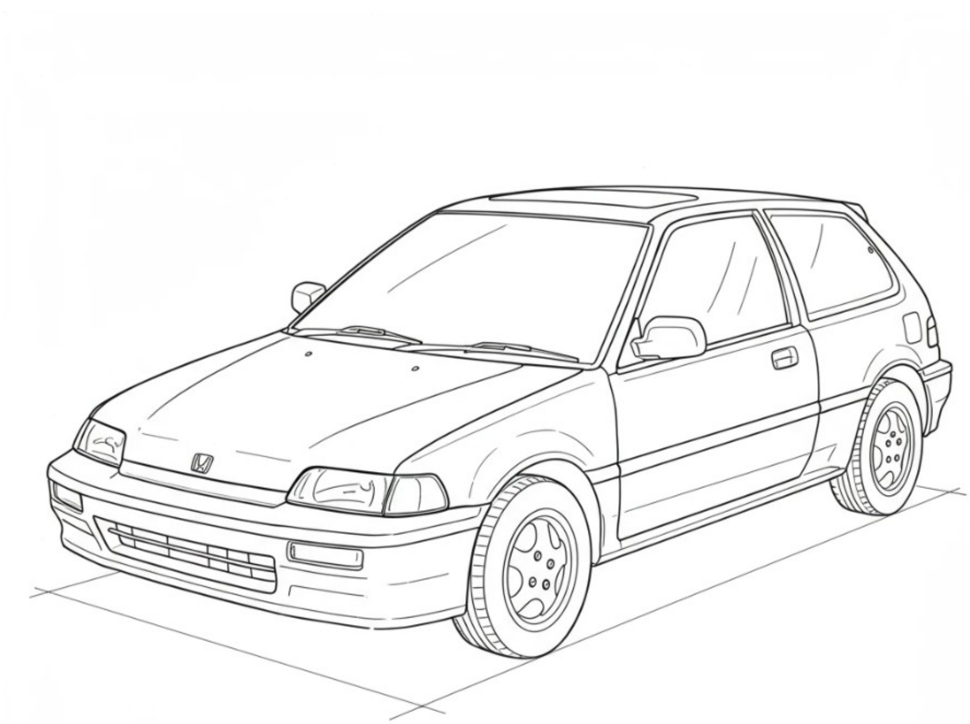
ENGINEERING SPECIFICATION DOCUMENT

EF Civic (1988–1991)
K24/K20 AWD Powertrain Conversion



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1 Executive Summary

This engineering specification document outlines the design intent, scope, methodology, component requirements, and fabrication procedures necessary to integrate a K-series AWD powertrain into the EF-platform Honda Civic (1988–1991). The purpose of this document is to provide a professional engineering-grade reference suitable for fabrication planning, machining outsourcing, system verification, and compliance with motorsport-grade structural integrity.

2 Project Scope

- Convert OEM FF (front-engine, front-wheel drive) EF chassis to a fully mechanical AWD system.
- Integrate a K24 short block with a K20 cylinder head ("K20/K24 hybrid").
- Install Honda CR-V (Real Time AWD) transmission, transfer case, rear differential, and associated driveline components.
- Fabricate structural systems (driveshaft tunnel, diff cradle, rear subframe reinforcement) in compliance with engineering welding standards.
- Maintain chassis rigidity suitable for track environments under sustained lateral loads.

3 System Description

The AWD conversion integrates a hybrid K-series power unit with the Honda CR-V AWD driveline. All engine-to-transmission interfaces remain OEM bolt-pattern compliant, while all rear driveline mounting systems require custom fabrication.

3.1 K20 Cylinder Head Integration

The K20A2/K20Z1 cylinder head mates directly to the K24A-series block. Required components include:

- K20 head gasket
- K20 timing chain, guides, and tensioner
- K20 oil pump and pickup (block guard modification required)
- K-series VTEC solenoid

3.2 Notes

- Deck both head and block mating surfaces before assembly.
- No adapter plates or custom brackets are required.

4 Performance Requirements and Powertrain Strategy

4.1 Target Power Output

- **Target crankshaft power:** approximately 300 hp (260–270 whp).
- **Use case:** track days, time-attack style driving, and high-performance street operation.

4.2 Primary Configuration: Naturally Aspirated K24/K20

The baseline configuration for meeting the 300 hp target is a naturally aspirated (NA) K24/K20 hybrid.

- High-compression forged pistons
- Stage 2/3 NA camshafts
- Upgraded valvetrain
- High-flow intake system
- Long-tube header
- ECU tuning via KPro/Ktuner

4.3 Secondary Capability: Forced Induction Provision

Although NA-focused, the chassis and driveline are specified with headroom for 400–500 hp future upgrades.

5 K-Series AWD Transmission Compatibility

- CR-V AWD transmission (bolt-on)
- CR-V transfer case
- Billet AWD spool
- Helical LSD

6 Fuel System Requirements and Specifications

6.1 Overview

The factory EF Civic fuel system was designed for a low-pressure D-series engine and is incompatible with the flow, pressure, and return requirements of a K24/K20 hybrid. A complete EFI fuel system upgrade is required to support the 300 hp naturally aspirated target and future forced-induction expansion.

6.2 Fuel System Architecture

The upgraded fuel system is configured as a high-pressure return-style EFI system with the following major components:

- High-flow in-tank electric fuel pump (255–340 LPH).
- AN-6 (3/8”) feed line and AN-6 return line.
- High-flow fuel filter (6–10 micron EFI-rated).
- Adjustable fuel pressure regulator (base pressure 50–60 psi).
- K-series fuel rail with AN fittings.
- 1000–1200 cc/min high-impedance injectors (sized for NA power with headroom).
- EFI-rated rubber isolators, clamps, and wiring upgrades.

6.3 Required Mechanical Components

- **Fuel Pump:** Walbro 255, Walbro 450, or Deatschwerks DW300.
- **Fuel Lines:** PTFE or rubber-lined AN-6 hose rated for >100 psi.
- **Filter:** 6-micron in-line filter, AN-6 male/male.
- **Regulator:** AEM or Radium adjustable FPR with boost reference port.
- **Fuel Rail:** K20/K24 rail with AN-6 inlet/outlet.
- **Injectors:** Flow-matched, high-impedance, EV6/EV14 style injectors.
- **Fittings:** AN-6 45°, 90° elbows, bulkhead fittings, and mounting brackets.

6.4 Electrical Requirements

Because the K-series demands higher fuel flow than the EF’s OEM wiring can provide, the following electrical upgrades are required:

- Dedicated 12–14 AWG power feed for the pump.
- Relay-controlled pump circuit (30 A relay).
- 20 A fuse or circuit breaker.
- Chassis grounding upgrade (engine block and rear frame).

6.5 Fuel System Cost Summary

Component	Estimated Cost (CAD)	Notes
High-Flow Fuel Pump (255–450 LPH)	$150–$350	In-tank installation
AN-6 Feed + Return Line Kit	$200–$400	PTFE recommended
Fuel Pressure Regulator	$150–$250	Boost reference ready
High-Flow Fuel Filter (6–10 micron)	$60–$120	EFI-rated
K-Series Fuel Rail	$100–$180	AN-compatible
1000–1200 cc Injectors	$300–$600	Flow-matched set
Pump Relay + Wiring	$30–$60	12–14 AWG
Fittings, Clamps, Brackets	$80–$150	AN hardware
Total Fuel System Cost	**$1,070–$2,110**	

6.6 Installation Notes

- The EF fuel sending unit must be modified or replaced to accept AN fittings.
- The factory fuel line locations may be repurposed (feed or return) depending on routing.
- PTFE (Teflon) hose is strongly recommended for ethanol c

7 Cooling System Requirements and Specifications

7.1 Overview

The K24/K20 hybrid produces significantly more heat than the EF Civic's original D-series engine, and AWD conversions further restrict airflow around the downpipe, subframe, and transfer case. A complete cooling system redesign is therefore required to maintain engine stability during track use, sustained high RPM, and high ambient temperature operation.

7.2 Cooling System Architecture

The upgraded system uses a high-capacity aluminum radiator, electric fan control via ECU, proper K-swap hose routing, and dedicated oil cooling. The system includes:

– Full-size or half-size aluminum radiator (K-swap compatible).
– Dual-speed electric radiator fan or single high-flow slim fan.
– K-series upper and lower coolant hoses with EF/K adapter fittings.
– Thermostat housing and coolant bypass adapter.
– External oil cooler system (mandatory for K24 hybrid under track load).
– Expansion/overflow tank and proper bleed points.

7.3 Radiator and Fan System

- **Radiator:** 2-row or 3-row TIG-welded aluminum radiator (half-size or full-size).
- **Fan:** 12"–14" slim electric fan, minimum 1400–1600 CFM.
- **Shroud:** Full shroud recommended for track usage.
- **Mounting:** Custom brackets if using half-size radiator to clear AWD downpipe.
- **Coolant Type:** Honda Type 2 or equivalent premix, 50/50.

7.4 Thermostat Housing and Hose Routing

The K-series thermostat housing points toward the firewall in an EF chassis. Proper hose routing requires:

- K-tuned or Hybrid Racing swivel thermostat housing.
- Lower radiator hose with K-swap geometry (EF-to-K adapter / Custom).
- Upper radiator hose (custom length or modular aluminum hose kit).
- Heater core return line routing (optional delete for track-only use).

7.5 Oil Cooling System

Due to elevated oil temperatures from the K24 block and AWD drivetrain loading, a dedicated oil cooling system is mandatory.

- **Oil Cooler:** 19-row or 25-row stacked-plate cooler.
- **Oil Sandwich Plate:** Thermostatic (180–195°F activation).
- **Lines:** AN-10 or AN-8 oil lines with fire-resistant sheathing.
- **Mounting:** Front support or bumper beam location with airflow exposure.

7.6 Cooling System Sensors and Electronics

- **ECT Sensor:** OEM K-series coolant temp sensor tied into KPro/ECU.
- **Fan Control:** ECU-controlled relay (20–30 A) or dedicated fan controller.
- **Bleed Ports:** Integrated in upper hose or radiator cap housing.

7.7 Cooling System Cost Summary

Component	**Estimated Cost (CAD)**	**Notes**
Aluminum Radiator (half/full size)	\$180–\$450	K-swap compatible
High-Flow Electric Fan (12”–14”)	\$80–\$150	1400–1600 CFM
Fan Shroud Assembly	\$80–\$150	Recommended for track use
Swivel Thermostat Housing	\$120–\$200	Required for EF hose routing
K-Swap Upper/Lower Hoses	\$80–\$120	EF-to-K adapters
Oil Cooler (19–25 row)	\$150–\$380	Stacked-plate style
Thermostatic Sandwich Plate	\$90–\$180	180–195°F
AN Oil Lines + Fittings	\$120–\$220	AN-8 or AN-10
Coolant + Bleed Hardware	\$30–\$60	Honda Type 2
Fan Relay + Wiring	\$20–\$40	ECU-controlled
Total Cooling System Cost	**\$950–\$1,950**	

7.8 Installation Notes

- Full-size radiators may require trimming near the AWD transfer case.
- Oil cooler lines must avoid contact with the downpipe and driveshaft tunnel.
- A swirl tank or expansion tank is recommended for high-RPM track use.
- Bleeding the K-series is critical; improper bleeding causes overheating.

7.9 Summary

The upgraded cooling system ensures stable operating temperatures for the K24/K20 hybrid under sustained load, supports high-revving track use, and provides thermal headroom for future forced-induction upgrades. Integration of a radiator, fan control, oil cooling, and K-swap hose routing is mandatory for reliable operation in the AWD EF platform.

