Document incomplete

Ways to break a gearbox.

Manufacturing fault

. Pre existing hairline crack. This could be from manufacturing fault or impact damage before fitment. This is exceptionally rare but can happen. One of the main features of this kind of failure is the crack will have exposed the inside surface of the break to air for a significant length of time before final failure. This leads to a darkening of the metal in the existing fracture, usually quite obvious next to the lighter colour of the 'fresh' break.
Hardening issue: It is also possible that the hardening and surface treatment penetrate too far and make the gear brittle. The surface hardness depth is usually easily visible in a clean break as it has a different grain.

Existing hair line crack

It is possible that a gear may receive an impact at some point in its life prior to fitting that has left a crack but not completely taken a tooth off. The shape of the gear means that such impact would typically come from the side of the tooth rather than the face the meshes in the gearbox. This would be distinctive because the crack will have propagated from the side of the tooth and would often also be accompanied by an impact mark on the side of the tooth.

Impact

Crush

If the gearbox continues to be run for some time with teeth missing or other loose hard material it will have crush damage this can make it impossible to assess earlier damage

Wear

How to create impact:

Kick back

The most common method specific to 1st gear is a kick back. This occurs when starting the bike, As the piston is traveling towards TDC the bike fires and pushes the piston back the way it came, turning the crankshaft backwards rather than continuing forwards. This puts the energy back through the drive train and as the kickstart ratchet will not be released when the force is in this direction, the force is transmitted through to the kickstart lever, and the bike ‘kicks back’ through the leg of the person starting the bike. This typically means most of the impact force is taken by the riders leg and the kickstart return buffer. However if the kick start buffer has been reduced or removed or the kickstart piston ramp does not force the piston to

disengage the kickstart will hit its stop hard. This impact is more than adequate to knock a tooth off, and can also damage the kickstart teeth on the gear and the plunger, and even damage the Li style kickstart ramp (it will bend out of shape and no longer disengage the kickstart piston). On the older pre mod kickstart shaft, they could also shear in this event, the later post mod kick shaft of the later SX and all GP's is much stronger, this actually keeps the force contained in the drive train.

This mode of failure can be difficult to be conclusive, close inspection of the kickstart mechanism may provide further evidence and the rider may remember such events. They can be painful.

There are several mitigations to avoid the kick back failure mode.

1st is to try to minimise the chance of a kickback. If this is a regular occurrence when starting a bike, the cause should be found and corrected. Advanced timing (note: some variable ignition timing systems can give very great levels of advance at low rpm), and ignitions that can spark at very low rpm, and a 'slow kick' are the first checks. Do speak with us if you are unable to resolve the issue as there are a number of potential causes.

2nd Ensure the kickstart mechanism is correct and adjusted correctly. The kick start piston should fully release from the first gear in its return position. The kickstart buffer should be in complete and good condition. The kick start piston peg should not hit the end of the kickstart ramp even when the kick buffer is removed, or it will damage the ramp and change its adjustment (the kick buffer will be crushed when there is a kick back). Check the kick piston will not hit the casing when the buffer is removed, for the same reason.

Missed gear

The other primary cause of impact on a gear tooth is to select the gear when there is a significant speed difference between the engine and the speed of the gear. Two examples would be dropping into 1st gear when the bike is stationary but the engine rpm is high, or selecting 1st gear when the bike is carrying a high speed. Neither of these events would be 'good' for the transmission and can also put the crankshaft out of true (the force goes through the whole drive train).

1. The rider should avoid gear changes that have a significant rpm jump.
2. The rider should use the clutch when changing gear even if only briefly, (this takes much of the shock out) in race bikes this can be the difference between a rider that destroys gearboxes and one that does not).

3. Selector spring strength should be carefully chosen, standard is best when in doubt. To light and it is difficult to 'feel' positive selection, too heavy and it can require so much force to push out of gear that accurate selection becomes impossible and is especially problematic for 2nd and 3rd.
4. Friction in cables and controls, makes the selection very vague and makes it much more prone to partial selection and false neutrals. Selecting a false neutral , revving the bike and then slipping into gear creates massive impact forces.

Clutchless shifting going up the gearbox can be quick and efficient, if the drop in rpm as the throttle is closed closely matches the speed of the next gear selected. This is quite easy with practice and familiarity with the ratios especially through the higher gears, but near impossible to do between 1st and 2nd as 1st is over very quickly and the ratio jump is the largest in the box. I'd not recommend a road rider do clutchless shifting between 1st and 2nd at all as the wear on components far outweighs the small speed advantage, obviously when in competition a racer may decide this shortening of selector life could be worth it.

Ensure there is nothing that pushes on any of the gear controls through the full suspension travel (remove the rear shock and simulate this looking for any movement in the gear swivel). Check this in each gear, Rear brake cables pushing under the selector shaft and mudguards touching on the swivel are not uncommon, and can push a bike out of gear.

Ingestion

Impact mitigation:

Cush Drive

1. The cush drive should be in good condition, and standard. If the cush drive does not operate smoothly, or the preload on the cush spring has been increased (by shortening the front sprocket sleeve or fitting an earlier type front sprocket castle washer etc) failures will occur and drivetrain wear will be exaggerated. It is worth mentioning Casa's performance clutches here, they are not the lightest, but the addition of a cush drive in the crown wheel 'insulates' the gearbox from much of the impact force. There is a good reason they chose to do this.

Drive Train weight

1. Reduce the mass, do not increase it. Lighter flywheels and lighter clutches etc. reduce the inertia in the engine this has a profound effect on the peak

impact force and also the general force in the drive train. The old style 6 plate clutches that required a 10mm crankcase spacer typically reduce the gearbox life to a third of what we'd see running the newer 6 plate cassette design.

Rider Control

Clutch sticking

If a bike has been stood, when not in use many clutches can 'stick' over time. Meaning when the lever is pulled in and the clutch compressed, the plates do not free off. If a gear is then selected it is as if the clutch was not applied and the bike will jolt sending an impact through the drive train. This is best avoided.

1. Pull the clutch lever before trying to kickstart the bike. Often the first kick may still turn the engine over, but then free off the clutch, (the kickstart lever will hit the ground without turning the engine over. The clutch has now moved and should be less inclined to stick on launch.
2. With the engine running, before you select first gear start the bike rolling forwards. Then pull the clutch in and select first gear. If the clutch sticks you will now not have as much shock through the engine, and still holding the clutch lever in, you can use acceleration to free off the clutch, then pull to a stop and launch again as normal.

Clutch use when selecting gear

Back lash