

4 STOPPING OF SHIPS

4.1 Acceleration and stopping characteristics

4.1.1 Forces acting when accelerating and stopping

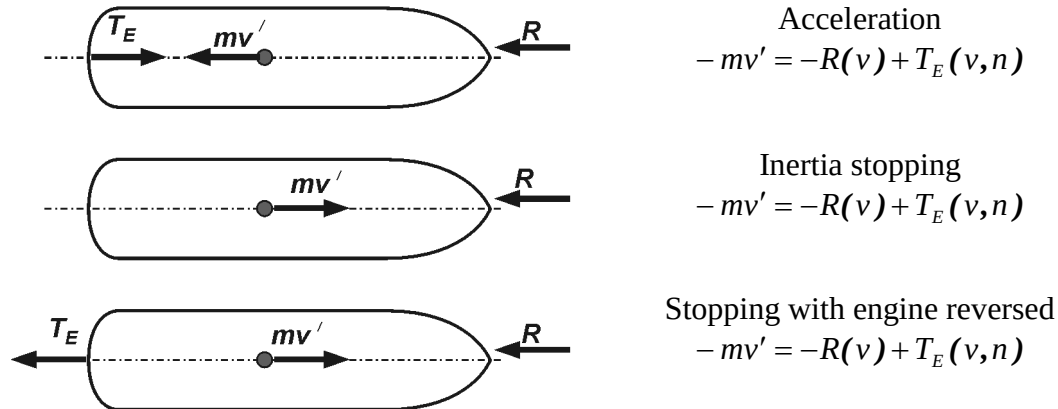


Fig. 4-1

Symbols: m - mass of the ship

V - velocity

R - resistance

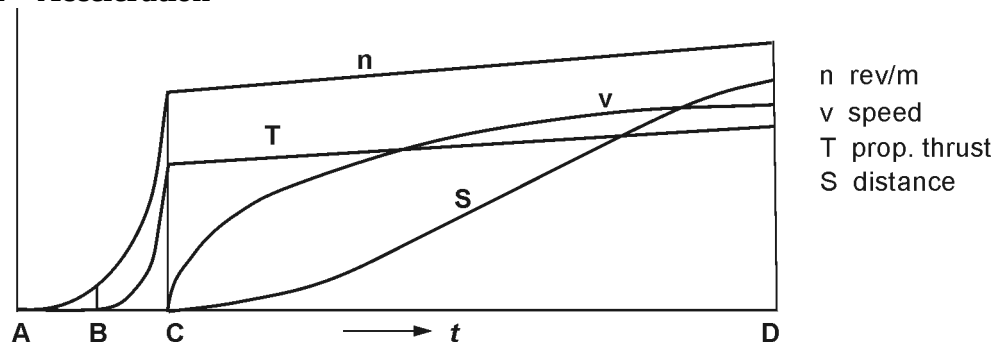
T_E - effective thrust

Acceleration is the period from the moment when order of starting the engine is given to the moment when nominal speed of the ship is reached.

Inertia stopping is a manoeuvre of stopping of the ship sailing at nominal speed when the main engine is stopped by closing down fuel supply.

Active stopping (crash stopping) is a manoeuvre of stopping of the ship using main engine working in astern condition.

