Recoules®
Quackenbush®

Advanced Drilling Equipment Cutting Tools

January 2015

Product Overview

Recoules Quackenbush

Precision	• Good surface finish • Fit to application special cutter with tight hole tolerance
Productivity	• One shot application cutters • Cutters for high speed applications
Durability	• Special coatings to increase cutter lifetime • Customized cutter design to reduce run-out
Total Cost of Ownership	• Increased holes per cutter • More regrinds per cutter options

Advanced Drilling Equipment (ADE/ADU) Cutting Tools

Product Overview

Recoules Quackenbush

Advanced Drilling Equipment (ADE/ADU) Cutting Tools

- Standard and special cutters
  - One shot drilling
  - One shot reaming
  - Drill and ream
  - Drill and countersink
  - Square drills (deep hole)
  - Ream and countersink
  - Taperlock ream and countersink

Recoules Quackenbush

Aerospace standard and special cutter definitions

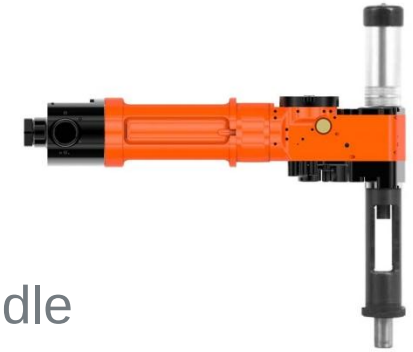
- Standard cutter
  - Cutter that is readily available and stocked by multiple venders.
  - Generic and basic geometries to cover multiple situations.
- Special cutter
  - Generally not in stock - must be manufactured.
  - Tighter geometry tolerances than a standard cutter
  - Unique geometry features making them application specific.

Advanced Drilling Equipment (ADE/ADU) Cutting Tools are Special Cutters

Product Overview

Why Advanced Drilling Equipment (ADE/ADU) needs Special Cutters

Advantages/disadvantages of ADE/ADU equipment



- Advantages
  - Portable
  - Lightweight
  - Accurate
  - Ability to fix RPM and feed rate
- Disadvantages
  - Free floating spindle
  - Cutter generally guides in bushing
  - Guide can also be on the spindle but runout is still greater than a ‘rigid’ spindle machine

- *Free floating spindle equals run out*
- *Run out is the cutter’s worst enemy*
- *Everything from point of contact with the spindle beyond is designed to mitigate run out*

Solution Example

Recoules Quackenbush

One shot drilling in Aluminium

- Operation / One shot Drilling
  - Material: Aluminium
  - Thickness: 15 mm / 0.59”
  - Hole diameter: 6.32 mm /0.250”
  - ADE
    - ADE : 20932
    - Speed: 2700 rpm
    - Feed: 0.07 mm/rev / .003ipr
  - No lubrication (Dry process)
- Solution
  - Non coated drill carbide cutter
- Results
  - Ra [1.4 – 2.5] µm / ~63 µin

Solution Example

- Operation / One shot drilling countersink
  - Material: CF - AL
  - Thickness: 20 mm – 20 mm / 0.787” – 0.787”
  - Hole diameter: 6.357 mm / 0.2500”
  - ADE
    - ADE : 20942M with vibratory system
    - Speed: 4500 rpm
    - Feed: 0.07 mm/rev / .003ipr
  - with lubrication
- Solution
  - Non coated carbide drill & countersink cutter
- Results
  - Cpk CF-Al > 1.6
  - IT9 [32µm]
  - Ra CF = 4.8 µm / ~ 125 µin
  - Ra Al =0.03 µm / ~ 2 µin

One shot drilling and countersinking in CF-AL

Solution Example

Recoules Quackenbush

One shot drilling and countersinking

- Operation / One shot Drilling countersink
  - Material: CF - AL
  - Thickness: 9.6 mm – 4.5 mm / .38” - .18”
  - Hole diameter: 6.807 mm / .2680”
  - ADE
    - ADE : 20942M with vibratory system
    - Speed: 4500 rpm
    - Feed: 0.07 mm/ rev / .003ipr
  - with lubrication
- Solution
  - Coated drill & countersink cutter
- Results
  - Cpk CF-Al > 3
  - IT10 [76µm]

