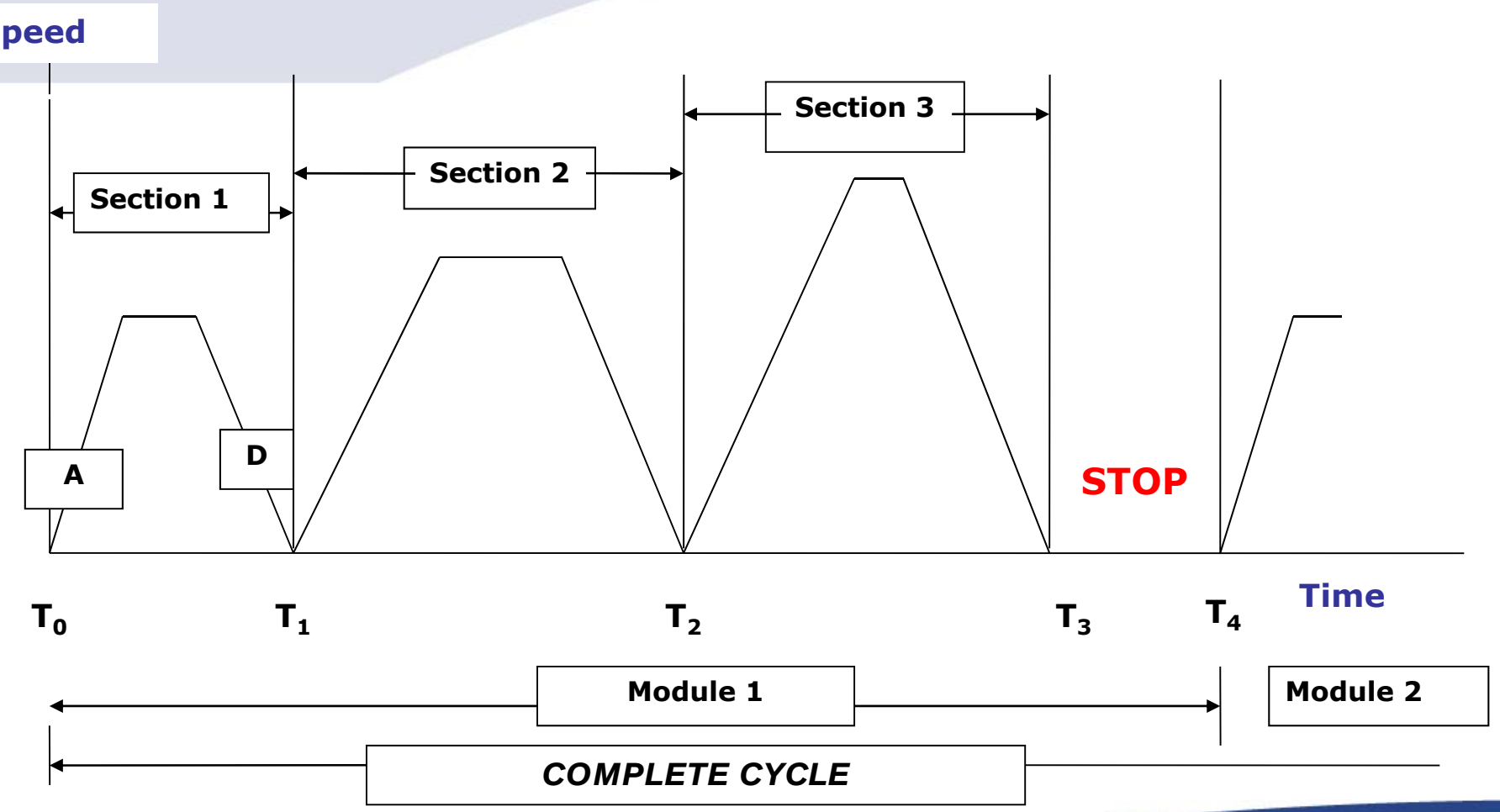
SORT partners

Transports Metropolitans
de Barcelona

