Contents

1 Starting

1.1 Maximum Load

- The maximum force a locomotive can output is equal to the friction between the wheels and rail
  - In other words the most force a locomotive can output (unless the engine can't produce more than this) is the locomotive's weight multiplied by the coeefficent of static friction of the wheels and rail (~.5 for steel-steel)
  - The most force a locomotive can output while stationary is called **starting tractive effort**
  - Thus if the train's static friction is greater then the starting tractive effort of all the locomotive's put together it cannot move, and trying to push the locomotives further will simply cause the wheels to spin

1.2 Accelerating

- The amount of power a locomotive can output is inversely proportional to the speed of the train
  - This means as the train accelerates and picks up speed, it's rate of accleration drops as the force output by the engine drops
    * The force for a desiel-electric motor can be approximated as `T=(Pn)/V`

      T tractive effort of locomotive in newtons

      P power of locomotive in watts

      n efficency of locomotive in converting power to force

V speed of locomotive in m/s

- Eventually this means the train can't accelerate past the point where the engine's tractive effort equals the rolling resistance of the train + air resistance

1.2.1 Math

2 While Moving

- Once a train reaches the equilibrium point where tractive effort is equal to resistances, the train will stop accelerating and stay at a constant speed

$$F = m \cdot a \tag{1}$$

Force is given by equation 1 above.