UNITED NATIONS ESCAP
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TRAINING ON ANTAM STANDARD CODE For TESTING OF KNAPSACK MISTERS CUM DUSTERS

Theory 7: Engine performance- Characteristics- Control of dynamometer

2nd Training of Trainers on ANTAM Codes
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ANTAM
Asian and Pacific Network for Testing Agricultural Machinery

Mode of control

- A test programme for an engine coupled to a dynamometer a sequence of desired values of engine torque and speed. This sequence is achieved by manipulating only two controls: the engine speed (‘throttle’) and the dynamometer torque setting.
- The dynamometer torque is set according to the design of dynamometer used . For any given setting of the throttle, the engine has its own inherent torque-speed characteristic and similarly each dynamometer has its own torque-speed curve for a given control setting.
- The interaction of these two characteristics determines the inherent stability of the engine dynamometer combination.

Modes of control

- The engine or throttle control may be manipulated in three different ways:
  - to maintain a constant throttle opening (position mode);
  - to maintain a constant speed (speed mode);
  - to maintain a constant torque (torque mode).
- The dynamometer control may be manipulated:
  - to maintain a constant control setting (position mode);
  - to maintain a constant speed (speed mode);
  - to maintain a constant torque (torque mode);
  - to reproduce a particular torque–speed characteristic (power law mode).

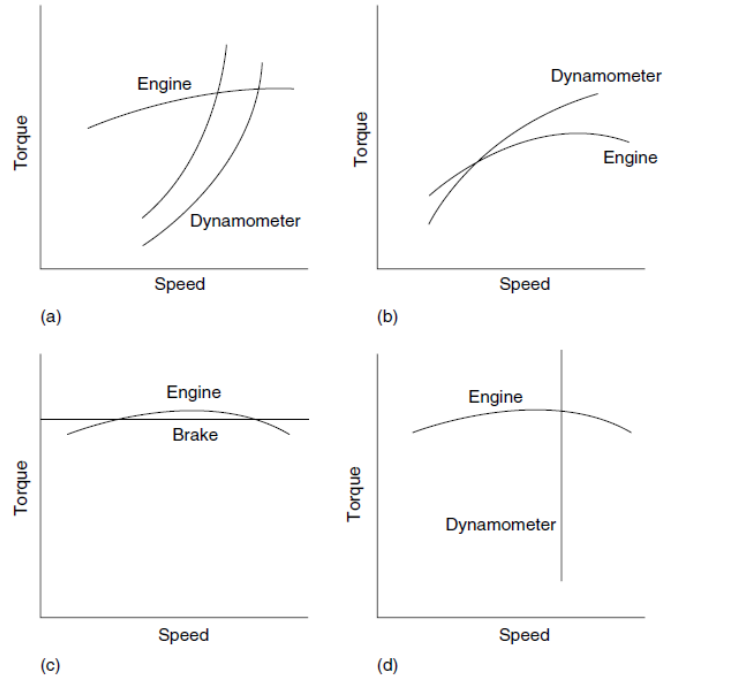
Position/position mode

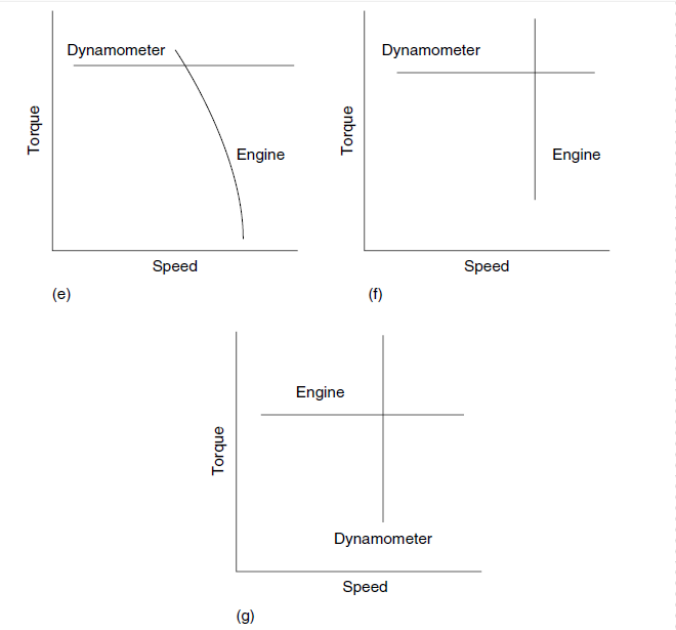
The throttle is set to a fixed position, the dynamometer control similarly set, and the system settles down in a stable state. Due to interaction of their characteristic speed torque relation for the particular setting

Position and power law mode

- This is a variation on position mode, in which the dynamometer controller is manipulated to give a torque–speed characteristic of the form
- Brake torque = constant × speed ^{n}

Control modes-engines and dynamometers:





(a) position mode stable hydraulic dynamometer;
(b) position mode unstable hydraulic dynamometer;
(c) position mode, friction brake;
(d) position/speed mode;

(e) position/torque, governed engine;
(f) speed/torque mode;
(g) torque/speed mode

Modes of control ….

- Position and power law mode:
  - This is a variation on position mode, in which the dynamometer controller is manipulated to give a torque–speed characteristic of the form

    Brake torque = constant × speed^{n}
- Position and speed mode:
  - In this mode, the throttle position continues to be set manually, but the dynamometer is equipped with an automatic controller which adjusts the torque absorbed by the machine to maintain the engine speed constant whatever the throttle position and power output, This is a very stable mode, and is generally used for plotting engine torque–speed curves at full and part throttle opening

- Position and torque mode (governed engines)
  - Governed engines have a built-in torque–speed characteristic, usually slightly ‘drooping’ (speed falling as torque increases). They are therefore not suited for coupling to a dynamometer in speed mode. They can, however, be run with a dynamometer in torque mode. In this mode the automatic controller on the dynamometer adjusts the torque absorbed by the machine to a desired value. Control is quite stable. Care must be taken not to set the dynamometer controller to a torque that may stall the engine.

Problems in achieving control

- An engine test system is an assembly of an engine, a dynamometer and various actuators and peripherals. Each of these has its own control characteristics and, in many cases, its own controller. The combined control characteristics are often very far from ideal. At the simplest level, a dynamometer with a control loop intended to produce a particular torque–speed characteristic can generate instabilities quite absent in an old-fashioned manually controlled (brake) dynamometer.