SECTION 4

ELECTRIC MOTORS

UNIT 19

MOTOR CONTROLS

DELMAR CENGAGE Learning

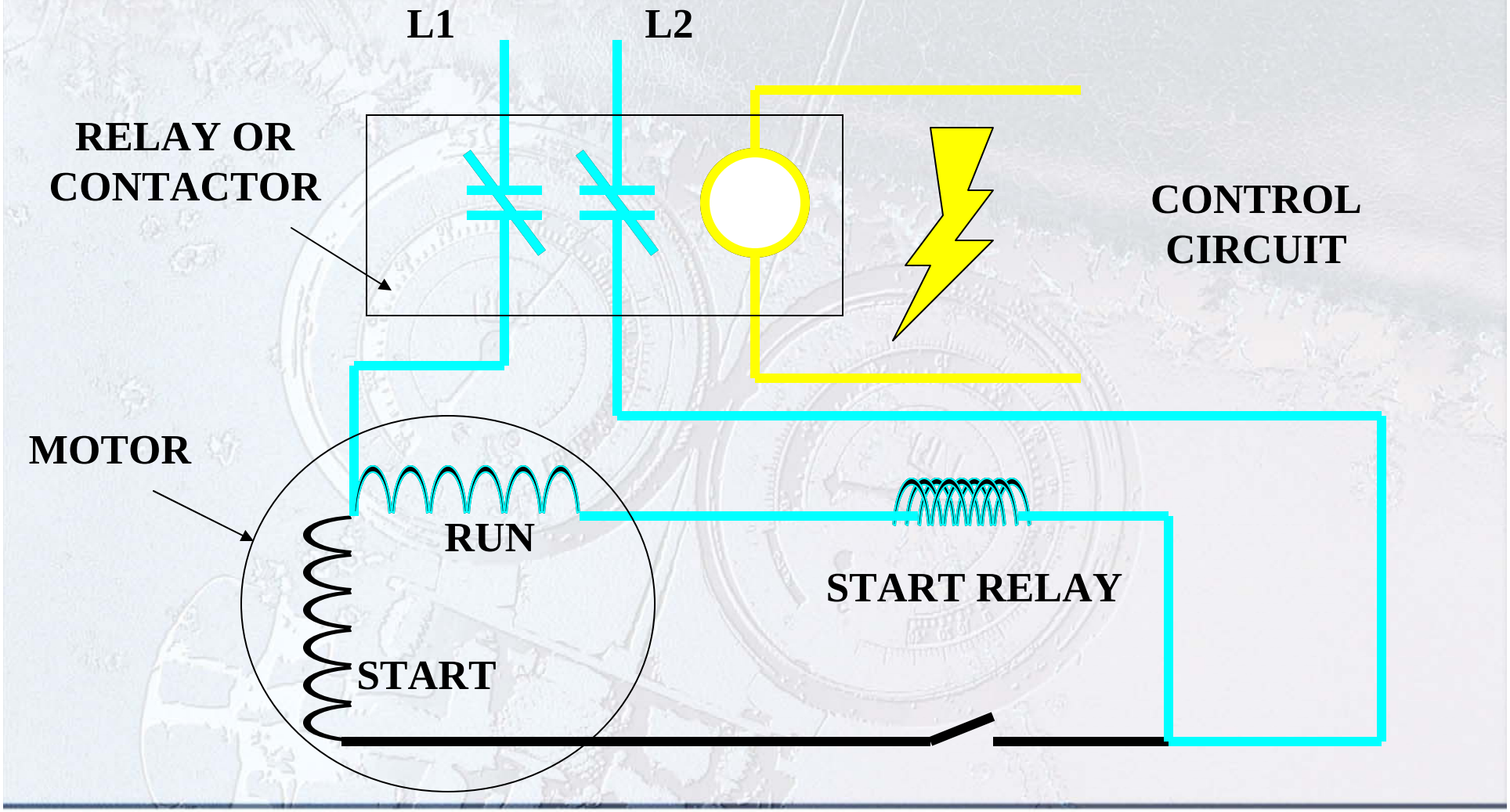
UNIT OBJECTIVES

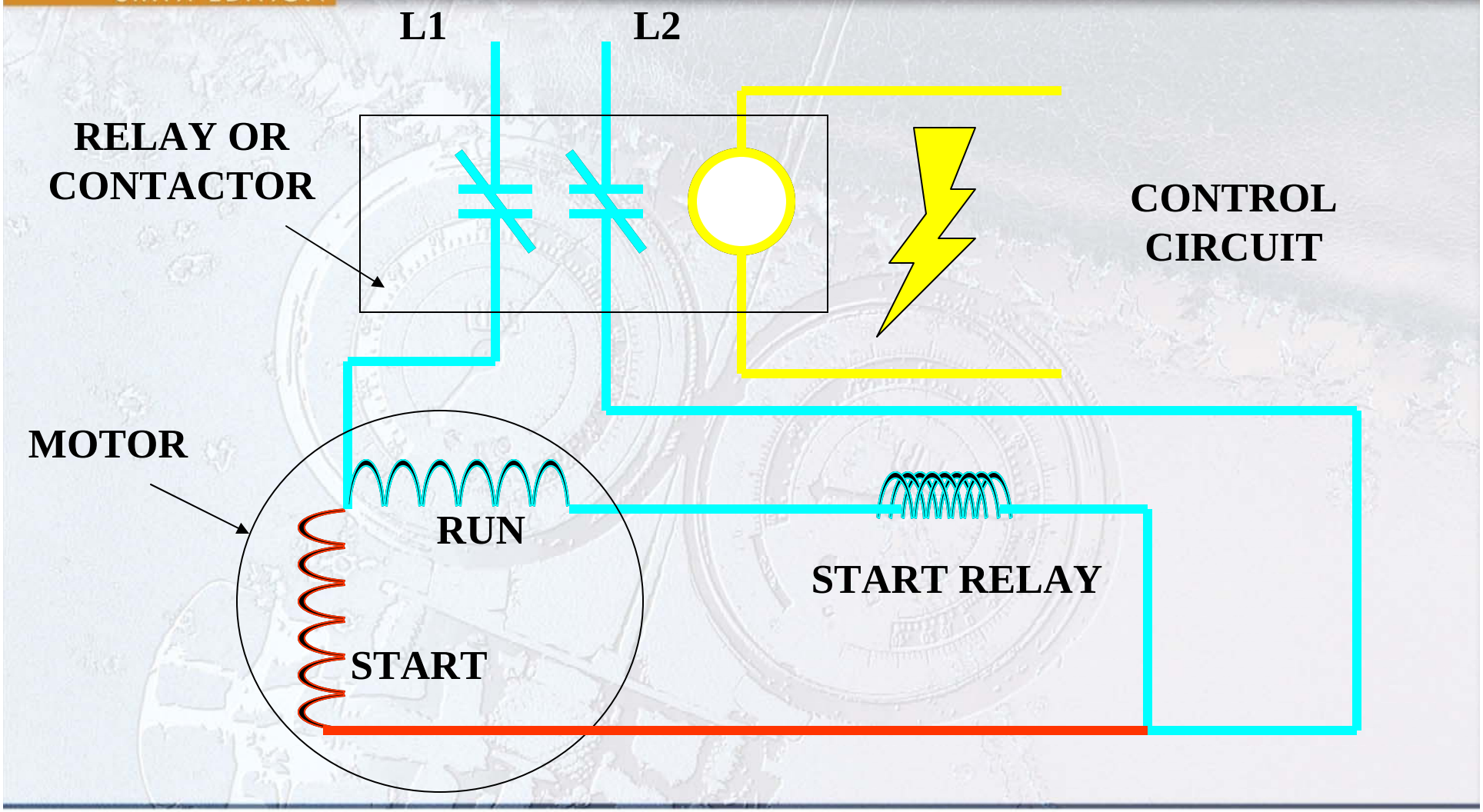
After studying this unit, the reader should be able to

- Describe the differences between a relay, a contactor, and a starter.
- State how the locked-rotor current of a motor affects the choice of a motor starter.
- List the basic components of a contactor and starter.
- Compare two types of external motor overload protection.
- Describe conditions that must be considered when resetting safety devices to restart electric motors.