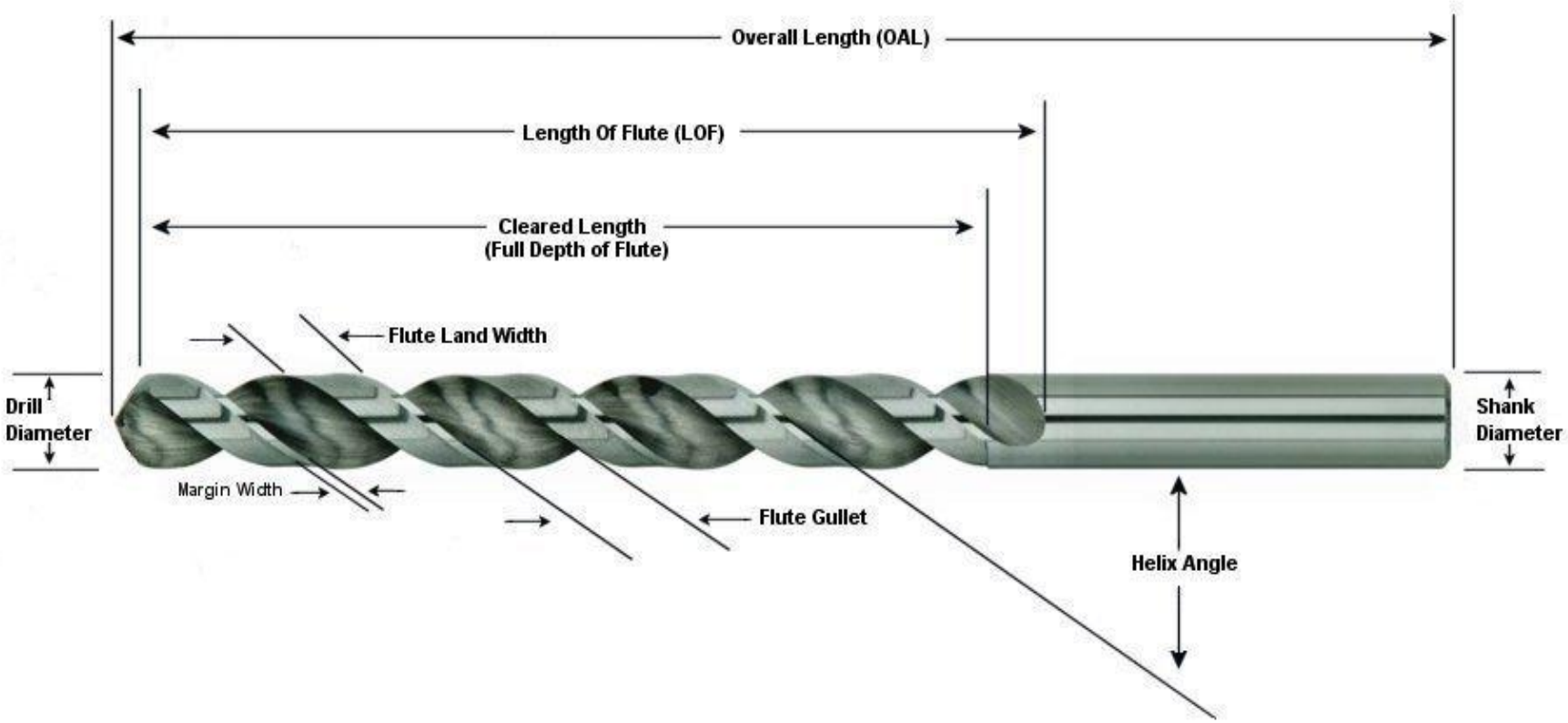
Solution Example

- Operation / Reaming
  - Material: Ti-CF- AL
  - Thickness: 7 mm – 19 mm – 12 mm
    .28” - .75” - .47”
  - Operation: Reaming
  - Hole diameter: 6.807 mm / .2680”
  - ADE
    - ADE : 20942M with vibratory system
    - Speed: 400 rpm
    - Feed: 0.1 mm/ rev / .004ipr
  - with lubrication
- Solution
  - Non coated square hss reamer
- Results
  - Cpk Ti-CF-Al > 1,6
  - IT9 [32µm]
  - Ra Ti = 0.4µm / ~ 16µin
  - Ra CF = 3.6µm / ~ 125µin
  - Ra AL = 0.12µm / ~ 4µin

