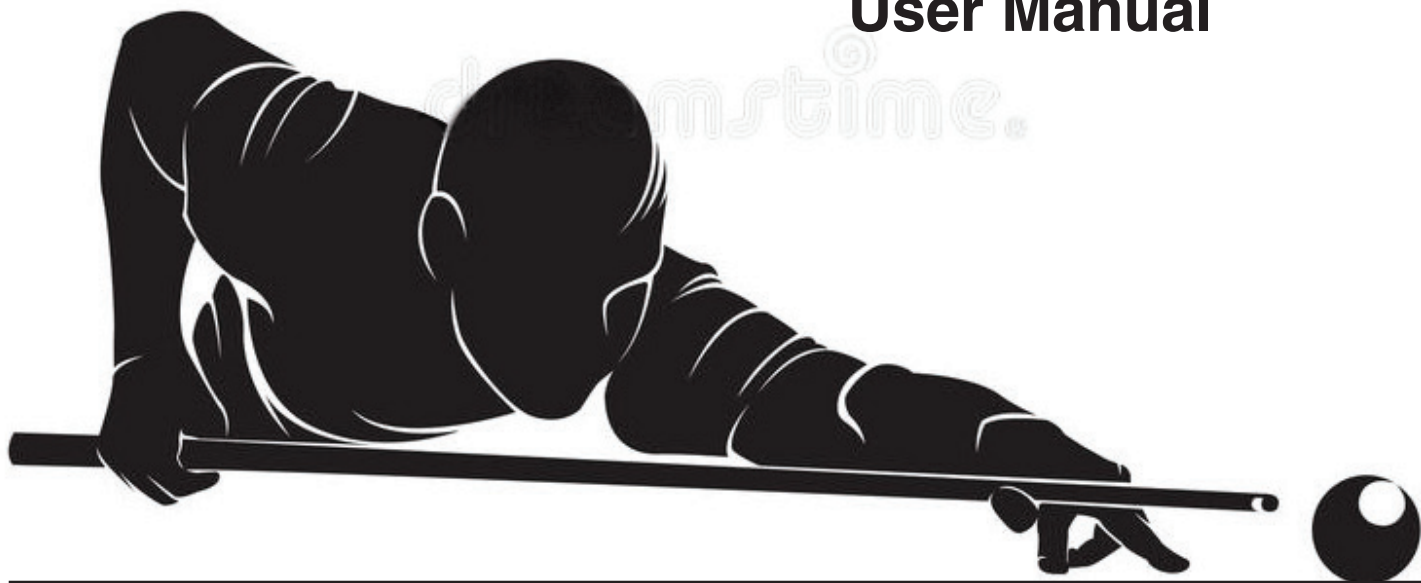


Make a pool cue

from PSI pool cue blanks,
cue accessories, and lathe accessories

User Manual



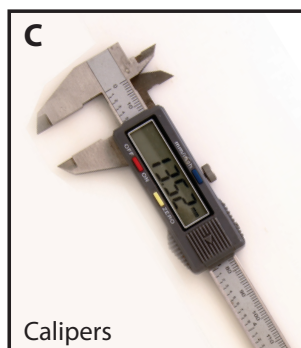
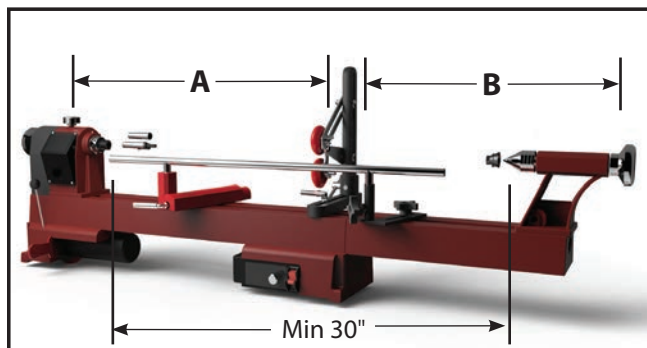
Item# CUEMANUAL

Welcome to the Penn State industries Pool Cue Project. This project is both challenging and fun – the result will be unique hand turned quality pool cue to be proud of. To properly perform in a shooting environment, a pool cue requires the proper size, weight, precision and reliability – you'll want your favorite cue to last forever. Consequently this kit includes precision quality components.

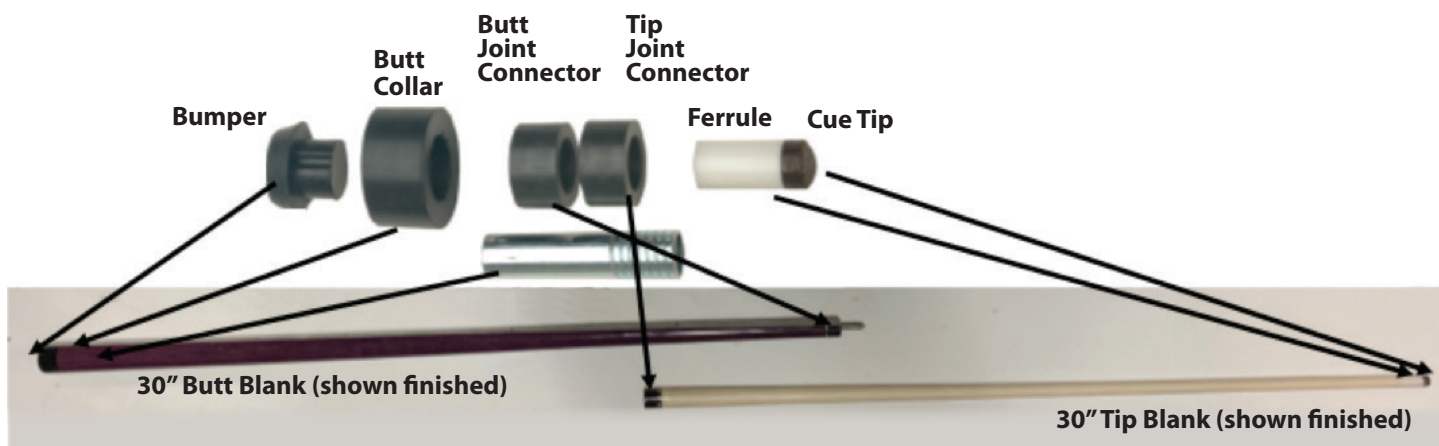
Hardware you'll need (not included with any cue project sets):