4.1.2 Acceleration



A - order of starting engine is given

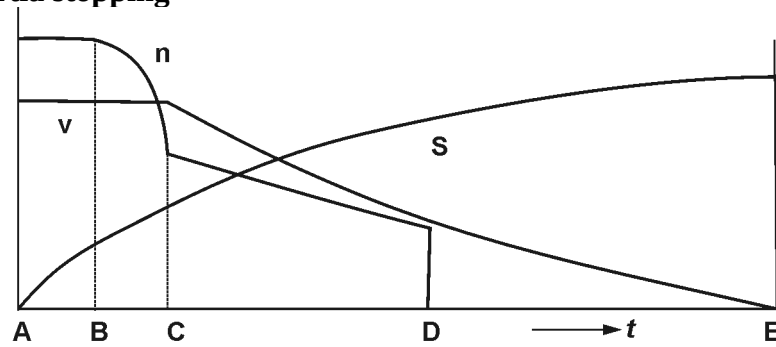
B - engine develops full nominal torque

C - engine develops revolution corresponding to bollard test

D - ship reaches nominal speed

Fig. 4-2

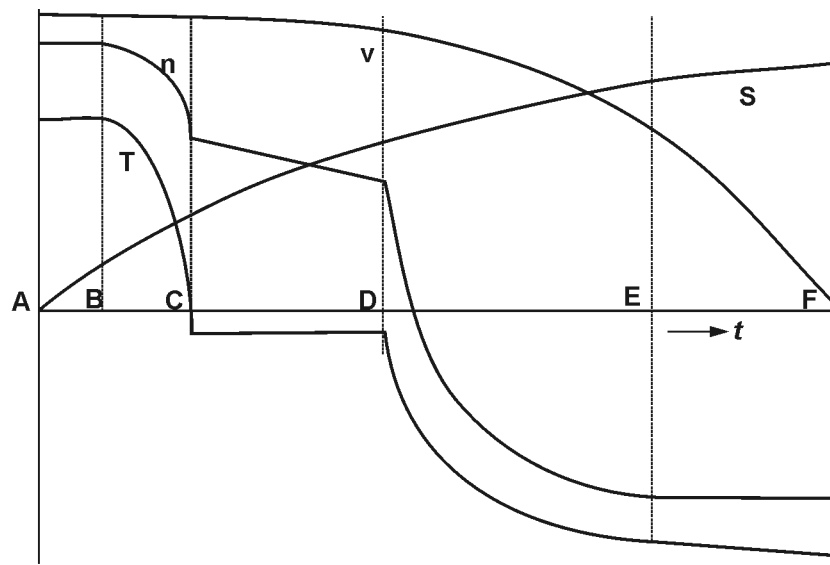
4.1.3 Inertia stopping



- A - order to stop the engine is given
- B - fuel supply is stopped
- C - propeller starts working in turbine mode
- D - propeller stops
- E - ship stops

Fig. 4-3

4.1.4 Active stopping – crash stopping



- A - order to stop the engine is given
- B - fuel supply is stopped
- C - propeller starts working in turbine mode
- D - astern order is given
- E - maximum astern revolution are reached
- F - ship stops

Fig. 4-4

4.2 Effect of engine characteristics on stopping of ships

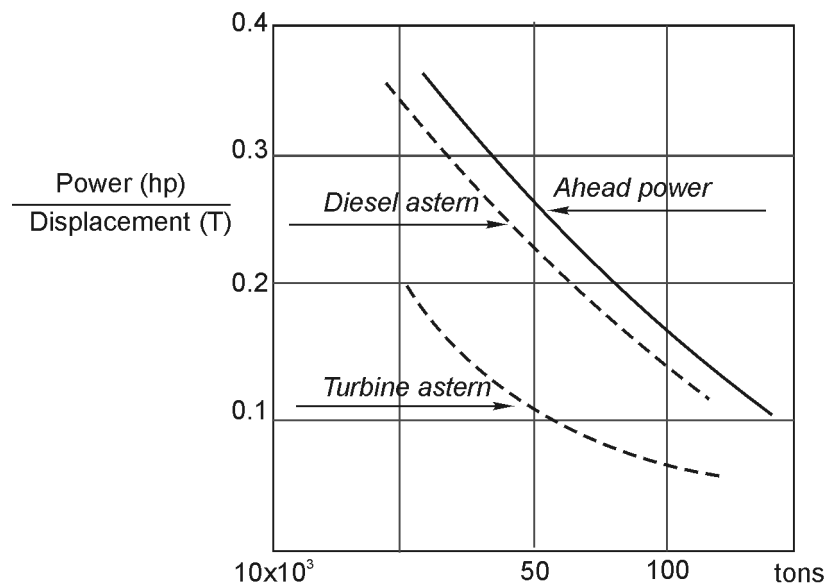


Fig. 4-5 Power available in astern motion

Remark: Turbine propulsion develops much less power in astern motion than diesel propulsion. Stopping distance is large.

