ENGINEERING SPECIFICATION DOCUMENT

EF/EK Civic AWD Time Attack Program

Master Engineering Summary & Technical Architecture

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Contents

1 Executive Summary

This Master Engineering Summary defines the complete technical architecture, validation strategy, and subsystem integration for the EF/EK Civic AWD Time Attack Program. It consolidates the content of all detailed subsystem documents—mechanical, electrical, safety, chassis, aero, interior, and branding—into a single high-level reference.

The purpose of this document is to:

- Present a unified, top-level engineering overview of the full vehicle program.
- Explain the intent, constraints, and performance goals of the AWD K-series–powered EF/EK platform.
- Provide cross-references to all subsystem specification documents produced in the program.
- Enable a fabricator, engineer, or technical partner to understand the project scope without reading every detailed document.

This document is not meant to replace the subsystem specifications; rather, it serves as an entry point that describes the entire vehicle system, its engineering philosophy, and where to find deeper information.

2 Program Overview

2.1 Vehicle Concept

The EF/EK Civic AWD Time Attack Program is a high-performance experimental platform built around:

- A K24/K20 Frankenstein hybrid engine (K20 head on K24 block).
- Honda CR-V AWD drivetrain adapted to EF/EK chassis geometry.
- Custom front and rear CV axles.
- A two-piece custom driveshaft (for realistic home-built alignment).
- A full 12-point chassis-integrated roll cage.
- A competitive time-attack-oriented suspension and aero package.

The car is intended for:

- Track days and time attack events,
- Aggressive driving with sustained high-G cornering,
- Reliable operation with cooling, braking, and safety performance prioritized over peak horsepower,
- Future expansion to forced induction.

2.2 Engineering Philosophy

The project follows three guiding principles:

1. **Reliability First** — thermal management, oiling, brakes, and structural integrity are prioritized above peak power.
2. **Modularity** — each subsystem can evolve independently (engine, drivetrain, aero, electrical, interior).

3. **Documentation-Driven** — every major system is recorded in its own engineering specification file to enable recreating the build.

2.3 Subsystem Reference Map

Each subsystem is documented in its own dedicated specification document. This Master Summary references the following documents:

- **Rear Differential Cradle & Axle Integration** (Honda Civic EF with CR-V AWD Drivetrain)
- **Front CV Axle Integration** (EF Civic & CR-V K-Series AWD Transmission)
- **AWD Driveshaft Specification** (EK Civic with CR-V AWD Drivetrain)
- **K24/K20 Frankenstein Hybrid Engine — Long Block Specification**
- **Chassis, Suspension & Alignment Specification** (EF/EK Time Attack Program)
- **K-Series Wiring, ECU Integration & F1-Style Start System**
- **Aero Package & Bodywork Specification** (Time Attack Program)
- **Safety, 12-Point Cage, Seating & Fire System Specification**
- **Interior, Brand Identity & Livery Specification**
- **Digital Instrument Cluster Development Program**

These documents together form the complete engineering record for the project.

2.4 Program Status

- **Design Phase:** 75–80% complete.
- **Fabrication Readiness:** Subsystems fully specified; measurements pending installation.
- **Risk Areas:** Axle length optimization, cooling system under track heat load, and drivetrain NVH tuning.
- **Next Stages:** Fabrication sequencing, mock-ups, tolerances, real-world testing.

2.5 Intended Outcome

When complete, the EF/EK AWD platform should behave as:

- A lightweight, corner-speed-focused time-attack chassis,
- With predictable AWD behavior via CR-V diff/t-case ratio matching,
- Moderately powered (200–300hp NA/turbo) but extremely high grip,
- With strong branding and professional presentation for sponsorship and documentation.

The ultimate goal is to create a fully engineered, fully documented race-development platform that helps advance the driver's personal motorsport portfolio and supports future automotive engineering aspirations.

