

TRAIL REPAIR COURSE





Purpose

To provide information on what breaks, what spares to carry,
and how to fix repair the breakage



What Breaks?

Engine related

- Electronic
 - Modern vehicles are entirely managed by sophisticated computers e.g. fuel delivery & ignition
 - Usually requires computer diagnosis
 - Usually requires replacing electronic parts
 - Seldom just a fuse
- Mechanical
 - Alternator, water pump, power steering
 - Drive belts, hoses,



Engine Related cont.

- Gas
 - Fuel, air, spark [40 kV – 100 kV]
 - Control of air and fuel
 - Low compression
- Diesel
 - Fuel, air
 - Control of fuel
 - High compression



What Breaks cont.

Drive train related

- Axles
 - Broken axle shafts, stub axles, differential components, universals, CV joints, bent knuckles, etc.
- Drive shafts
 - Bent drive shafts, disconnected drive shafts, broken universals,
- Transmission
 - Broken input and/or out put shafts, clutch damage, wont shift, punctured, cracked, etc.
- Transfer case
 - Broken input and/or output shafts, broken components, wont engage/disengage, cracked, punctured, etc.



What Breaks cont.

- Suspension related
 - Broken springs, track bars, control arms, mounts, shocks
- Steering Related
 - Bent steering components, rod ends, cracked steering gear box, misaligned steering, pitman arm, etc.
- Tires
 - Punctured, shredded side wall, popped bead
- Wheels
 - Bent rims, cracked rims, broken lugs, lost lug nuts,
- Brakes
 - Brake lines, pads, drums, rotors, stuck calipers, master cylinder, wheel cylinder,
- Fuel Tank
 - Punctured tank, broken fuel lines



Trail Fixes

Flat Tires

- Puncture in tread or sidewall (plugging a sidewall is strictly a trail fix, not safe at road speed)
 - Remove foreign object from tire
 - Ream hole with tool from tire repair kit
 - Apply adhesive or lubricant to plug and insert into reamed hole with insert tool



Trail Fixes cont.

Sidewall cut or tear (no sidewall repair is safe to drive on road at speed)

- Remove tire from rim (at least one side)
- Remove debris from damaged area
- If patch will not work Punch small holes (with awl, small screwdriver, etc...) in sidewall next to the puncture. Use as many holes as necessary to pull the tear back together
- Use wire or strong string to stitch the sidewall together using the previously punctured holes
- Remount the tire on the wheel
- The stitching will probably not hold air pressure. You must try to plug the leaks between the stitches with your tire plugs.
- Using large patches with vulcanizing fluid may be more appropriate than sewing.
- C-clamps and small pieces of wood help with vulcanizing and adhesion.



Trail Fixes cont.

Tire comes off the rim due to low air pressure

- Safe method
 - Take weight off tire (jack tire off ground or remove tire from vehicle)
 - Remove valve core, from valve stem if necessary.
 - Attach air source
 - Position tire on wheel to try to seal bead against the wheel using soap in squirt type bottle helps the tire seat. Ratchet straps, supporting the tire and allowing the wheel to “sag” helps seal the bead.
 - Inflate the tire



Trail Fixes cont.

Alternate method (dangerous, may require a fire extinguisher)

- Take weight off tire
- Leave wheel attached to tire
- Remove valve core
- Spray a short spurt of starting fluid into tire, ignite fumes with lighter
- Reinstall valve core, inflate tire
- Warning this is not scientific, use too much starting fluid and the pressure skyrockets, not enough and the tire may catch fire can also cause chemical burns to the rubber internally.



Trail Fixes cont.

Damaged Wheel

- Bent wheel
 - Steel wheels can be straightened by the use of a hammer to help seal the wheel rim to the tire bead
 - Alloy wheel
 - cast material is generally not repairable
 - forged material treat as steel, should form easier but, don't overwork material



Trail Fixes cont.

Wheel studs

- Damaged or missing - can reduce clamping pressure up to 25%
- Broken studs (multiple studs, 1 location)
 - Remove and inspect wheel for damage caused by broken studs
 - Remove brake hardware, broken studs
 - Install new studs from your spare parts kit
- If you have no spares, remove 1 stud from the 3 remaining wheels. Use these to replace the broken studs. This a temporary trail fix. Install brake hardware, and tires
- Torque to spec, and recheck often. This is not a permissible repair for highway travel
- Stripped
 - Remove wheel and brake parts
 - Install new stud from your spare parts kits(if not available use one from your spare tire carrier)
 - Install brake parts and torque wheel, recheck after 25 miles



Trail Fixes cont.