8 Exhaust System Requirements and Specifications (DIY Fabrication)

8.1 Overview

The EF Civic’s OEM exhaust path is eliminated during AWD conversion because the center underbody is replaced with a custom driveshaft tunnel. As a result, a completely custom exhaust must be fabricated. This section outlines all required components for a DIY-built stainless exhaust system suitable for the 300 hp K24/K20 hybrid and future turbocharging.

8.2 Exhaust System Architecture

The DIY exhaust system consists of:

- K-series long-tube header (K24/K20 compatible)

- DIY 2.5”–3.0” stainless-steel exhaust system
- V-band modular joints
- Straight-through resonator and muffler
- Custom hangers and heat shielding
- Optional high-flow catalytic converter

8.3 Header and Downpipe Requirements

- Equal-length long-tube header provides optimal midrange torque for the hybrid.
- Downpipe must clear:
  * AWD transfer case,
  * front subframe,
  * and the custom driveshaft tunnel.
- **V-band** flanges are recommended for removable service sections.

8.4 Midsection and Routing Considerations

- Exhaust must route beside the tunnel, not inside it.
- Maintain 0.75”–1.0” clearance from the driveshaft at all times.
- Use heat shielding near:
  * fuel lines,
  * brake lines,
  * and tunnel reinforcement plates.
- 2.5” pipe recommended NA; 3.0” recommended for future turbocharging.

8.5 Rear Section and Muffler

- Over-axle or under-axle routing depending on differential cradle design.
- Use a straight-through muffler for minimal backpressure.
- Resonator required to reduce rasp and interior drone.

8.6 Optional High-Flow Catalytic Converter

- 200–300 cell catalyst for emissions compliance.
- Should be placed as close to the header as possible.

8.7 DIY Exhaust System Cost Summary (Parts Only)

Component	DIY Cost (CAD)	Notes
K-Series Long-Tube / Race Header	\$450–\$900	K24/K20 compatible
2.5"–3.0" Stainless Piping (mandrel bends + straight)	\$180–\$320	304 stainless recommended
V-Band Clamps + Flanges (3-piece sets)	\$60–\$120	Stainless-steel
Flex Pipe Section	\$40–\$80	Prevents header cracking
Resonator (straight-through)	\$80–\$150	12"–18" recommended
Performance Muffler	\$120–\$220	Straight-through design
High-Flow Catalytic Converter (optional)	\$120–\$200	200–300 cell
Hangers, Isolators, Hardware	\$30–\$60	Universal kits
Heat Shielding Wrap / Plates	\$30–\$60	Protects driveshaft + fuel system
Exhaust Gaskets (header + V-band)	\$20–\$40	Multi-layer steel
Total DIY Exhaust System Cost	**\$1,130–\$2,150**	Parts only, 100% DIY fabrication

8.8 Installation Notes

- All welds should be TIG or MIG on stainless; backpurging recommended for durability.
- Route the exhaust first on jack stands, tack-weld sections, then final weld off the car.
- Maintain sufficient articulation in hangers to prevent cracking under AWD torque load.
- Keep piping away from driveshaft angles and rear differential mounts.

8.9 Summary

The AWD EF conversion requires a fully custom DIY exhaust system due to loss of the original exhaust tunnel. Using stainless piping, V-band joints, and a long-tube header ensures high flow, durability, and compatibility with future turbocharging while maintaining full DIY fabrication control.

9 Intake System Requirements and Specifications (DIY Fabrication)

9.1 Overview

The K24/K20 hybrid requires a high-flow intake system with proper cold-air positioning and clearance modifications for the EF chassis. The AWD conversion and radiator placement further tighten the available engine bay space. A custom intake assembly is required to ensure appropriate airflow, accurate IAT readings, and reliability under track conditions.

9.2 Intake System Architecture

The custom intake system consists of:

- 3.0"–3.5" aluminum or stainless intake tubing

– Low-restriction cone air filter (heat-resistant)
– Properly positioned IAT sensor (in-tube or bung-mounted)
– Intake pipe support brackets
– Heat shielding or air ducting as needed

9.3 Intake Tube Routing

Because the AWD transfer case, radiator, and front subframe alter the available space, the intake pipe must be routed strategically:

- **Short Ram Intake (SRI) Configuration:** Ideal for tight engine bay packaging. Filter positioned behind the headlight area.
- **Cold Air Intake (CAI) Configuration:** Filter routed down toward the front bumper for colder air, requiring splash protection.
- **Pipe Diameter:**
  * **3.0"** recommended for NA 300 hp configuration.
  * **3.5"** recommended for future turbocharging or high-flow throttle body.

9.4 Intake Air Temperature (IAT) Sensor Placement

For accurate air density measurement and proper ignition timing:

- The IAT sensor must be placed **in the intake tube**, not in the manifold.
- A welded or threaded bung is required for OE K-series IAT.
- Distance from throttle body: 4"–8" recommended.

9.5 Hood and Chassis Clearance Considerations

The K24 block and long intake manifold increase height relative to the EF chassis. Clearance requirements:

- Intake tubing must clear the hood support beam.
- Radiator hoses and fan shroud must not interfere with intake routing.
- No contact permitted with:
  * brake master cylinder,
  * clutch reservoir,
  * battery relocation lines,
  * radiator cap/hoses.

9.6 Filter Placement and Heat Management

To avoid hot-air ingestion from radiator airflow:

- Use a high-quality cone filter with heat-resistant material.
- Add heat shielding between filter and radiator fans.
- Optional: fabricate a small air duct or box to isolate intake air.

9.7 DIY Intake System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
3.0”–3.5” Aluminum Intake Tubing	$60–$120	Straight + mandrel bends
Cone Air Filter (High-Flow)	$40–$80	Heat-resistant
IAT Sensor Bung (weld-on or thread-on)	$10–$20	Aluminum or steel
Silicone Couplers (3” or 3.5”)	$20–$40	Heat-resistant
T-Bolt Clamps (Stainless)	$20–$35	High-strength
Intake Pipe Support Brackets	$10–$20	Universal fit or DIY
Heat Shielding Material	$20–$50	Gold foil or reflective sheeting
Optional Splash Shield (CAI Only)	$15–$25	Prevents water ingestion
Total DIY Intake System Cost	**$195–$390**	100% DIY fabrication

9.8 Installation Notes

- Keep intake piping as straight as possible for best airflow.
- Avoid routing pipes near sharp heat sources (header, radiator fans).
- Ensure filter is not exposed to direct tire splash in CAI setups.
- Validate IAT readings during tuning; improper placement will cause timing errors.

9.9 Summary

A fully custom intake system is required for the K24/K20 hybrid in the AWD EF chassis due to space constraints and airflow demands. Using a 3.0”–3.5” intake tube, correctly placed IAT sensor, and proper heat shielding ensures accurate airflow measurement and reliable performance under track and street operation.

10 Electrical System Requirements and Specifications (DIY Wiring)

10.1 Overview

The electrical system of the EF Civic must be significantly upgraded to support the K24/K20 hybrid, AWD drivetrain requirements, modern engine sensors, ECU power demands, and high-flow components such as the fuel pump and radiator fan. The OEM D-series wiring cannot safely power the new systems. A complete electrical integration strategy is required to ensure reliability and tuning accuracy.

10.2 Electrical System Architecture

The upgraded electrical architecture consists of:

- K-series engine harness (RSX/EP3 style or aftermarket K-swap harness).
- EF-to-K-series chassis conversion harness.

- Upgraded alternator and starter wiring.
- Dedicated relay circuits for:
  * High-flow fuel pump,
  * Electric radiator fan(s),
  * ECU/ignition power.
- Battery relocation system (optional but recommended).
- Enhanced grounding system for stable ECU reference signals.

10.3 K-Series Engine Wiring Requirements

The K-series engine requires the following sensors and circuits to be wired correctly:

- Crank position sensor (CKP)
- Cam position sensor (CMP)
- VTEC solenoid + VTEC oil pressure switch
- MAP sensor (3 bar optional)
- IAT sensor (in intake tube)
- TPS (throttle position)
- ECT (coolant temperature)
- Primary O_2 wideband input
- Knock sensor
- Alternator charge circuit

10.4 Starter and Alternator Wiring Upgrades

10.4.1 Starter Circuit

- Dedicated 8 AWG power feed from battery to starter.
- OEM EF starter trigger wire reused with K-swap adapter.

10.4.2 Alternator Circuit

The K-series alternator requires a heavier-gauge charge wire:

- 4 AWG charge cable from alternator to fuse block or battery.
- 80–120 A fuse inline with charge cable.
- Sense wire connected to ECU/charge system.

10.5 Battery Relocation (Recommended)

To improve engine bay packaging and thermal protection:

- Relocate battery to rear trunk or behind passenger seat.
- Use 2 AWG or 0 AWG power cable.
- Install 150–200 A fuse within 12 inches of battery.
- Ground cable from battery to rear frame rail.
- Engine block to chassis ground upgraded to 4 AWG.

10.6 Relay and Fuse System

10.6.1 Required Relays

- 30 A fuel pump relay (triggered by ECU)
- 30 A fan relay (ECU-controlled)
- 40 A ignition/ECU relay (constant + switched 12 V feed)

10.6.2 Fuse Panel Requirements

- Dedicated fuse block with:
  * Fuel pump: 20–25 A
  * Fan: 25–30 A
  * ECU/Ignition: 15 A
  * Wideband controller: 5 A

10.7 Grounding System Requirements

Proper grounding is essential for K-series ECU operation:

- Engine block to chassis ground (4 AWG)
- Cylinder head to chassis ground (8–10 AWG)
- Battery to chassis ground (2 AWG)
- ECU ground isolated from noisy high-current grounds

10.8 AWD System Electrical Considerations

Although the AWD system is mechanically driven in the CR-V platform, the EF AWD swap requires:

- ABS system delete or proper wiring termination.
- Wheel speed sensor delete or signal conditioning depending on cluster used.
- Reverse light switch wiring from K-series transmission.
- Optional driveshaft speed sensor (aftermarket digital dash input).

10.9 Cluster, Gauges, and Dash Integration

- KPro CAN output may be used for digital dash display.
- Tachometer calibration required for 4-cylinder K-series signal.
- Coolant temp gauge needs EF-specific resistor or K-swap conversion harness.
- Wideband AFR gauge required for tuning.

10.10 DIY Electrical System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
K-Swap Engine Harness	\$300–\$600	RSX/EP3 or tucked harness
EF-to-K Conversion Harness	\$250–\$450	Integrates chassis + ECU
Battery Relocation Kit (0–2 AWG)	\$80–\$150	Cables + clamps
Fuse Block + Fuses	\$20–\$40	Mini or MIDI style
Relays (3–4 pcs)	\$20–\$40	30–40 A
Ground Strap Kit (4 AWG)	\$20–\$35	Block + chassis
Alternator Charge Cable (4 AWG)	\$20–\$40	Requires 80–120 A fuse
Starter Cable (8 AWG)	\$10–\$20	Battery → starter
Wideband Controller Power Wiring	\$10–\$20	5 A circuit
Misc Wiring, Loom, Heat Shrink	\$20–\$40	General wiring supplies
Total DIY Electrical System Cost	**\$750–\$1,435**	Complete DIY wiring

10.11 Installation Notes

- Route power cables away from exhaust, driveshaft, and sharp edges.
- Use loom and heat-resistant sleeving near the header and radiator fan area.
- Ensure all grounds contact clean, bare metal surfaces.
- Test all circuits individually before starting the engine.
- Verify fuel pump prime, fan activation, and ECU power-on behavior.