3 Drivetrain Systems Overview

The AWD system is based on adapting the Honda CR-V K-series AWD drivetrain to the EF/EK Civic platform. The system consists of four major driveline subassemblies:

1. Rear Differential Cradle & Rear CV Axle Integration
2. Front CV Axle Integration (K-series AWD transmission)

3. Center Driveshaft Assembly (two-piece with CSB)
4. Transfer Case Output + Driveline Geometry

Each subsystem is fully documented in its own engineering specification document, with this section providing the high-level architecture and integration logic for the AWD conversion.

3.1 Rear Differential Cradle & Axle Integration

Referenced Document: *Rear Differential Cradle & Axle Integration — Honda Civic EF (1988–1991) with Honda CR-V AWD Drivetrain*

Purpose

The rear cradle serves as the structural interface between the CR-V rear differential and the EF chassis. It ensures correct pinion angle, axle geometry, and diff rigidity under track loads.

Key Features

- Fully custom cradle designed around CR-V rear differential dimensions.
- Reinforced mounting points tied into EF chassis longitudinal rails.
- Adjustable diff height and pinion angle (shim-based) for fine NVH control.
- Rear CV axles sized for correct plunge, compression, and articulation.

Engineering Notes

- Track loads demand stiff diff mounting to avoid wheel-hop and driveline shock.
- Pinion angle must be matched with driveshaft output angle for minimal vibration.
- Axle length selection is critical; documented values are based on mock-ups.

3.2 Front CV Axle Integration

Referenced Document: *Front CV Axle Integration — Honda Civic EF (1988–1991) & CR-V K-Series AWD Transmission*

Purpose

Defines the front axle solution for mating EF Civic front hub geometry with the longer, AWD-specific CR-V K-series transmission output shafts.

Key Features

- Hybrid axle setup using OEM Honda outer joints for EF geometry.
- CR-V inner CV joints for compatibility with AWD transmission.
- Accurate axle length determination based on knuckle, hub, and engine placement.

Engineering Notes

- A strong focus on plunge distance ensures suspension travel without bind.
- Hybrid CV design allows serviceability using off-the-shelf components.
- Required measurements for axle fabrication are noted in the dedicated document.

3.3 AWD Center Driveshaft Assembly

Referenced Document: *AWD Driveshaft Specification — Honda Civic EK (1996–2000) with Honda CR-V AWD Drivetrain*

Purpose

Provides the torque link between the transfer case and rear differential. A two-piece system is selected for realistic alignment tolerances and improved critical speed.

Key Features

- Two-piece driveshaft with center support bearing (CSB).
- Custom tube diameters and lengths based on vehicle wheelbase.
- Front and rear flanges matched to CR-V transmission & differential.
- Designed for high RPM stability and minimal NVH.

Why Two-Piece?

- EF/EK wheelbase too long for a vibration-free one-piece shaft without perfect jigging.
- Allows vertical and lateral adjustment via CSB shims.
- Greatly increases critical speed margin.

3.4 Transfer Case Output & Driveline Geometry

Overview

The CR-V AWD transmission outputs torque rearward via a fixed flange. Proper angular alignment across three points is required:

1. Transmission output flange
2. CSB driveshaft midpoint
3. Rear differential input flange

Key Geometry Constraints

- Working U-joint/CV angles must remain within 0.5°–3° at ride height.
- Transmission and differential must be parallel in pitch.
- Lateral offset should be minimized and corrected with CSB position.

Integration Considerations

- Engine and transmission mount position directly influence front axle length.
- Diff cradle determines rear axle symmetry and pinion angle.
- Driveshaft design ties both halves together; incorrect geometry anywhere causes NVH.

3.5 Drivetrain System Validation

Static Validation

- Confirm all flange measurements and bolt patterns.
- Ensure axles achieve full suspension travel without bind.
- Verify diff and driveshaft angles match documented targets.

