3.7 damaged bullets

One day in the summer of 2004, after casting some 311299 bullets, I emptied the container of bullets onto the concrete floor from a height of about 3 feet.
After saying the obligatory words I was ready to re-melt the bullets and start again, but then thought that these bullets gave me an opportunity to experiment.
I inspected and weighed the bullets, discarding any with casting defects or outlying weights, as I do with almost all my cast bullets. The acceptable dropped bullets had dents ranging from pretty bad to no dent at all. I rejected no bullet for a dent.
I was working with a M54 Winchester in 30 WCF at the time. I loaded the dropped bullets and undropped bullets with the same loads, and shot them for group at 100 yards. Here are the results.

GROUPS
AVERAGE
AVERAGE

SHOT
GROUP,
GROUP,

WITH
DROPPED
NOT
DATE
POWDER
CHARGE
EACH
BULLETS
DROPPED
8/4/2004
AA#9
12.5
4
1.569"
1.650"
8/25/2004
SR4759
12
4
1.181"
1.613"
9/8/2004
IMR4227
14.5
5
1.060"
1.290"
11/3/2004
AA#9
12.5
4

0.913"
1.019"

If I'm testing two loads, I shoot load "A" first, then load "B". Then I wait about fifteen minutes, may clean the gun if that is part of the test, and then shoot load "B", then load "A". This takes the "clean" and "hot" bias out of the testing.
In each of the four tests, the dropped and dented bullets shot smaller average groups than did "perfect"= not dropped and dented bullets. I don't know what conclusions can be drawn from this experiment, other than that dents don't seem to radically degrade the accuracy of cast bullets.

To see if damaged bases affected accuracy, I took a box of 18 Hoch bullets for the 32/35 Maynard, and made one file pass across the bases at about 45 degrees. This filed a flat defect on the bases, readily seen.
2/23/05 12/IMR 4227, Rem 2 1/2, breech seated, multiple cases, Model 1882 Maynard No. 16 in 32/35, Iron Sights, Hot and plenty of mirage. 100 yards, 5-shot group with perfect base bullets, then 5-shot group with damaged base bullets-alternating for 3 groups each.
Group Sizes:
Perfect bases: 2.15", 2.20", 2.675" Avg. 2.342".
Damaged Bases: 1.2", 2.975", 2.025" Avg. 2.067"
On a good day, with one case and going carefully, this rifle has made many groups under an inch, probably averaging about 1 1/2 inches. The Irons are harder to see than ever.
Ohaus 45-405 bullets, 434.5 +/-.5 grains, Darr lubed, 21.5 grains SR4759, Dacron wad, WLP primers, breech seated, 100 yards, five shot groups, C. Sharps 45/70 Model 1875, 30X STS, Muzzle Clamp/Anti-Cant device.

A set of bullets had the bases filed at a 45-degree angle for about half the thickness of the base band.
Shot 3/2/05 to see the effect of damaged bases. Windy enough to blow empty plastic ammo boxes off the bench, 70 degrees, bright sun, plenty of mirage. Alternating perfect and damaged bases.

Group sizes:
Perfect bases: 2.1", 4.3", 2.05", 3" Avg. = 2.863"
Damaged bases: 3.35", 2.675", 3.95", 2.9" Avg. 3.219"
I thought there might be lead in the barrel, couldn't find any. I read through the notebook on this rifle last night. Many 10 shot 200 yard groups under 4", many 100 yard 5-shot groups under 2", some under 1", one measured .693"-all with this load. I've used the Wolf No-Grease-Groove bullet almost exclusively in this rifle since 1993. I don't know why I'm shooting such big groups in this damaged bullet testing-but here it is. Maybe these damaged bases caused the larger groups.
3/23/05, nice and windy, with gusts, varying from bright sun to rain showers. About 84 degrees with excellent high humidity. Martini 30/30 bench rifle, Lyman 20X STS, Wolf No-Grease-Groove 213 grain bullets with two coats of Lee Liquid Alox, 12.5/AA#9, Remington 2 1/2 primers. One hundred yards, five-shot groups, one sighter, shoot two groups, clean.
Good bases 1.1", 1.6", 1.825" Average 1.508"
Filed bases, 45 degree at the edge 1.325", 1.65", 1.075" Average 1.35"
As an aside, I also tested 311299's from a "Beagled" mold, these averaged 1.069" for four groups with the same load.
The Wolf NGG bullet has always shot adequately if not as well as other bullets in this rifle, but sometimes leads about a foot up the barrel-hence the cleaning.
This is the third test.
It starts to look like we can say that damage to the edges of bullet bases doesn't radically affect accuracy.
3/22/06 308403, Darr Lubed, Rem 2 1/2 primers, one case, 7/Unique, 30WCF M54 Winchester, 30X STS, Sandbag bench rest (Hoppes). 85 degrees, very windy, clouds then clear, very hot in the sun. 100 yard five shot groups. 26 bullets had the bases filed at a 45-degree angle to make a defect about half way up the base band. Fired about 6 sighters and stopped. Next relay (15 minute relays) fired 1 fouler, 5 filed base, 5