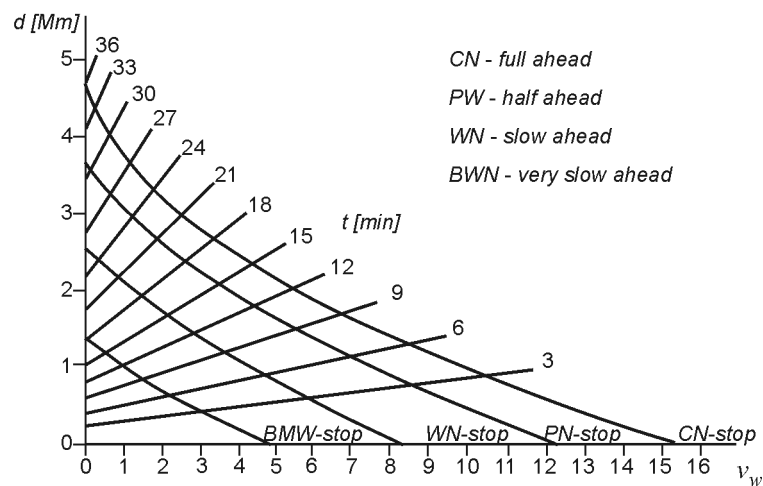


Fig. 4-6 Curves of stopping characteristics of inertia stopping

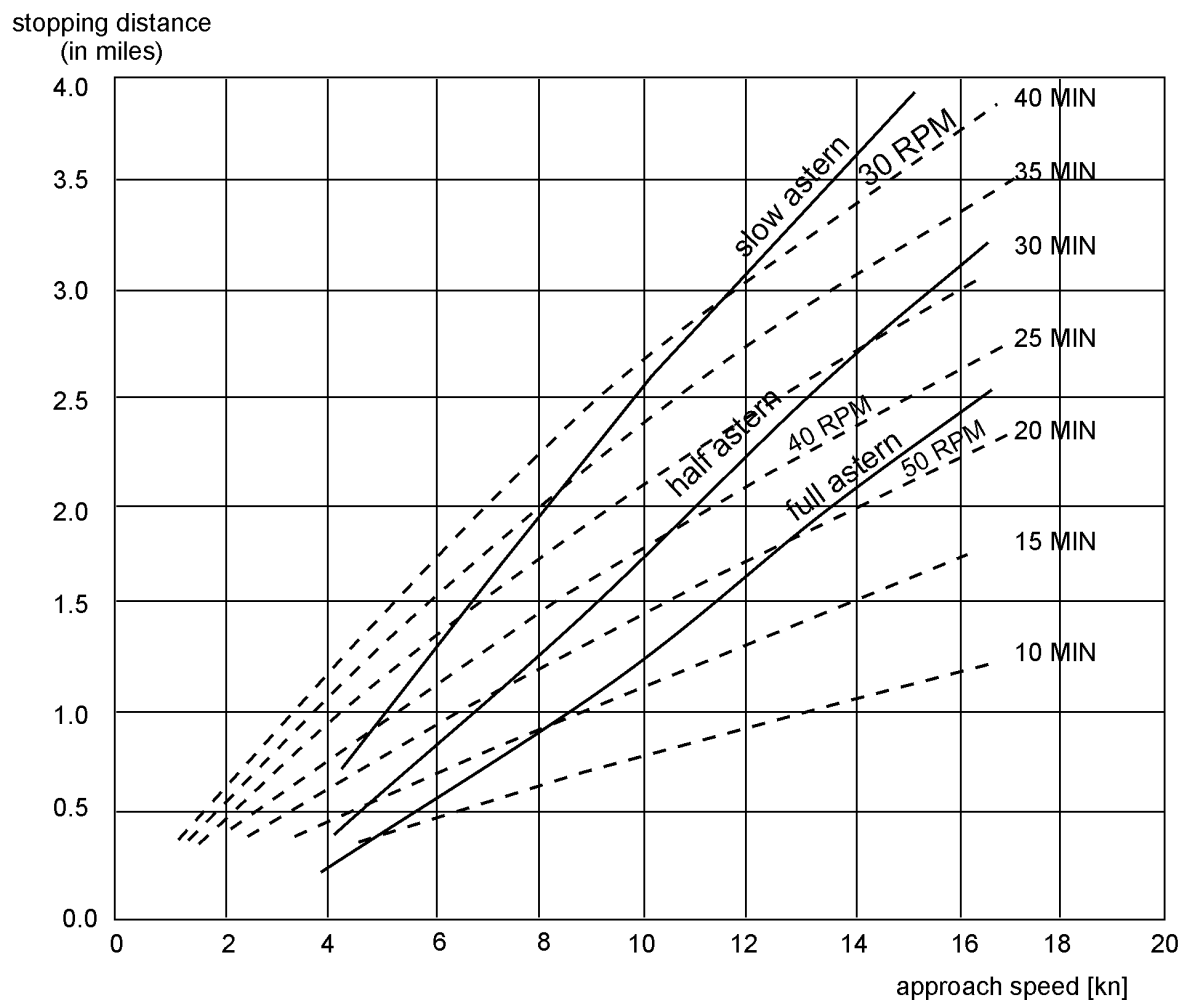


Fig. 4-7 Stopping distance for 210000 tdw tanker

4.3 Effect of different stopping techniques on stopping distance