INTRODUCTION TO MOTOR CONTROL DEVICES

- Relays, contactors and starters pass power to the motor by closing sets of contacts
- Contacts controlled by coils in the control circuit
- Starting relays are only in the active circuit for a short period of time
- The type of motor control used is determined by the size and application of the motor used



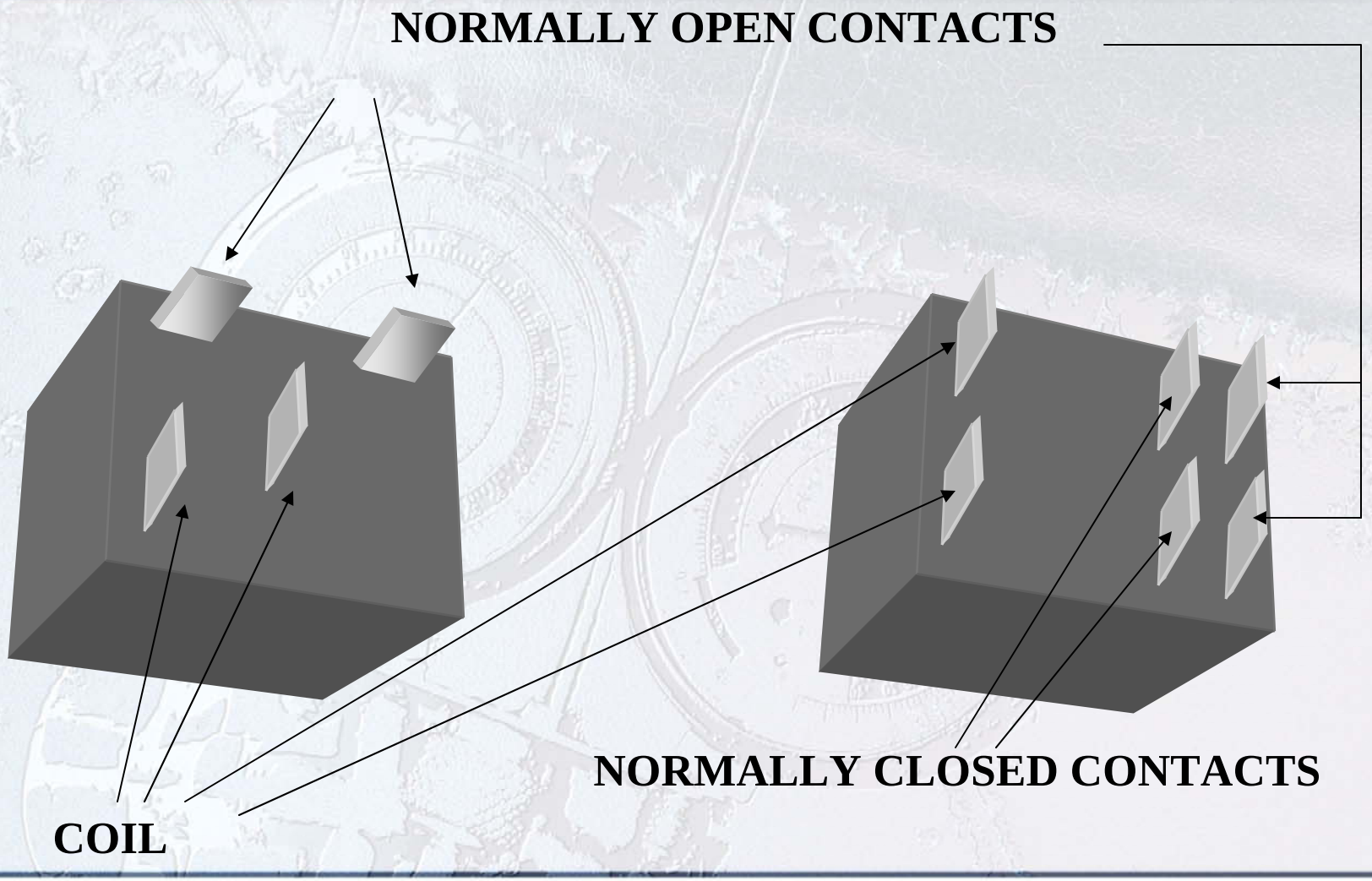


MOTOR AMPERAGES

- Running load amperage (RLA)
  - Similar to full load amperage (FLA)
  - Amperage drawn by the motor while operating
- Locked rotor amperage (LRA)
  - Amperage drawn by motor on startup
  - Five to seven times greater than RLA or FLA
- Both LRA and RLA must be considered when choosing a control device

