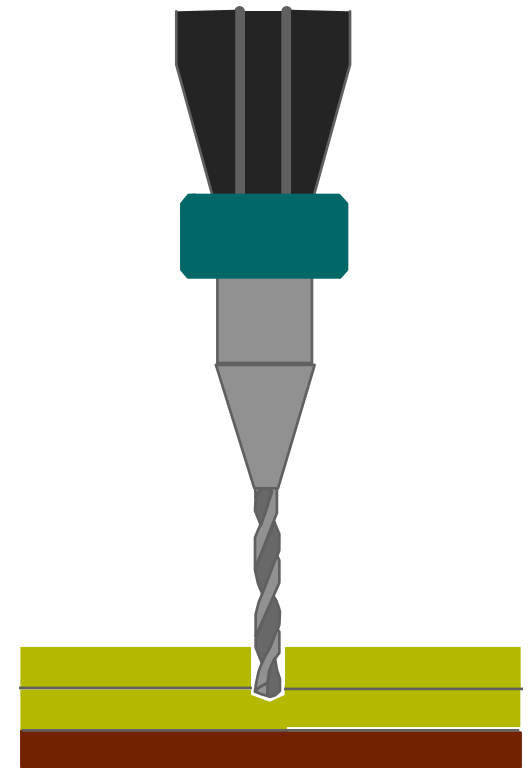


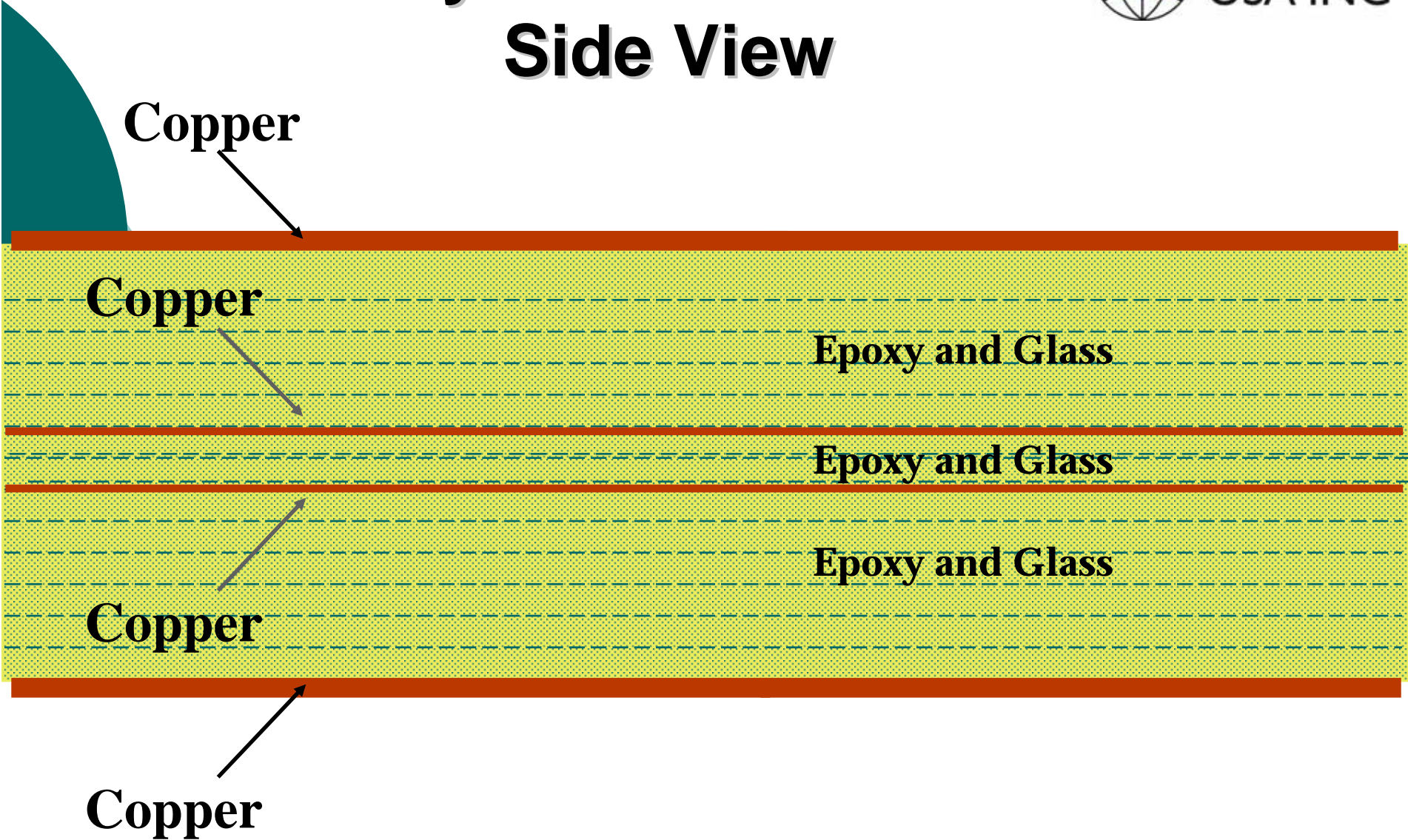
Basic Drilling Concepts



What Is Laminate Made of?

- Copper Sheets
 - Copper acts as a conductor.
- Glass Cloth
 - Provides stability
 - Keeps the circuits away from each other.
- Epoxy Resin
 - The glue that holds the laminate together.

