

AVCS Features Overview

Advanced Vehicle Combat System | Product Edition | Updated 2 August 2026

AVCS is a complete armored-vehicle framework for Roblox. It combines tracked and wheeled mobility, server-authoritative weapons and damage, singleplayer and true multicrew operation, logistics, recovery, training systems, scalable effects, and conversion tools under one shared architecture.

This document describes the current product build and supersedes earlier feature lists. The current top-machine-gun shortcut cycles the available RWS and Loader MG stations.

Current fleet

- M1A2 SEP3 Abrams - tracked main battle tank with 120 mm main armament, protected bustle ammunition, thermal/night optics, RWS, Loader MG, and optional field modifications.
- Leopard 2A7V - tracked main battle tank with 120 mm main armament, layered armor, advanced optics, and Loader MG operation.
- M3A3 Bradley - tracked infantry fighting vehicle with a belt-fed 25 mm autocannon, coaxial machine gun, deployable wire-guided missiles, commander CITV, and passenger capacity.
- M1296 Stryker Dragoon - wheeled 8x8 infantry fighting vehicle with a 30 mm remote turret and infantry seating.
- M1128 Stryker MGS - wheeled 8x8 fire-support vehicle with a 105 mm gun.
- Military Truck - wheeled utility and recovery platform.
- AVCS Tracked Conversion Jig - unsigned primitive template for customer-made tracked vehicles.
- AVCS Wheeled Conversion Jig - unsigned primitive template for customer-made wheeled vehicles.

All included vehicles use the same framework and are differentiated through their authored rig, per-vehicle specification data, crew layout, weapons, armor, and optional modifications.

Mobility and drivetrain

- Separate tracked and wheeled drive stacks share one vehicle contract and common HUD, power, combat, logistics, recovery, and networking systems.
- Tracked vehicles use independent left/right drive behavior for skid steering and neutral steering.
- Manual transmissions use vehicle-specific forward and reverse gear limits, with corrected gear display and speed limiting.

- Shift feedback combines a controlled body impulse with camera feedback while preventing jolts while stationary, outside a valid gear change, or after leaving the vehicle.
- Tracked suspension includes per-bogie travel, animated swingarms and dampers, roadwheel motion, and runtime-generated individual track links.
- Sprocket, idler, return-roller, and track-belt presentation follows actual vehicle displacement so stationary vehicles do not visually drive their running gear.
- A reversible tracked ledge-assist layer reduces cases where a hull becomes suspended on an obstacle while usable track contact still exists.
- Wheeled vehicles support individually configured drive and steer axles, including 4x4 and 8x8 layouts.
- Wheeled step assistance detects individual front-wheel contact, including angled approaches, and supplies bounded low-speed torque for small obstacles.
- Incline behavior, steering response, service braking, reverse braking, and parking-brake deceleration are independently tunable.
- Camera stabilization absorbs suspension chatter and vertical bumps without making steering or normal vehicle translation feel disconnected.
- High-speed tree impacts preserve part of the vehicle's momentum once a tree begins falling instead of stopping the vehicle dead.

Engine, electrical, and fuel systems

- Battery/APU and engine states are separate and replicated.
- Cold and warm starting sequences use configurable crank times and a warm-start window.
- Fuel consumption includes idle and throttle/load burn, a configurable capacity, low-fuel state, and engine shutdown when dry.

Main armament and fire control

- Single-shot cannons support chamber, reload, deload, ready-rack, and ammunition-type state.
- Belt-fed autocannons support authored rate of fire, belt capacity, burst cadence, and belt reload behavior.
- Shell libraries support kinetic, chemical, high-explosive, bullet, airburst, and vehicle-specific ammunition profiles.
- Each shell can define muzzle velocity, gravity/drop, mass, penetration, penetration decay, direct damage, fragmentation, splash, tracer color, and human damage.
- Projectiles use travel time and gravity instead of hitscan-only firing.
- Main guns use visual recoil and firing jolt without physically pushing the entire vehicle.