10.12 Summary

A complete wiring redesign is required to support the K24/K20 AWD platform. Upgraded power and ground circuits, ECU integration, relay control, and battery relocation ensure reliable operation, accurate sensor readings, and safe power delivery to all major systems under high-performance use.

11 Shifter and Cable System Requirements and Specifications (DIY)

11.1 Overview

The AWD K-series transmission from the Honda CR-V requires a cable-operated shifter system. The EF chassis was originally designed for rod-style D-series shifters, making the OEM shifter assembly incompatible. A complete conversion to a K-series cable-shift mechanism is required.

11.2 System Architecture

The shifter system consists of the following major components:

- K-series shifter box (RSX Type-S style or aftermarket billet unit)
- K-series shift cables (OEM RSX or heavy-duty aftermarket)
- EF-specific shifter mounting plate or tunnel adapter
- Cable firewall and subframe brackets
- Cable retention hardware and bushings

11.3 Shifter Box Requirements

11.3.1 OEM Style

- 2002–2006 RSX Type-S (PRB) shifter box is compatible.
- Provides factory feel, longer throw.

11.3.2 Aftermarket Billet Style (Recommended)

- K-Tuned, Hybrid Racing, or Acuity billet shifter box.
- Stronger housing with shorter, more precise throw.
- Adjustable cable angles improve EF chassis packaging.

11.4 Shifter Box Mounting (EF Chassis)

The EF chassis requires a custom shifter plate because it lacks the bolt pattern for K-series cable shifters. Mounting options:

- **Bolt-In Adapter Plate:** A steel or aluminum plate that bolts to factory EF shifter holes and accepts RSX-style shifter boxes.
- **Weld-In Plate (Track Spec):** Provides a stronger, rigid base and eliminates flex under aggressive shifting.

The shifter assembly must align the cables directly toward:

- the firewall pass-through,
- the transmission linkage bracket,
- and the AWD transfer case.

11.5 Shift Cables

- RSX Type-S (OEM Honda) cables fit with minor firewall trimming.
- Heavy-duty aftermarket cables recommended for track durability.
- Heat shielding required around:
  * header/downpipe,
  * transfer case,
  * radiator fan.

11.6 Cable Firewall Routing

The EF firewall must be modified to allow the K-series shift cables to pass through:

- Use a **3–4" oval** or **round pass-through hole**.
- Install rubber grommet or bulkhead plate to prevent abrasion.
- Route cables above the transfer case and below the intake manifold.

11.7 Transmission Cable Bracket Requirements

The CR-V AWD transmission uses the same cable mount style as RSX transmissions.

Required:

- OEM CR-V/RSX shift cable bracket or aftermarket billet bracket.
- Short-throw linkage upgrade (optional).

11.8 DIY Shifter System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
RSX Type-S Shifter Box (OEM)	\$120–\$220	Used, OEM feel
Billet Shifter Box (K-Tuned / HR / Acuity)	\$300–\$550	Recommended
RSX/Type-S Shift Cables (OEM)	\$120–\$200	Works with EF swaps
Aftermarket Heavy-Duty Cables	\$200–\$350	Track-rated
EF Shifter Adapter Plate (bolt-in)	\$50–\$120	Steel/aluminum
Firewall Cable Grommet/Plate	\$10–\$25	Seals pass-through
Cable Bracket (Trans Side)	\$20–\$60	OEM or billet
Cable Heat Shielding Wrap	\$10–\$25	Protects from header heat
Total DIY Shifter System Cost	**\$550–\$1,550**	Depending on parts choice

11.9 Installation Notes

- Ensure cables do not rub against transfer case edges or downpipe.
- Maintain smooth bends in cable routing to prevent binding.
- Shifter box must sit rigidly; movement will cause sloppy gear engagement.
- Test all gears with engine off before first startup.
- After initial heat cycles, re-check cable tension and bracket hardware.

11.10 Summary

A K-series cable shifter system is mandatory for the AWD CR-V transmission. Using RSX-style shifter boxes, reinforced cables, and EF-specific mounting plates ensures smooth, reliable gear engagement under high-load AWD operation. Proper firewall routing, cable heat management, and solid mounting are essential for track-ready shifting precision.

12 Axles and Driveline Requirements and Specifications (DIY)

12.1 Overview

The AWD K-series conversion requires a complete redesign of both the front and rear axle systems. The EF chassis was never designed for an AWD driveline; therefore, custom-length axles, AWD- compatible hubs, reinforced bearings, and proper differential alignment are essential. Proper axle geometry is critical for preventing vibration, binding, or premature CV failure under high torque loads.

12.2 System Architecture

The driveline consists of:

- Front K-swap axles (EF length, K-series splines).
- Rear CR-V RT4WD axles or custom-length hybrid axles.
- AWD-compatible hubs and wheel bearings.
- Rear differential matched to CR-V driveshaft spline count.
- Driveshaft center carrier support and pinion alignment.

12.3 Front Axles (K-Swap)

The front axle solution is similar to traditional K-swapped EF setups:

- Use EF/K-swap axles designed for:
  - EF wheel hubs (26-spline),
  - K-series transmission inner joints (36-spline).
- Recommended brands:
  - Hasport,
  - Insane Shafts,
  - DSS (DriveShaft Shop).
- Axle length must match:
  - EF front control arm geometry,
  - EF track width,
  - K-series AWD transmission output shaft spacing.

12.4 Rear Axles (AWD)

The rear axle system is based on OEM CR-V RT4WD components, modified as required:

- Use CR-V RT4WD rear axles (98–01 recommended).
- If track width or trailing arm geometry changes:
  - Custom-length hybrid axles may be required.
  - Axles must match EF hub splines and CR-V differential output splines.
- Axles should operate within:
  - 0–5° plunge angle,
  - minimal lateral offset,
  - aligned differential-to-hub axis.

12.5 Hub and Bearing Requirements

Due to AWD torque and additional load, EF OEM hubs/bearings are insufficient.

12.5.1 Front Hubs

- 26-spline EF/CRX/DA hubs recommended (OEM spec).
- Replace wheel bearings with new OEM or high-quality aftermarket.

12.5.2 Rear Hubs (AWD)

- CR-V or Wagon RT4WD rear hubs recommended.
- Hybrid hubs may be required if:
  - EF trailing arms are modified,
  - custom spindle brackets are used,
  - different brake setups (DA/CRV/RT4WD) are chosen.
- Wheel bearings must be NEW to prevent heat-induced failure.

12.6 Differential and Axle Alignment

Axle reliability depends heavily on differential placement:

- Rear differential must be centered and squared to the chassis.
- Pinion angle must match driveshaft carrier angle within 1–2°.
- Axle output shafts must be level:
  - too high → binding and CV overheating,
  - too low → vibration at speed.

12.7 Driveshaft and Carrier Integration

Although covered in the driveshaft tunnel section, axle considerations require:

- Proper driveshaft slip-yoke engagement,
- Carrier bearing positioned to avoid axle interference,
- No contact with:
  * fuel lines,
  * exhaust system,
  * rear suspension arms.

12.8 DIY Driveline Component Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
Front K-Swap Axles (EF length)	\$350–\$600	Hasport/Insane Shafts/DSS
Rear CR-V RT4WD Axles	\$150–\$300	OEM style
Custom Hybrid Rear Axles (optional)	\$350–\$550	Only for altered geometry
Front Wheel Bearings (new)	\$60–\$120	Two required
Rear Wheel Bearings (new)	\$60–\$120	Two required
Front Hubs (26-spline EF/DA)	\$60–\$120	OEM or aftermarket
Rear AWD Hubs (CR-V or RT4WD)	\$100–\$220	Depending on setup
AWD Axle Seals (CR-V)	\$20–\$40	Differential + trans
Driveshaft Carrier Hardware	\$20–\$40	Bolts + bushings
Heat Shielding for Axles	\$10–\$20	Prevents boot damage
Total DIY Axle & Driveline Cost	**\$1,180–\$2,130**	100% DIY assembly

12.9 Installation Notes

- Always torque axle nuts to manufacturer spec (180–220 ft-lb depending on hub).
- Ensure CV boots are angled naturally and not stretched at full droop.
- After chassis welding and cage installation, re-measure all axle plunge angles.
- Inspect for vibration starting at 40–60 km/h — common sign of misalignment.
- Avoid excessive lowering; AWD axles have limited articulation tolerance.

12.10 Summary

A functional AWD system requires K-swap front axles, CR-V based rear axles, upgraded hubs, and properly aligned differential geometry. Custom fabrication and precise alignment ensure reliable torque transfer for both NA and future turbocharged configurations.

13 Braking System Requirements and Specifications (DIY)

13.1 Overview

The AWD K24/K20 EF Civic requires a complete braking system upgrade. The factory EF brake components were designed for a sub-100 hp chassis and are unable to safely manage the increased torque, weight distribution, and sustained braking loads expected from a 300 hp AWD platform. High-performance front and rear braking components are necessary for safety, track reliability, and pedal consistency.

13.2 System Architecture

The upgraded braking system consists of:

- High-performance front calipers and rotors (Integra, ITR, or aftermarket big brake kit).
- Rear disc conversion (CRX Si, Integra DA, or RT4WD components).
- Upgraded master cylinder and booster.
- Adjustable proportioning valve for brake bias control.
- High-temperature pads and DOT 4 brake fluid.
- Stainless braided brake lines.

13.3 Front Brake Requirements

13.3.1 OEM Upgrade Option

- 262 mm–282 mm rotor upgrade (Integra GSR/Type R).
- Dual-piston or high-performance single-piston calipers.
- Works well for NA configuration.

13.3.2 Big Brake Kit Option (Recommended for Track Use)

- 4-piston Wilwood or K-Tuned/StopTech kit.
- Slotted or two-piece rotors.
- Increased thermal capacity prevents fade on AWD setups.

13.4 Rear Brake Requirements

13.4.1 Rear Disc Conversion

The EF rear drums must be replaced with a disc brake system:

- Donor components: CRX Si, Civic Si, or Integra DA trailing arms.
- Alternatively: RT4WD trailing arms (rare; may require modification).

13.4.2 Rotor and Caliper Specifications

- 239 mm–260 mm rear rotors.
- OEM-style single-piston calipers.
- Track pad compounds recommended for improved balance.

13.5 Master Cylinder and Brake Booster

Due to the increased fluid volume of upgraded calipers:

- **1" Integra Type R master cylinder** recommended.
- 15/16" master cylinder from DA Integra acceptable but softer pedal feel.
- Brake booster compatibility:
  * DA/ITR booster fits with minor EF firewall modification.
  * EF booster may be reused with adapter lines but is not preferred.

13.6 Proportioning Valve Requirements

The EF's OEM proportioning valve is calibrated for drum brakes.

Required upgrade:

- DA/ITR disc–disc proportioning valve (40/40 split).
- Optional: adjustable brake bias valve for track tuning.

13.7 Brake Line Requirements

- Stainless braided brake lines (front + rear).
- Fresh hard lines if lines were moved during AWD tunnel fabrication.
- Line routing must avoid:
  * driveshaft,
  * exhaust heat,
  * diff cradle edges.

13.8 Brake Cooling (Track Use)

Although optional, brake cooling is recommended for AWD track setups:

- Front ducting from bumper to rotor hat.
- Shielding to direct airflow at calipers.

