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ΠΑΤΡΩΝ  
UNIVERSITY OF PATRAS

ΑΝΟΙΚΤΑ ακαδημαϊκά  
μαθήματα ΠΠ

# Αριθμητικός Έλεγχος Εργαλειομηχανών

## Ενότητα 5: Programming Coordinates

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# COMPUTER NUMERICAL CONTROL OF MACHINE TOOLS

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# Objectives of section 5

- Explain what a hole operation is
- Program hole operation coordinates using absolute and incremental positioning
- Program milling coordinates using absolute and incremental positioning



# Hole Operations

- The holes is one of the most common processes
- In most cases, the creation of a hole requires the **repetition of particular steps**
- The **standardization** of these steps allows the introduction of drilling cycles to simplify programming
- For drilling the holes a **control method from point to point** is used
  - Control the movement of the cutter at X-Y axes with maximum speed
  - Control of the Z axis with cutting speed (feed-rate)



# Drilling a Hole

## Minimum number of steps for drilling a hole:

- **1<sup>st</sup> Step** : Rapid cutting tool movement of the at the hole ... *movement in axes X and / or Y*
- **2<sup>nd</sup> Step** : Rapid movement at the cutting height .... *movement in the Z axis*
- **3<sup>rd</sup> Step** : Cutting with feed-rate speed to the desired depth of the hole .... *movement in the Z axis*
- **4<sup>th</sup> Step** : Return to the reference plane .... *movement in the Z axis*



# Different Types of Canned Drilling Cycles

## ● G code :

- **G80** - Cancel canned cycle
- **G81** - Simple drilling cycle
- **G82** - Drilling cycle with dwell
- **G83** - Peck drilling cycle
- **G84** - Tapping cycle, right-hand thread
- **G85** - Reaming cycle
- **G86** - Boring cycle and spindle stop



FIGURE 1 Titanium Drilling



# Milling Operations

## MILLING Operations

- The system of coordinates presented thus far is used for centering a spindle over a particular location specified on a drawing
- This means that when a coordinate location is given to the machine the ***center of the spindle*** is sent to that location

## Milling Cutters PROBLEM

- More than the correct amount of stock would be removed from the part
- This amount will be equal to the ***Radius of the Cutter***

## SOLUTION

- When positioning the spindle for the milling operation an ***allowance*** must be made for the radius of the cutter



# Summary

- To program a **hole location coordinate**, the **center line** for the hole is used
- To program a coordinate for milling operations, the coordinate for the location must include an appropriate **allowance for the radius** of the cutter
- For **absolute positioning**, the datum reference plane remains the X0, Y0 point for all programmed moves
- For **incremental positioning**, the current coordinate location is the X0, Y0 point for the next move
- CNC machines are capable of **mixing absolute and incremental positioning**. This allows for flexibility in programming
- Metric measurement in the machine shop is based on the millimetre, where: 0.02mm is roughly equivalent to 0.001inch
- To **convert** an inch dimension to millimetres, **multiply the inch dimension by 25.4**
- To **convert** a metric dimension to inches, **multiply the metric dimension by 0.03937**, or
- Divide the **metric dimension by 25.4**





# End of Section



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