Single Point Cutting Tool Geometry

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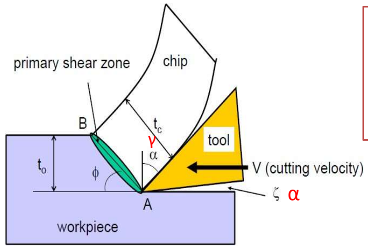
Outline

- Tool Geometry, Tool Angles
- Systems for Tool nomenclature
  - ISO System - *ORS/NRS*
  - American Standards System - *ASA*
- Tool Angle Conversion: ISO ⟷ ASA
  - Mathematical Basis

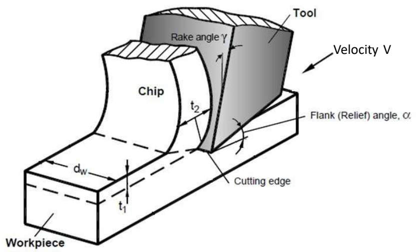
Orthogonal Machining



Rake angle γ

Clearance angle α

Orthogonal machining

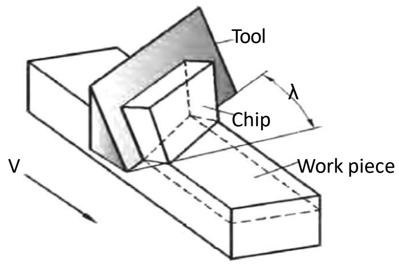


Orthogonal machining

Characteristics

- Tool Cutting edge is Perpendicular to the cutting Velocity Vector (V)
- Plain Strain (2D) deformation phenomenon
- No Spread of material along the Tool width

Oblique machining



Inclination Angle λ

Oblique machining

Characteristics

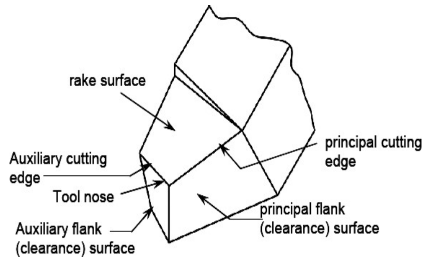
- Tool Cutting edge is at an angle (λ) to the Normal to the velocity vector (V) in the cutting plane
- Inclination angle λ
  - modifies Tool angles
  - governs the Direction of chip flow

Stabler's Law for Chip flow

$n_c = k.\lambda$ nc = chip flow angle

K = 0.8 – 1.0

Single Point Tool Geometry



Tool Nomenclature Systems

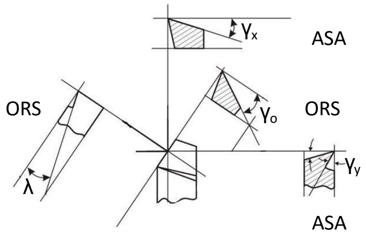
Tool in Hand

- ISO System : *ORS/ NRS*
  - Orthogonal/ Normal Reference System
- American Standards Association (ASA) system

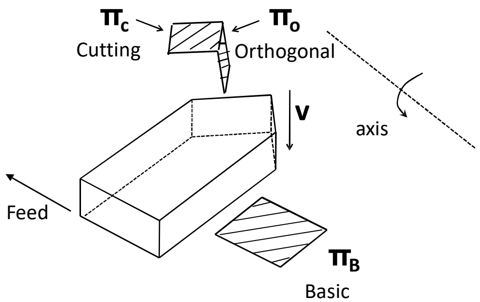
Tool in Machine

- Tool /Insert setting in fixture

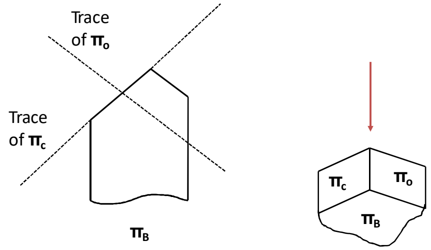
Tool Angle Reference Systems ORS and ASA