13.9 Pad and Fluid Requirements

- Track pads for front and rear (Hawk HP+, Winmax, Project Mu).
- DOT 4 or DOT 5.1 high-temperature fluid.
- Avoid DOT 5 (silicone-based, incompatible with ABS delete cars).

13.10 DIY Braking System Cost Summary

Component	DIY Cost (CAD)	Notes
Front Brake Upgrade (GSR/ITR)	\$200–\$450	Calipers + rotors
Front Big Brake Kit (optional)	\$600–\$1,200	4-piston setup
Rear Disc Conversion (CRX/DA)	\$200–\$400	Trailing arms + hardware
ITR/DA Master Cylinder (1”)	\$80–\$150	Required for pedal feel
ITR/DA Brake Booster	\$60–\$120	Recommended
40/40 Proportioning Valve	\$40–\$80	Disc–disc compatible
Stainless Braided Lines (set)	\$80–\$150	Front + rear
Track Pads (front + rear)	\$120–\$250	High-temp compounds
DOT 4 / 5.1 Brake Fluid	\$20–\$40	Two bottles
Brake Line Hardware	\$20–\$40	Clips + adapters
Total DIY Brake System Cost	**\$1,020–\$2,880**	100% DIY installation

13.11 Installation Notes

- Bleed brakes in the following order: **RR** → **LR** → **RF** → **LF**.
- Ensure rear disc conversion includes correct e-brake cable routing.
- Recheck brake bias after first track session.
- Avoid cheap pads — AWD loads generate significantly more brake heat.

13.12 Summary

The AWD K24/K20 EF Civic requires a complete brake system overhaul to ensure safe and repeatable stopping performance. Upgraded calipers, rotors, master cylinder, stainless lines, and correct biasing provide the reliability needed for street and track use while accommodating the higher mass and torque distribution of the AWD platform.

14 Suspension System Requirements and Specifications (DIY)

14.1 Overview

The suspension system of the EF Civic must be upgraded to handle the additional weight, torque distribution, and chassis dynamics introduced by the AWD K24/K20 swap. Coilovers with appropriate spring rates, reinforced trailing arms, and adjustable alignment components are required for safe and predictable performance under street and track conditions.

14.2 Suspension Architecture

The system consists of:

- Coilover suspension system (front and rear)
- Adjustable camber and toe components

- Polyurethane or spherical bushings
- Uprated rear trailing arm bushings (critical)
- Sway bar upgrades (optional depending on chassis stiffness)

14.3 Coilover Requirements

14.3.1 Recommended Coilover Specifications

For a 300 hp AWD EF chassis:

- **Front Spring Rate:** 10k–12k (560–670 lb/in)
- **Rear Spring Rate:** 8k–10k (450–560 lb/in)

These rates balance:

- AWD weight increase,
- rear differential mass,
- driveshaft tunnel stiffness,
- roll cage rigidity.

14.3.2 Recommended Coilover Brands

- BC Racing BR/DS
- Yellow Speed Racing
- Tein Flex Z
- Fortune Auto 500 (premium)
- KSport Kontrol Pro (budget track option)

14.4 Trailing Arm and Rear Suspension Requirements

The AWD diff and axles introduce new suspension geometry constraints:

- EF trailing arms require:
  * reinforced bushings,
  * custom brackets for toe/camber,
  * potential trimming for axle clearance.
- High-durometer polyurethane trailing arm bushings recommended.
- Spherical bushings optional for track vehicles.
- Rear lower control arms must clear AWD axles.

14.5 Camber, Toe, and Alignment Adjustability

14.5.1 Front Adjustments

- Adjustable camber upper control arms.
- Toe adjustment through OEM tie rods.

14.5.2 Rear Adjustments

The EF chassis does not have factory rear camber/toe adjustment.

Required components:

- Adjustable rear upper control arms.
- Adjustable toe arms or camber shims depending on arm choice.

14.6 AWD-Specific Suspension Considerations

- Lower ride heights increase axle-to-diff angles, risking CV bind.
- Minimum safe ride height: **1.0"–1.5" drop** from OEM.
- Avoid excessive camber in the rear — increases axle stress.
- Stiffer rear springs prevent diff cradle squat under load.

14.7 Brake Dive and Weight Transfer

Coilover damping should be set to:

- Firm front rebound to minimize dive,
- Moderate rear rebound for AWD stability,
- Soft–medium compression for mechanical grip.

14.8 DIY Suspension System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
Coilovers (Front + Rear)	\$900–\$1,800	10k/8k to 12k/10k rates
Front Adjustable Camber Arms	\$120–\$200	Required for alignment
Rear Adjustable Camber Arms	\$80–\$160	Needed for AWD setup
Rear Toe Arms or Shims	\$40–\$120	Toe adjustability
Polyurethane Suspension Bushings	\$80–\$150	Full set
Trailing Arm Bushings (HD)	\$40–\$80	EF-specific, critical
Rear Lower Control Arms	\$80–\$150	Ensure axle clearance
Sway Bar Endlinks	\$20–\$40	Replacement wear items
Total DIY Suspension Cost	**\$1,360–\$2,700**	100% DIY installation

14.9 Installation Notes

- Verify axle clearance at full droop and full compression.
- Torque control arm and trailing arm bushings at ride height.
- Perform alignment after full vehicle reassembly:
  * Front camber: –2.0° to –2.5°
  * Rear camber: –1.0° to –1.5°
  * Front toe: 0 to slight toe-out
  * Rear toe: 0 to slight toe-in

14.10 Summary

A coilover-based suspension with reinforced bushings and alignment adjustability is essential for the AWD EF Civic. Proper spring rates, geometry adjustments, and diff-aware ride height ensure predictable handling, traction, and axle reliability under high-performance driving.

15 Driveshaft and Carrier Bearing System (DIY Fabrication)

15.1 Overview

The AWD conversion requires a fully custom driveshaft system to connect the CR-V AWD transmission to the rear differential. The EF chassis does not provide a driveshaft tunnel, carrier bearing mounts, or correct pinion angle geometry. A complete redesign of the underbody driveline path is therefore necessary. Proper alignment is critical to prevent vibration, binding, and premature U-joint failure.

15.2 System Architecture

The driveshaft system consists of:

- CR-V AWD front yoke and rear driveshaft flange
- Custom DOM steel driveshaft (2.5" OD, 0.083"–0.095" wall)
- Center carrier bearing assembly
- Custom carrier bearing crossmember/mounts
- U-joints (Spicer 1310 series or equivalent)
- Hardware for balancing and installation

15.3 Driveshaft Specifications

- **Tube Material:** DOM steel, 2.5" OD, 0.083"–0.095" wall thickness
- **U-Joints:** Spicer 1310 series recommended
- **Front Yoke:** OEM CR-V AWD spline
- **Rear Flange:** CR-V AWD differential flange
- **RPM Rating:** 6,000–8,000 RPM balance recommended

15.4 Carrier Bearing Requirements

The CR-V driveshaft uses a center carrier bearing to support the two-piece assembly.

15.4.1 Carrier Bearing Mounting

The EF chassis requires:

- A custom crossmember welded between the new driveshaft tunnel rails.
- Polyurethane or rubber isolator mounts to reduce NVH.
- Correct vertical height placement to maintain driveline angle.

15.4.2 Carrier Bearing Angle

To avoid vibration and bearing wear:

- Carrier bearing must not sit twisted or offset.
- Horizontal misalignment should be less than 1–2 mm.
- Vertical misalignment should be less than 1° relative to the tunnel.

15.5 Pinion Angle and Alignment

Proper alignment between the transmission output and rear differential pinion is essential.

15.5.1 Specifications

- Transmission output shaft and rear diff pinion angle must match within 1–2°.
- Driveshaft angles must form:
  * a front U-joint working angle of 1–3°,
  * a rear U-joint working angle of 1–3°,
  * equalized angles to prevent high-speed vibration.

15.5.2 Common Misalignment Issues

- Diff mounted too high → binds rear U-joint under compression.
- Diff mounted too low → vibration at 40–70 km/h.
- Carrier bearing too far forward → driveline shudder.
- Exhaust positioned too close → thermal damage to U-joints.

15.6 Driveshaft Tunnel Considerations

The new tunnel fabricated earlier must incorporate:

- clearance for driveshaft articulation,
- brackets for carrier bearing crossmember,
- heat shielding between exhaust and shaft,
- access panels (optional) for U-joint servicing.

15.7 DIY Driveshaft System Cost Summary

Component	DIY Cost (CAD)	Notes
DOM Steel Tubing (2.5")	\$60–\$120	0.083"–0.095" wall
Spicer 1310 U-Joints (pair)	\$60–\$100	Heavy-duty
CR-V AWD Front Yoke	\$40–\$80	OEM or used
CR-V Rear Flange	\$20–\$40	OEM or used
Carrier Bearing Assembly	\$60–\$140	CR-V or aftermarket
Carrier Bearing Mount Materials	\$20–\$40	Steel plates + bushings
Balancing Weight Hardware	\$10–\$20	Weld-on tabs
Heat Shielding for Tunnel	\$20–\$40	Protects U-joints
Hardware + Fasteners	\$20–\$30	Grade 10.9
Total DIY Driveshaft Cost	**\$310–\$610**	100% DIY fabrication

15.8 Installation Notes

- Tack-weld driveshaft mount points first, then verify angles before final welding.
- Check for rotation clearance at full suspension droop and compression.
- Test for vibration between 40–120 km/h; re-adjust carrier height if necessary.
- Ensure U-joints are greased and aligned with yokes in-phase.

15.9 Summary

A custom driveshaft and carrier bearing system is required for the AWD EF platform. Proper alignment, correct U-joint phasing, and carrier bearing geometry ensure vibration-free operation and long-term driveline durability under both street and track use.

16 Fluids and Lubrication Requirements

16.1 Overview

Proper fluid selection is critical for the reliability of the K24/K20 hybrid engine, AWD CR-V driveline components, and high-performance braking and cooling systems. The EF chassis was not originally designed for these systems, so fluid capacities and specifications must be updated to match K-series and AWD requirements.

16.2 Engine Oil Requirements

16.2.1 Break-In Oil

For the first 500–800 km:

- **Viscosity:** 10W-30 or 10W-40 non-synthetic
- **Additives:** Zinc/phosphorus (ZDDP) recommended for new cams and rings
- **Capacity:** 4.5–5.0 L with K-series oil cooler system installed

16.2.2 Post Break-In (Track + Street Use)

- **Viscosity:** 5W-30, 10W-30, or 5W-40 synthetic
- **Recommended Brands:** Motul, AMSOIL, Redline, Mobil 1 Racing
- **Change Interval:** After every 2–3 track days or 5,000–7,000 km

16.3 Transmission Fluid (K-Series AWD Transmission)

The CR-V K-series AWD transmission requires Honda-type manual transmission fluid:

- **Fluid Type:** Honda MTF-III or equivalent
- **Capacity:** 1.8–2.0 L
- **Change Interval:** Every 10,000–15,000 km or every 2–3 track events

16.4 Rear Differential Fluid (CR-V AWD)

The CR-V viscous rear differential must use dual-pump compatible fluid:

- **Fluid Type:** Honda Dual Pump II (DP2)
- **Capacity:** 1.1–1.3 L
- **Change Interval:** Every 20,000 km or annually

16.5 Transfer Case Fluid

Some AWD K transmissions include a separate transfer housing:

- **Fluid Type:** Honda MTF-III (shares spec with gearbox)
- **Capacity:** 0.4–0.6 L

16.6 Cooling System Fluid

The K24/K20 hybrid and aluminum radiator require high-quality coolant:

- **Coolant Type:** Honda Type 2 premix or equivalent long-life blue coolant
- **System Capacity:** 5.5–6.0 L (with oil cooler + half-size rad)
- **Additives:** Water wetter optional for track use

16.7 Brake Fluid

Track use demands high-boiling-point brake fluid:

- **Fluid Type:** DOT 4 or DOT 5.1
- **Boiling Point Target:** 500°F+ dry boiling point
- **Brands:** Motul RBF600/660, Castrol SRF, ATE Typ 200

16.8 Power Steering (Optional Delete System)

Most K-swapped EF builds delete power steering.