good bases. Next relay fired 1 fouler, 5 good bases, 5 filed bases. And so on, alternating the first group shot between filed bases and good bases.
Filed Bases 2 .375", .825", 2.4", 2.5", 2.4" Average 2.1"
Good bases 3.3", 2.55", 2.3", 2.2", 2.3" Average 2.53"
There are a lot of bullets tipping. Maybe need more powder or Dacron; I've used 7.5 grains/Unique and Dacron in the past.
This bullet generally shoots into about 1.5" averages at 100 yards. Maybe the wind, which will stop in July, when it gets REAL hot.
Again, I don't think that filed/damaged bases shoot better than good bases, the .825" group is a fluke.
3/29/06 308403, Darr with some beeswax lubed, WLP primers, 7.2/Unique weighed/dribbled, Dacron wad tamped down on powder, 30WCF M54 Winchester, 30X STS, Muzzle clamp/anti-cant device, flat bench rest. 79 degrees, slightly windy, clouds then clear, 100 yard five shot groups. 26 bullets had the bases filed at a 45-degree angle to make a defect about half way up the base band. Fired 6 sighters and stopped. Next relay (15 minute relays) fired 1 fouler, 5 filed base, 5 good base. Next relay fired 1 fouler, 5 good base, 5 filed base. And so on, alternating the first group shot between filed bases and good bases.
Filed Bases 2.55", 2.2", 1.5", 2.525", 2.85" Average 2.325"
Good bases 1.125", 1.325", 2.3", 1.275", 1.8" Average 1.565"
Most of the bullets are still tipping.
Finally, the damaged base bullets shoot larger groups than the good bases.
4/5/06 308403, Darr with some beeswax lubed, WLP primers, 8.0/Unique weighed/dribbled, Dacron wad tamped down on powder, 30WCF M54 Winchester, 30X STS, Muzzle clamp/anti-cant device, flat bench rest. 84 degrees, quite windy, clear, 100 yard five shot groups. 27 bullets had the bases filed at a 45-degree angle to make a defect about half way up the base band. Fired about 6 sighters and stopped. Next relay (15 minute relays) fired 1 fouler, 5 filed base, 5 good base, cleaned barrel with 2 patches and MM oil. Next relay fired 1 fouler, 5 good base, 5 filed base, cleaned barrel. And so on, alternating the first group shot between filed bases and good bases.
Filed Bases 2.2", 3.7", 1.95", 1.525", 1.275" Average 2.17"
Good bases 1.7", 2.0", 2.6", 1.825", 1.675" Average 1.96"
Maybe half of the bullets are still tipping.
Those shot 4/5/06 were from a lot that weighed 170.6 to 170.9 grains. I just filed the base of one out of that lot. It started at 170.8 grains. After filing it weighed 170.5 grains. The filing lost .3 grains.
4/12/06 308403 lubed with Darr + some beeswax. 11/AA#9, WLP primer, CF Ventures soft gas check, Martini 30/30 bench gun, 30X STS, muzzle clamp/anti-cant device, flat bench rest. Five shot 100-yard groups, 1 sighter and 2 groups per 15-minute relay. Bases on some bullets filed at ~45 degree angle ~ half way up the base band. It was 82 degrees and windy. How windy was it? My Gatorade plastic bottle cap blew off the bench, my gun case blew open (it was slightly open) and a set of sky screens with holder and tripod blew over twice. I have little experience with this bullet in this gun.
Six of 25 shots with both good and filed bases were tipping.
Good bases 2.725", 1.175", .625", 1.45", 1.7" Avg 1.535"
Filed bases 3.125, 2.675, 1.45", 3.45", 1.025" Avg. 2.345"
Summary to date

	FILED BASES	GOOD BASES
3/22/06	2.1"	2.53"
3/29/06	2.325"	1.565"
4/5/06	2.17"	1.96"
4/12/06	2.345"	1.535"

Damaged Bullets, Distinction and Difference

After looking at forty groups fired, half with filed-base bullets and the other half with "good" = unfiled-base bullets, I've been assailed by a conclusion, to wit: Not all bullets with damaged = filed bases fly wildly to the target. The probability that any given bullet will land out of the group is greater shooting bullets with damaged bases.

I first thought that this was a distinction without a difference-it's starting to look like bullets with damaged bases make bigger groups than bullets with good bases. But I think that I see a difference.