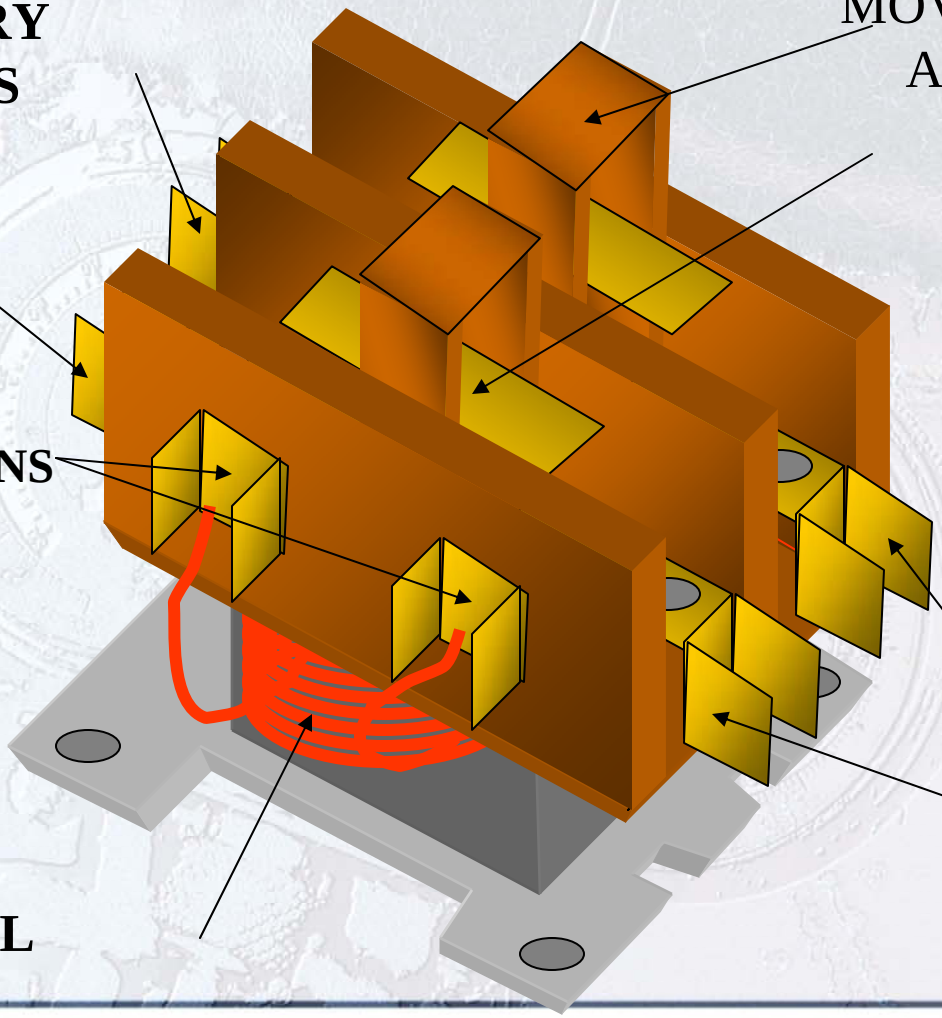
THE RELAY

- Uses a magnetic coil to open or close one or more sets of electric contacts
- Relays are not repaired. Replace on failure.
- Used for light duty applications
- Can be used as a pilot-duty relay
- The relay contacts must be able to handle the amperage draw of the load being controlled

