# HP LaserJet 2400 Grinding Noise

This month's article addresses an issue with the HP LJ 2400 series we've heard about from a number of customers. The noise is clearly coming from the rear of the printer, but as we investigated further found there were two problems that needed addressing. One is clearly surrounding the fuser, but not actually the fuser itself. The second one is related to the delivery assembly. In this first part of a 2-part series, we will focus on the issue creating the greatest amount of stir and needless warranty returns of fusers that aren't the problem. This information will not only help you now with the LJ 2400 printers, but could have a valuable application in the future: the newer models such as the LJ P3005, LJ M3027mfp and LJ M3035mfp all use the same general fuser drive theory.

This all started when one of our account reps, Doug Damon, told me about a problem, and solution they found on the LJ 2400 printer. In speaking with his customer, he was having serious noise issues surrounding the LJ 2400 fuser. He used the term "chainsaw" when describing the sound. Another customer who also had this issue, came up with a solution for it after hearing it in several printers. He took the customer's printer home, put it on his kitchen table and trouble-shot it until he got the noise to go away. Thanks to Clayton Fletcher and Joe Cox for sharing their knowledge and experience. It's good people like them who make this such a great industry and make great articles like this.

The noise, clearly coming from the rear of the unit, starts when the fuser starts to turn. In the LJ 2400 series the fuser and delivery assemblies have a separate motor and drive assembly, so the sawing noise doesn't instantly start when "a motor noise" is heard. Both technicians who helped us with this noted the sound getting louder or softer as they would push on one side or the other of the fuser while the unit was running. But, it was when the gear side of the fuser was backed away slightly, that the noise went away.

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We have a LJ 2420 printer, but with all our efforts we were not able to recreate the problem even with used fusers returned to us on exchange. This was a clue as our printer has had very little use. It began to point us to something in the printer itself -- not the fuser -- creating the problem. The customers I spoke with and our tech support staff all knew the fix. They were installing spacer washers behind the small screw that holds the fuser in place (gear side). One of the techs who didn't have spacer washers took the star washer off the machine screw that goes in the bottom left of the fuser and put it between the fuser and chassis, thus creating a gap. They noted sometimes they had to add more spacers to eliminate the noise. The greater concern with more spacers was getting the teeth of the drive gears too far apart and creating other problems.

In our research we looked at multiple fusers returned to us on exchange and expected to find chewed up or damaged fuser drive gears but all looked fairly normal. After talking with one of the field techs who had experienced this problem, he noted he didn't note any gear wear either. In his first attempt to fix the noise problem, he replaced the fuser drive assembly and gears, which is no simple job. That fixed the problem, but only temporarily. Ultimately he found the spacer washer solution mentioned earlier and the problem hasn't returned since.

Our theory on the cause of the noise and why it went away when the spacer washers were added is simple. Studying the gears more closely, the fuser drive gear meshes with a double set of gears in the printer, more specifically the smaller of the two (see figure A). So the drive gear on the fuser that interfaces with the smaller of the two gears in the printer would have to parallel with the larger set of the two. If the teeth on the two parallel gears (turning in opposite direction) would catch one another, they could create a chainsaw like noise. If this is true, why would putting a spacer between the fuser and chassis make the noise go away? Simple: it changes the angle between the fuser and the gears, ever so slightly. It's enough to pivot them away from each other so the teeth on the gears don't pass side by side and grind. Imagine two plates staggered with one another, but parallel. Now, change the angle of one of them leaving them no longer parallel. If the teeth are cutting at each other and creating this noise, a slight tilt would move the teeth away from each other and thus eliminate the noise.

## The HP LaserJet 2400 Grinding Noise - Part II

A noisy printer is never a welcome officemate. We described a solution in Part 1 to reduce the grinding noise related to the LaserJet 2400 fuser.

In this article, we offer even more options. But we've heard from techs that there are actually some new noises coming from a completely different location: near the delivery drive assembly and duplex and gearing system. We'll offer solutions to address this new noise as well. The office should get a little quieter after you read Part 2.

Grinding Noise from the Fuser

In Part 1, we found that placing a spacer washer between the fuser chassis on the bottom gear side of the fuser reduced or eliminated the grinding noise. Since the April article, we've had some good input from techs in the field. One noted a common problem with the bushing on the lower pressure roller to wander slightly from side to side. The movement did two things. First, it wore away at the bushing which would cause the fuser drive gear in the printer (spur gears trying to mesh with a now semi-helical gear is not a good thing). Second, the wandering lower pressure roller would allow the drive gear on the fuser to chip away at the larger of the double set of drive gears in the fuser- as we discussed in the April article- and thus the noise.