4.3.1 Stopping using rudder cycling procedure

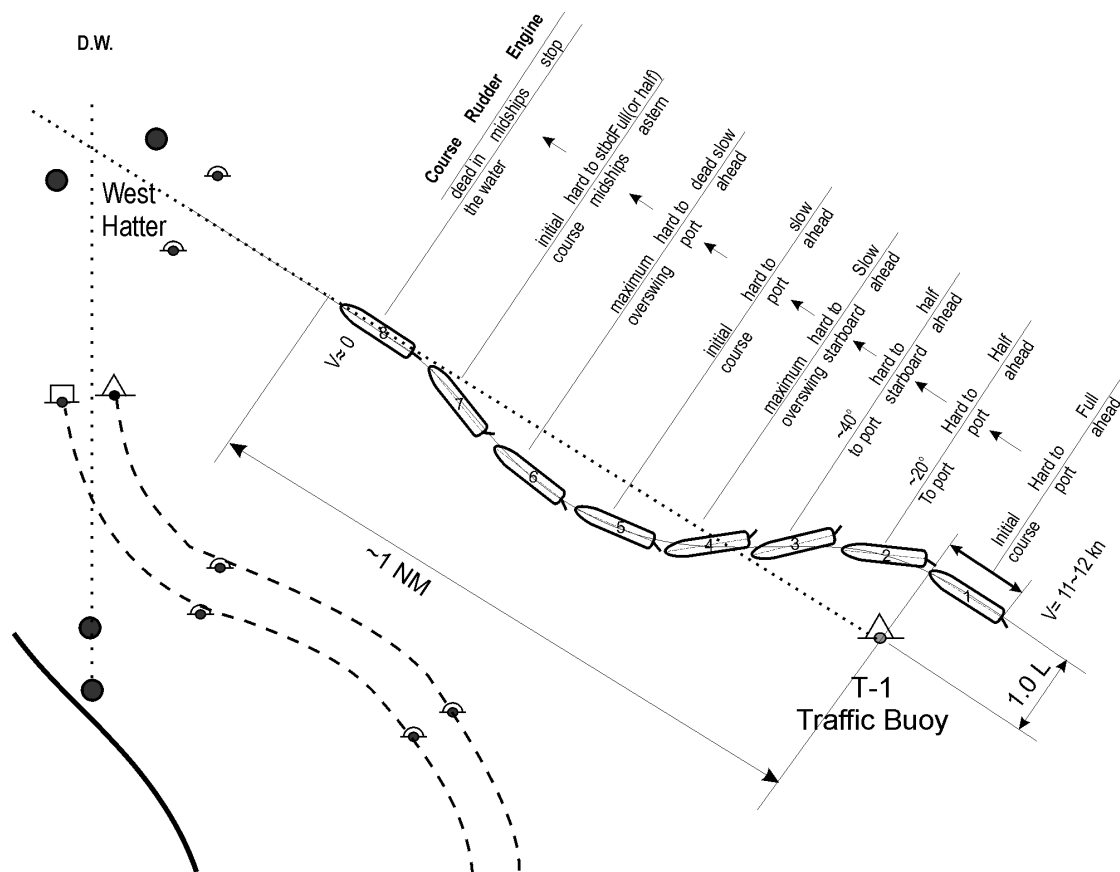


Fig. 4-8

4.3.2 Fairway stopping procedure

General remarks;

Try to keep the center of gravity, pivot point and midship section, always in the middle of the fairway.