If retained:

- **Fluid Type:** Honda PSF
- **Capacity:** 0.8–1.0 L

16.9 Clutch Hydraulic Fluid

- **Fluid Type:** DOT 3 or DOT 4
- **Capacity:** Minimal (approximately 100–150 mL)

16.10 DIY Fluids Cost Summary

Fluid	DIY Cost (CAD)	Notes
Break-In Engine Oil + Filter	\$40–\$70	Conventional + filter
Full Synthetic Engine Oil (5 L)	\$60–\$120	Motul/Redline recommended
K-Series AWD Transmission Fluid (2 L)	\$30–\$50	Honda MTF-III
Rear Differential Fluid (DP2)	\$25–\$40	Honda Dual Pump II
Transfer Case Fluid	\$10–\$20	Honda MTF
Coolant (6 L)	\$30–\$60	Honda Type 2
Brake Fluid (DOT 4/5.1)	\$20–\$50	High-temp recommended
Clutch Fluid	\$8–\$15	DOT 3/4
Power Steering Fluid (optional)	\$10–\$20	Honda PSF
Total DIY Fluids Cost	**\$233–\$445**	Complete AWD + K-series system

16.11 Installation Notes

- Prime oil system before first startup by cranking with injectors unplugged.
- Fill rear diff last to ensure correct fluid distribution.
- Bleed cooling system at highest point (IAT housing or swirl tank).
- Use two-person brake bleeding or vacuum bleeder for best pedal feel.

16.12 Summary

All fluids must meet modern K-series and CR-V AWD specifications to ensure drivetrain longevity, thermal stability, and reliable braking performance. Using correct fluid types and capacities is critical for a track-capable AWD EF platform.

17 Front Subframe, Clearance, and Mounting Requirements (DIY Fabrication)

17.1 Overview

The factory EF front subframe was designed for a small D-series drivetrain and provides limited space around the firewall, oil pan, and downpipe area. The AWD K24/K20 hybrid requires additional clearance for the K-series oil pan, AWD transfer case, long-tube header, and radiator system. Subframe modification or replacement is therefore mandatory to achieve correct drivetrain fitment, geometry, and reliability.

17.2 Subframe Architecture

Two primary approaches may be used for K-series AWD installation:

- **Option A: Modified EF Subframe (OEM Base)**
- **Option B: EG/DC Subframe Conversion with Traction Bar (Recommended)**

Each option impacts engine mount position, steering rack fitment, radiator placement, and transfer case clearance.

17.3 Option A: Modified EF Subframe

Retaining the EF subframe requires significant trimming and reinforcement.

17.3.1 Required Modifications

- Notch and clearance the subframe for the K-series AWD transfer case.
- Reinforce notched areas with 1/8" or 3/16" plate steel.
- Relocate or trim OEM torque mounts.
- Modify steering rack brackets if interference occurs.
- Add lower radiator support brackets for K-series radiator fitment.

17.3.2 Advantages

- Retains OEM geometry.
- Lower cost option.

17.3.3 Disadvantages

- Tight fit around downpipe and transfer case.
- Reduced accessibility for drivetrain servicing.
- Strength depends on quality of reinforcement.

17.4 Option B: EG/DC Subframe Conversion (Recommended)

The EG/DC subframe provides substantially more clearance and allows use of traction bars.

17.4.1 Required Components

- EG/DC front subframe
- EG/DC lower control arms
- EG/DC steering rack (manual or power)
- Hasport conversion mounts for EF→EG/DC
- K-series traction bar (K-Tuned / Hasport / custom)

17.4.2 Advantages

- Significantly improved downpipe and transfer case clearance.
- Increased radiator fitment options.
- Allows adjustable traction bar for mount positioning.
- More engine bay room for maintenance and turbo upgrades.

17.4.3 Disadvantages

- Higher cost.
- Requires drilling new mounting points.

17.5 Transfer Case Clearance Requirements

Regardless of subframe choice, the following clearances must be achieved:

- Minimum **10–15 mm** clearance between transfer case and subframe.
- Minimum **20–25 mm** clearance between transfer case and downpipe.
- Heat shielding required where exhaust passes near AWD components.

17.6 Radiator and Cooling Clearance

The AWD transfer case and K-series header reduce front-end packaging space.

- Full-size radiator may require trimming radiator support.
- Half-size radiators improve clearance but reduce coolant volume.
- Use slim fans to avoid interference with:
  * downpipe,
  * transfer case,
  * steering rack.

17.7 Engine Mounting Geometry

Hasport EF-K2 mount kit or EF→EG/DC conversion mounts must be used.

Critical requirements:

- Engine must sit level with chassis roll center.
- Transfer case must be angled to match driveshaft geometry (see driveline section).
- No engine-to-subframe contact under load or full suspension compression.

17.8 Reinforcement Requirements

Areas requiring reinforcement plating:

- Subframe notches
- EF frame rails (if trimmed)
- Radiator support (if modified)
- Traction bar mounting points

Use:

- 1/8" steel for subframe and brackets
- 3/16" steel for traction bar mounting and high-load areas

17.9 DIY Subframe and Clearance Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
EF Subframe Reinforcement Steel	\$20–\$40	1/8" or 3/16" plate
EG/DC Subframe (optional)	\$80–\$160	Used OEM
EG/DC Lower Control Arms	\$40–\$80	Required for conversion
Traction Bar (K-series)	\$200–\$350	K-Tuned/Hasport/custom
Conversion Mount Kit	\$250–\$450	EF→K or EF→EG/DC
Heat Shielding Materials	\$20–\$40	For downpipe + case
Hardware + Bushings	\$20–\$40	Grade 10.9 recommended
Total DIY Subframe Cost	**\$630–\$1,160**	Based on chosen configuration

17.10 Installation Notes

- Always test-fit engine + transmission + subframe simultaneously.
- Verify downpipe and transfer case clearances before final welding.
- Do not remove too much subframe material—reinforcement is mandatory.
- After welding, verify subframe alignment to avoid steering geometry errors.

17.11 Summary

The front subframe and clearance system is a critical component of the AWD K24/K20 EF build. Whether modifying the OEM EF subframe or converting to an EG/DC platform, proper clearance for the transfer case, downpipe, and radiator is essential. Reinforcement and correct engine geometry ensure reliable drivetrain placement and long-term structural integrity.

18 Throttle System Requirements and Specifications (DIY)

18.1 Overview

The EF Civic throttle system was designed for a cable-actuated D-series throttle body. The K24/K20 hybrid also uses a cable-actuated throttle body (unless using K20Z/K24A electronic units), but the cable routing, manifold height, and bracket positioning differ significantly. A custom or K-swap throttle cable setup is required for proper pedal feel, idle stability, and full-throttle engagement.

18.2 System Architecture

The throttle system includes:

- Throttle cable (RSX, EP3, or K-swap-specific)
- Throttle body (K20A2 or K24A2 recommended)
- Cable bracket (manifold-mounted)
- Firewall pass-through grommet
- Adjustable stop/return mechanism

18.3 Throttle Cable Selection

18.3.1 Recommended Cables

- **2002–2004 RSX Type-S cable** (best fit for K20 manifold)
- **EP3 Civic Si cable** (slightly shorter)
- **Hybrid Racing / K-Tuned K-Swap cable** (perfect length for EF swaps)

18.3.2 Reasons OEM EF Cable Cannot Be Used

- Too short for K-series manifold geometry
- Incorrect end fittings for K throttle linkage
- Interferes with intake piping and fan shroud

18.4 Intake Manifold Compatibility

Different intake manifolds affect throttle cable bracket height and alignment:

18.4.1 K20A2 / PRB Manifold (Recommended)

- Throttle body sits forward and low
- Works well with RSX/EP3 cables
- Easiest routing for AWD applications

18.4.2 K24A2 / RBB Manifold

- Taller and further rearward
- May require longer cable or custom bracket

18.5 Cable Routing and Firewall Integration

- Use original EF firewall throttle cable hole.
- Install new rubber grommet to prevent fraying.
- Route cable above:
  * transfer case,
  * intake piping,
  * radiator fan assembly.
- Avoid sharp bends that cause throttle sticking or poor pedal feel.

18.6 Throttle Bracket Requirements

- K-series throttle body requires a **manifold-mounted cable bracket**.
- Adjustable brackets (K-Tuned/Hybrid Racing) improve cable angle and pedal feel.
- Bracket must align cable straight into throttle linkage with no lateral force.

18.7 Full-Throttle Calibration

Proper calibration ensures the pedal delivers 100% throttle opening:

- Adjust firewall-end slack.
- Verify pedal hits WOT stop without excessive cable tension.
- Check for smooth return to idle with no binding.
- Confirm throttle returns firmly using OEM return springs.

18.8 Idle Control Considerations

The following components must be functional for a stable idle:

- IACV (Idle Air Control Valve) connected to coolant loop.
- Clean throttle body and properly adjusted stop screw.
- Sealed intake piping for accurate IAT measurement.

18.9 DIY Throttle System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
RSX Type-S Throttle Cable	$20–$40	Best OEM fit
EP3 Throttle Cable	$20–$35	Slightly shorter
K-Swap Throttle Cable (HR/K-Tuned)	$50–$80	Perfect length
Throttle Cable Bracket	$20–$40	Adjustable or OEM
Firewall Grommet	$5–$10	Seals cable entry
Throttle Body (K20A2/K24A2)	$80–$150	62–70 mm
Return Spring / Hardware	$5–$10	Safety item
Total DIY Throttle System Cost	**$150–$365**	Based on cable + manifold choice

18.10 Installation Notes

- Ensure no binding at full pedal depression.
- Avoid routing cable near the header—heat weakens cable sheathing.
- After first heat cycle, re-check cable tension.
- Confirm pedal modulation during tuning to avoid fueling errors.

18.11 Summary

A K-swap-compatible throttle cable and bracket system is required for the AWD EF platform. Proper routing, firewall integration, and manifold compatibility ensure smooth pedal response, stable idle operation, and reliable wide-open-throttle control for both street and track use.

19 Automatic-to-Manual Conversion Requirements (EF to K-Series AWD Manual)

19.1 Overview

If the base EF chassis is originally equipped with a factory automatic transmission, additional mechanical, electrical, and interior modifications are required before integrating the K24/K20 AWD manual transmission system. These differences must be engineered into the swap plan, as they affect pedal assembly, chassis wiring, shifter mounting, safety interlocks, and ECU behavior. Converting an automatic EF to a manual K-series setup therefore involves both restoration of OEM manual components and new K-swap-specific hardware.

19.2 Mechanical Conversion Requirements

19.2.1 Clutch Pedal and Brake Pedal Assembly

The automatic EF uses a wide brake pedal and no clutch pedal. Manual conversion requires:

- Manual clutch pedal assembly (EF, DA Integra, or aftermarket)
- Manual brake pedal (narrow type)
- Clutch master cylinder mounting and firewall drilling (if not pre-punched)
- Pushrod alignment and pedal travel adjustment

Note: Some EF chassis have factory clutch master cylinder indents; others require precision drilling and reinforcement during K-swap installation.