- Mini or Midi lathe: Requires a split bed **(A)**, bed length must be 30" or longer to mount up the long cue spindles. Variable speed is useful but not essential. Lathe must be fitted with a 60deg live center at the tailstock and a #2 Morse taper headstock spindle. Most modern mini and midi lathes are fitted with these components but may require an extension bed to bring the bed length up to 30". **(B)**
- Extension beds for PSI brand lathes:
 - Free Floating bed extends KWL lathes to 30": #KWLXBED10 for 10" lathe, #KWLXBED12 for 12" Lathes
 - Infinite bed extends KWL and TCL style PSI lathes to 42": #TCLC10XB for 10" lathes, #TCLC12XB for 12" Lathes
- Measuring calipers: to measure spindle diameters to .001" accuracy **(C)**. Digital Preferred.
- Sandpaper: Larger sheets (3" x 5" min) from 120grit through 600grit.
- Wood sanding block (3" x 6" prox) for straight finish sanding
- Lathe Chisels: 1" Roughing Gouge for rough turning **(D)** #LX260 or similar. 1" and 1/2" Skew chisel for finish turning **(E)** #LX020 and 2X010 or similar. 1/8" Parting tool to cut sizing grooves for the spindle blank tapers **(F)** #LX420 or similar.
- Glue – 2 Part epoxy or Cyanoacrylate instant glue **(G)** to glue decore components onto turned blanks (#PKGLUE2 or similar)
- Finishing polishes: Sanding sealer for the tip shaft #PKFRIC3 or similar. See appendix 2 for Butt Finish Options
- Headstock chuck: (H) #CSC3500SE or similar. For final finishing / turning entire cue to match joint connectors.

Essential Hardware



[Fig 1] Anatomy of a finished pool cue:

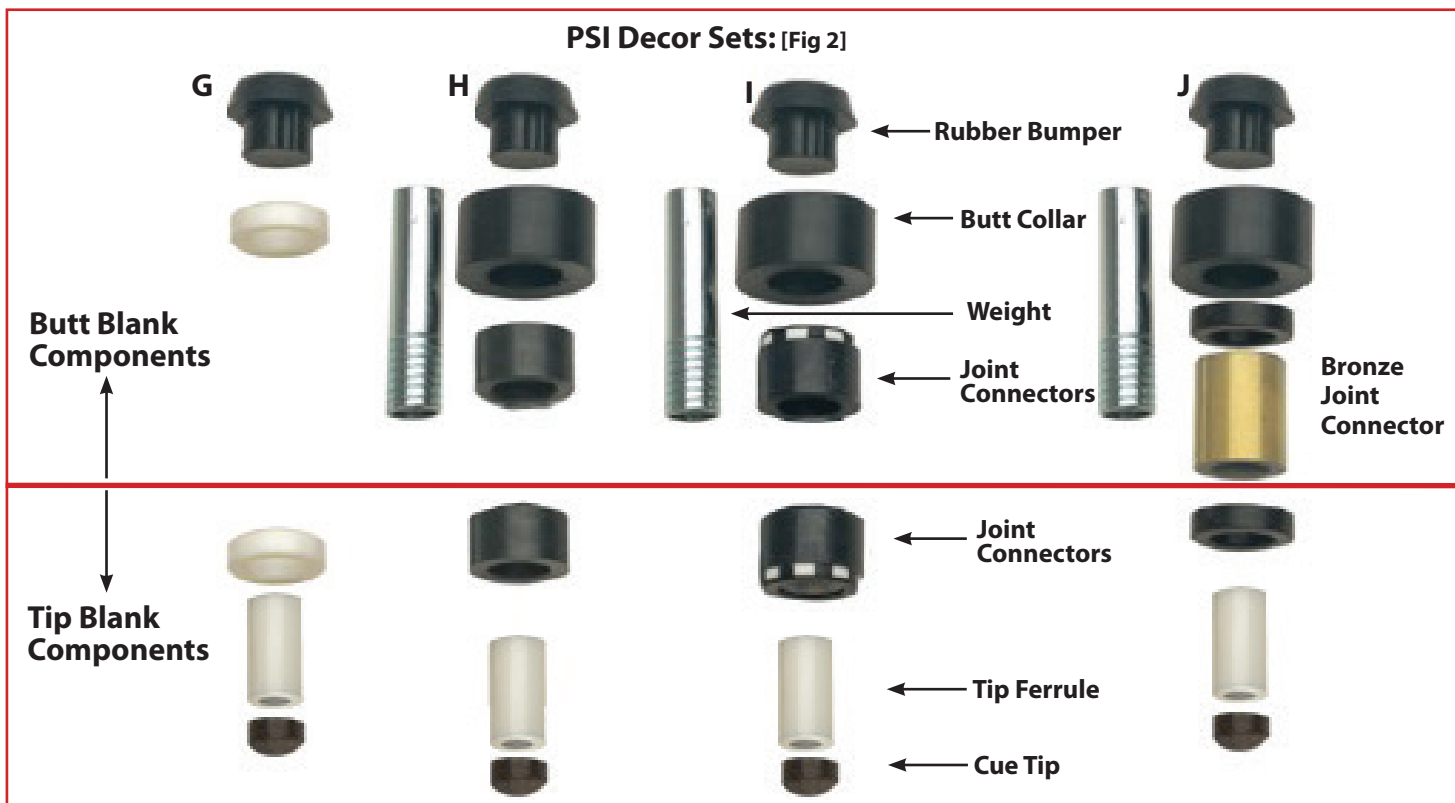


PSI Decore Components: Include all of the Connectors, Butt and tip end components