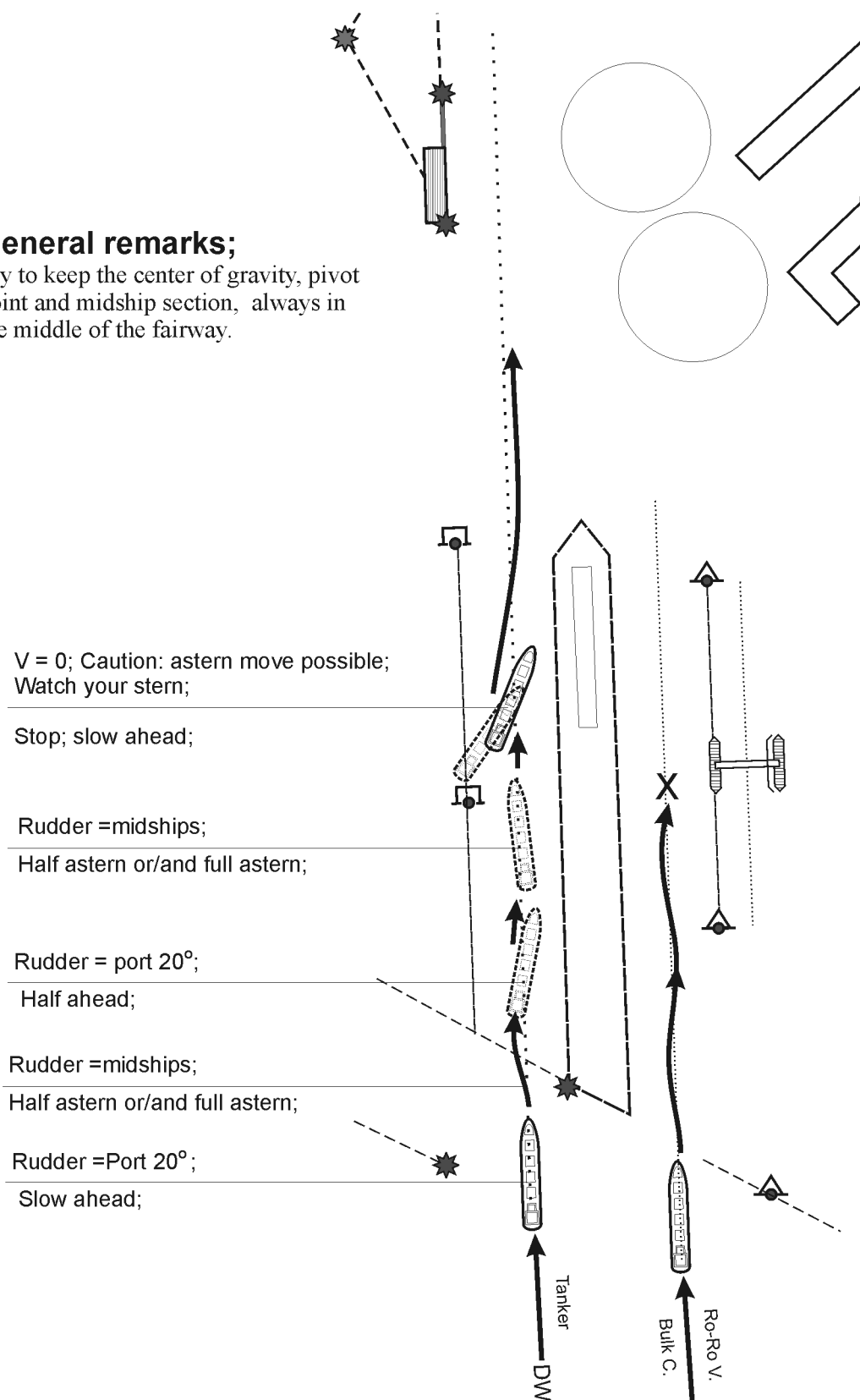
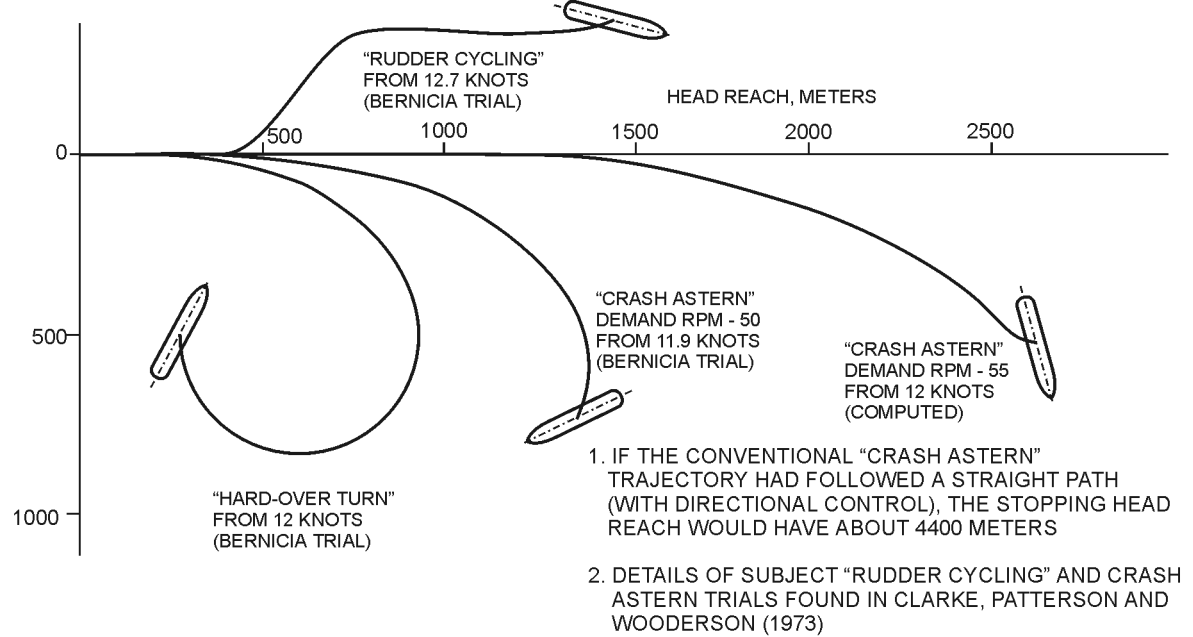