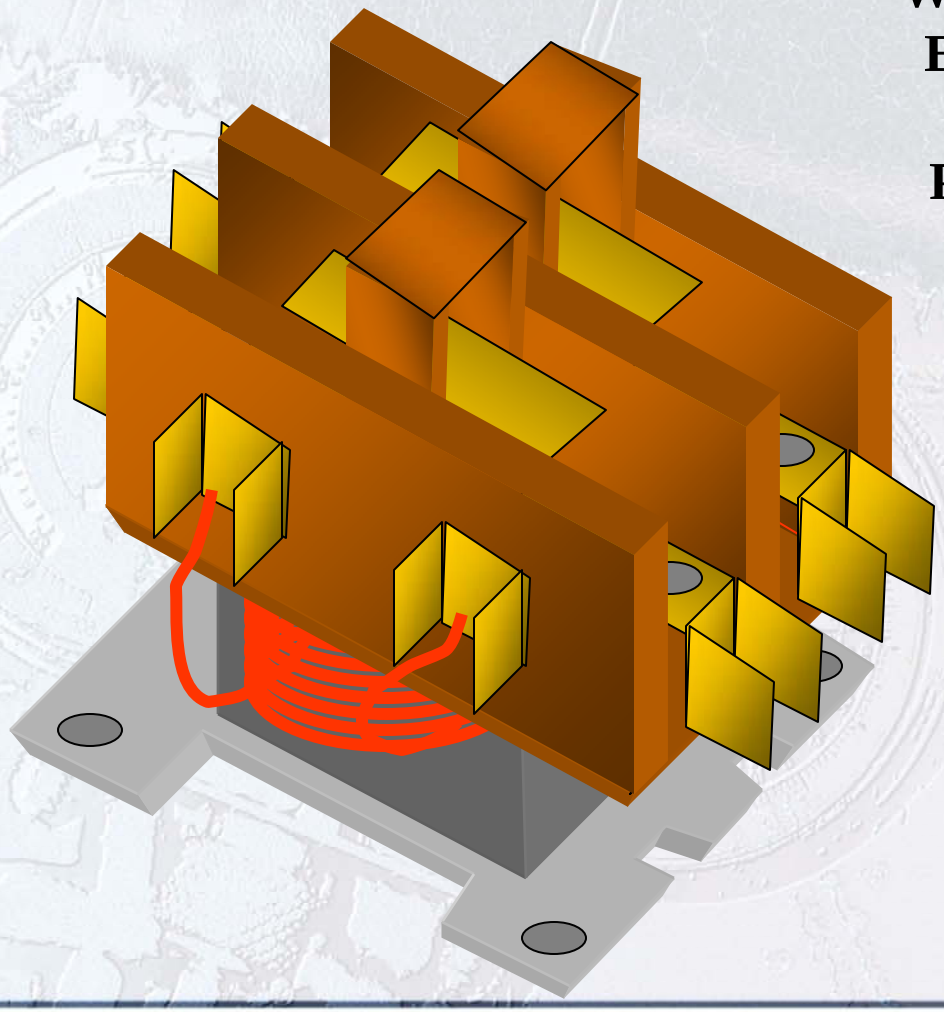


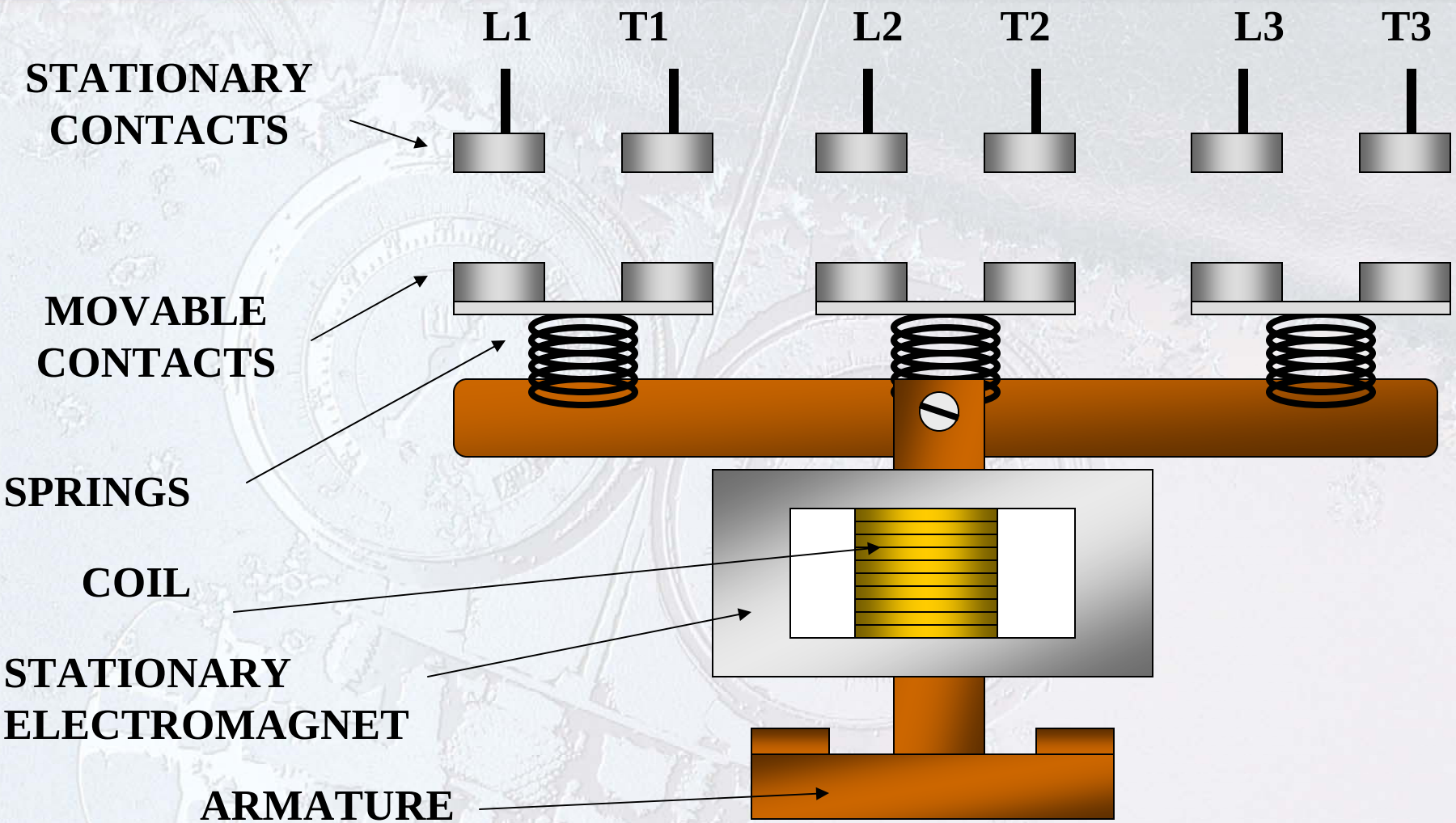
THE CONTACTOR

- Larger version of the relay
- Has movable and stationary contacts
- Holding coils are rated at different voltages
- Can have one or more sets of contacts
- Some are equipped with auxiliary contacts
- Contacts and coils can be replaced
- Use the exact replacement whenever possible