Dynamic Validation

- Low-speed driveline shakedown to detect knocking or vibration.
- Medium-speed tests to evaluate CSB alignment and preload.
- High-speed/track testing to evaluate axle temperature, NVH, and plunge.

Failure Modes to Monitor

- Premature axle boot tearing (excessive angle or plunge).
- Vibration above 80–120 km/h (CSB height or diff angle mismatch).
- Diff cradle deflection under torque.

4 Engine Systems Overview

The powerplant for the EF/EK AWD Time Attack Program is a K24/K20 hybrid commonly referred to as the "Frankenstein" configuration: a high-flow K20A2/K20Z1 VTEC cylinder head on a high-torque K24 block. The full long-block details are captured in the dedicated specification document:

K24/K20 Frankenstein Hybrid Engine — Long Block Engineering Specification

This section summarizes the engineering intent and key subsystem interactions.

4.1 Engine Architecture Summary

Core Configuration

- **Block:** K24A2 (TSX) bottom end for long-stroke torque.
- **Head:** K20A2/K20Z1 VTEC head for superior high-RPM flow.
- **Displacement:** 2.4L
- **Intended Output:** 220–260 hp NA, 300–400+ hp turbo (future).

Why This Hybrid Works

- K24 block offers significantly stronger midrange torque.
- K20 head dramatically improves top-end horsepower potential.
- Ideal for time attack where corner exit torque and sustained power matter.

4.2 Long Block Mechanical Integration

Block–Head Interface

- MLS head gasket sized for 87–88 mm bore.
- Oil feed alignment for K20 VTEC system provided by correct gasket selection.
- Rear oil ports must be plugged or restricted (machine shop documented).

Pistons & Rods

- OEM or forged pistons depending on NA vs turbo.
- Forged rods recommended for future boost.
- Compression ratio tuned via piston dome and gasket thickness.

Timing System

- K20 chain, guides, tensioner.
- K24 crank gear retained for compatibility.
- Cam degreeing optional for precision powerband control.

4.3 Oiling System

Pump & Conversion

- K20A2 oil pump conversion eliminates balance shafts.
- Provides higher-RPM oiling stability for track use.

Oil Flow Control

- Windage tray and baffled pan recommended for high-G corners.
- Critical for AWD time attack where grip is very high.

Pressure Targets

- Idle hot: 20–30 psi.
- High RPM: 70–80 psi depending on bearing clearances.

4.4 Cooling System

Hybrid Cooling

- K24 water pump housing + K20 head compatibility confirmed.
- Some small coolant ports must be checked for mismatch (documented with gasket overlay).

Track Cooling Requirements

- Large aluminum radiator with dual fans.
- Possible oil cooler integration for sustained high duty.
- Bleed points added for simple air removal after service.

4.5 Intake, Exhaust & Airflow

Intake Manifold Strategy

- RBC/RRC intake manifold recommended for NA builds.
- Potential transition to ITBs for future race configuration.

Exhaust Header

- K20A2 port spacing matched.
- 4-2-1 layout for midrange torque or 4-1 for top-end power.

Airflow Notes

- Head flow supports 8500+ rpm with correct springs.
- Mild bowl porting optional for additional efficiency.

4.6 Fuel System

Injectors

- 300–550 cc/min NA.
- 750–1300 cc/min turbo.

Fuel Delivery Hardware

- High-flow pump (255 lph+).
- Return-style regulator recommended.
- K-series compatible rail.

4.7 Ignition System

- K-series coil-on-plug ignition.
- One or two steps colder spark plugs for boosted application.

- Proper grounding and power distribution documented in electrical spec.

4.8 ECU & Tuning

Referenced Document: *K-Series Wiring, ECU Integration & F1-Style Start System*

ECU Requirements

- Hondata K-Pro or comparable standalone.
- Supports hybrid crank/cam patterns.
- Full fuel/ignition table control.

