SAFETY MATTERS
From the Eye of a Survivor

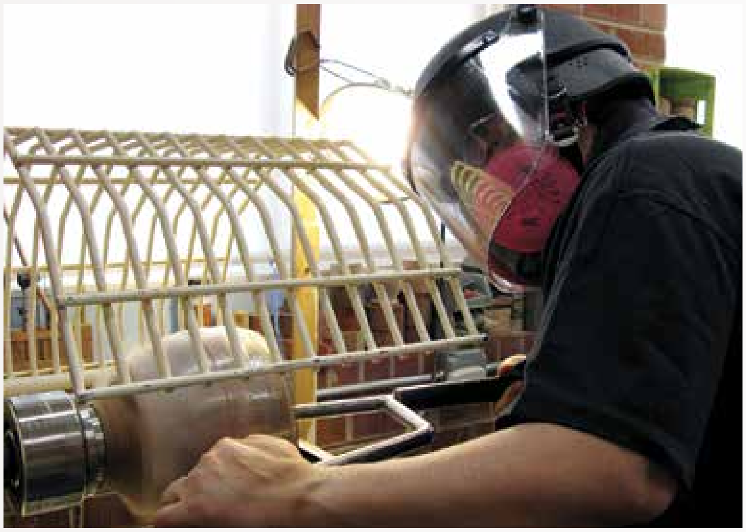
Lynne Yamaguchi

"Pretty safe" would have been my answer two years ago if asked how safe I was while turning. I follow safety guidelines: I dress appropriately, wear a respirator, and wear a faceshield except when sanding. I stand on a platform so I can work ergonomically (I'm short). I keep my tools sharp and equipment maintained. I read manuals carefully, including warnings. I would not dream of working after drinking a beer. I like imperfection, so I take calculated risks turning unbalanced, irregular, and flawed wood, but I also take extra precautions and countermeasures. I am clumsy and distractible but not reckless, and I am experienced: turning has been my full-time occupation since 2003.

On September 21, 2012, I learned I was not safe enough.

I was turning an endgrain hollow vessel from a short segment of badly cracked mesquite, about 6½" long (16cm) and 10" (25cm) in diameter at its shoulder. I had chosen a cracked log to fill an order for vessels with turquoise inlay—12 of which I had already safely turned. The wood was obviously dangerous, and I had been treating it as such, shaping the exterior at low speeds (150 rpm to 450 rpm) between centers and wrapping duct tape around the shoulder and body before hollowing. I had mounted the vessel in a chuck to hollow it, using speeds up to 550 rpm. Because of the cracks, I deliberately left the wall substantial, 1¼" (32mm) to more than 2" (51mm), planning to reduce it further after finishing the interior.

As I finished hollowing, I turned up the speed to 1200 rpm to make a few cleanup passes. This speed did not feel unsafe. There was no vibration, and I was out of the line of fire. Although I normally dial the speed up from and down to zero every time I start or stop the lathe, in this case after I found the sweet spot—a smooth fast speed that allowed a clean cut on the interrupted surface—I used the power button to stop, check my cut, and restart for another cut or two. I stopped and restarted once or twice, possibly three times.



Turning with the wire guard in place, wearing my riot helmet and respirator. The piece, which has multiple cracks, is wrapped in plastic stretch wrap for reinforcement.

Photo: Karen Barber

Then I stopped to answer a phone call.

Without the interruption, what would likely have happened next, based on previous experience, is this: I would have sucked the shavings out, taken a last look, and, deciding I was ready to start filling the interior cracks, I would have reached over to turn the speed back to zero without turning the lathe back on.

Interruptions happen

Answering the phone call interrupted my normal sequence. Further, it changed the protection I was wearing. Up until that point, I had been wearing a half-mask respirator, my glasses, and a full faceshield. To answer the phone, I took off my faceshield and dropped my respirator. After hanging up, I straightaway pulled the respirator back on, out of habit. Instead of putting the faceshield back on, however, I took a moment to look at the vessel.

I had cut as much as I dared from the interior. The exterior curve at the mouth was not quite as I wanted, so I decided to look at the vessel spinning to see past the duct tape, to check the rest of the curve. I pulled the power button on.

I cannot blame the interruption for what happened. Interruptions happen, and I knew from experience the hazard of turning the lathe on when the speed is high. I had, in fact, been trying to train myself to check the speed dial position before turning the lathe back on after an interruption. This I failed to do—my foul, my harm.