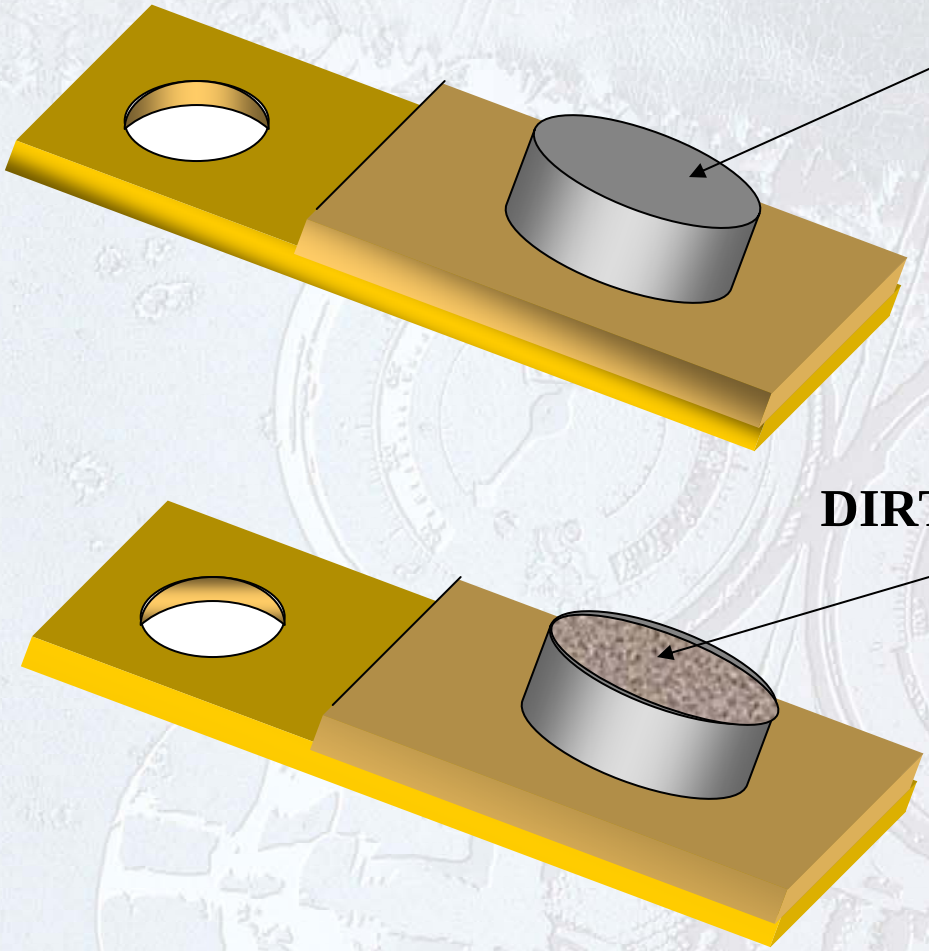
WHEN THE COIL IS ENERGIZED, THE CONTACTS ARE PULLED CLOSED





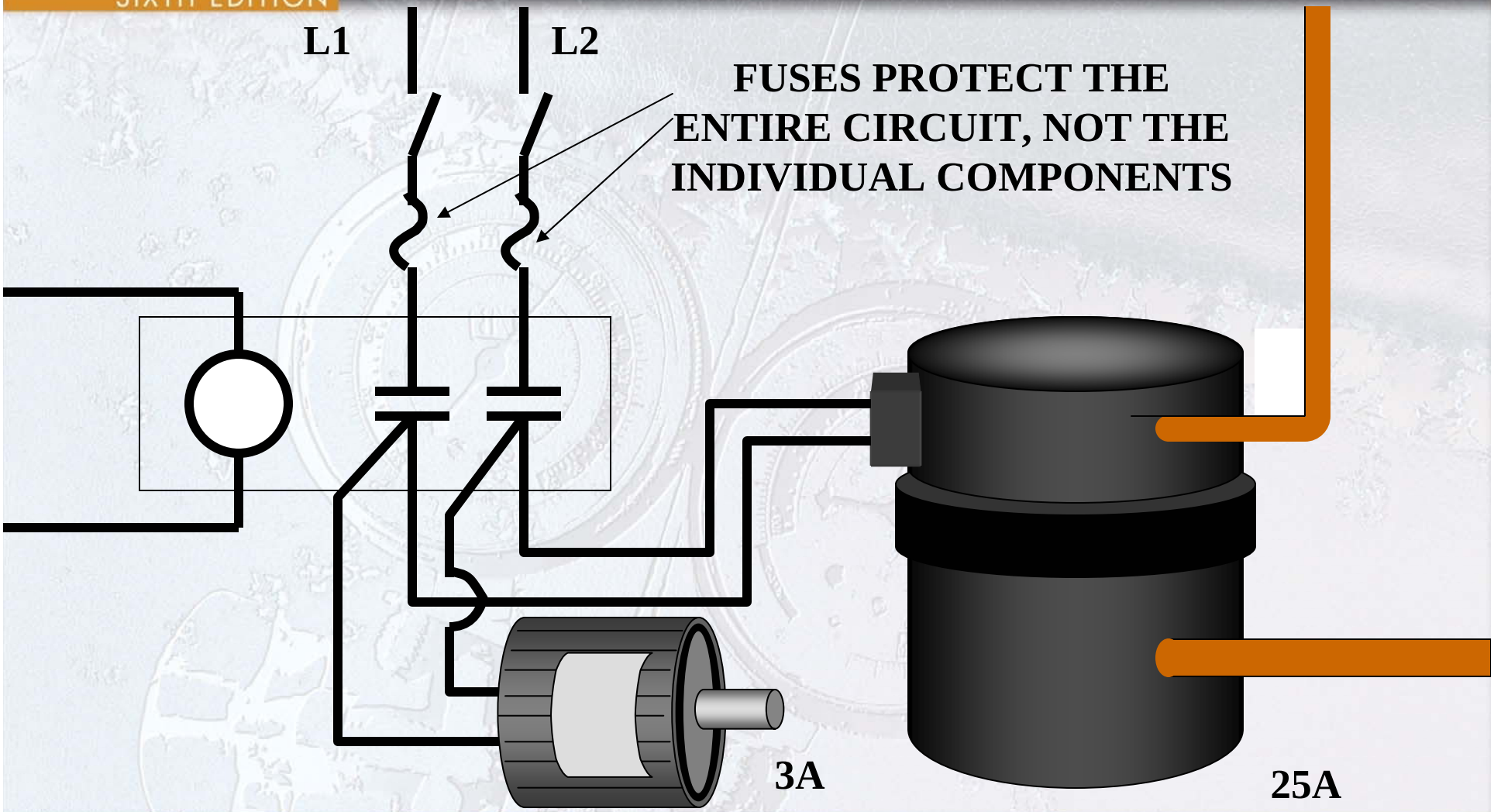
MOTOR STARTERS

- Contactor equipped with overload protection
- Coils, contacts and heaters can be replaced
- Contacts become pitted over time
  - Pitting increases the resistance across the contacts
  - The voltage across the contacts will increase
  - The voltage across a good set of contacts should be about zero volts



MOTOR PROTECTION

- Motors are expensive and must be protected
- Fuses and circuit breakers protect the entire circuit, not the individual circuit components
- Motors can operate under an over current condition for a short period of time
- Most small motors have no overload protection
- The larger the motor, the more elaborate the method of motor protection should be
- Motor protection can be inherent (internal) or external



INHERENT (INTERNAL) MOTOR PROTECTION

- Internal thermal overloads
  - Usually embedded in the motor windings
  - Open on a rise in temperature
- Thermally activated bimetal snap discs
  - Positioned so that contact is made between the bimetal control and the motor
  - Snap action opens contacts if the motor temperature rises above the desired level

EXTERNAL MOTOR PROTECTION

- Devices that pass power to the holding coil of the starter or contactor
- Devices open when an over current condition exists
- The trip point and type of overload protector are determined by the manufacturer
- The overload device takes the service factor of the motor into consideration

NATIONAL ELECTRIC CODE (NEC) STANDARDS

- Sets standards for electrical installations
  - Conductor sizes and ampacities