General specs for connectors: Made from Ertalyte™ a composite having great dimensional stability, excellent wear resistance, high strength and easy machineability. Shaft Connector Size: 5/8" ID 1" OD. Butt collar is (Fig 2) PSI Decore Sets .75" ID, 1-3/8" OD and 3/4" long.

Decor Sets (Fig 2) :

Pre configured for easy selection and decoration of your finished Cue, each set includes sets for butt end, joint connection and tip (*)



G) #CUEJS01 (economy) includes: Rubber bumper, 2ea White 1/4" Joint collars, tip ferrule and tip

H) #CUEJS02 includes: Rubber bumper, Black 3/4" Butt Collar, 2ea Black 1/2" joint collars, 1oz. weight, tip ferrule and tip

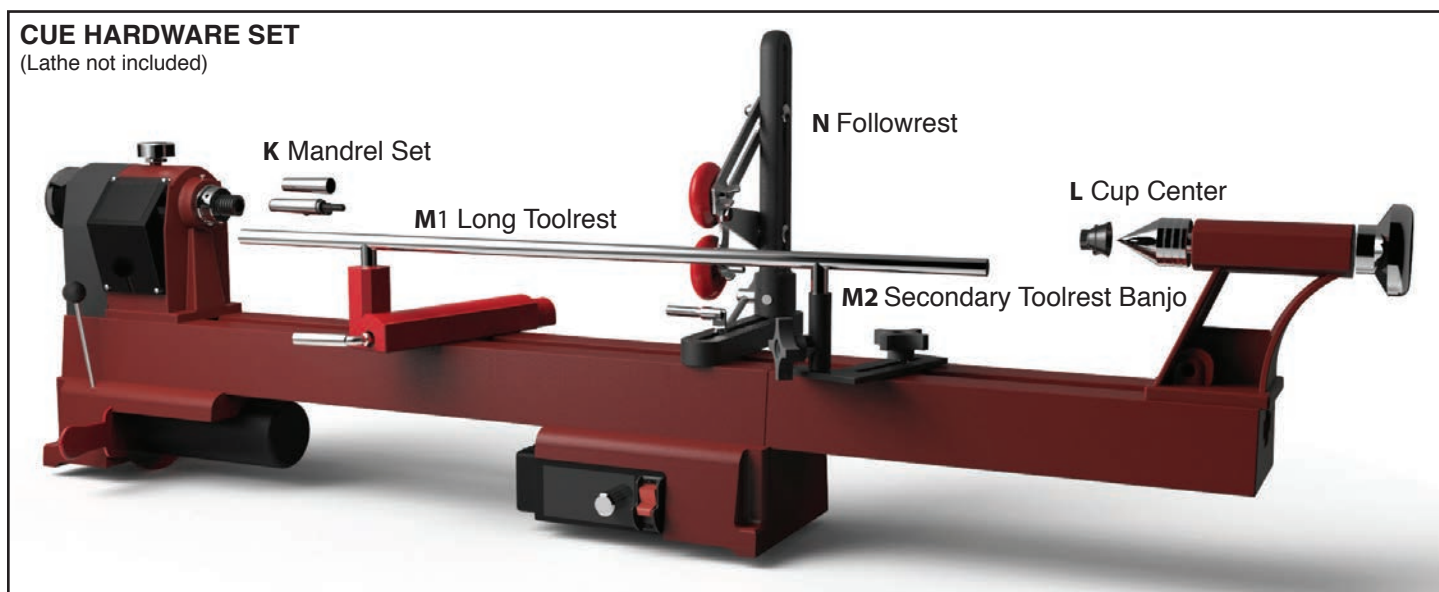
I) #CUEJS03 includes: Rubber bumper, Black 3/4" Butt Collar, 6 piece black and white segmented ring set, 1oz. weight, tip ferrule and tip

J) #CUEJS04 includes: Rubber bumper, Black 3/4" Butt Collar, Bronze Composite (turnable) 1" joint collar, 1 ea Black 1/4" joint collar, 1oz. weight, tip ferrule and tip

(*) Current as of printing of this manual. Refer to our website www.pennstateind.com for most current selection)

CUE HARDWARE SET

(Lathe not included)



Cue Turning Hardware Set

These are four essential accessories specifically designed for turning a PSI pool cue kit. We offer them here as a set—however each accessory can be purchased individually on our website.(combination; #CUENWS)

K) Shaft turning mandrel set – We’ve made it easy to mount your blanks to the headstock with this system when you purchase our Shaft and Butt set. It includes a #2MT male mandrel with a threaded pin to connect to the shaft blank insert. Plus a #2MT female mandrel with an internal thread to connect to the Butt Shaft threaded pin. These mandrels support the shafts with the opposite end supported by a live center. Requires lathes with #2MT headstock & tailstocks. (Separate purchase item #CUEMAN)

L) Tip end Cup center – Mounts onto a 60deg live center. It Holds the shaft tip precisely for turning—note the shaft tip is extra wide avoid splitting. (Separate purchase item #LCENLTC)