4 Layer Circuit Board Side View



Copper

Copper

Epoxy and Glass

Epoxy and Glass

Epoxy and Glass

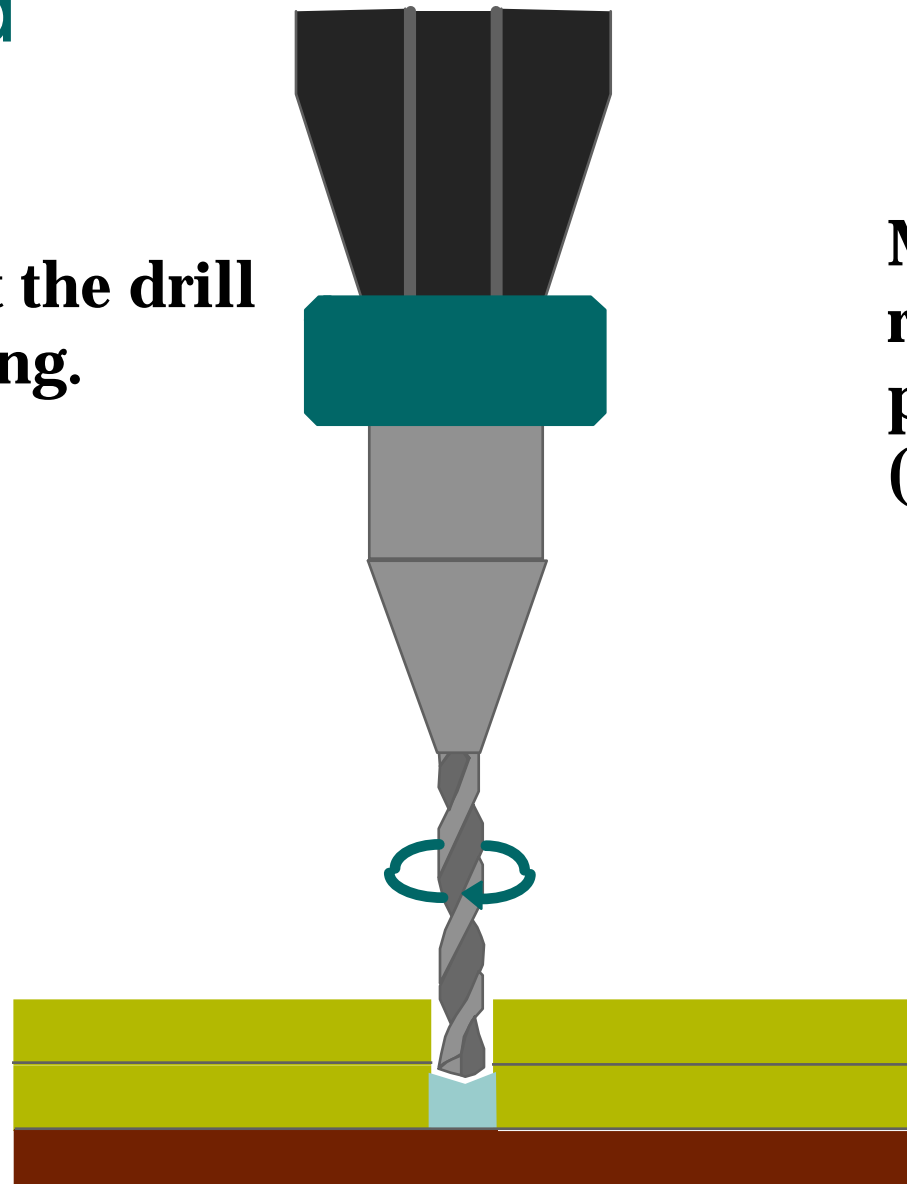