  - Cable materials and applications
  - Electrical devices
- Sets standards for motor overload protection
- The published code book should be consulted if questions or concerns are encountered on the job

TEMPERATURE-SENSING DEVICES

- Bimetal elements
  - Devices called heaters wired in series with the load
  - The heater is exposed to the current draw of the load
  - The bimetal warps and open when it gets too warm
  - The open bimetal de-energizes the starter holding coil
- Solder pot
  - Uses solder with a low melting point
  - The solder melts when excessive temperature is sensed
  - Excessive heat results from the overcurrent condition

MAGNETIC OVERLOAD DEVICES

- Accurate means to provide overload protection
- Device is not attached to the starter
- Device is not affected by increased ambient temperatures
- The contacts within the device will open to de-energize the motor at the desired amperage level

RESTARTING THE MOTOR

- Motors should not be restarted immediately
- Cause for the overload condition must first be located and repaired
- Motor must be given ample time to cool
- Many control devices are manually reset
- Some controls reset automatically after a predetermined time delay
- Time delay feature prevents short cycling

UNIT SUMMARY

- Relays, contactors and starters pass power to motors
- Contacts controlled by control circuit holding coils
- Relays are used for light duty, contactors for heavier duty applications, starters have built-in overloads
- Contacts on contactors and starters can be replaced
- Fuses and circuit breakers protect the entire circuit, not the individual circuit components
- Motor protect can be inherent or external