Base Tuning Targets (NA)

- Idle: 750–950 rpm, lambda 1.0.
- WOT: lambda 0.86–0.90.
- VTEC crossover: 4500–5200 rpm initial.

Boosted Considerations

- Conservative ignition timing.
- Richer mixture (0.78–0.82 lambda).
- IAT monitoring critical.

4.9 Engine System Validation

Static Validation

- Compression test and leak-down.
- Check oil pressure via priming before first fire.
- Verify timing marks and chain tension.

Dynamic Validation

- First fire: 2000–3000 rpm for oiling and ring seating.
- Monitor for leaks, chain noise, misfires.

Post-Break-In

- Oil change after 50–100 km.
- Recheck valve lash.
- Re-torque exhaust and intake fasteners.

5 Electrical Systems Overview

The electrical architecture is designed for reliability, serviceability, and motorsport functionality while maintaining OEM-level neatness. The system integrates:

- Hondata K-Pro engine management,
- A custom power distribution layout,
- An F1-style ignition/start system,
- Full chassis rewiring where necessary,
- A custom TFT digital instrument cluster.

Full subsystem detail is captured in:

K-Series Wiring, ECU Integration & F1-Style Start System Digital Instrument Cluster Development Program

This section summarizes the high-level logic and integration strategy.

5.1 ECU Integration (Hondata K-Pro)

ECU Requirements

- Full control of hybrid crank/cam signals (K24 block + K20 head).
- VTEC engagement logic.
- MAP-sensor–based fueling and boost control.
- Fan control, idle control, datalogging.

Required Sensors

- Crank position (K24 block sensor).
- Intake air temperature (IAT).
- Engine coolant temperature (ECT).
- MAP sensor (1–4 bar).
- Secondary wideband O2 for tuning.
- Oil pressure sensor (recommended for track safety).

Wiring Notes

- All sensor grounds should return to ECU sensor-ground pins.
- Shielded wiring recommended for crank/cam signals.
- ECU receives dedicated, fused power from the power distribution block.

5.2 Power Distribution Architecture

Overview

To support reliable operation under race vibration and heat, the electrical system uses a simplified, motorsport-style layout:

- Single main battery feed to distribution block.

- Individual fused circuits for:
  - ECU,
  - Fuel pump,
  - Ignition coils,
  - Starter relay,
  - Digital dash,
  - Fans and auxiliaries.
- Relays actuated by the F1-style switch panel.

Ground Strategy

- Engine block → chassis ground strap.
- Battery → chassis.
- Dash electronics → isolated ground bus.

5.3 F1-Style Switch Panel & Start System

System Purpose

Replaces the OEM ignition key with a race-style armed start sequence for:

- Driver engagement,
- Improved serviceability,
- Enhanced safety,
- Simplified wiring.

Switch Functions

- **MASTER POWER** — main battery relay / kills all circuits.
- **IGNITION** — powers ECU, coils, sensors.
- **FUEL PUMP** — activates pump independently for priming/testing.
- **START BUTTON** — triggers starter relay once ignition is armed.

Wiring Logic Overview

1. MASTER switch sends power to the accessory bus + ECU relay.
2. IGNITION switch energizes ECU, injectors, coils, and dash.
3. FUEL switch primes pump (relay controlled).
4. START button sends signal to starter relay → starter motor.

Safety Note

- MASTER switch must immediately disconnect alternator charge path.
- Switch panel is mounted within easy reach of driver per safety spec.

5.4 Digital Instrument Cluster System

Referenced Document: *Digital Instrument Cluster Development Program*

Purpose

The cluster is a custom TFT display providing real-time engine and vehicle telemetry in a race-focused layout.

Key Functions

- RPM, speed, coolant temp, oil pressure, IAT.
- Boost/vacuum (if turbocharged).
- Warning lights for oil pressure, coolant temp, battery voltage.
- Shift lights (programmable).
- Start-up screen with vehicle branding (kevxzr).