Reaming

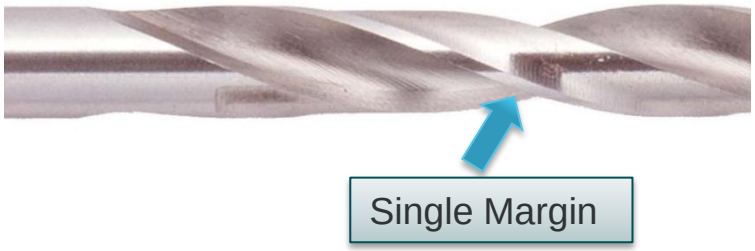
Recoules Quackenbush

General cutter terminology



Design Features

Body



- Standard cutter
  - Generally do not have unique attachment features
  - Shank Diameter (SD) tolerance +0 / - .0005” +0/-.013mm or greater
- Special cutter
  - Double margin configuration (critical for **proper** support within nose bushing)
  - Back taper .0001 - .0003” / .003 - .008mm entire drill length (critical for **proper** clearance and support in nose bushing)

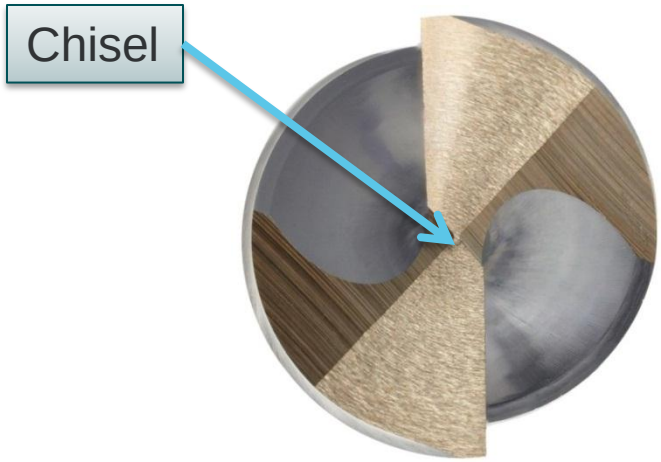
Design Features

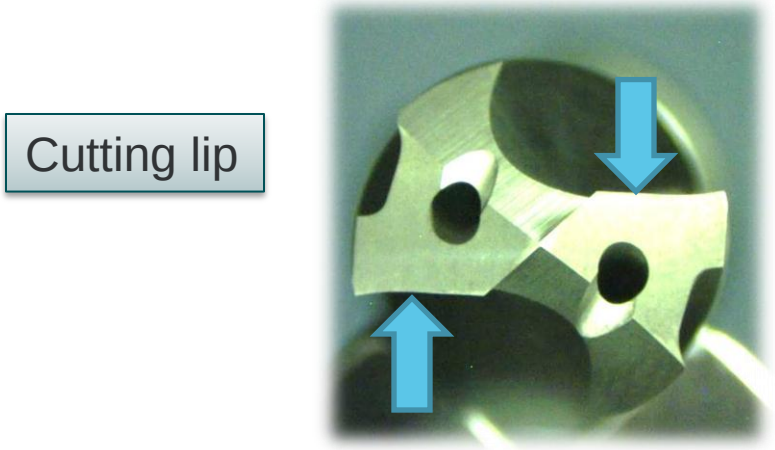
Shank

- Standard
  - Generally do not have unique attachment features
  - Shank Diameter (SD) tolerance +0 / - .0005” +0/-.013mm or greater
- Special
  - Threaded shank common often with seat angle or seat shank diameter
  - SD tolerance +0 / - .0003” +0/-.008 mm or less (critical for **proper** clearance in nose bushing)