- Laser rangefinding feeds the ballistic solution and reports a return only from valid surfaces or training targets.
- Direction stabilization, drop compensation, lead assistance, parallax handling, and corrected barrel/camera convergence are integrated into the sight.
- The aiming cursor changes state when the weapon can actually converge on the camera aim point rather than relying on camera movement as a workaround.
- Target lock/aim assist can acquire valid armored targets and authored training targets.
- Airburst-capable ammunition can switch fuse behavior.
- Turret traverse and gun elevation/depression respect per-vehicle limits and rates.

Secondary weapons and missiles

- Coaxial machine guns are slaved to the main gun and use held-fire server cadence.
- RWS and Loader MG stations are independently aimed, have separate mount data, and can use free look.
- In singleplayer, P enters the top-MG system and cycles the available RWS and Loader MG stations before leaving the mode.
- In multicrew, top-mounted weapons are assigned to the authored crew role. An unmanned role does not receive artificial operation.
- Loader MG operation can instantly place the loader at the exposed hatch position. Vehicle-specific rules determine whether the exposed player follows the turret, follows the MG around the seat's own axis, or remains fixed relative to the turret.
- The Bradley includes a deployable wire-guided missile launcher, guided missile flight, launcher tube state, and exterior-only reload interaction.
- Missile launch, guidance, impact, penetration, module damage, and shooter hit-camera feedback share the authoritative combat pipeline.
- Smoke launchers use configurable launcher count, salvo size, cooldown, duration, and reload state.

Optics, thermal, and commander systems

- Gunner optics support variable magnification, sight view, free look, and per-vehicle camera anchors.
- Thermal and night-vision modes are scoped to the local authorized crew member and cannot be triggered for players outside the vehicle.
- Thermal presentation can represent hot exhaust areas, moving running gear, and recently fired barrels.
- The commander CITV is an independently slewed panoramic optic with its own horizontal and vertical pivots.

- Hunter-killer designation allows the commander to hand a target to the gunner on vehicles where the feature is fitted.
- Optic doors and covers can be bound to their authored moving assemblies.
- Self X-ray mode reveals the configured internal crew, ammunition, engine, fuel, optics, and other component geometry only for authorized crew.
- X-ray elements follow the hull, turret, gun, and optional modification state that owns them; disabled modifications are not shown.

Armor, penetration, and internal damage

- A two-stage solver first resolves the broad collision shell, then evaluates the configured armor layers and internal path.
- Layered and spaced armor can accumulate effective thickness along the shot line.
- Plate angle, shell class, penetration decay, composite multipliers, reactive armor, and spall reduction can affect the result.
- Stable damage-zone identities separate crew, engine, fuel, hull ammunition, bustle ammunition, and other modules.
- Internal modules include barrel, breech, optics, horizontal and vertical drives, RWS, tracks, wheels, engine, transmission, driver controls, fire-control equipment, and ammunition storage where fitted.
- Penetration, spall, fragmentation, blast, fire growth, module health, hull health, and crew effects are resolved on the server.
- Exterior cannon, airburst, missile, and mine blast cannot directly damage a humanoid seated inside an armored vehicle through the hull; line of sight and armored-occupant protection are shared across those paths.
- Cannon and missile hit feedback attributes the shot to the actual gunner in multicrew instead of guessing from the driver seat.
- Light armored vehicles are intentionally vulnerable to powerful anti-armor weapons and repeated critical penetrations.
- Main battle tanks are less likely to suffer arbitrary one-shot destruction from marginal damage, while valid ammunition detonations, destroyed critical systems, and lethal internal damage remain decisive.

Ammunition cookoff and blowout protection

- Protected bustle racks can produce a survivable blowout result instead of treating every ammunition hit as immediate total destruction.
- Blowout logic distinguishes containment from an unprotected ammunition detonation.
- Authored blowout-panel meshes rotate from their correct hinge side and expose configured fire-spout locations.