Copper

Copper

Speed

**How fast the drill
is spinning.**

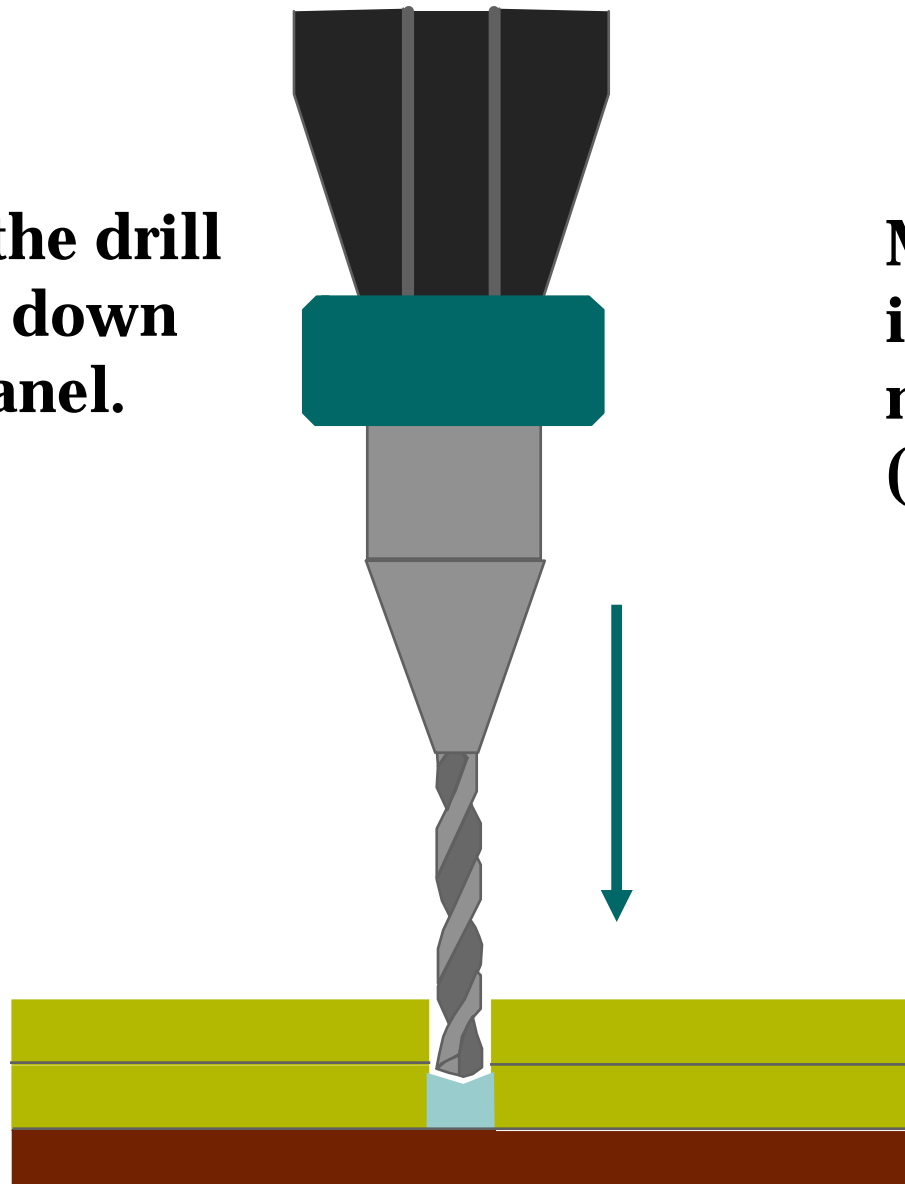
**Measured in
revolutions
per minute
(rpm).**