All our bullets would go through the same hole, we think, if not for the differences that creep in amongst our loads. Differences in brass or bullet or powder or primer or bore condition or weather or any of the dozens of variables. These differences, some or most of us suspect, yield shots outside the group. And

my assumption, shared, I think with others, is that if we assembled and shot a set of loads, all with a given difference, the groups would be larger than if that difference were not present. And we suspect that that is true because the differences make the bullets fly out of the group.

Now all bullets with damaged bases do not fly out of the group, some of them fly into very nice groups and others fly into nice four-shot groups with a flyer, or three shot groups with two flyers, or....

Since the filed-base groups look to be larger, probably bullets with damaged bases make larger groups on average than do bullets with good bases. Think of two normal-looking overlapping distributions.

This is where I get stuck. A bullet with a forty-five degree filed surface for about half of the height of the base band should fly to a different place than an unfiled bullet. And with no specific orientation of the bullet with the bore, these filed-base bullets should make a "big" group. There are any number of folks who can explain why these bullets should make these big groups. They do make bigger groups, on average, I think. But, why are some filed-base groups smaller than good base groups? Why doesn't every filed-base bullet fly out of the group? Why is this a probabilistic process? If damaged bullet bases cause the bullet to fly out of the group, why doesn't every damaged base bullet fly out of the group?

A cartridge without a primer doesn't go off, and it doesn't go off every single time. There's no business about it doesn't go off 96% of the time, it doesn't go off.

If damaged bases cause bullets to fly erratically, then every bullet should fly erratically. Every bullet.

Perfect loads make one hole.

Real-world loads make groups with the greatest density of the shots in the center, and reduced numbers of shots as the distance from the center increases. Dense in the middle, density decreasing as the distance from the center increases.

Loads with an intentional defect oriented randomly should make groups that look like a doughnut, with maximum density at some distance from the center, diminishing both toward and away from the center. I don't think that they do.

So, I'll make a bunch of filed-base bullets and fire them at one aiming point. Maybe thirty or so. And I'll fire a set of good-base bullets at another aiming point.

I'm thinking that if I don't get a doughnuty looking group from the filed base bullets that maybe we need to re-think some of those explanations.

4/26/2006 M54 Winchester 30WCF, 30X STS, 12/AA#9, WLP primers, CF Ventures Soft Gas Check, 308403 lubed Darr + beeswax, muzzle clamp/anti-cant device and flat bench rest. 65 bullets had 45 degree filed bases to about half the height of the base band. A set of 18 cases had file marks put on the base and rim for orienting. A fouler was shot before each set of shots, at the center dot. Bullets were put in the cases with the filed bullet marks at 12, 3, 6 and 9 o'clock, four shots, and the cartridge was put in the chamber with the case base/rim mark at 12 o'clock. Then as precisely as I could put the bullet in the case and then the cartridge in the gun, bullets/filed bases were oriented each shot.

Four with filed bases, four perfect bullets, then four with filed bases and four perfect bullets; with a sighter comes to 17 shots per fifteen-minute relay. 64 shots each with filed and perfect bases were made. All shot at 100 yards.

The weather varied from sunny to rain, still to very windy. In the still sunny conditions there was a lot of mirage, and biting horseflies about the size of robins. Lots of "damn"s and slapping body parts.

The damaged base group is 3 9/16" high by 4 11/16" wide, with no discernable pattern. The perfect base group is 2 7/8" wide by 2 1/2" high with the center shot out and outliers ~evenly distributed.

It is clear from the target that bullets with damaged bases do not shoot wildly, that many of the bullets cluster into a small group, and that the group/distribution is not doughnut shaped. This suggests that the mechanism decreasing accuracy is not one that operates every shot, but is probabilistic in nature.

More damaged bullets

To damage some bullets for testing I took 26 of the 5/6/07 cast Borton Darr bullets weighing from 183.4-183.6 grains and with a small round file filed away 1 grain worth of metal from the middle grease groove area. I weighed each bullet, filed away until the weight had dropped 1 grain. All Darr lubed.

Five groups of five shots at 100 yards each with perfect bullets and these damaged bullets was the plan.

Ten shots at 2 points of aim were enough for me. Bullets with a 1 grain hole filed in the side with a round file, at 100 yards, are not wildly inaccurate, 10 shots aimed at 2 points of aim were contained in an area 3"

X 7", but there were no groups.
Now one grain is a lot, and is a sphere .088" in diameter. I suspect that this is larger than would be found in all but a very, very few cast bullets.
I then prepared sets of 30 WCF cartridges with 314299 bullets; one set with perfect bullets, a set with .2 grain filed off, and a set with .5 grain filed off. Here is a picture of 314299 bullets with .5 grain round-filed off.