19.2.2 Shifter Box and Linkage

Automatic EF interiors do not have a factory manual shifter tunnel.

Requirements:

- Remove automatic shifter and linkage
- Block off unused auto shift cable holes
- Install K-series shifter plate (Hybrid Racing / K-Tuned)
- Install K-series shifter box and cables
- Reinforce floorpan around shifter mounting points

19.2.3 Transmission Mount and Subframe Differences

Automatic EF mounts differ from manual ones.

Required:

- Use full K-swap mount kit (Hasport EF-K2 or EF→EG/DC mounts)
- Remove OEM automatic gearbox brackets from frame
- Clean and seam seal unused holes

19.3 Electrical Conversion Requirements

19.3.1 Neutral Safety / Starter Interlock

Automatic EFs will not crank unless the neutral safety circuit is bypassed or converted.

To enable starting:

- Bridge the automatic neutral safety switch wires (factory method)
- Or wire neutral start logic into the K-series clutch switch

19.3.2 Reverse Light Wiring

Automatic shifter controls reverse lights via the gear selector assembly.

Manual K-series transmissions:

- Use a two-pin reverse switch on the gearbox
- Must be wired directly to EF reverse light circuit

19.3.3 Park Interlock and Auto Range Selector Removal

Automatic EF ignition cylinders include a "Park" release lock.
Required:

- Remove shift interlock cable
- Ensure ignition cylinder rotates freely

19.4 Interior Modifications

19.4.1 Pedal Box Installation

Install:

- Clutch pedal
- Manual brake pedal
- Clutch master cylinder
- Clutch pedal spring + stopper

19.4.2 Center Console and Shifter Trim

Automatic-car center consoles require trimming or replacement to fit:

- Manual shift boot
- K-series shifter assembly
- Cable routing into the floor

19.5 Fuel and Cooling System Differences

Automatic EF radiators may include an integrated ATF cooler.
Conversions require:

- Remove AT cooler lines
- Replace radiator with manual-style or K-series radiator

19.6 ECU and Harness Adjustments

19.6.1 EF Chassis Harness

Automatic EFs include additional wiring that is unused in manual K-swap configurations.
Required:

- Delete auto shift lock solenoid wiring
- Remove or tape off AT range selector connectors
- Convert reverse signal to K-series switch
- Integrate clutch safety switch (optional)

19.6.2 K-Series ECU (KPro) Requirements

Automatic EF cars do not affect K-series ECU behavior directly; however:

- Disable auto-transmission DTCs (if using CR-V ECU base)
- Enable "manual transmission mode" in KPro when applicable

19.7 AWD-Specific Considerations

The AWD drivetrain requires:

- Manual-style driveshaft tunnel (automatic does not assist)
- Custom shifter cable routing clear of tunnel reinforcement
- Rear diff wiring independent of auto harness removal

19.8 Summary

Converting an automatic EF chassis into a fully manual K24/K20 AWD configuration requires mechanical, electrical, and interior changes beyond the standard K-swap. These modifications allow proper clutch operation, safe starting logic, correct reverse light function, grounded shifter mounting, and complete manual drivability. With these components integrated, the former automatic EF chassis becomes fully compatible with the K-series AWD drivetrain and operates as a factory-style manual vehicle.

20 Clutch and Hydraulic System Requirements (DIY)

20.1 Overview

The K24/K20 hybrid paired with an AWD CR-V transmission requires a higher-capacity clutch and a properly matched hydraulic system to ensure consistent pedal feel, correct clutch engagement, and durability under track conditions. The EF Civic's OEM clutch hydraulics were designed for a D-series drivetrain and must be upgraded to support the K-series clutch pressure plate requirements.

20.2 System Architecture

The clutch system consists of:

- K-series clutch kit (pressure plate, disc, release bearing)
- K-series lightweight flywheel
- Clutch master cylinder (CMC)
- Slave cylinder (K-series compatible)
- Braided clutch line (EF-to-K conversion)
- Clutch pedal adjustment and return spring

20.3 Clutch Kit Requirements

20.3.1 Recommended Clutch Types

- **Stage 1 or Stage 2** organic for NA 300 hp setup
- **Stage 3 or Twin Disc** if future turbocharging is planned

20.3.2 Compatible Brands

- Competition Clutch
- Exedy Racing
- ACT
- Clutch Masters

20.3.3 Flywheel Specifications

- **8–12 lb lightweight flywheel** recommended for faster rev matching
- OEM K24 flywheel acceptable but heavier (not ideal for track)

20.4 Master Cylinder Requirements

20.4.1 EF Master Cylinder Limitations

The OEM EF CMC struggles with:

- higher pressure plate loads,
- inconsistent pedal feel,
- reduced fluid displacement.

20.4.2 Recommended Upgrade

- **Integra/DA or EM1 Civic Si (7/8" or 13/16")** clutch master cylinder
- Provides:
  * improved hydraulic leverage,
  * smoother pedal engagement,
  * more consistent clutch feel.

20.5 Slave Cylinder Requirements

Use a **K-series CR-V/RSX slave cylinder** to match the AWD transmission.

- Direct fit for K-series AWD gearbox
- Compatible with braided conversion lines

20.6 Clutch Line Routing

A braided stainless conversion line is required:

- Connects EF CMC to K-series slave cylinder
- Reduces fade and expansion
- Must route away from:
  * K-series header
  * radiator fan motors
  * AWD transfer case

20.7 Pedal Adjustment

Proper pedal setup ensures full clutch disengagement:

- Adjust pedal free play to 5–10 mm
- Verify full disengagement with engine running
- Ensure pedal returns smoothly via spring
- Over-adjustment may cause:
  * premature throwout bearing wear,
  * clutch slip at high RPM.

20.8 DIY Clutch System Cost Summary

Component	**DIY Cost (CAD)**	**Notes**
K-Series Clutch Kit (Stage 1–2)	$250–$450	300 hp NA setup
K-Series Flywheel (Lightweight)	$150–$350	8–12 lb
K-Series Slave Cylinder	$30–$60	CR-V/RSX
Upgraded Master Cylinder (7/8”)	$40–$80	DA/EM1
Braided K-Swap Clutch Line	$40–$70	Stainless, heat-resistant
Hardware + Banjo Bolts	$10–$20	For line + cylinder
Clutch Pedal Bushings	$10–$20	EF replacements
Total DIY Clutch System Cost	**$530–$1,050**	100% DIY installation

20.9 Installation Notes

- Bench-bleed master cylinder before installation.
- Avoid kinked clutch line routing near the transfer case.
- Confirm flywheel bolts are torqued to K-series spec (76 ft-lb).
- Ensure throwout bearing is fully seated on input shaft fork.
- Bleed system using gravity first, then pressure or pedal-assisted method.

20.10 Summary

A properly matched clutch and hydraulic system ensures consistent pedal feel, strong engagement, and long-term durability for the K24/K20 AWD EF platform. Upgrading the master cylinder, using a K-series slave, and installing a stainless clutch line are essential for reliable track and street performance.

21 Engine Mounting System and Engine Bay Integration (DIY Custom)

21.1 Overview

The K24/K20 AWD powertrain does not physically align with the EF Civic's factory mounting points. A custom mounting system is required to properly position the engine, transmission, and transfer case while maintaining correct driveline geometry. Engine bay integration must also account for clearance around the subframe, steering rack, radiator, exhaust, and AWD components.

21.2 Mounting System Architecture

The complete engine mounting system consists of:

- K-series swap mount kit (Hasport EF-K2 or EF→EG/DC conversion mount kit)
- Custom AWD-specific transmission mount trimming
- Reinforcement plates for subframe mounting areas
- Custom bracketry for:
  - transfer case clearance,
  - AWD transmission support,
  - exhaust/downpipe clearance.
- High-durometer or billet mount bushings

21.3 Mount Kit Options

21.3.1 Option A: Hasport EF-K2 Mount Kit (Direct Swap)

- Direct bolt-in for EF K-swaps (FWD originally)
- May require trimming to clear AWD transfer case
- Designed for stock EF subframe geometry

21.3.2 Option B: EF→EG/DC Subframe Conversion Mounts (Recommended)

- Allows more engine bay space
- Better downpipe and transfer case angles
- Compatible with traction bar systems

21.4 Custom Transmission Transfer Case Mounting

Because the CR-V AWD transmission is wider and angled differently, custom fabrication is required:

- Trim the EF passenger-side frame rail approximately 10–20 mm for case clearance.
- Weld 1/8"–3/16" plate reinforcement over trimmed areas.
- Space or notch Hasport transmission mount to clear AWD housing.
- Ensure mount location preserves:
  * correct axle centerline,
  * correct driveline angle,
  * proper subframe clearance.

21.5 Torque Mounting and Vibration Control

The AWD configuration increases drivetrain movement under load.

Required upgrades:

- 70A or 88A mount bushings (track use)
- Optional torque limiter or dogbone mount
- Additional chassis gusseting near passenger mount for rigidity

21.6 Engine Bay Clearance Requirements

21.6.1 Front Clearance

- Radiator must clear the header and transfer case.
- Slim fans recommended (2" or less).

21.6.2 Side Clearance

- Passenger frame rail must provide clearance for transfer case bulge.
- Intake routing must avoid brake master cylinder interference.

21.6.3 Rear Clearance

- Firewall may require:
  * minor hammering,
  * or a recessed firewall panel,
  * depending on K24 tall-deck manifold selection.

21.7 Subframe Reinforcement Requirements

Reinforcement plates should be added at:

- EF motor mount bracket welds
- Frame rail cut/relief areas
- Subframe-to-chassis bolts
- Traction bar mounting points

Recommended material:

- **1/8" (0.125")** mild steel for surface plating
- **3/16" (0.1875")** for high-torque load areas

21.8 Engine Mount Geometry and Alignment

Correct engine position is defined by:

- Axle centerline parallel to front hub height
- Engine tilt angle: 10–15° rearward (Honda specification)
- Transfer case level within 1–2° of driveshaft angle
- No metal-to-metal contact under:
  * engine torque load,
  * suspension compression,
  * braking dive.

21.9 DIY Mounting System Cost Summary

Component	DIY Cost (CAD)	Notes
Hasport EF-K2 Mount Kit	\$450–\$650	Direct EF K-swap
EF→EG/DC Conversion Mounts	\$350–\$550	Optional subframe swap
Steel Plate (1/8"–3/16")	\$20–\$40	For reinforcement
Cutting/Grinding Discs	\$10–\$20	Frame rail modification
Mount Bushings (70A/88A)	\$40–\$80	Polyurethane or billet
Custom Brackets Materials	\$20–\$40	For AWD-specific mounts
Hardware (Grade 10.9)	\$10–\$20	Engine + mount fasteners
Total DIY Mounting Cost	**\$900–\$1,400**	100% DIY fabrication

21.10 Installation Notes

- Always fit engine, transmission, and subframe together before final welding.
- Use a level to verify engine tilt and driveline angle before tightening mounts.
- Avoid excessive frame rail removal—strength must be retained with reinforcement plates.
- Confirm axle geometry after engine placement to prevent premature CV failure.

21.11 Summary

The engine mounting and integration system requires a combination of aftermarket mounts and custom fabrication to properly position the K24/K20 AWD powertrain in the EF chassis. Correct alignment, reinforced mount locations, and adequate clearance ensure long-term drivetrain reliability and serviceability for both street and track operation.