Infeed

**How fast the drill
is moving down
into the panel.**

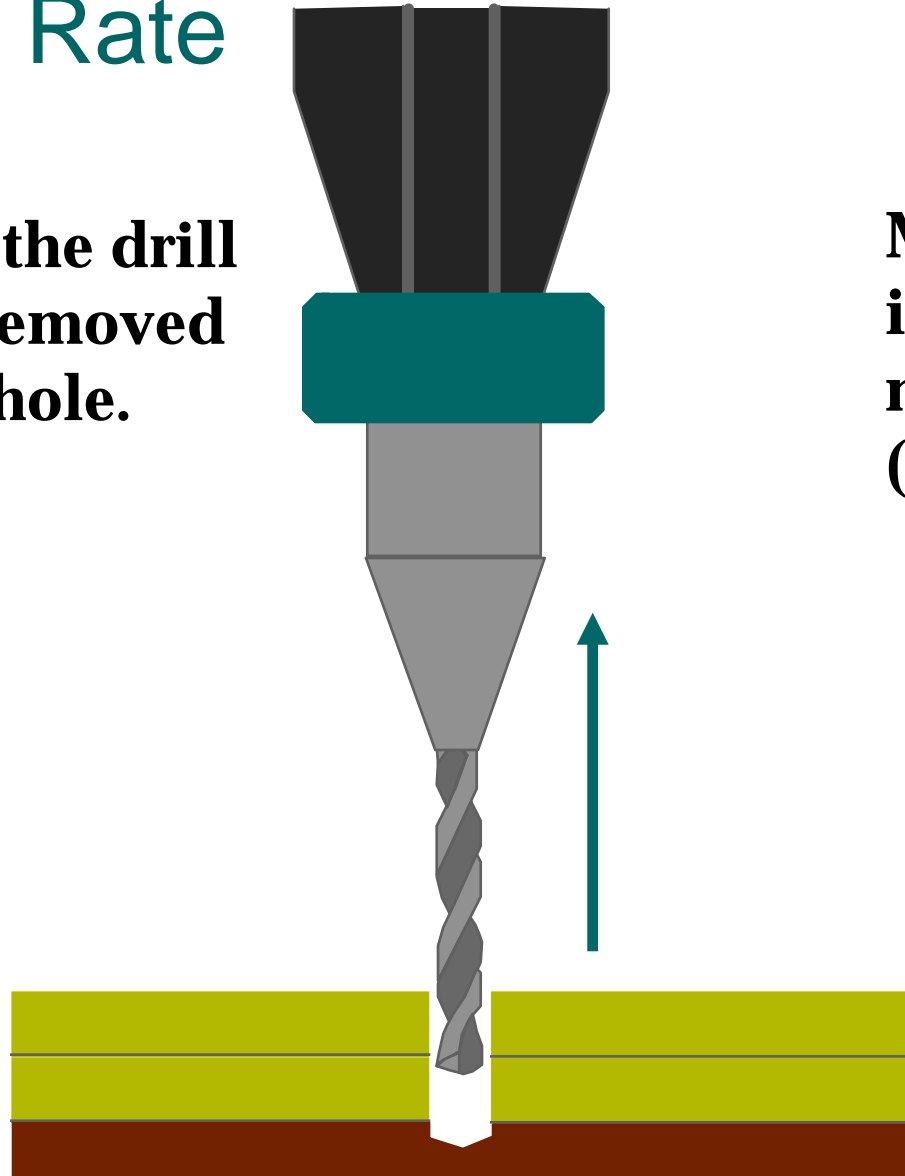
**Measured in
inches per
minute
(ipm).**



Retract Rate

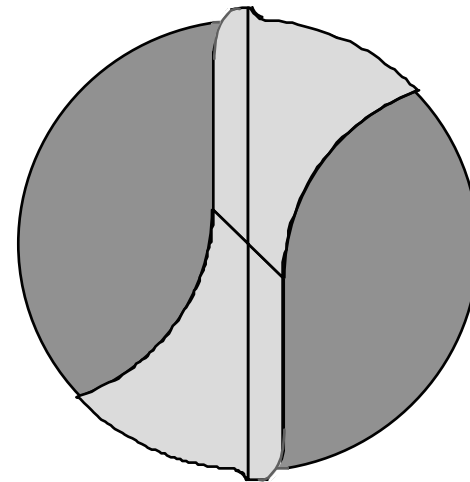
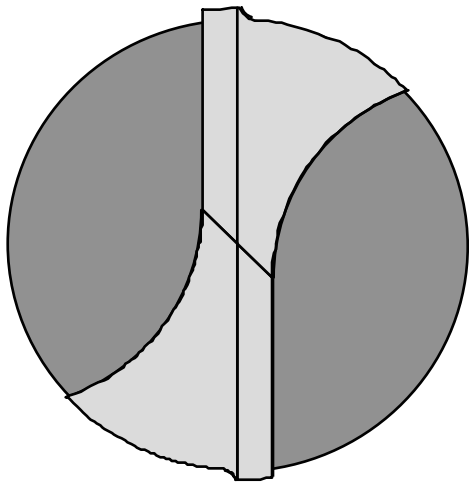
How fast the drill is being removed from the hole.