When I turned the lathe on, the high speed did not trigger alarm—I often turn at high speed, working on smaller, more delicate pieces. And I was only looking, after all.

The irony is that my next step would have been to turn the lathe off. I have a ▸

clear image of the piece as I last saw it, wrapped in duct tape: I could not have touched up the exterior surface even if I had wanted to. Also, the tool I held was not the right one, and I had not even raised it for use. If I had, my forearm might have provided some protection. As it was, I was just looking.

Impact

I heard the wood give, and something slammed my face. I stepped back off my platform and dropped to my knees. I could feel warm liquid begin to flow from my face. I was extremely dizzy and faint.

I pulled my respirator off, dropped it, then stood up. I looked at the garage door and dismissed the likelihood of reaching it and wresting it open. I took the few steps to my toolchest, turned off the radio, and groped for the telephone. I returned to my original spot and collapsed back to my knees. I felt strongly that I might pass out. If I dialed 911 and lost consciousness, EMS would have difficulty locating me and getting in. My partner works a mile away, next door to a hospital. I dialed her work number, and to the woman who answered, I said clearly and forcefully, "Tell Karen to come home right now," and hung up.

I stayed down for a moment trying to collect myself. I saw my glasses lying next to where I had dropped my respirator. I picked them up and stood up, made my way to the doorway, turned out the lights, locked and closed the door, and crossed the back porch to the kitchen door. I stopped; I couldn't remember if I'd locked the studio door. I turned around and went back to check. I had. As I was walking back, I noticed blood drops on the floor, so I picked up the corners of my apron to catch the blood. I locked the kitchen door behind me, walked to the refrigerator, and grabbed a dishtowel, holding it to my face, still clutching the corners of my apron. I passed into the living room, picked up my purse, and went out the front door. I had just turned to lock it when Karen pulled into the driveway.

I walked to the passenger side, got in, and told Karen to go lock the front door, which I had to repeat, because she didn't understand. She got out, did so, got back in, backed out, and drove. I did not attempt to buckle my seatbelt. I huddled in the seat, clutching the armrest to keep my balance. I could hear Karen debating which hospital to go to. I couldn't answer. Karen thought I had passed out. I heard us pull up, heard her leave to get help. Someone opened the car door, and people helped me into a wheelchair.

At that point, I surrendered control. That's the last I really remember of that day.

The damage

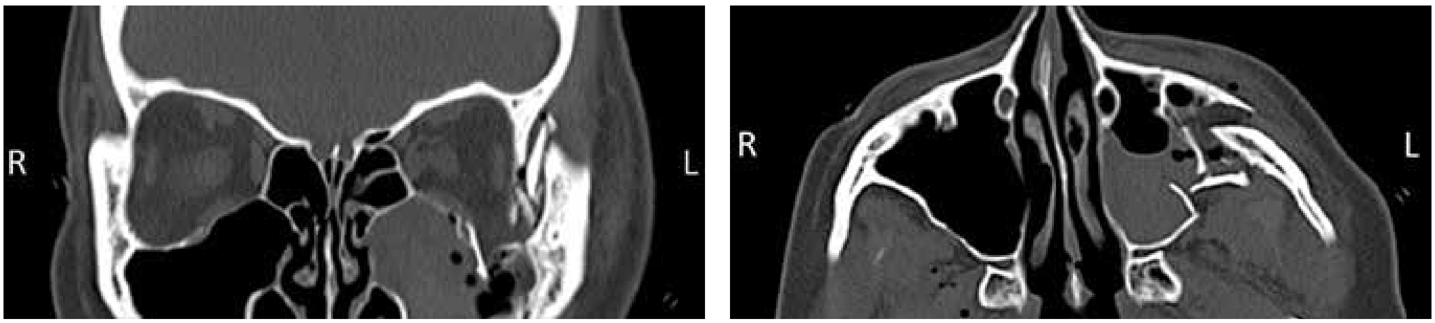
All of the bones in the left side of my face, from above my teeth up through my eyebrow, and from beside my nose to my temple, were fractured; it took four titanium plates to reconstruct my face. The bone at my temple was pulverized, with not enough left intact to even attach a plate. My eyelids were split through and hanging loose. My lower eyelid did not survive; my brilliant surgeon has since made me a new one using cartilage and skin from my left ear. My eyeball did not rupture, but my lens was knocked perpendicular and had to be removed. My iris ruptured, so my pupil is permanently blown. My retina detached soon after, necessitating two surgeries, and my macula is deeply scarred from hemorrhaging, leaving me without central vision in my left eye. The nerves of my cheek and around my eye were damaged and are still regenerating. My eye does not drain properly, so tears spill out constantly. For months, my eyelids would not close properly, leaving my cornea dry and painful. I have had six surgeries, and counting.