Fig. 4-9

4.3.3 Comparison of different stopping techniques



"Rudder cycling" stopping versus "crash astern" and hard-over turn from Esso Bernicia trials (Clark, 1970)
 Moderate approach speed of about 12 knots (Crane, 1973)

Fig. 4-10

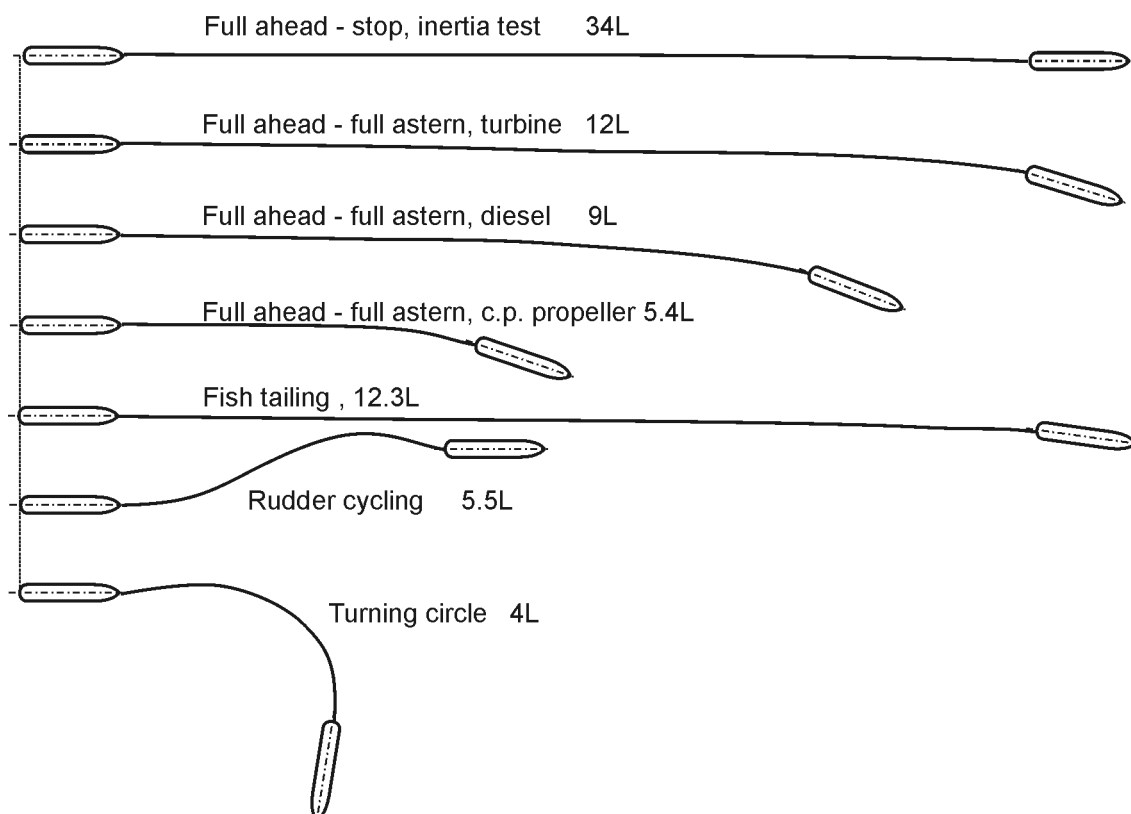


Fig. 4-11

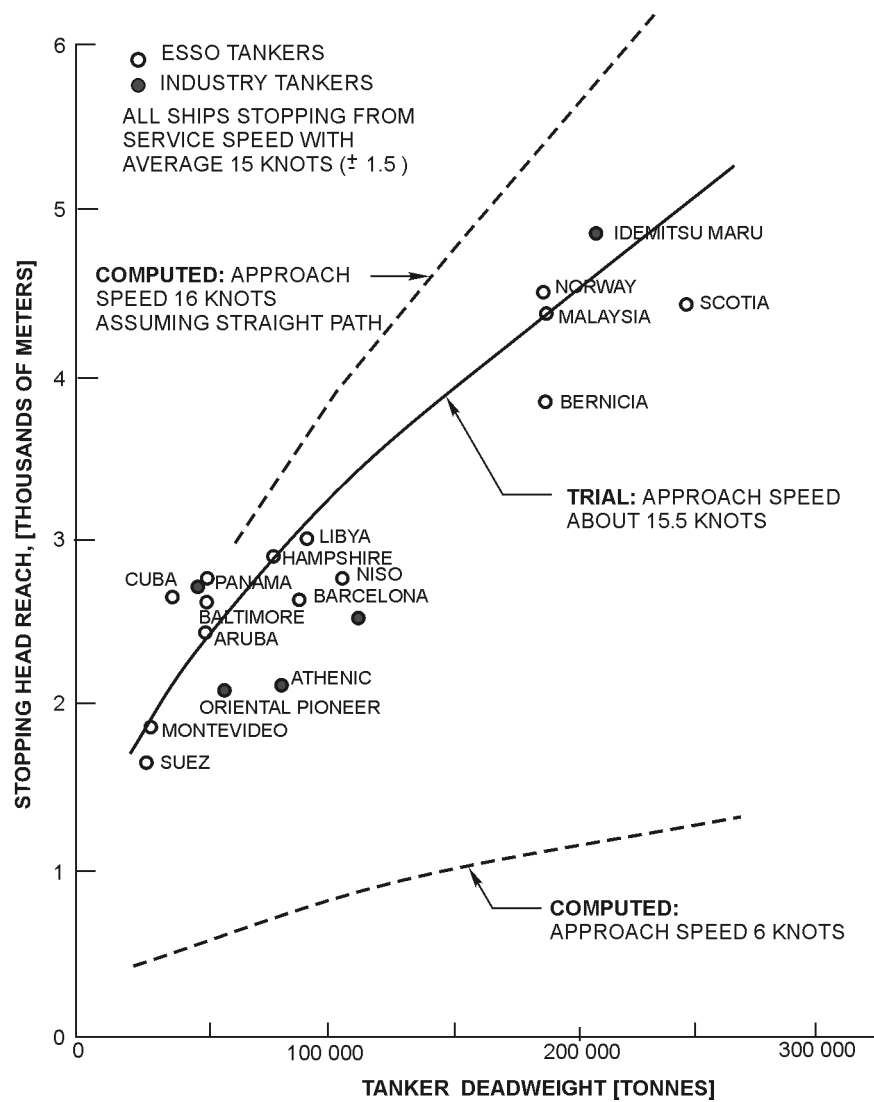


Fig. 4-12 General effect of ship size on stopping head reach (Crane, 1973)