Input Sources

- CAN or analog ECU outputs depending on configuration.
- Dedicated sensors for oil pressure/temperature if required.

Housing & Mounting

- Custom 3D-printed or aluminum enclosure.
- Mounted to steering column or dash bar depending on cage layout.
- Designed to appear OEM+ while matching the overall interior theme.

5.5 Electrical System Validation

Static Tests

- Verify all circuits draw expected current.
- Confirm sensor readings in ECU and digital dash.
- Check grounding continuity and voltage drop.

Dynamic Tests

- First-start sequence validation with F1 panel.
- Confirm fan trigger, VTEC engagement, and fuel pump duty.
- Shake/vibration test on wiring looms.

Failure Modes

- Poor grounds → erratic sensors.
- Overheating relays → intermittent pump/ignition issues.
- TFT display washout if cooling airflow is insufficient.

6 Chassis, Suspension & Alignment Systems

This section summarizes the complete mechanical foundation of the EF/EK Time Attack Program. While the detailed, subsystem-level design is documented in:

EF/EK Civic Time Attack Program — Chassis, Suspension & Alignment Specification

this master summary outlines the performance intent, geometry philosophy, and integration considerations for the AWD conversion.

6.1 Chassis Overview

Platform Basis

- EF/EK Civic platform, modified for AWD and time attack use.
- Seam welding recommended in high-stress areas.
- Integration with 12-point cage for stiffness and crash protection.

Chassis Objectives

- High cornering grip capability.
- Predictable transient response.
- Stability at 150–200 km/h.
- Compatibility with aero loading from front splitter, rear wing, and diffuser.

6.2 Suspension Architecture

Front Suspension

- Double-wishbone EF/EK geometry retained.
- Adjustable camber via upper ball joints or top mounts.
- Increased caster for straight-line stability under aero load.
- Roll center correction required for lowered ride height.

Rear Suspension

- Multi-link/Trailing arm setup depending on EF/EK chassis generation.
- Rear diff cradle integrated without compromising suspension kinematics.
- Adjustable toe links recommended for track alignment.

Shock/Coilover Selection

- 2-way adjustable dampers minimum.
- 3-way recommended for advanced tuning under aero load.
- Spring rates selected based on AWD weight distribution and aero package.

6.3 Bushings & Joints

- Polyurethane or spherical bearings in high-load areas.
- Spherical rear trailing arm bushings recommended for precision.
- Rubber retained in select locations for NVH moderation if street-driven.

6.4 Alignment Targets

Front Axle (Time Attack Baseline)

- Camber: $-3.0°$ to $-4.0°$
- Caster: $+5.5°$ to $+7.0°$
- Toe: 0 to slight toe-out (0 to 1–2 mm)

Rear Axle (AWD Stability Focused)

- Camber: $-1.0°$ to $-2.0°$
- Toe: slight toe-in (1–2 mm)

Notes

- Increased caster improves steering feel and mid-corner stability.
- Rear toe-in maintains AWD stability under power.
- Values adjusted depending on aero load and tire construction.

6.5 Roll Center & Suspension Geometry

Lowered time attack cars often suffer from:

- Excessively low roll center,
- Increased bump-steer,
- Poor camber gain,
- Roll moment mismatch front vs rear.

To correct this:

- Front roll center correction kit recommended.
- Adjustable ball joints or extended top hats used to recover droop.
- Rear roll center adjusted via custom subframe/diff cradle height.

6.6 Tires & Wheels

Tire Selection

- 200TW semi-slicks recommended (A052, RT660, AR-1).
- Track compound slicks optional depending on regulations.

Wheel Specs

- 15–17 inch depending on brake setup.
- Width: 8–9.5 inches recommended.
- Offset tuned for scrub radius and fender clearance.

Heat Notes

- AWD time attack will generate very high tire temperatures.
- Tire pressure monitoring recommended.
- Surface temps guide camber/toe adjustments.