Given the severity of my injuries, I wondered how much difference my faceshield would have made. Not much, I discovered to my surprise.

Faceshields

In the United States, the safety standards for eyeglasses and faceshields are specified in ANSI Z87.1-2010. Under those specifications, to be rated impact resistant, a faceshield needs to withstand an impact of about four joules of kinetic energy and a penetrating impact of about six joules. The vessel I was turning broke into three pieces, and the one that hit me weighed one kg (2.2 lb). Traveling at nearly 16 m/sec, it struck me with 127 joules of kinetic energy, more than 30 times the high-impact and 20 times the penetrating-impact standard.

Europe (EN 166:2001) and Australia and New Zealand (AS/NZS 1337.1:2010) have higher impact standards, with the highest rating ("high energy impact" and "extra high impact," respectively)



CT scans of my face right after the accident. Compare the left and right sides to see the bone damage and swollen soft tissue.

The vessel that broke apart while turning, finished. The segment that hit me is to the left, delineated by the turquoise.

My riot helmet and half-mask respirator

Photo: Karen Barber

requiring resistance to more than 15 joules. Even with those higher standards, I would not have been protected. What's a woodturner to do?

The solution I came up with is a riot helmet, which is required under the NIJ 0104.02 standard to withstand an impact of 111 joules (88 joules for a penetrating impact). That number is still short of 127, but at least it is in the same order of magnitude. To meet this standard, the helmet's faceshield has to not only remain intact under the impact, but also not contact the face it is protecting. I reason that the faceshield may deform with a greater impact (polycarbonate is not supposed to break) and I may receive some injury, but it will be considerably less than without it—or with a standard faceshield.

The riot helmet is affordable, less than $100 on sale, and it accommodates my half-mask respirator. For comfort, I chose the lightest one; it weighs 2 lb 3 oz, little more than a powered respirator. The faceshield itself measures about 0.162" (4.1mm) thick, compared to 0.043" (1.1mm) for my Bionic faceshield. You can get riot helmets with thicker faceshields if you are willing to go heavier; too heavy, though, and you might find yourself reluctant to wear it. The next step up would be a ballistic helmet, with three times the weight and 10 times the cost. If you feel the need for a combat-grade helmet, perhaps you should rethink what you're doing at the lathe.

I don't wear my riot helmet all the time. I weighed some pieces and ran sample numbers: the kinetic energy of a 0.05-kg fragment (less than two ounces) from a 7" bowl spinning at 1200 rpm would be about three joules; at 2200 rpm, more than 10 joules. A fragment of the same weight from a 12" platter spinning at 1200 rpm would hit with nine joules of energy; a larger fragment—say, 0.2 kg (seven ounces)—nearly 37 joules. Most of what I turn is under 7" diameter with little mass, so my regular faceshield suffices. But now I know how to more realistically assess the risk, and I choose my protection accordingly.

P-r-o-t-e-c-t

I have also installed the guard that came with my lathe, and I use it as much as is practical. It does obstruct my view when I am trying to perfect a curve, so I lift it in the final shaping phase, but otherwise I hardly notice it.

What else do I do differently? I always check that speed dial. I answer the phone only in between tasks. I use plastic stretch wrap, layers and layers of it, not duct tape, to reinforce iffy vessels. I turn at slower speeds.

The biggest change in my approach to safety is attitude. People say, "Safety first," but how often do we mean it? Instead, time, money, expediency, or convenience dictates our actions.

I have learned a lot about eyes: Human eyes are made to focus on one thing, then another, then another. It's not just easy to miss the big picture; it's hard to see it unless we actively attend to it. Safety is part of the big picture, and this smack in the face got my attention.

Among the lessons I have learned is this radical concept: I am worth protecting. I am worth the time, effort, and money. It does not take a lot: An extra moment to assess what I'm doing before I begin a task, a few seconds to stop the lathe before moving my toolrest. Minor investments in additional equipment: the riot helmet, chainsaw chaps (I already had a helmet), safety glasses. Afternoons spent building a sawbuck and rip and crosscut sleds for my bandsaw.

There is much more at stake than my physical well-being. The physical cost of my accident is obvious; the psychological and emotional cost to my loved ones cannot be measured: Karen seeing my destroyed face; my family and friends hearing the news, not knowing the prognosis; my need for support throughout my long recovery. The financial cost is considerable, even with insurance, and it continues to mount. Professional costs include lost momentum, time, income, and ability.