Recoules Quackenbush

Point Geometry



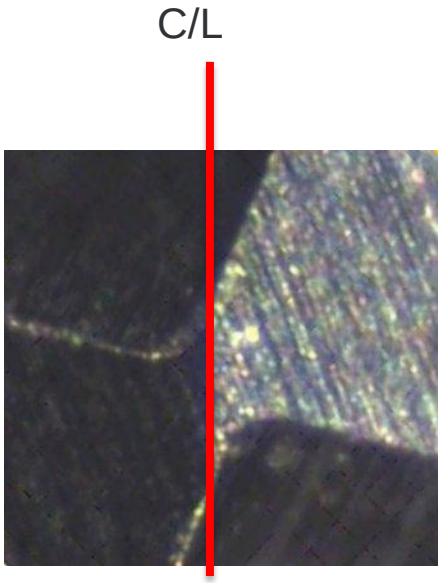


- Two main point geometries that are critical for to mitigating spindle run out are:
  - Chisel Centrality
  - Lip-to-lip run out
- The chisel is the first part that of the drill to come in contact with the material. If it's not correct, the effects will resonate and cannot be overcome by other geometries

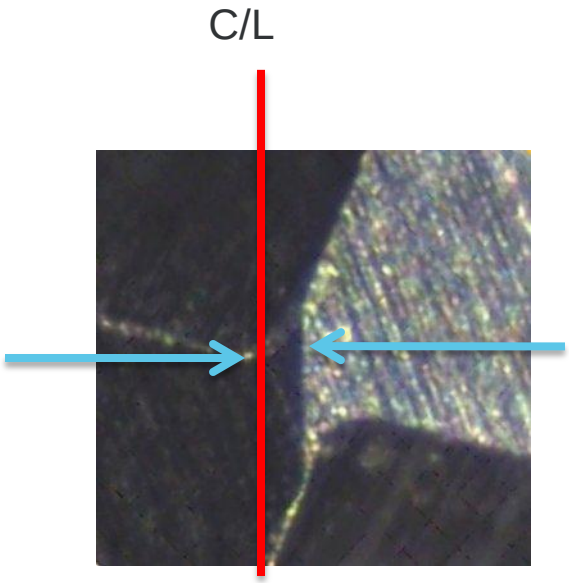
Recoules Quackenbush

Chisel run out (Centrality)

- Standard Cutter .007” / .18mm or greater
- Special Cutter .0002”/ .005mm or less



- Line up chisel in center line (C/L)

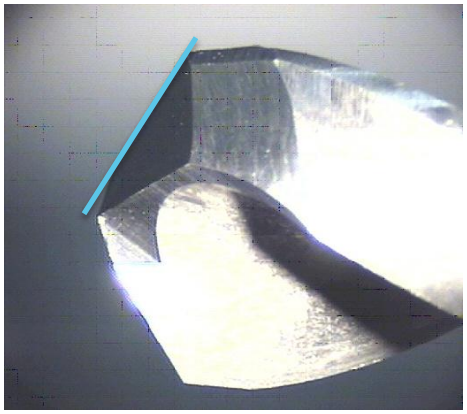


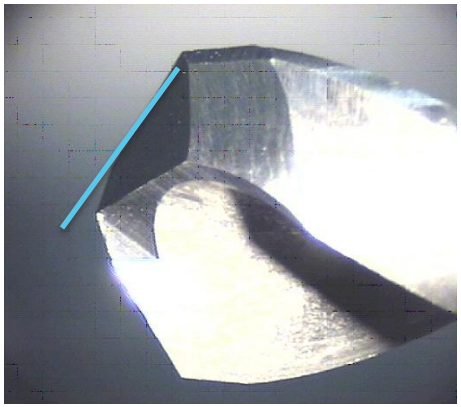
- Rotate tool 180°

Recoules Quackenbush

Lip-to-Lip run out

- Standard Cutter .002” / .05mm or greater
- Special Cutter .0005” / .013mm or less