Winchester M54. 30WCF, 30X Lyman STS
The load is:
314299 "No Dot", GC Alox lube, WLP, 12.5/AA#9, LOA 2.845"

"Perfect" bullets, Hard, cast 2/3/07, 199.4-200.2 gr., sized .309"

- 1/2 grain bullets, same as above but 1/2 grain filed off as shown

-.2 grain bullets, cast 3/9/07, 194.7-195.0 grains, sized .312"

On Wednesday, May 16, 2007 I shot these test "filed-side" bullets at 100 yards, 2 foulers and 2 5-shot groups per 15 minute relay, alternating between the 3 test loads. Groups measured to the nearest .025" with a plastic ruler with .1" increments.
Unfiled, "perfect" bullets: 1.4", 1.5", 1.95", and 1.475", 1.825 "Avg. 1.63"
Bullets with .2 grain round-filed off the side: 2.2", 1.35", 1.2", 1.95", 1.275" Avg. 1.595"
Bullets with .5 grain round-filed off the side: .95", 2.75", 1.175", 3.15", 2.5" Avg. 2.105"
I'm a little surprised at the "perfect" bullet groups; the 412 5-shot groups I've tested with this rifle and many powders/several bullets have averaged 1.466".
This data and last weeks data suggests that variations in bullet weight may cause variations in accuracy; and that bullets with bubbles/holes may be less accurate than those without.
All going toward the "Weigh bullets" question.

I repeated the tests on 5/23/07 and 6/20/07. Here is a table showing the results of the here tests:

Perfect
Filed .2 gr.
Filed .5 gr.
5/16/2007
1.400
2.200
0.950
5/16/2007
1.500
1.350
2.750
5/16/2007
1.950
1.200
1.175

5/16/2007
1.475
1.950
3.150
5/16/2007
1.825
1.275
2.500
Average
1.630
1.595
2.105
%
100.0%
97.9%
129.1%
5/23/2007
1.300
0.900
1.750
5/23/2007
1.700
1.750
1.300
5/23/2007
2.000
1.300
1.250
5/23/2007
2.100
2.150
2.050
5/23/2007
1.800
2.050
1.150
Average
1.780
1.630
1.500
%
100.0%
91.6%
84.3%
6/20/2007
1.450
1.900
2.400
6/20/2007
1.950
1.975
2.050
6/20/2007
1.450
1.750
2.450
6/20/2007
2.350

1.350
2.425
6/20/2007
1.750
2.800
1.250
Average
1.790
1.955
2.115
%
100.0%
109.2%
118.2%
Grand

Average
1.733
1.727
1.907
%
100.0%
99.6%
110.0%

Group sizes were measured with a plastic ruler graduated in tenths of an inch.
Resolution of group size was to .025" increments. All three-place decimals were formatted for consistency and ease of reading.
These three sets of groups were shot on three different days under three different sets of conditions.
If the grand averages are an indication of the process, then there is no "real" difference in group size for groups shot with "perfect" bullets and bullets with .2 grain round-filed off; and there may not be a "real" difference in groups shot with perfect bullets and bullets with .5 grain round-filed off.
In order to confirm that there is a difference in accuracy between "perfect" and ".5 grain" bullets, with 90% confidence, 28 groups with each bullet would be required. For 95% confidence, 47 groups, each, would be required. Now these groups should be shot with bullets, powder, etc. from the same lots, under the same conditions. I'm not going to do it, and suggest that the results of this test can be summarized as follows:
"In gun/load/etc. systems with capability to shoot 100 yard groups averaging 1.75" or greater, filed grooves on the sides of the bullets of up to .5 grain simulating holes only slightly increase average group size."
Note: A lead sphere .05" in diameter weighs .2 grains, .a 07" diameter sphere weighs .5 grains. These are pretty big holes or bubbles to imagine in the bullets.

DAMAGED 22 RIMFIRE BULLETS
Here's a picture of 22 RF bullets with .3 grain filed off.

Cartridges were prepared with .1 and .3 grains filed off with a triangular file.
On 6/27/2007, Model 12/15 BSA Martini, Lyman STS 30X, 50 yards, windy and starting to rain in fits.
Perfect, .1 grain filed, .3 grains filed ammunition.
This gun, like the rest, loves Eley Match ammunition.
I was going to file some Eley Match Red Box, I had the file in one hand and the first cartridge in the other, but a force stronger than I, (and I am enormously strong), kept me from touching that Eley cartridge with the file.
I was able to file the PMC Match Rifle, this ammunition works well in this gun.
Group sizes, leaded edge to leaded edge - .244", all in "
Perfect -.1 gr. -.3 gr.
.433 . 473 .353

.382	.564	.324
.439	1.294	.394
.419	.732	.546
.547	.443	.910
Avg.	Avg.	Avg.
.444	.699	.505

Here's the target:

As an aside, thirty cartridges had an average weight of 51.9 grains and a standard deviation of .228 grains.

Thirty empty cartridge cases had an average weight of 9.8 grains, and a standard deviation of .07 grains.