M) 30” Long Toolrest (M1) and secondary Banjo (M2)—Necessary for turning down the long 30” Butt and Shaft Blanks. Banjo is necessary to hold the post at the opposite end of the toolrest - compatible with 10” and 12” lathes. (Separate purchase item #CUEREST)

N) Followrest—Supports the long Butt and Tip spindle blanks while turning—similar to a Steadyrest but designed to make it easy to “follow” the long blanks from end to end without whip.(Separate purchase item #CUELSR2). The 2 wheel configuration allows access to a blank of nearly any diameter along the shaft without having to “work around” the third wheel of a traditional steady rest. With patience and practice, this rest will prove invaluable to your Cue making (and repairing endeavors). Typical use will involve pressing the blank into the rest with one hand while you Cut or Sand with the other hand. With a steady hand, you’ll find the technique of one-handed cutting will be the key to your executing a precision turned Cue.

Cue Blank Sets (See Fig 3)

Each set of Cue Blanks sold will include a 30” Butt end blank and 30” Maple Tip end shaft + blank. Both blanks are pre tapered to approximate the final taper of your finished cue. Your cue is designed to attach together at the center with an insert in the tip end and a threaded post at the butt end. The threaded insert (Tip end) and Post (butt end) are pre-installed using a precision metal turning lathe on your blanks to insure accuracy. The advantages of this pre-installation is two fold;

1) We’ve done the work to achieve the near impossible task of accurately installing the threaded components – even the slightest error in installing these components manually will lead to a cue that is out of balance. **2)** The components attach to your lathe for turning with a precision mandrel set that will match the Butt and Tip end components. Simply insert the proper mandrel, thread on your blank and you’re ready to turn. The tip end (**A**) will always be the same; Grade A Maple with a wood “Bubble” at the end to avoid splitting that could occur by inserting a 60degree center into a small diameter shaft end. This bubble can be conveniently parted off at the end of the cue making process.

A) Tip End Shaft Blank

Grade A Maple with a wood “Bubble” at the end to avoid splitting that could occur by inserting a 60degree center into a small diameter shaft end. This bubble can be conveniently parted off at the end of the cue making process.

(See Fig 3)

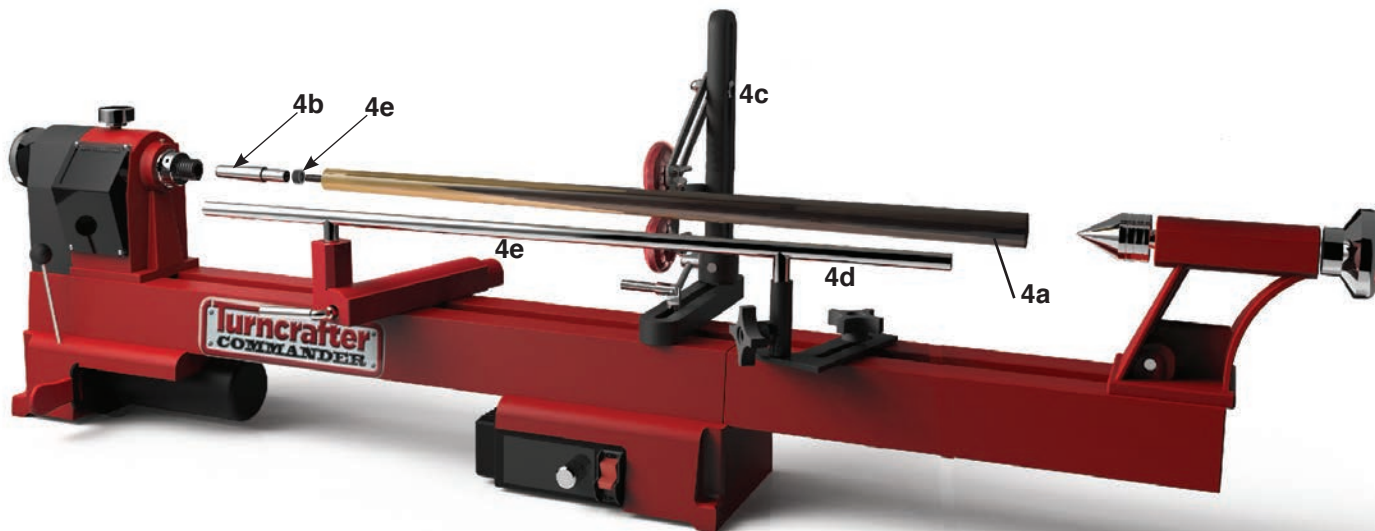
Current line of blank sets:

B) Maple Butt blank & Maple Shaft (economy)	#CUE01
C) Rosewood Butt blank w/ Maple Shaft	#CUE02
D) Goncalo Alves Butt blank w/ Maple Shaft	#CUE03
E) Bocote Butt blank w/ Maple Shaft	#CUE04
F) Rosewood	
4 Prong inlay Butt blank w/ Maple Shaft	#CUE05

Fig 3 Cue Blank Sets



Fig 4 Lathe Setup for Butt Blank turning



Section 1- Getting Started

1.1 Select a Cue Blank Set (Fig 3) and Decor set (Fig 2) for your Cue project

1.2 Mount the Butt blank 4a and lathe hardware as shown in Fig 4. Start with the #2MT male component of the Cue mandrel set (With bolt extension). (Fig 4b)

Mount the Followrest (Fig 4c) midway on the lathe bed.