The spacer washer is more of a temporary solution that moves the fuser and the gear, eliminating the grinding noise. The actual solution to the noise is the replacement of the fuser when the grinding occurs as the lower pressure roller bushing is on its way out. If left that way, the bushing has known to completely deteriorate.

Now the good news. With the identification of the bushing problem, Parts Now! has acquired an improved bushing that prevents the wandering lower pressure roller. Each fuser we rebuild has this upgrade which means these fusers will run to their full life expectancies and you won't have to deal with the noise issue going forward.

While the fuser fixes one growling noise, another buzzing noise is caused by parts inside the printer. Studying the noise issue and trying to recreate it, we discovered an interesting set of drive gears that helped us ultimately figure out the solution. The two drives and their motor do three things:

1. Drive the fuser at normal speed via the main motor 2. Drive the fuser and delivery via the fuser motor at a higher speed 3. Drive the delivery in reverse and engage the fuser when in duplex mode

What's interesting is the fuser is being driven by two motors which can run at two different speeds and in opposite directions. Let's take a closer look using figure 1. Note the fuser drive gear or LPR (Lower Pressure Roller) gear, is driven by two sets of gears, both "A" and "C". Gear "C" is driven by the main drive motor which also turns the pickup, registration, toner cartridge, transfer and duplex sections in the front. The fuser is driven by the main drive motor and also by the fuser motor. You would think they would fight each other, but they don't. They're designed to work this way. It makes more sense when we look at the running process.

When the printer first starts up, the fuser motor is not running even though the main drive motor has kicked in, turning the pickup, registration, toner cartridges and transfer and duplex sections in the front. The main drive motor is being driven via gear "C" on the bottom. A couple seconds later, the fuser motor kicks in and runs at a higher speed engaging, gear "A". This turns the fuser at a higher speed than the main drive. The gear below gear "C" has a spring clutch on it which allows it to turn at the higher speed without fighting against the other gears. Thus, when the fuser rotates faster than the main drive, the spring clutch allows gear "C" to rotate faster than the main drive without a fight.

In duplex mode, the delivery rollers rotate in reverse, as the fuser motor is running in reverse, and pulls the paper back into the printer. The swing gear then engages gear "B" due to the rotation of the gear above it and the fuser is driven by the gear on top of the fuser instead of by gear "A". The question now is does the fuser rotate in reverse since the fuser motor is now in reverse? The answer is no. The gearing is set so the fuser is always rotating forward, which makes sense. It seems it's hard enough to make the fusing film system work running one direction, to run it in two directions is only asking for trouble. So why does the fuser run during the duplex process? The fuser delivery rollers are used to help guide the reversed paper into the duplex section of the printer. Without the help of the fuser we greatly increase the risk of a paper jam getting paper to the duplex.

An important function of the printer is the swing gear which you've been hearing about and may be wondering how it swings to the right gear. In figure 2 you can see the swing gear along with its drive gears that hook up with the fuser motor. You can see a metal clip on the plastic arm of this assembly. This is actually a "break" that causes the arm to move in the direction of the gear above it. The "break", much like the pinching effect of a bicycle break on the rim, creates enough friction that the swing arm follows the rotation of the gear above it. If the swing gear's drive gear powered by the fuser motor is rotating in print mode, the swing gear moves toward a gear "A". When duplexing, the fuser motor runs in the opposite direction moving the swing gear to gear "B". When the main motor is driving the fuser, the swing gear kicks into neutral so the fuser motor is not being turned unpowered.

In trouble-shooting the noise problem, we experimented by removing gear "B" to see if the machine would still duplex. Interestingly enough, without the gear, the duplex and fuser still worked. The fuser was being driven solely by the main drive. Could it be the only need for gear "B" and the redundant drive is to "help" turn the fuser? The answer must be yes, since removing that gear made no difference. We also noticed a chatter with the gear missing but that was due to the swing gear contacting the bare shaft where gear "B" had been.

The chatter feeds into a theory our tech support department has surrounding the delivery noise. Their theory points to two areas. First is the grease on the gears inside the delivery assembly and fuser motor area. The grease has been known to dry out over time (or perhaps better put, gum up from paper and toner dust) which keeps the swing gear from properly engaging with gears "A" and "B". The second is the "break" on the swing arm may become less effective over time, thus the swing gear may not fully engage with gears "A" and/or "B". Both scenarios would cause a buzz like noise if the gears are only partially engaged. The fuser would still turn via the main drive assembly so no paper jam, just noise. In studying this swing gear, we noticed the P3005 (replacement for the LJ 2400) has a coil spring as the "break" instead of the bicycle type break. Either one would cause the swing gear to swing with the turning of its drive gear. A weak break however could be our buzzing culprit. The bad news is, to get at the delivery gears and the break on the swing arm, the

printer needs to be torn down to a large extent. This means removing all main unit covers, the fuser, formatter, engine controller and fan, un-routing cables near the delivery assemble, and partially splitting the chassis left to right to remove it and get at the gears for cleaning. Is there an easier solution to this noise issue?

