Detonation and Pre-ignition

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Normal Combustion

- Controlled burn of air/fuel mixture
- Lasts between .0005 and .004 seconds
- Flame front propagates at approx. 50 mph
- Combustion chamber temperature reaches between 2000 and 3000 degrees Fahrenheit

Detonation (post-ignition)

- The heat from compression along with the radiated heat from the initial flame front causes a secondary flame front to develop
- This second flame front can propagate at supersonic speeds
- This second flame front collides with the first creating extremely high cylinder temperatures (3500 F)and pressures (800 PSI)

Detonation Causes

- Excessive compression
- Insufficient fuel octane
- Carbon deposits

Pre-ignition

- Like detonation, pre-ignition causes two flame fronts to propagate and collide causing a dramatic increase in cylinder temperatures and pressure
- When the second flame front occurs before the spark plug fires the abnormal combustion is called pre-ignition
- Pre-ignition will cause excessive cylinder pressures (1200 PSI) and temperatures (4000 F)

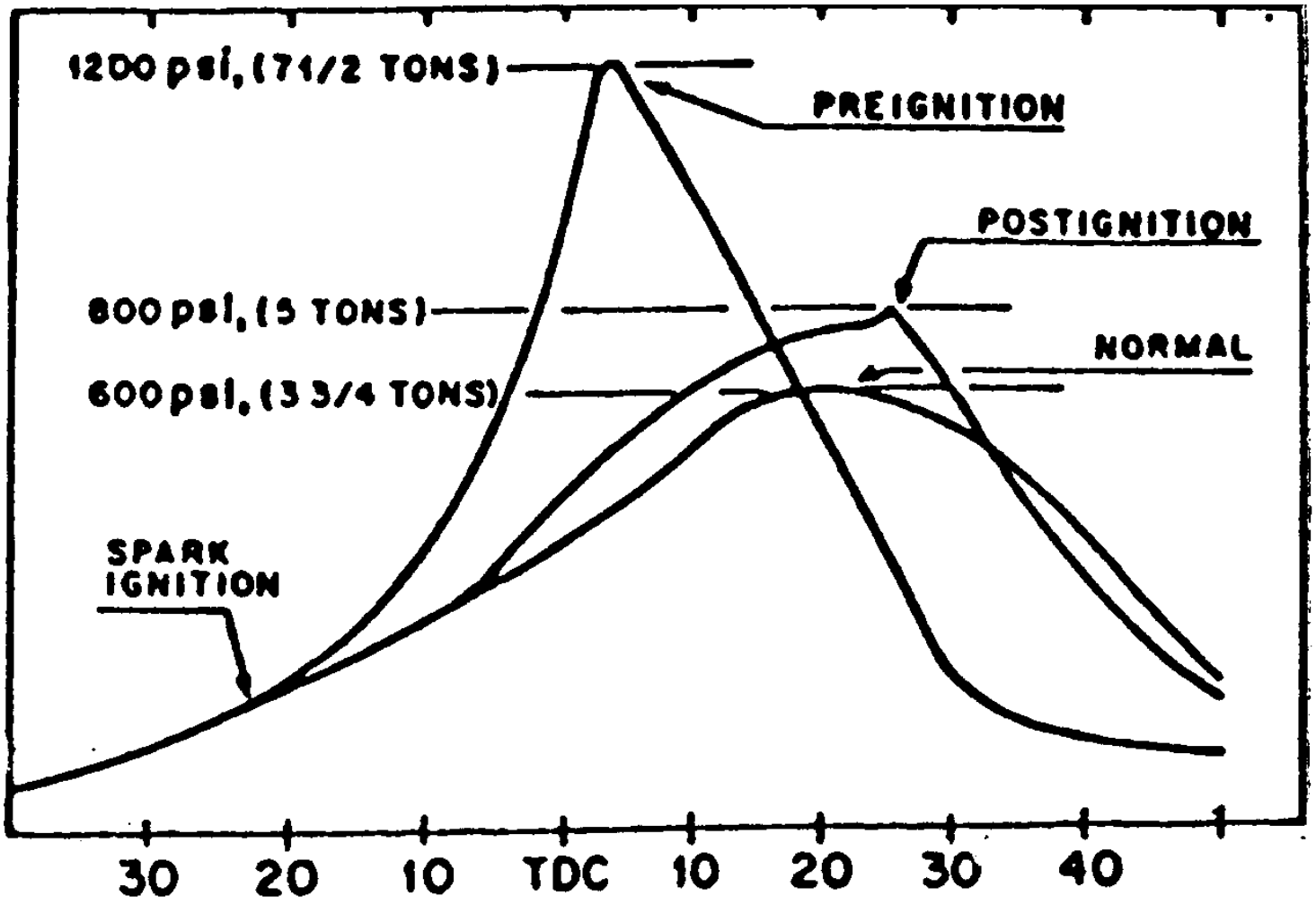
Pre-ignition Causes

- Excessive compression – as the temperature of compression approaches 1700 Fahrenheit fuel will spontaneously combust (depending on octane)
- Abnormal heat in the cylinder – caused by:
  - Detonation
  - Inoperative EGR valve
  - Faulty cooling system
  - Faulty intake air temperature control system
- Low octane fuel

Pre-ignition Causes

- Hot spots
  - Sharp edge on combustion chamber or piston
  - Carbon deposits
  - Too high heat range plug
  - Overheated valve (insufficient valve margin)
  - Head gasket fire ring protruding into cylinder
- Plug wire crossfiring

Abnormal Combustion Effects



Abnormal Combustion Effects

- Piston damage
  - Cracks in piston head
  - Cracks in ring lands
  - Melted piston head (aluminum spattered spark plug)
  - Micro-melting of ring lands causing stuck rings
- Broken rings
- Blown head gasket
- Spark plug damage
- Connecting rod, bearing, and crankshaft damage

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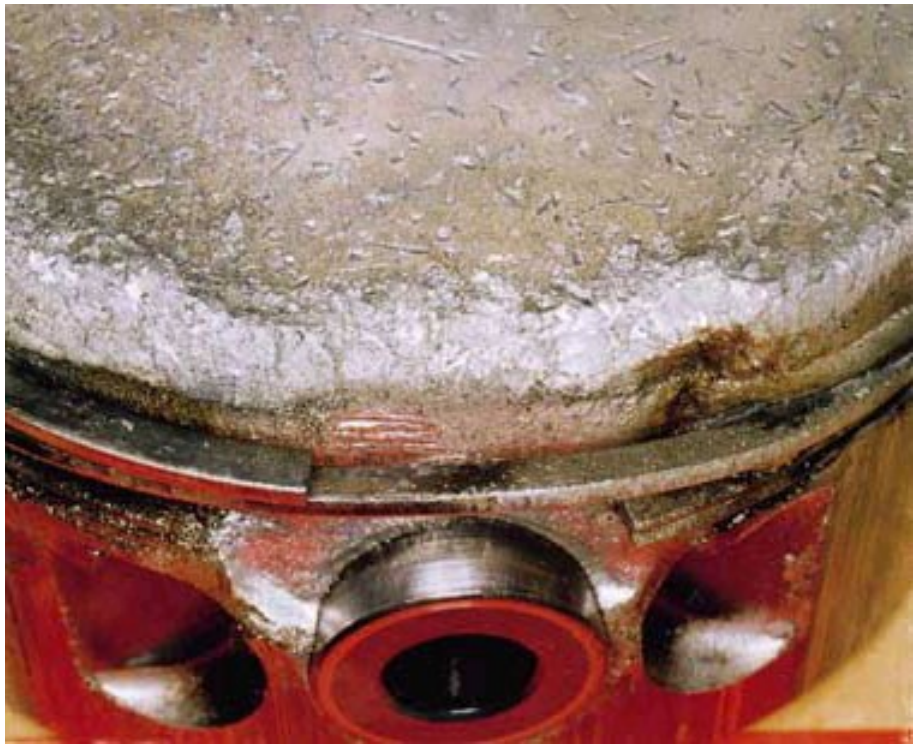

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