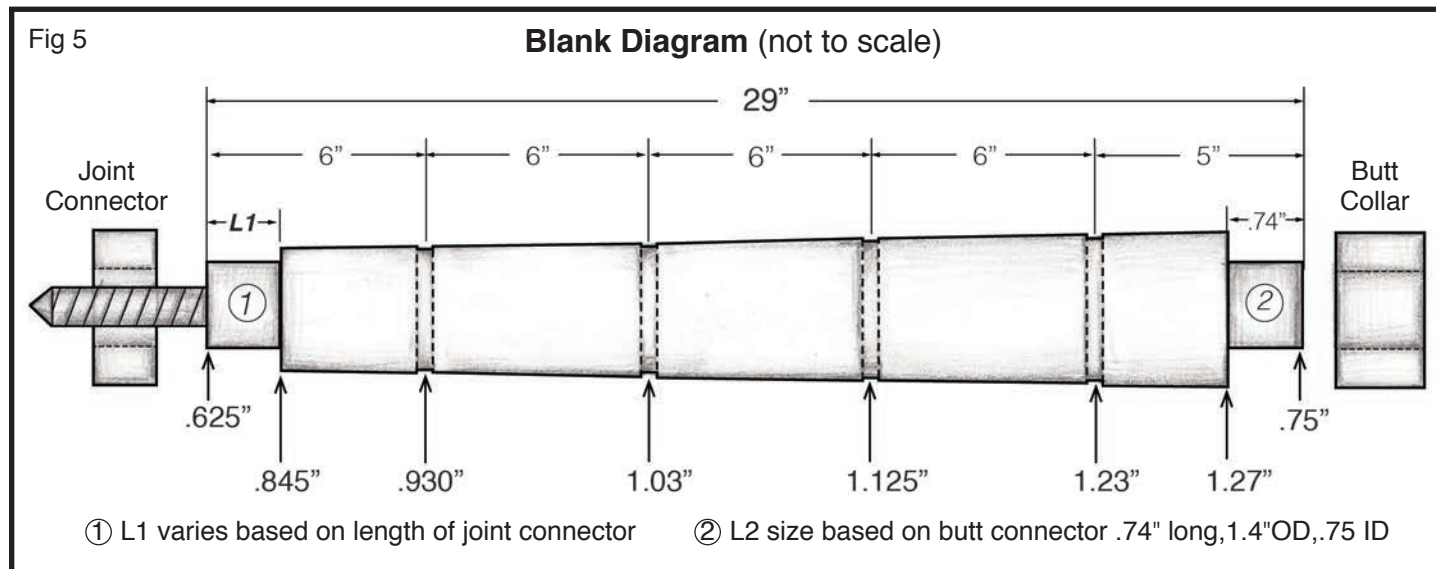
Mount the secondary toolrest banjo toward the tailstock end (Fig 4d)

Mount the toolrest with the posts to fit both banjo sleeves. (Fig 4e)

Slide the joint connector onto the mandrel shaft and tape on to avoid spinning (4e). (Essential for sizing the tenon)

If possible, lock the headstock to avoid spinning when mounting the blank. Screw the narrow end of the Butt Blank onto the threaded post of the Cue Mandrel (4a) until it securely bottoms. Slide the tailstock with the 60deg center to the wide end of the blank and insert the center into the large hole in the end. Lock in place. Position the toolrest (4d) in the center of the wood blank to span both ends, set the height so the top of the bar is slightly lower than the center of the blank. Lock the posts in place.

Set the distance between the toolrest bar and blank are about 1/8" from each other along the taper.



Section 2 Turning the Butt Blank

2.1 Mark taper diameters

Use white labels on the toolrest then mark the diameters along the blank as indicated by Fig 5. (See "Hint" below) Use a parting tool to cut grooves at various diameter points along the shaft, then "connect them" by turning the spindle down to the bottom of the tenon cuts. Both the Butt and Tip end shafts use that technique by marking diameters at 6" intervals along the shafts with cut depths as indicated in Fig 5. Use a caliper to check the 4 diameters between the shaft ends. It is ok to undercut the tenon slots a bit to allow for finishing but under no circumstances over cut (would result in an excessively thin cue). Mark your first measurement at the end of the wide butt end. Note that you won't be cutting grooves at the ends, because of the connectors. The process will be easier if you turn & install the joint connector and butt connector tenons first. This will allow you to turn the wood and end connectors together and give a smooth transition from connector to shaft.

Hint: Paste labels along the long toolrest with butt diameter & shafter diameters as shown



2.2 Cutting the Butt Collar Tenon (Fig 6a). The butt collars supplied with this project are all the same size with a .95" ID, 2-1/4" OD and 3/4" length. Therefore mark the tenon at the wide end to be cut to 1.265", i.e. with a tenon .95" dia and 2-1/4" long. Cut the tenon (Fig 6a) Test the size after you cut by slipping on the butt collar to make sure it is the right size. [Fig 6b] Note that this collar is not "critical" to pool cue function so if it's a little loose or long or short it will not effect your game. Glue on the collar at this time with epoxy and allow to dry.