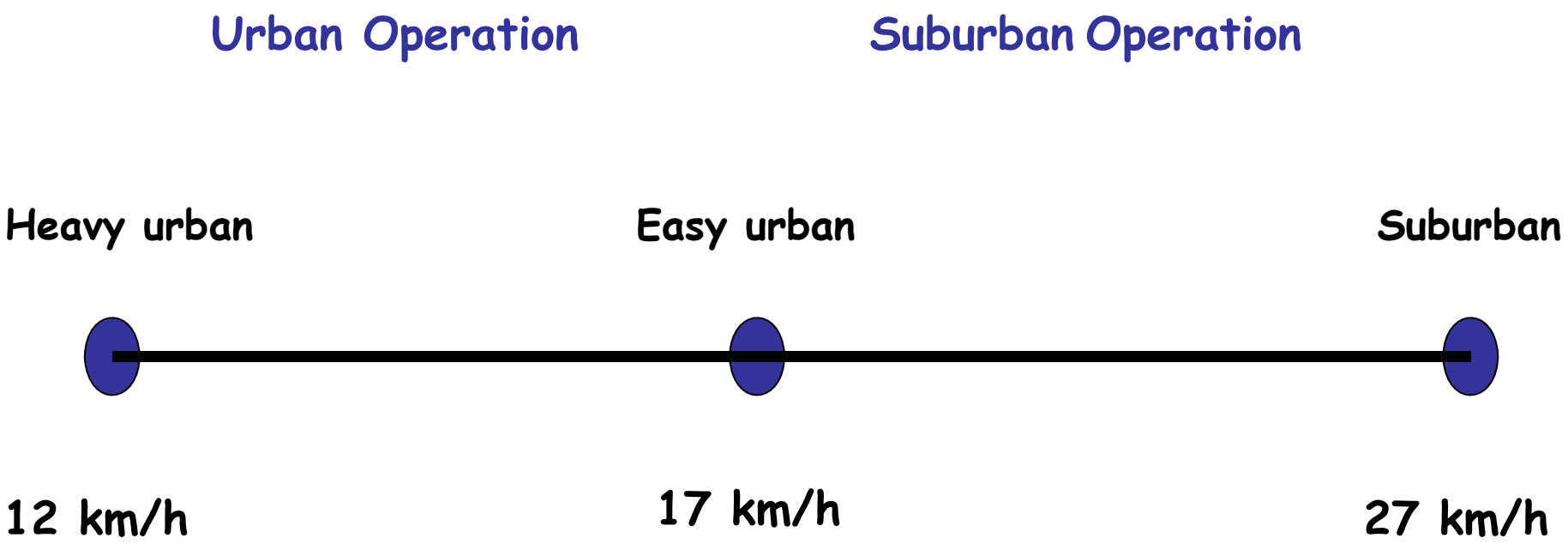
Elements influencing consumption



Structure of a cycle



Cycle design based on commercial speed