6.7 Brake System

- Big brake kit (BBK) recommended due to AWD cornering speeds.
- Track pads, high-temp fluid, and stainless lines required.
- Brake cooling ducts recommended for front brakes.

Bias Notes

- Slightly forward-biased brake balance improves rotation.
- AWD distributes load, so overheating rear brakes is less likely.

6.8 Steering System

- Quick-ratio rack optional for tighter tracks.
- Steering angle mods not required for time attack.
- Steering column integrated with digital dash mount and cage dash bar.

6.9 Chassis System Validation

Static Checks

- Ride height, droop, and bump measurements.
- Corner balance with driver weight.
- Verify full suspension travel without interference.

Dynamic Validation

- Slow-speed steering response.
- Medium-speed rotation on sweepers.
- High-speed stability under aero load.

Failure Modes

- Overheating brakes from repeated laps.
- Tire blistering due to high AWD cornering loads.
- Bump-steer from incorrect roll center correction.

7 Aero Package & Bodywork

The EF/EK Time Attack Program utilizes a custom, functional aero package designed to maximize mechanical grip and stability. While the full details are captured in:

EF/EK Civic Time Attack Program — Aero Package & Bodywork Specification

this section summarizes the aerodynamic philosophy, major components, and bodywork integration strategy.

7.1 Aero Philosophy

The aero package is built around three primary goals:

1. **High cornering efficiency** — maximize front downforce without inducing excessive drag.
2. **Stability under braking and high-speed load** — aero should complement suspension tuning, not fight it.
3. **Balanced platform behavior** — front/rear downforce distribution must match spring rate, damping, and AWD characteristics.

The resulting design is functional rather than cosmetic, with custom bodywork that reflects the project's brand identity while remaining performance driven.

7.2 Front Aero System

Front Splitter

- Full-width, chassis-mounted splitter.
- Designed to hold downforce independent of bumper flex.
- Endplates integrated to guide airflow around front wheels.

Front Bumper (Custom)

- Enlarged radiator opening for improved cooling.
- Integrated ducting to front brake cooling channels.
- Sculpted to match the Koi-inspired livery bodylines.
- Optional canards depending on track needs.

Cooling System Aerodynamics

- Ducting routes fresh air directly through radiator.
- Hot air extraction paths minimized for under-hood pressure buildup.
- Optional hood vents integrated for improved engine bay temperature management.

7.3 Side Aero Elements

- Side skirts to control underbody airflow and improve diffuser efficiency.
- Designed to visually match the asymmetrical Koi-themed livery.
- Optional vortex generators for high-speed stability depending on track.

7.4 Rear Aero System

Rear Wing

- Single-plane or dual-element wing options.
- Mounted to chassis or hatch reinforcement plates.
- Adjustable angle-of-attack for balance with front splitter loads.

Rear Diffuser

- Full-length functional diffuser.
- Reduced turbulence behind AWD rear differential.
- Integrated strakes to stabilize airflow.

Rear Bumper (Custom)

- Designed around diffuser exit.
- Integrated cutouts for thermal management.
- Compatible with asymmetrical livery lines.

7.5 Bodywork & Brand Integration

Custom bodywork is shaped to enhance performance while maintaining a unique identity consistent with the vehicle's Koi-inspired aesthetic.

Branding Notes

- Koi theme subtly influences bumper contours, vent shapes, and line directionality.
- Colors align with kevxzr brand identity (blue/white variations).
- Asymmetrical layout nods to Japanese time attack styling.

Functional Considerations

- All bodywork designed to clear AWD components (diff, axles, driveshaft).
- Front and rear bumpers include provisions for quick removal.
- Venting locations are chosen based on thermal flow analysis.

7.6 Aero Validation

Static Checks

- Verify chassis splitter mounts for rigidity.
- Inspect wing mounts for deflection under load.
- Confirm no interference between undertray/diffuser and driveshaft.