22 Fabrication Requirements

22.1 Driveshaft Tunnel Fabrication

- Remove OEM exhaust channel
- Cut floor from firewall to rear bulkhead
- Fabricate tunnel from 14–16 gauge steel
- Width: 4–4.5 in; Height: 3.5–4 in

22.2 Rear Differential Mount

- Remove spare tire well
- Build 3-point cradle from 3/16" plate
- Reinforce frame rails with 1/8" steel

22.3 Rear Suspension Modifications

- Modify EF trailing arms
- Fabricate toe/camber brackets
- Option: RT4WD arms

22.4 Driveshaft Fabrication

- CR-V front yoke
- 2.5" DOM tube, .083–.095 wall
- 6000–8000 RPM balance
- Spicer 1310 U-joints

23 Chassis Modifications

- Tunnel fabrication and reinforcement
- Transfer case crossmember trimming
- Fuel/brake line relocation
- Exhaust rerouting
- Trunk plating after diff install

24 Roll Cage Design, Standards, and Fabrication

24.1 Regulatory Compliance

The roll cage is designed as a competition-grade 12-point structure and follows the intent of the following rule sets:

- **FIA Appendix J, Article 253** – Safety Structures
- **SCCA GCR** – Roll Cage Specifications
- **NASA CCR Section 15** – Safety Equipment
- **CSCS / Gridlife HPDE+** – Local sanctioning body guidelines

24.2 Roll Cage Objectives

- Provide rollover and side-impact protection for both occupants.
- Significantly increase torsional rigidity for the AWD K-series powertrain.
- Tie the front, mid, and rear of the chassis into a single load path.
- Provide mounting structure for fixed-back seats, harnesses, and fire suppression.
- Package cleanly with the existing driveshaft tunnel and rear differential cradle.

24.3 Cage Configuration: 12-Point Competition Structure

The cage is specified as a **12-point weld-in multi-point cage** with twelve chassis pick-up points distributed across the front, center, and rear of the EF shell.

24.3.1 Primary Structural Elements

- **Main hoop** behind the front seats, following the B-pillars.
- **Roof halo** bar connecting the top of the A-pillars and main hoop.
- **A-pillar/front down tubes** landing near the front floor and rocker panels.
- **Rear backstays** running from the main hoop to the rear wheel arch / trunk area.
- **Roof V/X bracing** tying the halo and main hoop together as shown in the reference layout.
- **Front intrusion/forward braces** from the halo/A-pillar area toward the front strut tower region.
- **Harness bar** integrated into the main hoop at shoulder height.
- **Dash bar** tying the lower A-pillar tubes together behind the dashboard.

These elements together create twelve chassis anchoring points via foot plates and additional tie-ins at the front and rear structure.

24.3.2 Chassis Tie-In Strategy

- Main hoop feet tied into reinforced rocker and floor sections.
- A-pillar bases tied into front frame-rail/rocker junctions.
- Rear backstay feet landed on plated trunk/wheel arch areas above or adjacent to the differential cradle.
- Forward braces tied into front inner fender/strut tower structure (track-only configuration).

24.4 Material Specifications

24.4.1 Tubing Material

- **Primary choice:** DOM 1020/1026 mild steel (recommended for most series).
- **Alternative:** 4130 chromoly (requires TIG welding and controlled heat input; not always permitted without post-weld heat treatment).

24.4.2 Tubing Dimensions

For an EF chassis mass under 2500 lbs, the following meets FIA/SCCA-style requirements:

- **Main structural members (hoop, A-pillars, halo, backstays):** 1.50” OD x 0.095” wall DOM.
- **Secondary bracing (roof V/X, dash bar, harness bar, intrusion braces):** 1.25”–1.50” OD x 0.083”–0.095” wall DOM.

24.5 Fabrication Requirements

- Cage is fully **weld-in**; no bolt-in joints or slip joints.
- All tube junctions are fish-mouthed for 360° weld contact.
- Foot plates constructed from **3/16” (4.8 mm) steel**, minimum **20 cm^2** per pick-up point, with load spreading into the sill/floor.
- Weld processes: MIG or TIG for DOM; TIG preferred for 4130 with correct procedure.
- Cage must be fitted with the interior stripped and with final seat position set to ensure helmet and head clearance.

24.6 Integration With AWD Systems

- Rear backstays land on the trunk floor and wheel arch areas that have already been plated to support the differential cradle, creating a continuous load path from the rear drivetrain into the cage.
- The modified driveshaft tunnel is used as a reference for routing lower tubes and ensuring clearance for the shaft and exhaust.

– Harness bar height is set to maintain approximately 0–20° downward shoulder belt angle relative to the seat openings.
– Front intrusion/strut-tower braces reduce deflection at the front suspension pick-up points under braking and cornering.

24.7 Estimated Roll Cage Costs (12-Point)

Component / Service	**Shop Cost (CAD)**	**DIY Cost (CAD)**
DOM Tubing (40–60 ft)	\$350–\$600	\$350–\$600
Chromoly Tubing (optional)	\$600–\$900	\$600–\$900
12-Point Cage Fabrication (labour)	\$3,500–\$6,000	\$0
TIG/MIG Welding Labour (per hour)	\$90–\$130/hr	\$0
Coating/Paint	\$150–\$350	\$150–\$350
Total Estimated Cost	**\$4,000–\$7,500**	**\$500–\$1,250**
Total DIY Savings	**\$3,500–\$6,250 Saved**	

24.8 Summary

The 12-point competition cage transforms the EF chassis into a rigid, motorsport-capable shell. By tying the front structure, cabin, and rear differential cradle together, the cage is matched to the torque and grip levels expected from a 300 hp AWD K-series setup while being built to the intent of FIA/SCCA safety regulations.

24.9 Summary

The roll cage provides essential chassis rigidity and safety for AWD operation, meeting FIA/SCCA structural standards while supporting future power increases.

25 Engine Internal Torque Specifications (K-Series K24/K20 Hybrid)

25.1 Overview

This section summarizes the critical torque specifications required when assembling the K24/K20 "Frankenstein" engine, including cylinder head-to-block, main bearing caps, rod bolts, and valvetrain hardware. Values are based on typical OEM K20A2/K24A2 specifications and are provided for reference during engine assembly. Always verify against the factory service manual for the specific engine code and any aftermarket hardware manufacturer (e.g., ARP) documentation.

25.2 General Notes

– Many K-series fasteners (head bolts, rod bolts, main bolts) are **torque-to-yield** (angle torque). These are intended as **single-use** and should be replaced when rebuilding.

– When using ARP studs or aftermarket rod bolts, follow the **manufacturer's torque and lube instructions**, not the OEM values.
– All threads should be clean and lightly oiled unless otherwise specified.

25.3 Cylinder Head to Block

– **OEM head bolts (K20A2/K24A2 style):**
  * Step 1: 29 ft-lb (39 Nm) in the proper sequence.
  * Step 2: Tighten each bolt an additional 90°.
  * Step 3: Tighten each bolt a further 90° (second 90° on new bolts).
– **Head bolt pattern:** standard K-series criss-cross sequence (center outwards).

25.4 Main Bearing Cap / Bedplate Bolts

For the K-series lower block / main bearing girdle:

– Step 1: 18–22 ft-lb (25–29 Nm) in sequence.
– Step 2: Additional 56°–57° angle torque.

25.5 Connecting Rod Bolts (OEM)

Typical OEM K-series rod bolt torque:

– Step 1: 14 ft-lb (20 Nm).
– Step 2: Additional 90° angle torque.

25.6 Flywheel and Clutch

– Flywheel bolts: **76 ft-lb** (Honda spec, tighten in star pattern).
– Pressure plate bolts: **19 ft-lb**, tightened evenly in stages.

25.7 Cylinder Head Components and Valvetrain

25.7.1 Cam Cap / Cam Holder Bolts

K-series cam caps use two bolt sizes (M6 and M8):

– M8 cam cap bolts: **16 ft-lb** (22 Nm).
– M6 cam cap bolts: **8.7 ft-lb** (12 Nm).

25.7.2 Rocker / Lost Motion Assembly Hardware

– Rocker shaft / rocker assembly bolts: typically **16–18 ft-lb**.
– Always tighten in sequence from center outward to avoid warping the assembly.

25.7.3 Valve Cover and Ignition

- Valve cover nuts: **7–8 ft-lb** (hand snug + small turn).
- Coil pack hold-down bolts: **8–9 ft-lb**.
- Spark plugs: **13–15 ft-lb** with anti-seize used sparingly on threads.

25.8 Front Engine Components

- Crankshaft pulley bolt: **181 ft-lb** (requires crank holding tool).
- Timing chain tensioner mounting bolts: **8–9 ft-lb**.
- Timing chain guide bolts: **8–9 ft-lb**.

25.9 Oil System

- Oil pump mounting bolts: **8–9 ft-lb**.
- Oil pan bolts (upper steel pan): **8–9 ft-lb** in a criss-cross pattern.
- Drain plug: **29 ft-lb**.
- VTEC solenoid bolts: **8–9 ft-lb**.

25.10 Intake and Exhaust Manifolds

- Intake manifold nuts/bolts: **17–19 ft-lb**.
- Throttle body to manifold: **7–8 ft-lb**.
- Exhaust manifold / header nuts: **25–30 ft-lb**.

25.11 Summary

These engine internal torque values provide a baseline for assembling the K24/K20 hybrid long block and valvetrain. All critical fasteners should be torqued in the correct sequence using a calibrated torque wrench, and any torque-to-yield bolts should be replaced on rebuild. For ARP or other aftermarket hardware, always defer to the manufacturer's specified torque and lubricant procedure.

26 Engine Internal Torque Specifications (Complete Reference Table)

26.1 Overview

The following table summarizes all major torque specifications required for assembling the K24/K20 "Frankenstein" hybrid engine. This includes cylinder head, rotating assembly, valvetrain components, front engine accessories, oil system, sensors, and intake/exhaust hardware. **For all torque-to-yield bolts, follow the specified angle procedures. For ARP hardware, refer to the manufacturer's torque chart.**

26.2 Refer to Table for All Torque Values

All essential engine torque specifications are consolidated into the table below. These values should be used during all stages of long-block, valvetrain, and front-end assembly.