I have faith we will eventually recover. And great blessings, life-changing gifts of grace, have come with all this. But do I wish I had learned the importance of safety from someone else's mistake? Abso-damn-lutely. Here's your chance. Will you embrace it? ■

Lynne Yamaguchi is a professional woodturner who specializes in sculptural vessels that reflect her Japanese heritage. In between surgeries, she is back to turning full-time. She continues to find redemption in imperfection and is learning to live without depth perception. Find out more about her work and accident at lynneyamaguchi.com.

Two charts are available on AAW's website at woodturner.org/?page=safety: Assess Your Risk and Comparison of Kinetic Energy Values.

ASSESS YOUR **RISK**

Lynne Yamaguchi

The point of this exercise is not to get precise numbers, but to get a sense of the range of potential impacts you may encounter in the kind of turning you do.

1. Choose an unturned blank that is typical of what you turn. Weigh it and a finished object of similar size, using kilograms as your unit. Divide the weights—half, a third, a quarter, a fifth—to estimate the weight of typical fragments.

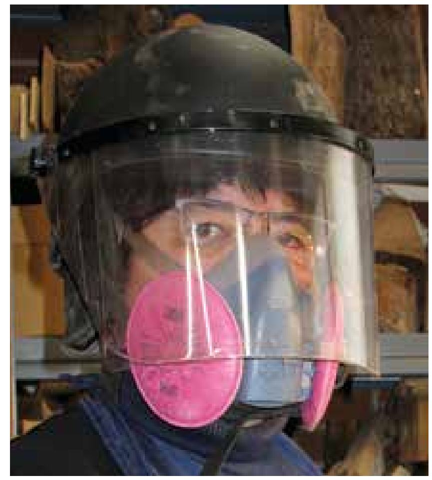
2. Convert the diameter of your blank and object to meters and multiply by π (3.14) to get their circumference.

3. Choose a few lathe speeds typical of what you would use for a blank of your chosen size. Divide each lathe speed by 60 to convert it to revolutions per second.

4. Multiply the circumference by the converted lathe speeds to get the velocities in meters per second.

Comparison of kinetic energy values

Regulatory test or example	Condition	KE (joules)
Z87.1 non-impact test	1" steel ball dropped from 50"	0.8
Z87.1 high-velocity impact test: glasses	¼" steel ball traveling 150 ft/sec	1.1
Z87.1 high-velocity impact test: faceshield	¼" steel ball traveling 300 ft/sec	4.4
Z87.1 penetration test	500-g pointed projectile dropped from 50"	6.2
AS/NZS 1337.1 high impact resistance test EN 166 medium energy impact test	6-mm 0.86-g steel ball traveling 120 m/sec	6.2
AS/NZS 1337.1 extra high impact resistance test EN 166 high energy impact test	6-mm 0.86-g steel ball traveling 190 m/sec	15.5
0104.02 impact test	5.1-kg assembly traveling 6.6 m/sec	111.1
0104.02 penetration test	3-kg pointed striker dropped from 3.00 m	88.2
My accident	1-kg fragment of 10"-dia. vessel turning at 1200 rpm	127.2
Bowl fragment 1	0.05-kg fragment of 7"-dia. bowl turning at 1200 rpm	3.1
Bowl fragment 2	0.05-kg fragment of 7"-dia. bowl turning at 2200 rpm	10.5
Platter fragment 1	0.05-kg fragment of 12"-dia. platter turning at 1200 rpm	9.2
Platter fragment 2	0.2-kg fragment of 12"-dia. platter turning at 1200 rpm	36.6



My riot helmet and half-mask respirator

Photo: Karen Barber

5. Find the kinetic energy (the energy of an object in motion) of the potential projectiles by multiplying mass times velocity^2 times ½, or ½mv^2. In other words, plug the velocities and the estimated weights of various fragments into the following formula:
   $0.5 \times \text{kg} \times \text{m/sec}^2 = \text{joules}$

   (Notice that, in contrast to mass, velocity affects kinetic energy exponentially.)

6. Compare the numbers you get with the following figures:
   - 4.4 joules: the impact standard for American faceshields
   - 15.5 joules: the impact standard for European ("high energy resistant") and Australian and New Zealand ("extra high impact resistant") faceshields
   - 111.1 joules: the impact standard for American riot helmets

Is your faceshield adequate?