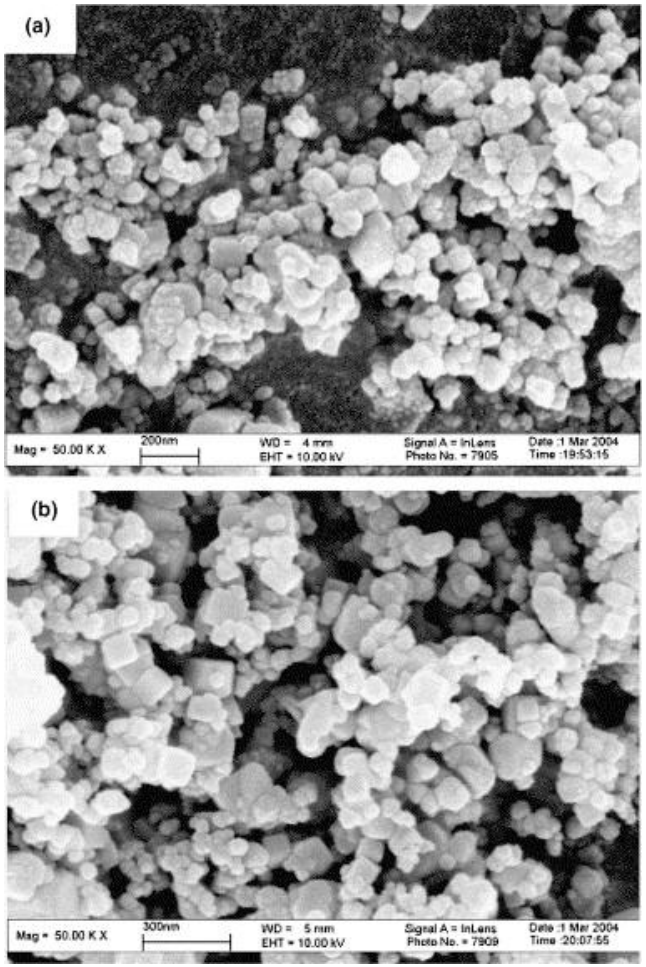


- Rotate tool 180°

- Excessive Lip Height variation or Lip-to-Lip run out is responsible for:
  - Producing a tapered hole
  - Over-sizing the hole
  - Premature tool wear
  - Corner of points being burned
  - Uneven wear on point
  - Reduced tool life
  - Breakage
  - Uneven chips

Recoules Quackenbush

Materials



- HSS (High Speed Steel)
- Carbide
- PCD (Poly-crystaline diamond)

Recoules Quackenbush

Coatings

- Coated cutters increased hole quality
  - Reduce torque
  - Increase micro edge geometry performance
  - Good wear resistance
  - Improve lubricity
  - Reduce heat at the cutting surface

Design Features

Coatings

Multi layer diamond coating for composites sandwichs, aluminium and fibres (CFRP/Glare), ***abrasive*** resistance

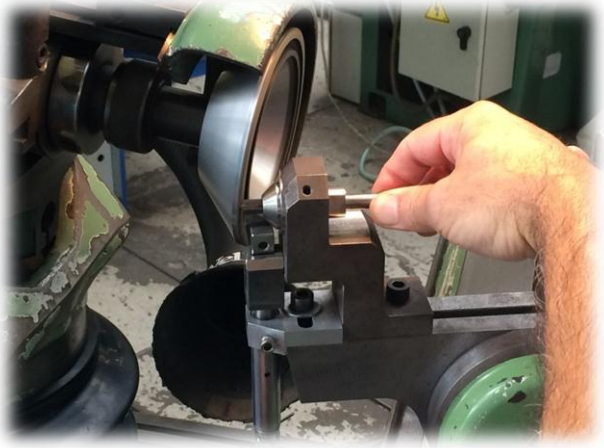
a-C H coating, color grey black for dry applications (alu) and slight quantity lubrication, ***abrasive*** and ***adhesive*** wear resistance.

AlCrN, color bright-grey for **dry applications** (Alu-Inox-CF) and slight quantity lubrication, wear resistance and hot hardness properties.

TiAlN, for Alu-Ti-CF and other applications, minimal quantity lubrication, **good hot hardness and oxidation resistance**.