Component	Torque Spec	Notes
Cylinder Head / Block		
Head bolts (OEM)	29 ft-lb + 90° + 90°	Torque-to-yield, replace on rebuild
Head cover / valve cover nuts	7–8 ft-lb	Do not overtighten
Rotating Assembly		
Main bearing cap / bedplate	18–22 ft-lb + 56°	Torque-to-yield
Connecting rod bolts (OEM)	14 ft-lb + 90°	Torque-to-yield
Rod side bolts (K24 rods)	16 ft-lb	If applicable
Flywheel bolts	76 ft-lb	OEM Honda spec
Pressure plate bolts	19 ft-lb	Tighten evenly
Valvetrain / Timing System		
Cam cap bolts (M8)	16 ft-lb	
Cam cap bolts (M6)	8.7 ft-lb	
Rocker assembly bolts	16–18 ft-lb	Center-out torque pattern
Timing chain tensioner bolts	8–9 ft-lb	
Timing chain guide bolts	8–9 ft-lb	
Front Engine Components		
Crankshaft pulley bolt	181 ft-lb	Requires holding tool
Water pump pulley bolts	8–9 ft-lb	
Alternator mounting bolts	33–38 ft-lb	
Belt tensioner bolts	16–22 ft-lb	
Oil System		
Oil pump mounting bolts	8–9 ft-lb	
Oil pan bolts (upper/steel)	8–9 ft-lb	Criss-cross pattern
Drain plug	29 ft-lb	
VTEC solenoid bolts	8–9 ft-lb	
Oil filter housing bolts	20–22 ft-lb	K24 style housing
Oil cooler housing bolts	16–18 ft-lb	If equipped
Piston oil jet (cooling nozzle) bolts	8–9 ft-lb	Critical for reliability
Cooling System		
Thermostat housing bolts	8–9 ft-lb	
Water pump housing bolts	9 ft-lb	
Intake / Exhaust		
Intake manifold bolts	17–19 ft-lb	
Intake support bracket (block side)	33 ft-lb	
Intake support bracket (manifold side)	22 ft-lb	
Throttle body bolts	7–8 ft-lb	
Exhaust manifold nuts	25–30 ft-lb	
Ignition / Sensors		
Spark plugs	13–15 ft-lb	Light anti-seize
Coil pack bolts	8–9 ft-lb	
Knock sensor	17–18 ft-lb	Fragile—do not overtighten
Crank position sensor (CKP) bolt	8–9 ft-lb	
Cam position sensor (CMP) bolt	8–9 ft-lb	
Fuel System		
Fuel rail bolts	12 ft-lb	
Injector retainer bolts	8–9 ft-lb	
Starter / Misc.		
Starter mounting bolts	33 ft-lb	AWD CR-V transmission compatible
Engine mount bracket bolts (block side)	40–43 ft-lb	Not mount-kit bolts

Table 1: Complete Torque Specifications for K24/K20 Hybrid Engine Assembly

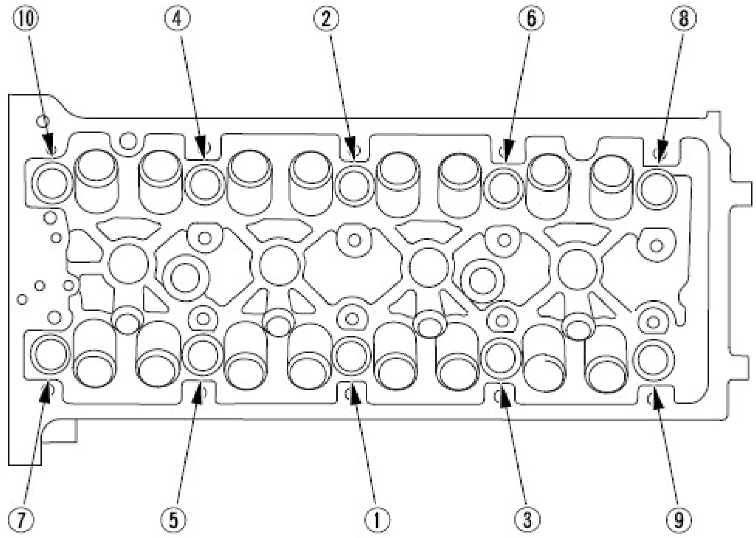

Figure 1: K20/K24 Cylinder Head Bolt Torque Sequence (OEM Pattern)

27 Engine Management and ECU Strategy

27.1 ECU Selection

To properly control the K24/K20 hybrid in an EF chassis and support future power increases, this build uses a reprogrammable factory ECU:

- **ECU:** Honda K20A2 / RSX Type-S PRB ECU
- **Tuning Solution:** Hondata KPro (V4 or newer)

The PRB ECU with KPro provides:

- Full control of fuel and ignition tables for the K24/K20 hybrid.
- Adjustable VTEC crossover and VTC cam advance.
- Support for larger injectors and higher rev limits.
- Built-in data logging, knock feedback, and protection strategies.
- Immobilizer delete, enabling use in a swapped EF chassis.

27.2 Required Engine Management Components

The following components are required to implement the KPro-based engine management system:

- PRB ECU (K20A2 / RSX Type-S).
- Hondata KPro board, installation, and software license.
- K-series engine harness (RSX/EP3 style or tucked K-swap harness).

- EF-to-K-series chassis conversion harness.
- Wideband O_2 controller and sensor for tuning (e.g., 0–5 V analog output to ECU).
- High-impedance injectors sized for the 300 hp goal (with published flow and dead-time data).
- 3 bar or 4 bar MAP sensor (optional, but recommended for future forced induction).
- Intake air temperature (IAT) sensor located in the intake tract.

27.3 ECU Cost Summary

Item	**Estimated Cost (CAD)**	**Notes**
Used PRB ECU (K20A2/Type-S)	\$350–\$600	Core ECU to modify
Hondata KPro (board + license)	\$1,000–\$1,400	Includes USB + software
K-swap / RSX Engine Harness	\$300–\$600	New or used
EF Chassis Conversion Harness	\$250–\$450	Plug-and-play adapter
Wideband O_2 Kit	\$250–\$450	Gauge + controller + sensor
Upgraded Injectors	\$300–\$600	Flow-matched set
Dyno Tuning Session	\$600–\$1,000	3–5 hours, pro tuner
Total ECU & Tuning Cost	**\$3,050–\$5,100**	Excluding future turbo support

27.4 Tuning Requirements for the K24/K20 Hybrid

The following parameters must be calibrated for safe and reliable operation of the K24/K20 engine:

27.4.1 Fuel System Calibration

- Input correct injector size, dead-times, and fuel pressure into KPro.
- Calibrate fuel tables (low and high cam) for safe air–fuel ratios at idle, cruise, and wide-open throttle.
- Verify short-term and long-term fuel trims during part-throttle operation.

27.4.2 Ignition and Knock Control

- Adjust ignition timing maps for the higher displacement and compression of the K24 bottom end.
- Use conservative timing on pump fuel, targeting safe knock sensor activity under full load.
- Establish separate low-cam and high-cam timing strategies for smooth VTEC transition.

27.4.3 VTEC and VTC Configuration

- Set VTEC engagement based on camshaft profile (typically 4,500–5,500 rpm for NA track use).

- Limit VTC cam advance to a safe value (e.g., 40° or tuner's recommendation) to prevent piston-to-valve contact.
- Blend fuel and ignition maps around VTEC crossover to avoid torque dip.

27.4.4 Rev Limit, Idle, and Protection

- Set rev limit in line with the valvetrain and rod/piston choice (e.g., 8,200–8,600 rpm for forged components).
- Configure idle speed and cold-start enrichment for track and street drivability.
- Configure fan control temperatures and overheat protection strategies.

27.4.5 Data Logging and Verification

- Log coolant temperature, intake air temperature, knock count, AFR, and cam angle during shakedown.
- Verify there is no detonation under sustained high-load track operation.
- Record baseline power curves for future comparison when adding forced induction.

27.5 Summary

Using a PRB ECU converted to KPro provides a tunable, OEM-based engine management solution that is proven for K24/K20 hybrid builds. Proper calibration of fuel, ignition, VTEC, and protection strategies is essential to safely achieving the 300 hp crank target and preparing the platform for future turbocharging.

28 Required Bolt-On Components

28.1 Engine and Swap Components

- Hasport EF K-swap mount kit
- K-swap axles
- Conversion harness + fuel system
- KPro/Ktuner ECU

29 Cost Overview

29.1 Cost Breakdown Table

Subsystem	Parts Cost (CAD)	Machine Shop Cost	DIY Cost
K24/K20 Engine Assembly	$1500–$2500	$150–$300	$0
CR-V AWD Transmission	$800–$1400	$100–$200	$0
Billet Spool + LSD	$1300–$2000	$0	$0
Transmission Rebuild	$150–$300	$100–$200	$0
Rear Differential	$200–$400	$0	$0
Custom Driveshaft	$100–$200	$300–$500	$0
Tunnel Steel	$150–$300	$0	$150–$300
Diff Cradle Steel	$100–$250	$0	$150–$300
Suspension Components	$800–$1600	$0	$0
Brake Upgrades	$250–$400	$0	$0
Turbo System (optional)	$1800–$3000	$0	$0
Cooling Systems	$400–$800	$0	$0
Welding Consumables	$150–$300	$0	$150–$300
Chassis Reinforcement	$200–$400	$0	$200–$400
Total Cost	$8,500–$16,000	$650–$1200	$700–$1,300

29.2 DIY Savings Summary

- Tunnel fab saves $800–$1500
- Diff cradle saves $1500–$3000
- Chassis reinforcement saves $800–$1500

30 Conclusion

Building an AWD K24/K20 EF Civic is not just a mechanical project—it becomes a long, messy, frustrating, addictive, and strangely rewarding engineering journey. Nothing about this swap is simple. Nothing about it is "bolt-on." Every subsystem touches another, and every change you make ripples through the rest of the car. It is a project that forces patience, precision, and a lot of problem-solving improvisation.

This document presents the technical backbone of the build: the fabrication strategy, torque references, driveline geometry, electrical integration, safety structure, and fluids. But the reality behind the numbers is that this conversion demands the builder to constantly adapt. Panels never line up perfectly on the first try. Angles get re-measured. Welds get cut out and redone. Parts arrive late. Something always leaks the first time you fill it. In other words: it behaves exactly like a real project—not a theoretical one.

Realistic Timeline

Completing this entirely as a DIY operation (weekends, late nights, and whatever time is left after work or school), the timeline stretches quickly. Some weeks you make huge progress;

others you spend two hours staring at the car trying to figure out why something won't clear.

A realistic schedule looks like this:

- **Chassis prep and reinforcement:** 3–5 weeks
- **Tunnel fabrication + diff cradle:** 4–7 weeks
- **Engine assembly and long-block build:** 2–4 weeks
- **Subframe, mounts, and transfer case fitting:** 2–3 weeks
- **Suspension + brakes + rear geometry setup:** 1–2 weeks
- **Fuel, cooling, intake, throttle:** 1–2 weeks
- **Wiring, ECU, sensors, troubleshooting:** 1–3 weeks
- **Final assembly + torque verification + fluids:** 1–2 weeks
- **First startup + debugging + pre-tune fixes:** 1–2 weeks

Some steps move fast; others fight you the entire way.

A realistic, normal timeline: 4–6 months of steady DIY work.

Budget Reality

The financial side behaves the same way the build does—predictable at the start, chaotic near the end. Parts add up, but so do the small things: another box of welding wire, a new cutoff wheel, a sensor you forgot existed, bolts you snapped, replacement hoses, fluids you drained twice, and tools you didn't know you needed.

A grounded budget range:

- **Core parts + AWD components:** $8,500–$16,000 CAD
- **Fabrication materials (DIY):** $600–$1,300 CAD
- **Engine internals, seals, fluids:** $600–$1,200 CAD
- **Random hardware, tools, "forgotten stuff":** $500–$1,000 CAD

Total real-world DIY cost: $10,000–$19,500 CAD.

It can be done cheaper, but rarely. It can be done more expensively, very easily.

Final Thoughts

This build pushes the EF platform into territory Honda never intended it to reach. When it finally comes together—when the driveshaft spins smoothly, the engine idles clean, and the rear differential actually pulls the chassis forward—it becomes something special. It feels engineered. Earned. Built, not bought.

And although this document outlines the technical requirements with precision, the project itself thrives on perseverance, iteration, and the willingness to re-do things until they are right. That is the true nature of an AWD K24/K20 EF Civic conversion.

With enough time, patience, and stubbornness, this project becomes completely achievable—typically over a 4 to 6 month DIY timeline with a total investment of roughly $10k–$20k CAD.