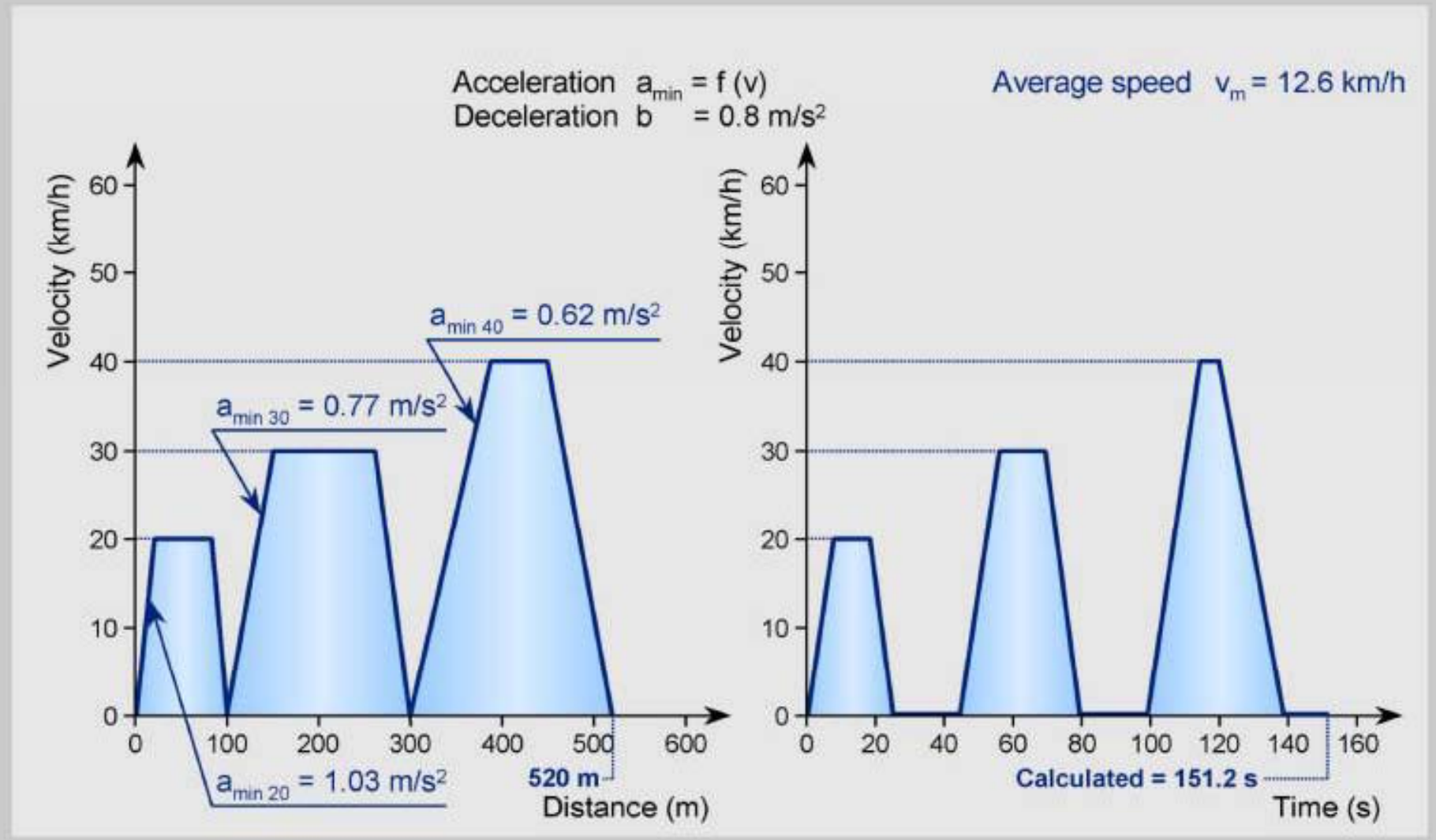
Designing SORT cycles

The following need to be determined:

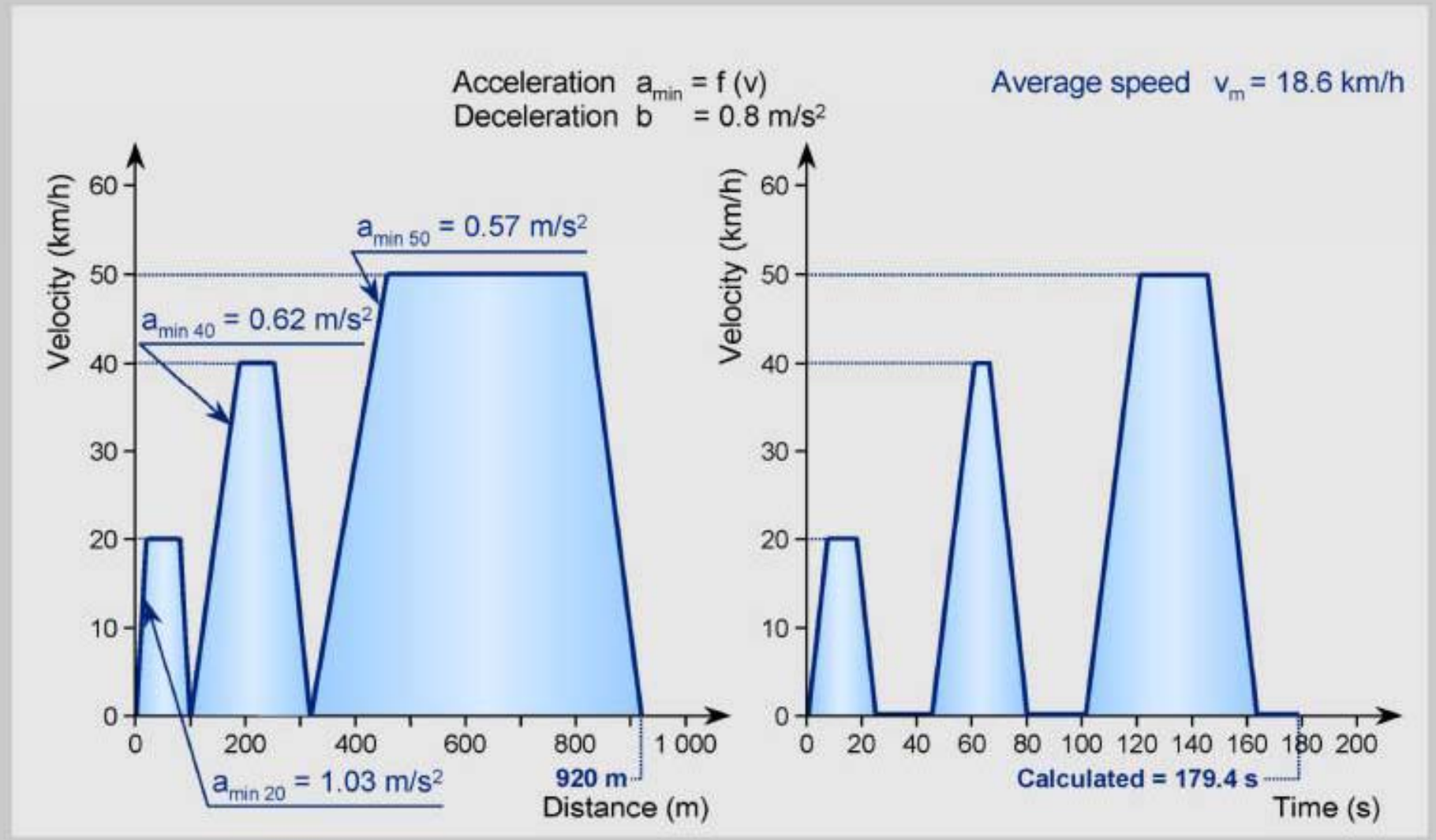
- **The number of trapezes**
- **The number of base cycles**
- **The acceleration values**
- **The target speed**
- **The braking values**
- **The idle time stops**