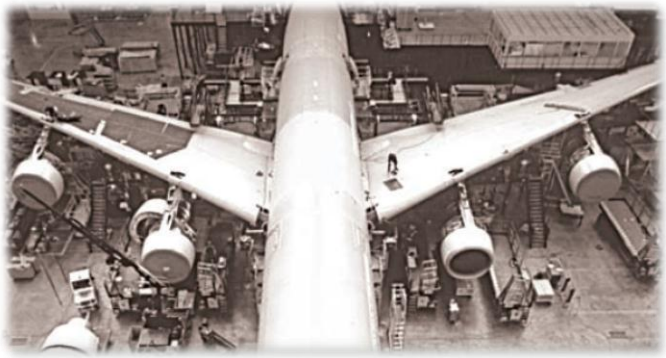
Recoules Quackenbush

Regrinding



- Extends life of cutter
- Design for maximum number of regrinds
- Optimize the total number of holes from a cutter
- Regrind quality critical to maintain original design intent

Applications



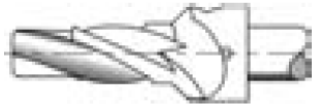
- Aerostructures
- Nose
- Fuselage
- Wings and Wingbox
- Shells
- Panels
- Tail
- Final Assembly

Value

Precision	Productivity	Durability	Total Cost of Ownership
• Good surface finish • Fit to application special cutter with tight tolerance	• One shot applications cutters • Cutters for high speed applications	• Special coatings to increase cutter lifetime • Customized cutter design to reduce run-out	• Increased holes per cutter • Increase regrinds per cutter

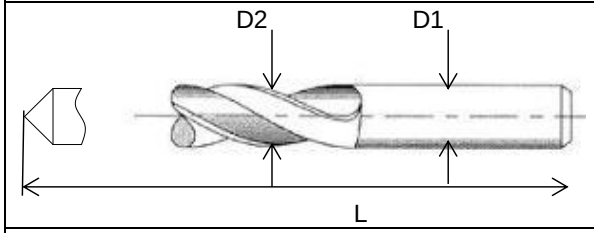
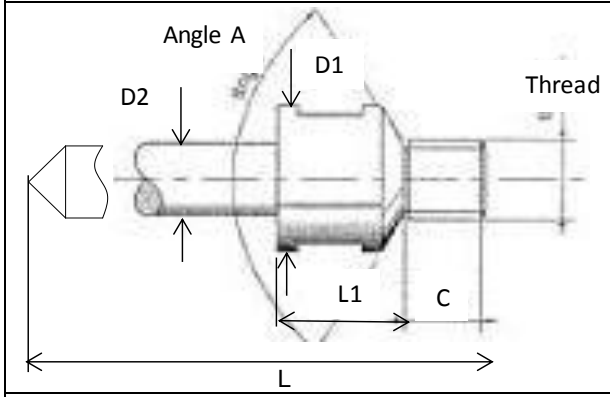
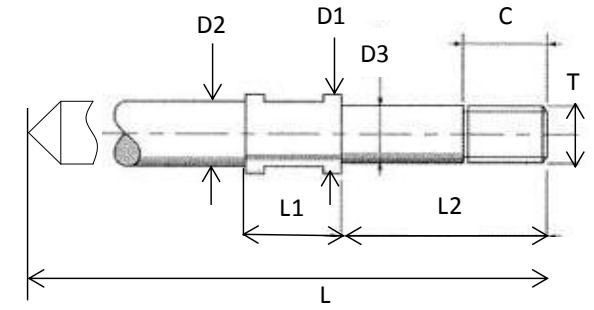
Configurations & Options

Recoules Quackenbush

Machining Operation	Cutter Material	Illustration
Drill only • Split point is standard	HSS Carbide PCD	
Ream only • Left hand helix • Swarf directed away from cutter ensuring quality of surface finish and hole size	HSS Carbide	
Drill and ream • Produce good quality finished hole	HSS Carbide	
Square drill • Square drill is strong, permits good lubrication and chip formation • Especially good for deep holes precision and good surface finish. • Countersink is available	HSS Carbide PCD	
Drill and countersink • Produces standard hole and countersink in one operation. • Split point is standard	HSS Carbide PCD	
Ream and countersink • Ream-Countersink cutter with pilot for accurate alignment in pre-drilled hole.	HSS Carbide PCD	
Taperlock ream and countersink • Taper-Lock specifications are based on Briles standards. • However, many variations exist and complete specifications are required. • Limited attachment interface options	HSS	