- Layered flipbook effects provide the initial fragments, directional flame jet, large smoke column, and secondary smoke for a successful blowout event.
- Staged cookoff can continue with smaller intermittent events before a catastrophic result if fire is not controlled.
- Fire-control, ammunition, crew, and vehicle state determine whether the vehicle survives, burns, reignites, or is destroyed.

Fire suppression and survivability

- Vehicles carry a finite configurable number of fire-extinguisher bottles.
- Suppression removes active fire growth when the discharge succeeds, while severe remaining damage can still create a later reignition or cookoff.
- Repaired fire sources and mine-created fire states clear their persistent effects correctly.
- Engine, ammunition, fuel, and hull fires can use different growth behavior.
- Destroyed vehicles transition into a controlled wreck state with appropriate effects and module shutdown.
- Crew inside armor are protected from exterior splash, but exposed players remain vulnerable to direct cannon, autocannon, machine-gun, fragmentation, and missile effects.

Repairs, refueling, and rearming

- A consolidated repair interaction presents the damaged components that can actually be serviced.
- RepairKit authorization is consistent: the tool must be equipped, not merely stored in the backpack.
- Module repairs, track repairs, wheel repairs, and external-panel restoration use server-confirmed completion.
- All damaged repairable external panels can glow at once; the system no longer intentionally collapses several damaged panels into one highlighted mesh.
- Cosmetic external panels can be restored as one grouped exterior-panel operation rather than creating a separate prompt for every plate.
- Refuel and ammunition ports are toggled from the Tab quick menu.
- Refueling requires an equipped RefuelKit and can be performed with the engine running.
- Rearming requires an equipped AmmoKit and restores the live vehicle ammunition state.
- Ports close after a successful full service, disappear when the resource is already full, and can be manually disabled.
- Interaction UI waits for authoritative completion rather than declaring a repair, refuel, or rearm successful from the local hold alone.

Mines and engineering

- Pressure mines detect that an armored vehicle is physically above the mine rather than requiring a specific track link to touch it.
- Directional roadside mines use a configured forward sector and limited range.
- Mine damage uses dedicated mine profiles instead of borrowing an unrelated shell fallback.
- Track vehicles are detracked on the side nearest the detonation; wheeled vehicles can lose the wheels nearest the mine.
- Mine placement uses an EngineerKit with smooth held Q/E rotation.
- Demining is an authored interaction with a deliberate challenge rather than a single effortless hold.
- Placement and demining UI follow the same LuaReact visual language used by the vehicle interface.

Recovery and towing

- Vehicles can expose front and rear recovery points with custom interaction UI.
- Recovery supports cable towing, winch reel control, rigid tow, release, and immediate detach when the quick-menu recovery toggle is disabled.
- Wheeled towing retains its steering/path behavior.
- Tracked towing uses a dedicated heading/path assistance layer so the towed hull begins following before the cable reaches an extreme side angle.
- While towing, the towed main gun can ignore collision against the towing vehicle to prevent the barrel from wedging the pair together.
- Tow domains use coordinated ownership rather than leaving an exited driver in control of the connected physics assembly.
- Nested or overlapping tow relationships are validated as a connected authority domain, reducing freezes, drivetrain collapse, and violent correction.

Singleplayer and multicrew

- Every combat vehicle can be spawned in Singleplayer or Multiplayer crew-control mode where supported by its crew definition.
- Singleplayer keeps the integrated one-player operation used by the original system.
- Multiplayer does not create AI crew or hidden backfill. If an essential crew station is empty, that station's function is unavailable.
- Vehicles with an authored loader require that loader for manual reload. Vehicles without a loader station retain their authored automatic reload behavior.
- Driver, gunner, commander, loader, and passenger roles receive only the controls and HUD state that belong to them.

- Passengers do not receive gunner or driver controls simply because they are seated in the vehicle.
- Players can switch into a vacant crew station from the existing Tab quick menu without leaving the vehicle.
- Vehicle-specific hatch prompts can share one physical hatch using stacked role prompts.
- Server-owned dismount placement, collision restoration, and camera teardown reduce exit desynchronization, roof teleporting, and fall-through-map failures.
- Chat focus suppresses vehicle hotkeys so typing does not operate the tank.