Measured in inches per minute (ipm).



Hit Counts

The maximum number of hits on a specific drill before the drill is considered 'DULL'.




What Determines the Maximum Hit Count?

- **Drill Size**
- **Drill Material (carbide)**
 - Wear Characteristics**
- **Stack Height**
- **Construction of Board**
 - **Copper Weight**
 - **Number of Layers**
 - **Glass Style**
- **Entry Material**
- **Backup Material**
- **Feeds & Speeds**
- **Hole Wall Quality**
- **Depth Into Backup**

Chipload

Definition: The amount of material removed during one revolution of the drill.





$$\mathbf{CHIPLOAD = \frac{INFEED}{SPEED}}$$

Example of calculating CHIPLOAD:

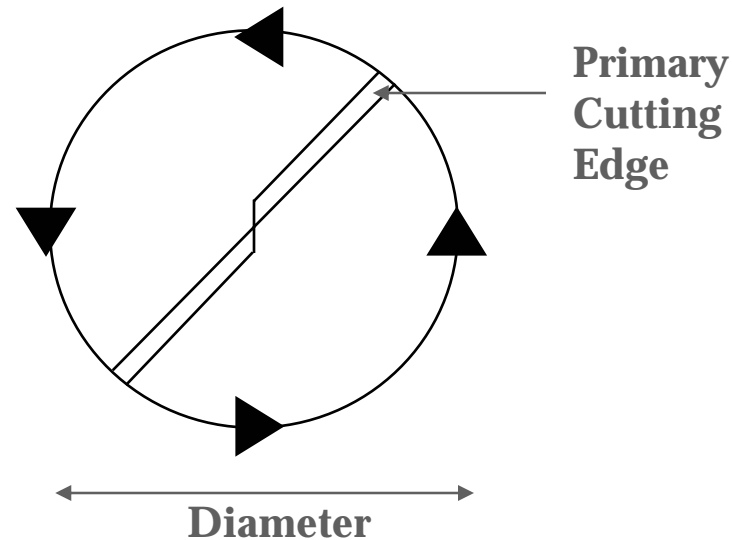
Drill Bit Size 0.250
Infeed 40 ipm
Spindle Speed 20,000 rpm

$$\mathbf{CHIPLOAD = \frac{40}{20,000} = 0.002}$$

$$\mathbf{CHIPLOAD = 2 \text{ mils}}$$

Surface Feet per Minute (SFM)

Definition: The amount of linear feet the cutting edge corner travels in one minute.





$$\text{SFM} = \frac{\text{Speed} \times \Pi \times \text{Diameter}}{12}$$

Example of calculating SFM:

Drill Bit Size 0.250
Spindle Speed 20,000 rpm

$$\text{SFM} = \frac{20,000 \times \Pi \times 0.250}{12}$$

$$\text{SFM} = 1308 \text{ SFM}$$



Entry Material

- Increases Drilled Hole Accuracy
- Protects the Surface of the Top Panel
- Helps Reduce Burring on the Top Panel



Types of Entry Material

- Solid Aluminum
- Aluminum Clad
- Resin-Based Phenolic
- Paper-Based Phenolic
- Paper

Backup Material

- Provides an Exit for the Drill
- Reduces Bottom Panel Burring
- The Type of Material Used Can Affect
Hole Wall Quality

Types of Backup Material

- Aluminum Clad
- Phenolic Clad
- Paper Clad
- Phenolic
- Hardboard

Stack Height

Definition: The total number of panels being drilled through with each stroke.





Stack Height Considerations

- Drill Design and Diameter
- Panel Thickness
- Flute Length
- Depth Control Into the Backup
- Annular Ring Requirements
- Percentage of Copper in panel