2.3 Cutting the Joint connector Tenon (Fig 7). Joint connectors all have a 5/8" diameter ID but lengths may vary from 1/4" to various lengths. Use the joint assembly to mark an exact length for your tenon. Be conservative, mark a bit short of the measured length since cutting too long would leave a gap when assembled. We've simplified cutting the 5/8" tenon by making the Mandrel diameter exactly 5/8" at the point that it meets the cue. This will act as a "bushing" to match as you cut the diameter of the tenon. You should still measure along the tenon length to make sure the tenon is a perfect cylinder. Start removing wood with a spindle gouge, switch to a skew to smooth the tenon cylinder (5/8 od, .625"), then use a parting tool to make a square connection from wood to your joint connector(s). Slide the (pre-mounted) joint connector from mandrel to tenon and turn until there's a perfect fit (Fig 7a). When fit, Glue the connectors onto the tenon. This is important because when the cue is assembled, that the joint connection is as solid as possible when connectors are dry, turn the connectors & blank down to size together. (Fig 7b)



2.4 Cutting the taper (Fig 8a). Position the Followrest at the center of the blank. Now starting at either end or in the middle of the blank carefully and slowly turn the spindle down to the bottom of the diameter slots. Measure along the blank with connectors installed to insure proper diameters (.840" at the joint connection, 1.265" at the back.) (Fig 8b) Start removing wood with a spindle or roughing gouge, then transition to a skew for a smooth slope. Use a straight edge (at least 6" long) and place it along the slope to indicate high and low spots as you proceed. Go slowly sliding your tools along the long toolrest with a firm steady grip. At the ends of the blanks, make a smooth transition from the wood to the plastic joint connector (front) and butt collar (rear) (Fig 6c, 7b) with the skew chisel. If the blank starts to "whip" move the Followrest closer to the area that you are cutting. If there are slight slope variations, not to worry, the next sanding step will assist flattening the slope.



2.5 Sanding the turned Butt Blank (Fig 9). Wrap sandpaper sheets around a 3 x 6" sanding block and sand along the cue taper, attempt to reduce high spots if possible. Start with 150grit and Continue to sand with 240, 350, 400, 600 and perhaps 800 until the shaft is completely smooth. Touchup and chisel marks or other irregularities along the way. To help progress with sanding, clean up as much dust as possible after each grit step. Use acetone or denatured alcohol on a paper towel to wipe off excess dust and leftover sanding material. These will evaporate quickly without damaging the wood and remove oils that can undermine the final finish. Avoid following the same patterns when sanding – this can reinforce a deep scratch. Try to sand without rhythm, varying lathe speed and sanding motions. Stop the lathe frequently to check for stubborn marks and apply extra sanding in those areas to eliminate them. Sanding along the work piece with the lathe off can also help remove stubborn sections.



2.6 Finishing the turned Butt Blank The Butt shaft is the most decorative part of the cue and deserves a great finish. A gloss or semi-gloss finish is the way to go. The finish must be extremely durable because of constant use. (See Appendix 2) for Possibilities for final finishes. However, after testing several final finishing methods we found the GluBoost™ CA finish and process was the most forgiving plus providing a deep rich finish. See Appendix 3) for Glu-Boost application instructions.

Section 3 Turning the Tip end Shaft Blank – up to the tip

Fig10 Setup for tip blank turning

3.1 Setup the

lathe per Fig (10).

Place the Male Mandrel component (10a male) into the lathe's headstock. Place the magnetic cup (10b) center on the 60 degree tailstock center. (note: this will help to avoid splitting the narrow tip end). Screw the wide part of the blank (10c) onto the threaded pin (10a).

Slide the tailstock cup point into the hole on the end of the blank. Position the long toolrest along the slope of the blank, position the Followrest at about the center of the blank(i).

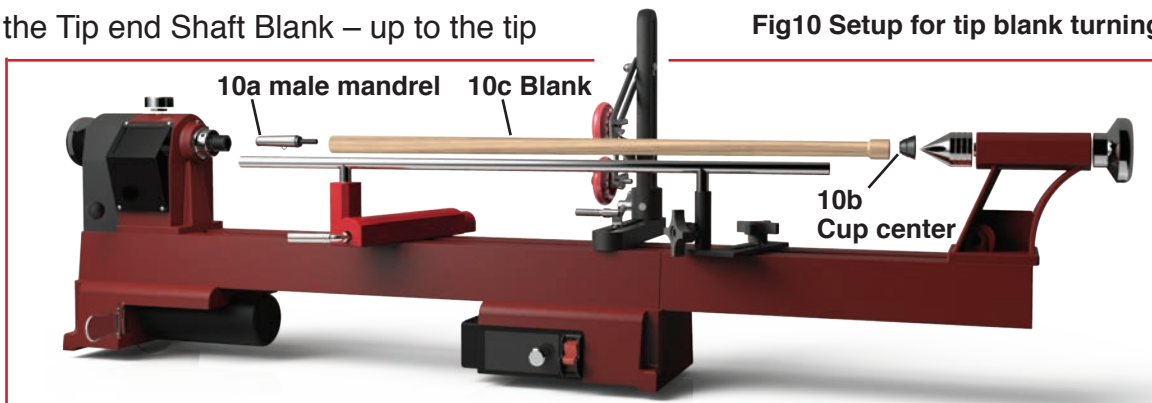
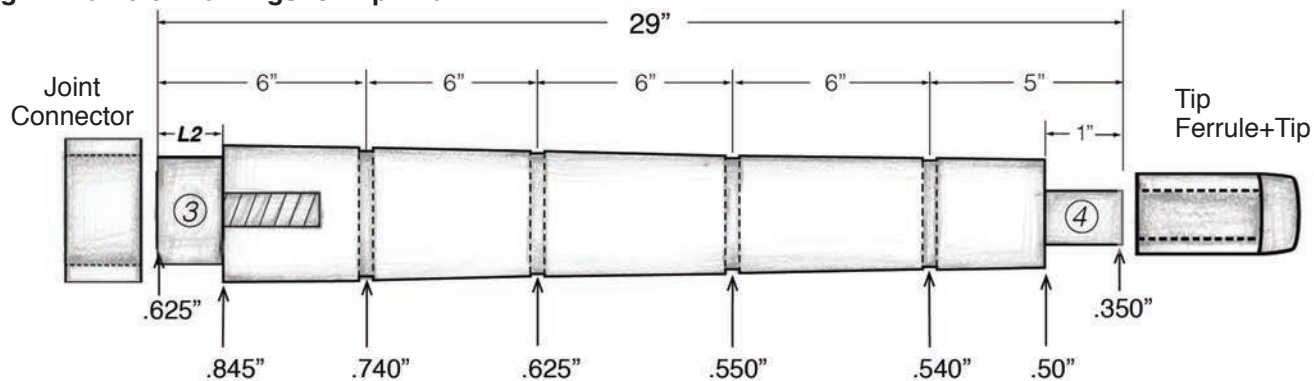