Brake lines and brake hoses

- Brake hose is flexible, (rubber, stainless)
- Brake line is solid
- Crushed break line
 - Check for leaks
 - Check for proper brake function
 - No leak-repair at earliest opportunity Bleed brakes on that axle, be advised this is not an acceptable repair for highway travel
- Leaks
 - Cut brake line
 - Fold back on itself
 - Crimp with pliers
 - If necessary leave vice grip type pliers attached to hold crimp tight
 - Bleed brakes on that axle, be advised this is not an acceptable repair for highway travel



Trail Fixes cont.

Steering

- Bent tie-rod
 - Put vice grips on each side of middle of the bend, attach winch hook between vice grips, use winch to pull tie-rod into shape.
 - Remove one end of tie-rod from vehicle, sleeve tie-rod with Hi-Lift Jack handle, reinstall tie-rod end and or install tie rod in vehicle.
 - Option once tie-rod is straightened is to weld an angle iron reinforcement along length of tie-rod.
 - Failure to sleeve tie-rod will result in a much weaker than stock tie-rod, that will be more susceptible to damage again.



Trail Fixes cont.

Engine oil pan

- Dented or crushed oil pan
 - Small dent
 - If not affecting oil pressure, or not contacting internal engine parts (knocking noise etc.). This is an in shop repair. Monitor oil pressure and listen to engine to avoid any engine oil related problems.
 - Large Dent
 - If the pan contacts internal engine parts (knocking noise etc.) it must be removed to inspect damage and remove the offending dent.
 - If the engine has low or no oil pressure the pan must be removed for inspection and dent removal.
 - Check the oil pick up for damage, adjust if necessary.



Trail Fixes cont.

Automatic transmission pan

- Automatic transmissions do not have a pressure gauge.
- Some models have an overheat light.
- Monitor transmission performance if slippage or overheating conditions occur, pan removal may be necessary for inspection.



Trail Fixes cont.

Punctured engine oil pans and automatic transmission pans

- Small punctures can be temporarily repaired with a sheet metal screw and a piece of rubber gasket screwed into the puncture. Keep the screw short as to not interfere with the internal engine parts.



Trail Fixes cont.

Large puncture

- Remove and clean the pan.
- The puncture may be patched with RTV, sheet metal, rubber gasket material, duct tape...
- This is a crude attempt to make the vehicle movable under its own power. Regard any such fix as questionable, and monitor accordingly. If the patch fails unnoticed the engine or transmission will fail.



Trail Fixes cont.

Exhaust system

- Crushed
 - Try to reform if possible with a hammer, channel locks, etc..
 - Remove damage part of exhaust system with a hacksaw replace with a spare from your spare parts kit, or possibly use a piece of your tail pipe.
 - Have the exhaust properly repaired at your earliest convenience.
- Exhaust has been removed from vehicle
 - Exhaust system torn from hangers
 - Reinstall into factory hangers
 - Hangers damaged, repair with wire, hose clamps
 - Exhaust system has separated from itself
 - loosen muffler clamps reposition exhaust parts reinstall the clamps , tighten.



Trail Fixes cont.

Fuel tank

- Punctured
 - Small punctures can be repaired using a sheet metal screw and a rubber gasket or a 2 part epoxy for the repair of gas tanks.
- Crushed
 - Use caution when handling gasoline.
 - If vehicle is functioning correctly and not leaking, have this professionally repaired at your earliest convenience.
 - You may need to remove the tank to check the fuel pump or the fuel pick-up tube if the vehicle is not functioning correctly.
 - This may also entail pounding the dent out of the tank .



Trail Fixes cont.

Drive shafts

- Bent or twisted
 - Remove from vehicle and replace with spare driveshaft
 - Cutting and welding tube material with proper jig and awareness to balance and phasing.

Broken U-joints – replace from spares kit.

- C-clamps, rubber mallet and grease gun – keep phasing in flanges and slip-joint.

Mounting hardware failure

- Inspect for trail damage driveshaft, u-joint, mounting hardware. Replace as necessary with proper parts.



Trail Fixes cont.