Dynamic Evaluation

- High-speed stability tests at 120–180 km/h.
- Medium-speed cornering evaluation for balance.
- Brake-zone stability checks with aero load.

Failure Modes

- Front splitter deflection reducing downforce.
- Rear wing oscillation under vibration.
- Diffuser stall if ride height varies excessively.

8 Safety Systems

The EF/EK Time Attack Program incorporates a full motorsport-grade safety package designed to meet or exceed typical time attack, track day, and club racing standards. Full details are provided in:

Safety, 12-Point Cage, Seating & Fire System Specification

This master summary outlines the core safety philosophy and the integration of safety-critical components across the chassis and cockpit.

8.1 Safety Philosophy

The vehicle is built around the principle that:

Driver survivability and chassis integrity take priority over power and speed.

The safety architecture is designed for:

- High-speed time attack cornering and braking,
- Potential rollovers due to high grip + AWD load transfer,
- Fire risk associated with fuel system modifications,
- Predictable driver extraction during emergencies.

8.2 12-Point Roll Cage

General Description

The car uses a custom 12-point cage that exceeds the minimum requirements of typical sanctioning bodies. It is designed to integrate cleanly with interior panels, giving an "OEM+" appearance once trimmed and reinstalled.

Key Features

- Main hoop with diagonal and harness bar.
- A-pillar bars following windshield angle.
- Roof cross-bracing.
- Door bars (NASCAR-style or X-brace depending on clearance).
- Rear downbars tied into rear shock towers.
- Front dash bar incorporated into digital cluster mounting strategy.
- Additional chassis tie-ins for AWD diff cradle stress distribution.

Integration Notes

- Interior plastics are cut, trimmed, and CAD-fitted so the cage appears factory-installed.
- Cage gussets added at A/B pillars for improved stiffness.
- All base plates tied into reinforced floor sections.

8.3 Seating System

- FIA-rated fixed bucket seat.
- Side-mount brackets bolted to reinforced floor plates or seat rails.
- Proper seating position for helmet clearance inside a 12-point cage.
- Seat angle tuned for visibility with TFT digital cluster and low ride height.

Ergonomics

- Steering wheel quick-release for easier entry/exit.
- Pedal box alignment checked against cage intrusion.

8.4 Harness System

- 5- or 6-point FIA harness recommended.
- Harness bar integrated into main hoop.
- Sub-belt anchorage installed per FIA angle requirements.
- Harness replaced per FIA expiration cycles.

8.5 Fire Suppression System

- On-board fire suppression bottle mounted low in the cabin.
- Dual-discharge nozzles:
  - One for engine bay,
  - One for driver cockpit.
- External pull cable accessible from outside the vehicle.
- Optional handheld extinguisher mounted near driver seat.

8.6 Window, Netting & Interior Safety

Side Windows

- OEM glass or polycarbonate replacements allowed.
- Polycarbonate preferred for safety and weight distribution.

Window Nets

- Required for side impact protection.
- Mounted to cage with quick-release hardware.

Interior Padding

- FIA-approved cage padding used in head contact zones.
- All sharp edges removed or covered.

8.7 Electrical Safety

Referencing the electrical subsystem specification, critical safety elements include:

- MASTER cutoff switch that kills battery + alternator charge circuit.
- Relay-based F1-style ignition separation.
- Fuse sizing matched to anticipated racing electrical loads.

8.8 Safety System Validation

Static Validation

- Cage weld inspection and paint coverage.
- Harness angle verification and bolt torque checks.
- Fire system line routing and pull cable smoothness.

Dynamic Validation

- Low-speed shakedown to check seat rigidity.
- Track test to ensure no helmet-to-cage contact under G-load.
- Fire system function test (dry pull test).

Failure Modes

- Harness slack due to incorrect routing.
- Cage flex from improper weld penetration.
- Fire system pressure drop over long storage periods.