Fig 11 Diameter Markings for Tip End



③ L2 varies based on length of joint collar ④ L4 Tip ferrule tenon

Again mark the toolrest with the 6 diameter markings and position the toolrest so the first mark is at the end of the wide/joint end, then 4 marks every 6", and the last mark is 29" from the wide end of the shaft, just short of the wood "bubble" and the cue tip end. Then mark 1" in from that point for the ferrule position. Follow the same process as above in Section 3, using the parting tool to cut slots along the blank.

3.2 Install joint connectors-tip end As with the Butt joint connectors all require a 5/8" diameter tenon but lengths may vary from 1/4" to various lengths (up to 1-1/4"). Use the joint connector to get an exact length for your tenon and mark it on the shaft. As with the butt joint connection tenon, the mandrel has a 5/8" diameter you will use as a bushing as you cut the tenon for the joint connector (12a). Turn to an even cylinder (with 1/2" skew) then remove the shaft from the lathe, test for fit. After the fit is confirmed, spread glue on the tenon to glue on the joint connectors and allow to dry. It's important here to cut the connector flat and square at the end for a solid connection to the joint connectors at the butt end. DON'T cut the tenon at the tip end at this time since the very narrow diameter may compromise the integrity of the shaft as you cut the taper. Turn the connectors and blank together down to spec (12b).

Hint: For a perfect square tenon, use a carbide tool with a square tip.



3.3 Cut Tip Shaft Taper

Since the shaft is so narrow at this end, positioning the Followrest to support the shaft is very important as you cut the shaft down to size. Use a spindle gouge then a skew chisel (same as with the Butt blank) until you've turned the diameters marked by the parting tool. You may want to stabilize the shaft by gripping them together as you do your final cuts Fig(13a). Use the straight edge to verify that your taper is straight. Turn down to .52" at the 1" mark. Sand the blank and connector much the same as done above for the butt blank (Fig 13b)– sand the narrow end of the blank to ½".

Section 4 – Finishing the Tip Shaft

4.1 Finishing the tip

Now cut the tenon for the ferrule. This is the thinnest part of the shaft and requires the most precision and care. Cut a tenon to .350" (the ID of the Ferrule) about 1-1/16" long between the 27" mark and the wood bubble. (Fig 14a). Part off the wood "bubble" at the end of the tenon (now about 1-1/16" long). Move the Followrest as close to the tip end as possible. Slide the ferrule onto the tenon to test fit, (Fig 14b) once fitting firmly on the tenon, remove then glue the ferrule onto the tenon. Allow the glue to dry. Holding the Followrest with one hand, use the other hand to turn the end of the blank down to the same diameter as the ferrule (.50). (Fig14c) Part, sand or turn off any excess tenon wood that extends through the length of the ferrule. Cut the end of the ferrule square with a parting tool. (Fig 14d)

4.2 Applying final finish to the shaft. You only need to use sanding sealer. This end must slide easily through the players hand and requires a well sanded but "slippery" finish that the sealer provides.

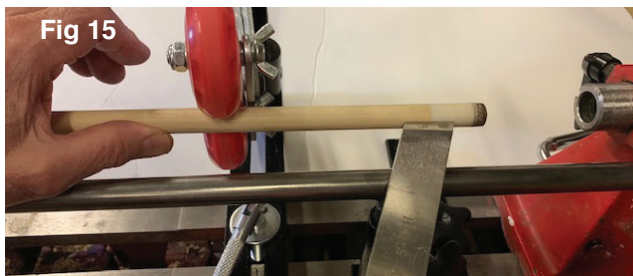
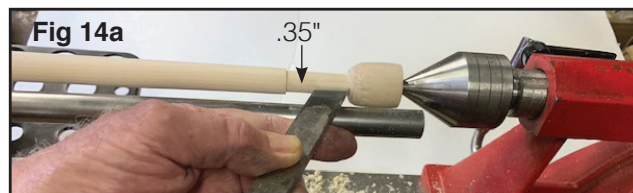
4.3 Installing the tip -Glue the tip onto the end of the ferrule with Epoxy (other adhesives are recommended in the industry but not available in our catalog). Advance the tailstock to press the tip onto the ferrule. Allow to dry supported by the Followrest and one hand, (Fig 15) turn and sand the tip even with the ferrule diameter. Prep the tip end with abrasives readily available on-line.

Section 5 – Final Finishing

5.1 Finishing the center connections together (optional)

- screw together both ends to make a completed cue. If the joint connectors do not meet exactly to your expectations then here's a method to finish them to meet exactly. Insert the 1-1/4" butt end into a lathe chuck on the headstock. (16a) Carefully tighten the chuck onto the Butt shaft and support the center of the cue with the Followrest. Holding the shaft against the rest with one hand, turn on the lathe and use a skew chisel then fine sandpaper to even the connector joints to meet evenly. (16b)

5.2 Final Steps (Fig 17) The PSI butt blanks are pre-drilled 7" deep to accept weights up to 3 ozs. (heavier weights are ideal for "break cues") Select a weight to insert into the Butt end. (1,2, and 3 oz. weights available) The amount of weight is a matter of personal choice but the weight allows play and break action that the user prefers. Screw the weight deep as possible into the butt end cavity. Cap the butt end by pressing the rubber bumper firmly into the butt end. Your hand turned cue is now finished! Enjoy your cue!