Front driveshaft-A vehicle can be driven without a front drive shaft

- Under the following conditions
 - The transfer case has a fixed yoke instead of a slip yoke for the driveshaft attachment point.
 - You no longer need 4 wheel drive
 - The vehicle has a 2 wheel drive mode in the Transfer case or..
 - If the vehicle has a full time 4 wheel drive Transfer case with a center lock differential, you must lock the center differential
 - Check your vehicles owners manual for your specific details.

Rear driveshaft A vehicle can be driven without a rear driveshaft

- Under the following conditions
 - The Transfer case has a fixed yoke instead of a slip yoke.
 - The vehicle is 4 wheel drive.
 - The vehicle has a center differential lock or a part time Transfer case in 4 wheel drive mode.



Trail Fixes cont.

Front axle shaft or steering u-joint breakage

- Solid axle-manual locking hubs
 - Replace broken parts with spare parts from your spare parts kit.
 - No spare parts Remove broken axle shaft, push rags into axle tube to stop the flow of gear oil, install new parts at your earliest convenience.
- Solid axle full time hubs
 - Same as above, if this is a full time system you will need to remove the driveshaft and engage the center differential lock.



Trail Fixes cont.

Solid axle hub bearing assemblies

- Broken u-joint with axle damage.
- Remove inner axle shaft , plug axle tube with shop rags, to stem the flow of gear oil(in as far as possible).
- You must keep the outer axle (stub axle) attached to the hub bearing assembly or the bearing will fail.
- Reinstall all parts without the inner axle shaft.
- If the vehicle is a full time four wheel drive, you will need to remove the front drive shaft and engage the center differential lock.
- If the vehicle has a part time 4 wheel drive system engage 2 wheel drive mode.

Solid axle with CV joint (constant velocity)

- Same as solid axle with hub bearing assembly.



Trail Fixes cont.

Independent front axle

- The best fix is to carry a spare axle shaft assembly and switch with the damaged one.
- No spares
 - You must use the outer stub shaft to hold the hub bearing assembly together.
 - You must use the stub that installs into the differential to retain the differential gear oil.
 - Be advised this a trail fix, not suitable for highway travel.



Trail Fixes cont.

Rear axle breakage

- Full floating axle
 - Remove broken axle shaft and all pieces.
 - Cover axle mounting location to prevent oil loss and dirt contamination.
 - Engage 4 wheel drive, drive to a location where you can properly replace the axle shaft.
- Semi float axle
 - Remove broken axle and all pieces.
 - If broken in spline area reinstall axle shaft and drive slowly. Replace axle shaft as soon as possible. This a trail fix, be advised the tire and axle could pull free of the housing.
- Semi float –C-clip axle
 - Drum brakes
 - Remove axle shaft and broken pieces.
 - Make a skid, or a method to retain the axle shaft and tire assembly in the axle housing. HLJ handle or trail tool.
 - Slowly move vehicle to a location to be towed to be properly repaired.
 - Monitor wheel assembly for lateral movement away from axle housing.



Trail Fixes cont.

Semi float –C-clip axle

- Disc brake
 - Remove broken axle and the broken pieces.
 - If the shaft is broken at the spline end, reinstall axle shaft. The disc brake assembly will hold the tire axle assembly in the axle housing allowing you to limp the vehicle to a location to be towed.
 - Monitor wheel assembly for lateral movement away from axle housing.



Trail Fixes cont.

Broken suspension parts

- Leaf springs- broken main leaf
 - Jack up vehicle, install something (piece of wood, log...) between the axle and the frame to get the vehicle back to a safe ride height. You must then locate the axle so that it can not shift location by using ratchet straps, chain, tow straps etc. you must also strap the axle to the frame so as not to have your spacer fall out. The rear axle is straight forward, the front however you will need to account for side loads as a result of steering. Drive slowly as you effectively have no suspension on that side of the axle and all the impact loads will be transferred directly to the axle housing and the frame as well as the spacer. Have the vehicle towed as soon as possible (or replace the spring).
- Coil springs
 - Same basic idea as leaf springs



Trail Fixes cont.

Track bars, suspension links

- Use ratchet straps in a crossed configuration to load the damaged suspension piece. The basic plan is to locate the axle in its original location using straps instead of solid links. This is a trail fix, drive slowly, monitor straps often. Have the vehicle towed as soon as able, or replace the affected parts.

Shock mounts

- Although a critical suspension component, if driven carefully, the vehicle can be moved quite a distance without a shock absorber.
- You must remove the damaged shock and/or mount to keep from causing more damage to it and surrounding suspension pieces.
- IFS/IRS the exception to this is if the shock or mount is part of a strut assembly in the independent suspension setup. In this case the vehicle will have to be towed.