➔ Average commercial speed

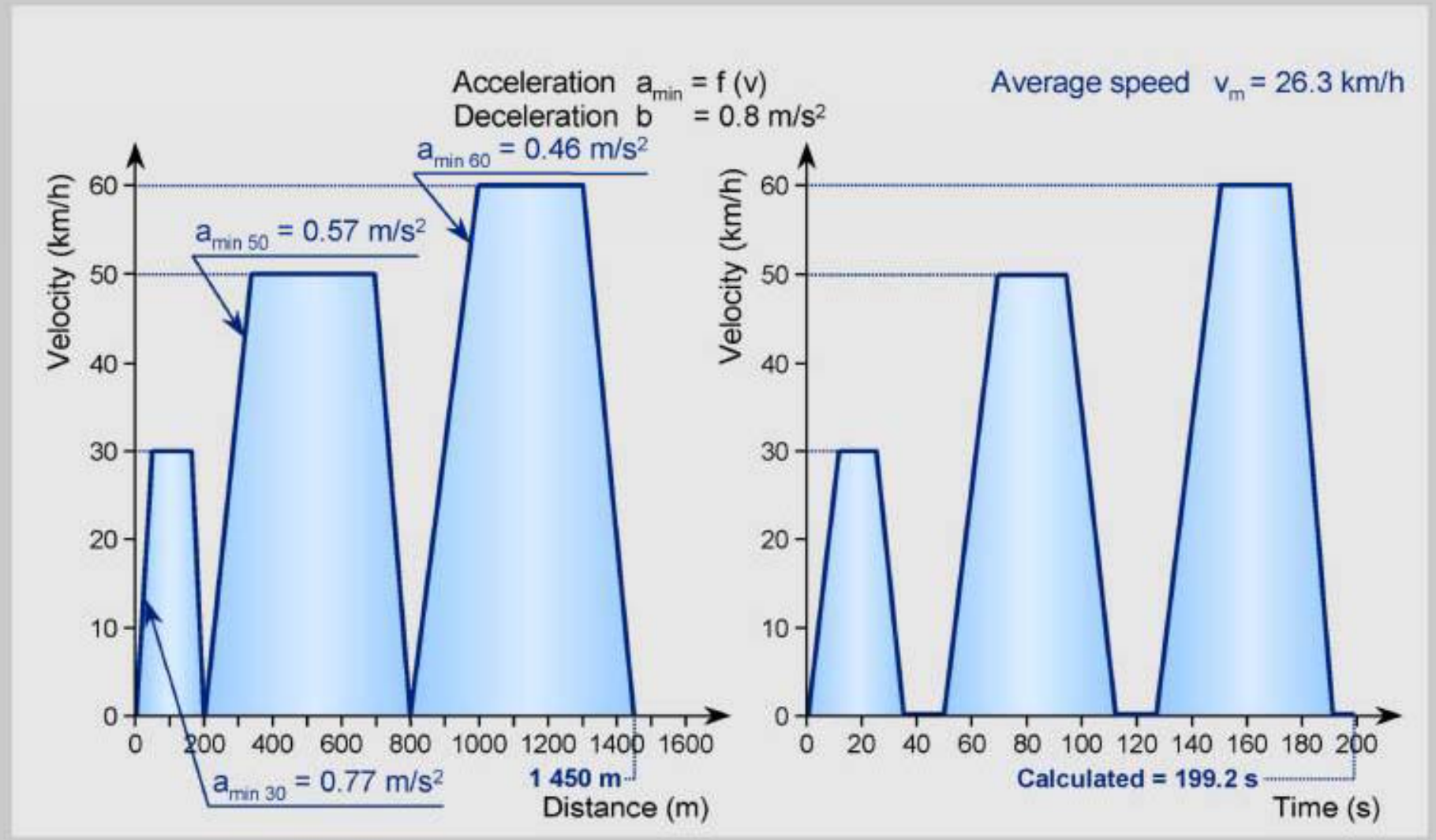
SORT 1: Heavy Urban



SORT 2: Easy Urban



SORT 3: Suburban



Comparison of the 3 SORT-Cycles (14.3 t)

	SORT 1	SORT 2	SORT 3
Rated average speed (km/h)	12.6	18.6	26.3
Stops / km	5.8	3.3	2.1
Stop time (%)	39.7	33.4	20.1
Trapez 1 v-const. (km/h) / length (m) Acceleration (m/s^2)	20 / 100 1.03	20 / 100 1.03	30 / 200 0.77
Trapez 2 v-const. (km/h) / length (m) Acceleration (m/s^2)	30 / 200 0.77	40 / 220 0.62	50 / 600 0.57
Trapez 3 v-const. (km/h) / length (m) Acceleration (m/s^2)	40 / 220 0.62	50 / 600 0.57	60 / 650 0.46
Length of stops (s)	20 / 20 / 20	20 / 20 / 20	20 / 10 / 10
Total length (m)	520	920	1 450
Deceleration (m/s^2)	0.8	0.8	0.8
Fuel consumption measurement (l/100 km)	ca. 50	ca. 42	ca. 39