As we were working on this, a customer contacted us after reading the first article on the LJ 2400 noise who also had a noisy printer he couldn't figure out. He had replaced the fuser and was not successful in using the spacer washers. In the interests of sharing the knowledge, the customer shipped us the printer so we could learn from it and return it to them with a free repair. This repair definitely shed light on the noise problem. This service company said their customer didn't use the printer in the office because it was so loud when printing that you couldn't talk on the phone – yes, that loud. What we found was simple, but not some place you would look if you were trying to find the cause. It all goes back to the drives we were discussing earlier. We noticed the noise did not start when the printer turned over. Instead it waited a couple seconds after the main drive motor started up – sound familiar? The sound corresponds with the engagement of the delivery rollers and the fusing motor. Could it be a bad delivery assembly? Searching further we were surprised to see the 20 tooth gear that drives the fuser was worn. The wear corresponded perfectly with the size of the teeth on the fuser gear. It appears the stress of turning the fuser at the higher speed was causing the 20 tooth gear to wear out (letter "d" in Figure 1). This was easy to trouble-shoot as we replaced the gear with a good one and the noise went away. We put the bad gear into our LJ 2400 printer which duplicated the noise exactly.

So what was going on and why was the spacer washer fixing some of these but not this one? Looking at the gears and how they mesh it is apparent the wear in the 20 tooth gear cut steps into its teeth. As the gears would turn from the torque, the fuser teeth would first encounter that step in the 20 tooth gear and push the fuser away from it. This would be followed by it slipping into its proper mesh as it turned. As each of the teeth did this, a loud buzzing sound would result. This is diagramed in figure 3. The part number for the 20 tooth gear is RU5-0378-000. It was interesting to look up this part in our ordering system to see we've sold a lot of these gears. More than twice as many as the other gears in that area. As a tech, it may be wise to inspect the other gears – "A", "B" and swing gear for damage. However as the 20 tooth gear was badly chewed up we saw no damage to the others so it looks like the solution is just the 20 tooth gear. This is easy to replace by bending out the clip that holds it in place and sliding it off the shaft. The part numbers for the other gears, should you need them are:

"A" RU5-0379-000 19 tooth gear "B" RU5-0377-000 28 tooth gear

The swing gear along with the gears in the delivery assembly area are not available – thus the suggestion to clean and re-lube if you need to do anything with them.

This also brings another question to mind. As noted in the last article, the LaserJet P3005, LaserJet M3027mfp and LaserJet M3035mfp all use the same type of drive assembly for the fuser. However in closer study, the problem may be averted for them. These machines use beefed-up gears and they are also using helical gears instead of spur gears in the LJ 2400. The helical gears will hopefully keep this from happening in the newer units. I consider it a clue when the OEM beefs up certain areas of the printer that replaced the prior model. It tells me they saw a weak spot that needed to be addressed: thus another indicator that the gear solution is the right one. Another clue is the delivery gear (as mentioned earlier) are not available on the LJ 2400 printers, but are available on the P3005, M3027mfp and M3035mfp units. This indicates the likely hood that the unavailable gears in the LJ 2400 may be a problem as well. HP's current solution for fixing LJ 2400 problems that have expensive or non-obtainable parts is a unit exchange.

While the fuser and 20 tooth gear are good finds in a world flooded with models that we all need to somehow be experts on, I question whether this will be the end of the story. Like the LJ 4000 series that had multiple paper jam related problems in the front part of the unit, I believe we'll find more issues and solutions. Do know that as they are discovered another article will be out. In the mean

time I still have to give kudos to the many people who provided input for these article, especially David Cagalj who shipped us the printer for study. All the good people in this industry continue to impress me. They know they have a job to do yet have the vision to see that sharing the information for industry-wide problems like this make us all better as a whole, and individually. A thank you to all of you.

Caption for figure 4 Note the cut marks in the teeth of the 20 tooth gear

Caption for figure 2 The break is the metal clip on the top of the plastic arm. This causes the arm to rotate in the direction that the gear is rotating to engage different gears