Appendix 1) Cue Accessories

Type	Item No	Count	Color	Size	Material	Photo
Cue Tip	#CUEXTIP	1		14mm		
Tip Ferrule	#CUEXFER	1	White	13mm 0° x 1"L	Polycarbonate	
Weight	#CUEXW1	1	Zinc Plate	1oz, ½" OD, 2-1/4" L	Steel	
Weight	#CUEXW2	1	Zinc Plate	2oz, ½" OD, 2-1/4" L	Steel	
Weight	#CUEXW3	1	Zinc Plate	3oz, ½" OD, 2-1/4" L	Steel	
Joint Collar	#CUEXJ25W	2	White	1/4" L x 5/8"ID, 1" OD	Ertalyte	
Joint Collar	#CUEXJ50W	2	White	1/2" L x 5/8"ID, 1" OD	Ertalyte	
Joint Collar	#CUEXJ25B	2	Black	1/4" L x 5/8"ID, 1" OD	Ertalyte	
Joint Collar	#CUEXJ50B	2	Black	1/2" L x 5/8"ID, 1" OD	Ertalyte	
Joint Collar	#CUEXJ10B	10	Black	1/16" L x 5/8"ID, 1" OD	Ertalyte	
Joint Collar	#CUEXJBR	1	Bronze	1"L x 5/8"ID x 1" OD	Turnable Bronze Composite	
Joint Collar	#CUEXJBW	2	B&W Segmented	1/16" L x 5/8"ID, 1" OD	Stabilized Wood	
Butt Collar	#CUEXBCB	1	Black	¾"L x .95"ID x 1-3/4" OD	Ertalyte	
Butt Collar	#CUEXBCW	1	White	¾"L x .95"ID x 1-3/4" OD	Ertalyte	
Bumper	#CUEXBUM	1	Black	1-1/8OD top, .7"insert	Rubber	
Connector Set	#CUEY	2pc set		Male/Female 5/16" Bolt Set (Compatible with #CUEMAN MANDREL SET)	Metal	

(*) Current as of printing of this manual. Refer to our website www.pennstateind.com for most current selection)

Essential Hardware for Cue Turning

Appendix 2) Butt finishing options

Finish Options Butt End	Pros	Cons	PSI Item no.
Polyurethane Spray	Easy to spray (multiple coats), Fast application, inexpensive	Medium shine, cannot be touched up, requires multiple coats	N/A
Aussie Oil	Easy to apply (multiple coats) as a friction polish, inexpensive, easy to touch up, Medium shine	May need touch up after continuous use. Requires multiple coats	#PKSWAUS
2 Part epoxy	Long lasting hard surface. Can be applied with multiple coats for best results	Medium to low shine Cannot be re-applied, Expensive. Difficult to apply and finish. Short working time	#PKGLUE2
CA Finishing Kit	Durable Plastic Hi-Gloss finish, Long lasting, Hard surface	Expensive, Very difficult and time consuming to apply, can't be touched up, Very short working time	#PKCAFINKIT
Glu-Boost Finishing Kit (refer to Appendix)	Durable Plastic Hi-Gloss finish, Long lasting, Hard surface, Easy to apply than CA, Longer working time than CA. fewer. Coats than CA (only 2 required)	Expensive (but less expensive than CA) , can't be touched up	#PKGLUSET
Finish options - Tip end			
Sanding Sealer (Preferred for tip end)	Easy to apply as a friction polish, inexpensive. Can be touched up. Natural finish	Satin or no shine.	#PKFRICT3

Appendix 3) After much trial and error we found that Glu-Boost CA was the most user friendly system for getting a deep rich result. It provided: a long 15 minute "working" time. Required fewer finish applications. Produced a deep rich finish. The 6 piece finishing kit #PKGBCSET contains all of the materials discussed below.

Applying GluBoost CA

Apply GluBoost with thin craft foam or heavy duty plastic bag, such as the bags that contain PSI pen kits. You can insert a folded paper towel on the bag to provide cushion during the application. With the lathe running at a comfortable speed, drip a pool of Fill 'n Finish Thick (blue label) onto the applicator surface and apply to the entire workpiece including any non-wood sections. Use moderate pressure to reduce ripples on the surface. Add additional CA while applying until surface is completely coated.

Spray surface with GluDry Accelerator and allow surface to cure for a few minutes. You can then apply additional coats as desired.

Always use a fresh applicator for additional coats and accelerator in between coats.

Apply a final coat of Fill 'n Finish Thin (orange label) and spray with accelerator. Allow this to cure a minimum of 15 minutes (overnight is better) before proceeding.

Final Polishing

Use 400 grit sandpaper to reduce any ripples along the surface until it is smooth. Do not sand aggressively! This step is just to remove high spots and create uniform surface. Once the surface is smooth, progress to higher grits through at least 600 (higher is better) taking the same steps as before. Use minimal pressure in lower grits and increase pressure with higher grits to reduce the chance of stubborn marks. It is very important to remove all scratches from previous grits, but do not sand so much that the GluBoost is stripped from the cue requiring re-application.

After sanding to maximum grit. Use Ultrafine Polishing Paper (can be cut into long strips). Start with highest micron paper and progress to lowest micron, using the same techniques as were used when sanding. When finished with polishing paper, use OneStep Plastic Polish to remove any remaining micro-abrasions. Use a generous amount and coat completely with lathe off. Turn on lathe and apply pressure with polishing cloth or paper towel. Use a clean section of cloth or paper towel to remove polish and buff the surface to a final shine.