Trail Fixes cont.

Starter failure

- Manual transmission
 - Put vehicle into 2nd gear with clutch pedal depressed, pull or push vehicle up to speed, rapidly release clutch pedal (pop) vehicle should start. Do not stall vehicle. Make sure key or switch is 'on' for ignition.
- Automatic transmission
 - Can't be push started, must replace starter.



Trail Fixes cont.

Alternator or battery failure

- Reduce all nonessential demands on the electrical system. This means turning off the radio, aircon/heater, it may mean disconnecting items such as headlights, running or tail lights to conserve electricity.
- Most vehicles will keep running without a battery, but only for a short period without an alternator (depending on battery condition and charge).
- If battery is bad but alternator is good reduce electrical demand to make it easier on the alternator. Replace battery as soon as possible.
- If alternator is bad you will use all available power from the battery and the vehicle will no longer run. Reduce electrical consumption to lengthen battery life. If traveling in a group you may trade off batteries (they charge yours, you deplete theirs) until you can get a replacement alternator. If traveling alone with dual battery setup, reduce electrical consumption and switch to second battery as necessary to get home. Be advised when the 2nd battery goes dead the 1st battery will still be dead. Conserve all available energy, its all you have.



Trail Fixes cont.

Water pump failure

- Leaking water pump
 - Loosen the radiator cap (caution let engine cool so as not be burned by the steam and water in the radiator under pressure).
 - Put heater on high heat and high fan to pull as much heat from the engine as possible.
 - Check and refill coolant often, do not let engine overheat. It may be necessary to shut off engine and let it cool.
- Catastrophic failure
 - This usually is the result of a bearing failure that affects the seal causing the leak. It is possible that the shaft the fan is bolted to can separate from the water pump, this can bring a spectacular end to the life of the fan belts, radiator hoses, and also the radiator.
- Leaking with a wobbly fan
 - Loosen the radiator cap, remove the fan, loosen the fan belt, check the coolant level often. Be advised this may get you off the trail, but could rapidly turn into a catastrophic failure. Replace water pump as soon as possible.



Trail Fixes cont.

Power assist steering failure

- Pump noise / hard steering
 - Check fluid level
 - Check for leaks
 - Check hoses for cuts, breakage, crushed.
 - If necessary bypass the power steering pump and still drive the vehicle.
Be advised you will have no power assist, steering will be very hard.



Trail Fixes cont.

Transmissions

- Manual – clutch failure
 - Check linkage / master cylinder fluid level
 - Start vehicle in gear, to shift gears match rpm to road speed. You will need to shut off vehicle to stop or to shift into reverse.
- Manual – mechanical failure (internal damage)
 - Check all gear positions, if any work, drain fluid, remove any pieces, refill transmission with fluid.
 - Limp to a safe location, you will need to be towed.
- Automatic transmission – slipping or fails to engage.
 - Check fluid level
 - Check for leaks
 - Check linkage
 - If these check out ok, tow to a location that will enable you to have the transmission repaired.



Trail Fixes cont.

Electrical problems

- Carry enough fuses of each kind for diagnosis plan – it may take 3 or 4 to find the problem.
- Relays and fuses in spares kit for large amp accessories like fuel injection and ignition system.
- Follow wires from fuse panel to failed unit.
- There may be a jump connection point to by-pass the failed wire/connector to make the unit work.

Fuel problems

- Systems have external or internal fuel filter.
- Fuel pump may be in-tank or external.
- Small pressure gauge for measuring rail pressure in fuel-injection systems.
- Pressurizing the fuel cell with CO₂ or compressed air may help 'limp' the vehicle to a tow place. May take up to 50 psi or more to produce fuel injection pressure. For low volume systems – 7 to 15 psi.



Trail Fixes cont.

Basic automotive systems require: Air, Fuel and Electricity. Check the source of each, follow the distribution points to the end unit find the problem in route.

- Fuel – starts at fuel cell/tank (full/empty), fuel pump, fuel filter fuel lines (pipes clogged), injectors not getting electricity, in-line filter at manifold clogged, fuel not getting to cylinder.
- Electricity – batter charged/discharged – wires to fuse block(s) – alternator not charging (belt slipping/failure of unit), wires to end unit, connections and connectors, switching mechanisms.