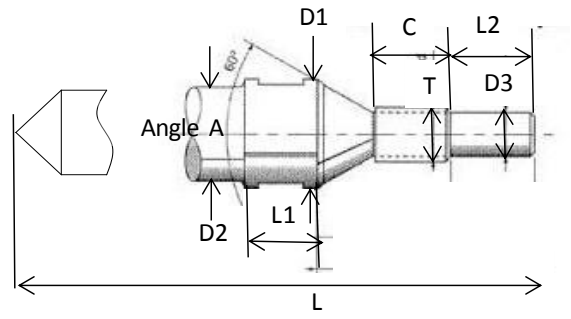
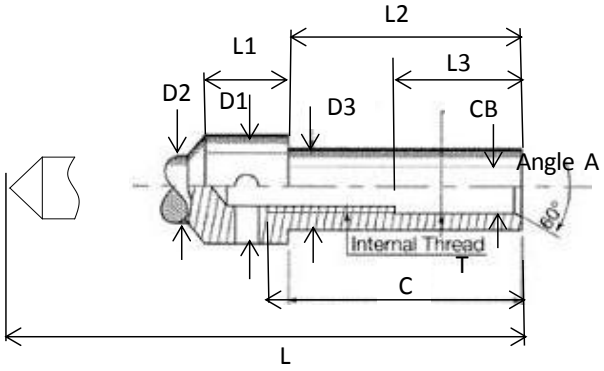
Recoules Quackenbush

Cutter/spindle interface options

Picture Reference	Cutter Mounting Type	Code	Dimensions
	Straight Shank	A	Shank Diameter D1 (in, mm) · Cutter Diameter D2 (in, mm) · Overall Length L (in, mm)
	External Thread with Seat Angle	B	Thread T (in, mm) · Thread Length C (in, mm) · Seat Angle A Degrees Body Diameter D1 (in, mm) · Body Length L1 (in, mm) · Cutter Diameter D2 (in, mm) · Overall Length L (in, mm)
	External Thread with Pilot Diameter	C	Thread T (in, mm) · Thread Length C (in, mm) · Pilot Diameter D3 (in, mm) · Pilot Length L2 (in, mm) Body Diameter D1 (in, mm) · Body Length L1 (in, mm) · Cutter Diameter D2 (in, mm) · Overall Length L (in, mm)

Recoules Quackenbush

Cutter/spindle interface options

Picture Reference	Cutter Mounting Type	Code	Dimensions
	External thread with Pilot Diameter and Seat Angle	D	Thread T (in / mm) · Thread Length C (in / mm) · Pilot Diameter D3 (in / mm) · Pilot Length L2 (in / mm) Seat Angle A Degrees Body Diameter D1 (in / mm) · Body Length L1 (in / mm) · Cutter Diameter D2 (in / mm) · Overall Length L (in / mm)
	Internal Thread Optional Counterbore Larger Body diameter	E	Internal Thread T (in / mm) · Thread Length C (in / mm) · Diameter D3 (in / mm) · Length L2 (in / mm) Counterbore Diameter CB (in / mm) · Length L3 (in / mm) · Seat Angle A Degrees Body Diameter D1 (in / mm) · Body Length L1 (in / mm) · Cutter Diameter D2 (in / mm) · Overall Length L (in / mm)

Related ATG Products

Recoules Quackenbush

Products

Advanced Drilling

- Positive Feed

- Self Colleting

Cutters

- Countersinking (Manual)

- Back Spot Face

Tightening

- DC Electric Fastening

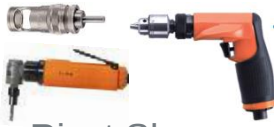
- Pneumatic Fastening

- Riveting

- Bits & Sockets

Material Removal

- Hand Drills & Microstop Cages



- Rivet Shavers

- Grinders

- Sanders

Universal Joints

- Universal Joints

APEX

Custom Solution/ Service

Brands

Recoules Quackenbush

Recoules

Cleco
APEX

Recoules
DOTCO

Recoules Quackenbush
Cleco
DOTCO