HUD and interaction design

- The main combat HUD shows the information relevant to the current seat: speed, gear, fuel, power state, weapon, ammunition, reload state, range, stabilization, and warnings as applicable.
- Multicrew uses the same lower-left LuaReact HUD design as singleplayer and removes unrelated sections instead of creating a second visual language.
- The Tab quick menu contains power, lighting, crew, fire-control, recovery, logistics, and context actions appropriate to the current role and vehicle.
- A built-in Controls / Shortcuts panel is available from the Tab menu.
- Scrolling the controls panel is captured by the panel instead of simultaneously zooming the vehicle camera.
- Custom-styled proximity prompts are used for vehicle entry, repair, service, recovery, missile reload, engineering, and other interactions.
- The hit camera shows the target's configured internals, impact location, penetration result, effective armor, damage, and affected components.
- Autocannon and missile hits use the same feedback path as main-gun shots.

Audio and visual effects

- Layered engine audio transitions through idle and effort states using replicated speed, load, and throttle data.
- Track/wheel movement, turret traverse, weapon fire, impacts, reload mechanisms, hatches, alarms, and damage states use positioned audio.
- Nearby observers can hear other vehicles without needing to occupy a vehicle themselves.
- Main-gun muzzle flash is followed by residual barrel smoke and optional casing ejection.
- Missile launch and flight use launch-puff and exhaust/trail layers.
- Material-aware impact effects distinguish surfaces such as armor, soil, concrete, sand, and snow.

- Surface drivetrain effects cover dirt, sand, and snow without requiring gameplay changes.
- Damage effects include engine overheating, damaged exhaust, fuel leakage, ignited leakage, engine fire, staged cookoff, protected blowout fire, unprotected ammunition detonation, fuel explosion, and ordinary vehicle destruction.
- Ricochets can generate sparks and metal fragments; heavy landings and collisions can generate larger dust events.
- Antennas react to gun barrels and nearby environment geometry such as bridges. A stabilized idle state prevents continuous weaving while the vehicle is stationary, and a lightweight replicated bend state allows other players to see the result.

Destructible environment and training

- The optimized tree system uses an authored ground-base pivot for each tree.
- Trees require a high-speed heavy collision or sustained vehicle thrust; a single machine-gun hit or light bump is insufficient.
- Fall direction is derived from the attack, impact, and sustained-force direction.
- A fallen tree becomes non-collidable so it does not permanently trap the vehicle or create unnecessary physics load.
- The target-practice package contains a moving target and a popup target set.
- Targets are server-authoritative, fall when hit, return laser range, and appear in the hit camera.
- Training controls are available in the tank's Tab menu only while the vehicle is near the invisible practice-range sensor.
- The moving-target course can be used to practice laser rangefinding, lead calculation, stabilization, and target lock.

Garage, depot, and standalone spawning

- The Vehicle Depot uses a LuaReact selection interface with live 3D previews, loadout/modification choices, and Singleplayer/Multiplayer selection.
- Garage bays support team restrictions, group-rank restrictions, per-player limits, cooldowns, and admin bypass lists.
- Garage doors/slats use visible per-bay controllers and data-based configuration rather than hidden hardcoded door logic.
- Garage rollout sequences engine command, startup audio, running state, and movement in the intended order.
- Standalone spawn pads use the same visual selection system but are independent of garages, depots, and other standalone pad groups.
- A standalone pad does not start the engine or drive the vehicle out; it places the selected vehicle and releases it for normal operation.

- Pad occupancy is based on the physical spawn region and active reservation, not on whether the player still owns a vehicle elsewhere in the map.
- Cancelled/despawned in-progress spawns release their reservation.
- Each standalone group exposes only its own configured roster and does not leak vehicle choices from other pad groups.