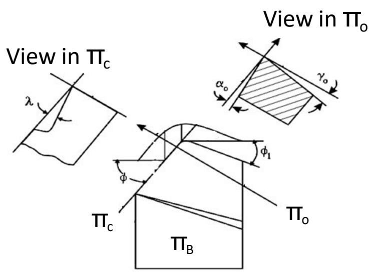
Tool Reference Planes



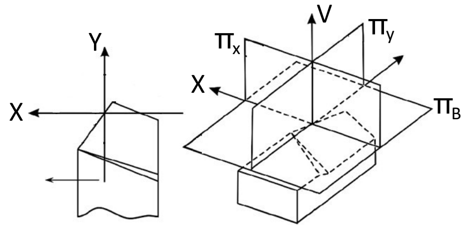
Orthogonal (ORS) Reference Planes



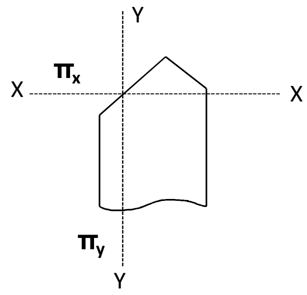
Reference Planes - ORS



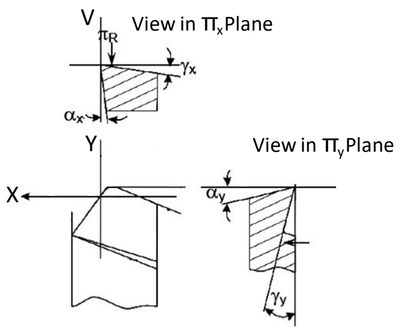
Reference Planes – ASA system



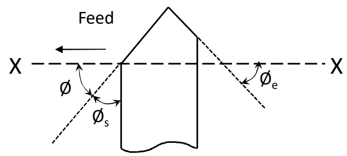
ASA Reference Planes



Tool Angles – ASA System



Tool Angles



Ø = Plan Approach angle
$Ø_s$ = Side cutting Edge angle
$Ø_e$ = End cutting Edge angle

Ø = 90 - $Ø_s$

Tool Designation

ASA System

γ_y, γ_x, α_y, α_x, $Ø_e$, $Ø_s$, r

γ_y : Back rake angle
γ_x : Side rake angle
α_y : Front clearance angle
α_x : Side clearance angle
$Ø_e$: End cutting Edge angle
$Ø_s$: Side cutting Edge angle
r : Nose radius (mm)

Tool Angle Conversion

ORS ⟶ **ASA**

(γ_o, λ) (γ_x, γ_y)

$$\begin{bmatrix} tan\gamma_x \\ tan\gamma_y \end{bmatrix} = \begin{bmatrix} sin\emptyset & -cos\emptyset \\ cos\emptyset & sin\emptyset \end{bmatrix} \begin{bmatrix} tan\gamma_o \\ tan\lambda \end{bmatrix}$$

$\emptyset$ = Plan Approach angle

Tool Angle Conversion

ASA ⟶ **ORS**

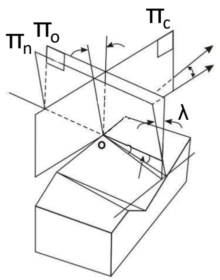
(γ_x, γ_y) (γ_o, λ)

$$\begin{bmatrix} tan\gamma_o \\ tan\lambda \end{bmatrix} = \begin{bmatrix} sin\emptyset & cos\emptyset \\ -cos\emptyset & sin\emptyset \end{bmatrix} \begin{bmatrix} tan\gamma_x \\ tan\gamma_y \end{bmatrix}$$

$\emptyset$ = Plan Approach angle

Does Orthogonal Plane $\boldsymbol{\pi_o}$ represent <u>True</u> rake angle?

Orthogonal and Normal Reference Planes



Tool Angle Conversion

ORS ⟶ NRS

$\boldsymbol{\gamma_o}$ $\boldsymbol{\gamma_n}$

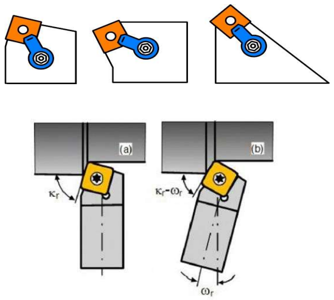
$$tan\gamma_n = tan\gamma_o \,.\, Cos\lambda$$

Tool in Machine System

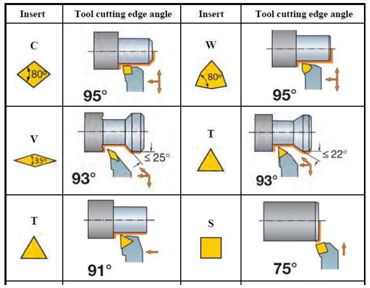
Static angles on Tool/Insert change due to

- Setting in tool Holders/ Fixtures
- Tool/ Work relative motion.

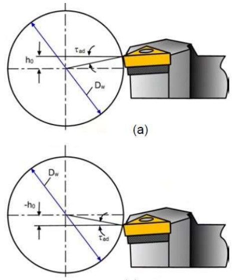
Inserts in Tool Holder



Inserts and Tool Angles



Tool Setup on Machine



Tool Set up - Working Rake Angle

H – Set up error
R – Job Radius
Γw - Working Rake angle

Γw = γ – δ

Sin (δ) = H/R