Influence of the Bus Weight on the SORT Cycles

	SORT 1	SORT 2	SORT 3
Weight (t)	14.3	14.3	14.3
Average speed (km/h) gradient acceleration	12.4	18.5	26.2
Average speed (km/h) full load acceleration	13.0	19.6	28.5
Fuel consumption (l/100 km) full load acceleration	ca. 50	ca. 42	ca. 39
Influence of weight on the Fuel consumption in Liter/100 km per ton	ca. 1.9	ca. 1.7	ca. 1.5

Vehicle set-up for measurement

Vehicle set-up for measurement

Measurement methodology

- **Measuring accuracy:**
  - **Fuel-flow meter: ≈2%**
  - **Gravimetric fuel meter: ≈2%**
  - **Speed: ≈0.5%**
  - **Distance: ≈0.2%**
- **Test protocol defines:**
  - **External test conditions**
  - **Vehicle set-up**
  - **Test implementation**
  - **Test result**

Permissible fuel consumption deviation

The maximum deviation between the SORT consumption values, as stated by the manufacturer, and the result of the repeat measurement, may not exceed 5%. It reflects:

- **Accuracy of measurement**
- **Tolerance of complete driveline (transmission efficiency, engine performance, tyre influence...)**
- **External Test conditions (external temperature, air pressure, humidity, wind speed, state of track surface...)**

References

SORT has been successfully used by the following operators when launching a call for tenders for new buses:

- **RATP, Paris**
- **TMB, Barcelona**
- **SRWT, Belgium**
- **BVG, Berlin**

All UITP Bus Committee members will apply SORT in future tenders.

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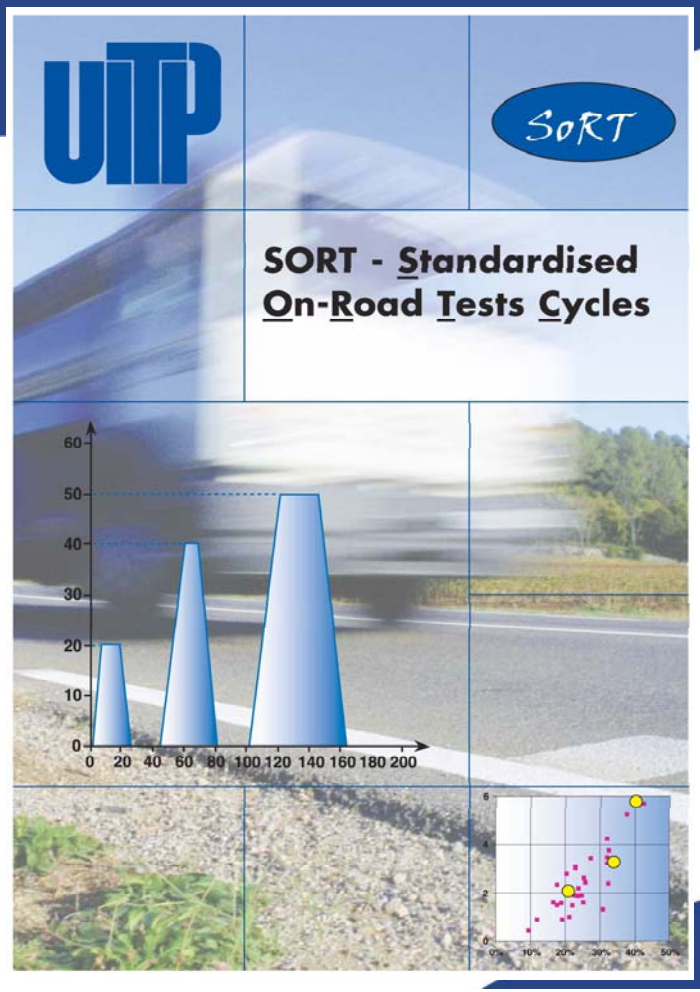

Thank you for your attention!

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