Networking and large-server operation

- Vehicle authority is coordinated through bounded ownership leases and controlled handoffs during entry, exit, coasting, parking, towing, and disconnects.
- Former drivers do not retain indefinite authority over unattended or towed vehicles.
- Towed combinations share one validated authority domain.
- Held-fire weapons send start/stop intent while the server owns cadence, reducing delayed remote queues and phantom firing.
- Aim, missile guidance, vehicle audio, light, and presentation updates use configurable rate budgets.
- Critical combat, damage, crew, and ownership state remains server-authoritative.
- Interest filtering and distance-based presentation reduce remote effects work without changing nearby gameplay.
- Four performance profiles are supplied: Legacy, Cinematic, Balanced, and LargeBattle.
- Nearby vehicles retain full tracks, suspension, antennas, weapon effects, and detailed audio. Medium, distant, offscreen, and dormant work is progressively budgeted according to the selected profile.
- The performance system is designed so remote players still see and hear the vehicle at an appropriate level of detail; it does not simply disable the running gear for everyone else.

Conversion and extension support

- Separate tracked and wheeled conversion jigs are included.
- The jigs use replaceable primitive visual envelopes and clearly separated functional pivots, collision volumes, damage zones, X-ray components, lights, seats, recovery points, and running gear.
- Customer conversions are intentionally unsigned and do not require copying protected signatures from the included production vehicles.
- Per-vehicle behavior is configured through attributes, *Spec* configurations, shell data, crew definitions, and spawner entries.
- Finished conversions can be registered in the animated garage/depot, in one or more isolated standalone pad groups, or placed directly in Workspace through the deterministic startup path.

- A validator is included to identify missing contract elements before a vehicle is published.
- Included production vehicles remain protected by automatic license verification and authored rig-integrity checks.

Current default controls

Driving

- W - accelerate.
- S - brake, then reverse.
- A / D - steer.
- R / F - shift up / shift down.
- B - toggle parking brake.
- G - start or stop the engine.
- M - battery/APU.
- L - exterior lights.
- Q / E - left/right indicators on supported wheeled vehicles.

Gunnery and optics

- Mouse - aim the active weapon.
- Left Shift - enter weapon sight or change the current weapon view.
- Left Mouse Button - fire the main gun or active top-mounted weapon.
- Right Mouse Button - fire the coaxial machine gun in gunner view.
- Mouse Wheel - sight magnification or external camera distance.
- V - laser rangefinder.
- J - direction stabilizer.
- Y - target lock/aim assist.
- X - center the turret.
- T - cycle ammunition.
- Z - change fuse mode where supported.
- N - cycle the fitted thermal/night/day vision modes.
- H - open or close the fitted optic cover.
- P - enter, leave, or cycle RWS/Loader MG stations.
- Left Alt - free look without moving the active weapon.
- 5 - authorized crew X-ray view.

Defence and special systems

- C - launch a smoke salvo.
- K - discharge a fire-extinguisher bottle.
- U - deploy or stow the Bradley missile launcher.
- Left Mouse Button - launch a missile while the launcher is deployed and the role is authorized.
- Tab - open the vehicle quick menu and Controls / Shortcuts guide.
- Hold the displayed entry prompt - board the selected crew or passenger station.
- Jump - dismount using the vehicle's safe exit placement.
- Refuel port - hold R with an equipped RefuelKit after the port is enabled.
- Ammunition port - hold T with an equipped AmmoKit after the port is enabled.

Developers can change the central keyboard map in

`ReplicatedStorage.VehicleConfig.KeybindConfig`; wheeled drivetrain defaults are also exposed in each wheeled vehicle's `Systems.WheelSettings`.

Product scope

AVCS is a Roblox development framework and vehicle package, not a finished standalone game. A licensed copy includes the shared runtime, the six configured vehicles, garage and standalone spawning systems, engineering and training systems, conversion jigs, and customer documentation. Developers remain responsible for their map, game rules, teams, economy, permissions, moderation, and any additional content they add.