9 Interior, Brand Identity & Livery Specification

This section defines the interior requirements, driver–vehicle interface, safety integrations, and the global aesthetic direction for the EF/EK Civic AWD Time Attack Program. The interior must balance three competing goals:

- **Driver Functionality:** Ergonomics, visibility, safety, and control access.
- **Track Durability:** Materials, mounting, heat resistance, and vibration management.
- **Program Identity:** OEM+ race-inspired visual language with Koi-themed asymmetry.

A detailed interior and livery exploration is contained within the subsystem document: *Vehicle Aesthetic, Interior & Livery Specification — Civic EF/EK AWD Time Attack Program.*

This master section summarizes the high-level engineering and identity requirements.

9.1 Interior Functional Design

9.1.1 Primary Objectives

- Maintain an **OEM+ appearance** while integrating motorsport hardware.
- Ensure the interior does not visually conflict with the 12-point cage.
- Preserve select interior trim components to support desired weight and acoustics.
- Avoid the stripped, unfinished appearance common in grassroots builds.

9.1.2 12-Point Cage Integration

The 12-point cage (see: *Safety, 12-Point Cage, Seating & Fire System Specification*) must appear visually "factory-installed." Requirements:

- All interior plastics must be **precision-trimmed** around cage nodes.
- Gaps created by trimming must be:
  - CAD-modeled,
  - Cut in ABS or PETG plastic,
  - Secured using countersunk hardware or OEM mounting clips.
- Panels must snap cleanly into place and hide cage footings.
- No jagged cuts, exposed foam, or misaligned edges permitted.

This ensures the interior communicates intentional design and professional finish.

9.1.3 Driver Interface

- **Steering wheel:** Quick-release hub with motorsport-grade collapsible column.
- **Pedal box:** OEM pedals retained; adjustable pedal pads optional.
- **Seating:** FIA fixed-back seat with OEM belt retention points removed.
- **Instrumentation:** Digital display (see subsystem document *Digital Instrument Cluster Development Program*).
- **Switchgear:**
  - Toggle switch for ignition,
  - Toggle switch for fuel pump,
  - Toggle switch for accessories,
  - Momentary button for starter.

Switches must be mounted on a front console plate CNC-cut from aluminum or ABS.

9.1.4 Sound System Retention

Although unconventional for time attack, the sound system is retained for:

- Weight distribution (rear-biased mass helps AWD cornering balance),
- Personal branding and street-legal usability,
- Interior finish quality.

System requirements:

- Single amplifier mounted on reinforced rear tray,
- Lightweight subwoofer enclosure positioned symmetrically,
- All wiring secured with motorsport harness tape to avoid vibration-induced faults,
- No rattling or loose trim allowed under track vibration.

9.1.5 Safety-Integrated Components

- Fire extinguisher mounted within driver reach,
- Battery cutoff in center console or dash mount,
- Harnesses routed through cage-integrated harness bar.

9.2 Brand Identity and Livery Direction

This section defines the aesthetic identity of the EF/EK Civic AWD Time Attack Program. It must reflect the builder's brand while remaining track-appropriate and recognizable.

9.2.1 Aesthetic Objectives

- Express the **kevxzr** brand identity.
- Include **K. Caldwell** on the door area in bold block typeface.
- Use an asymmetrical Koi-themed visual language.
- Remain clean, high-contrast, and compatible with aero components.

9.2.2 Koi-Themed Visual Language

The livery uses a direct **Koi fish theme**, executed in a motorsport-appropriate style:

- Blue-on-white palette, matching program-wide color alignment.
- Asymmetrical composition referencing traditional Japanese layout rules.
- Koi curves follow the bodyline and flow rearwards toward the hatch.
- No cartoon elements; the style is modern, geometric, and track-focused.
- Rear-quarter panels receive the primary Koi form.

This theme is mentioned lightly in aero documentation but fully defined here.

9.2.3 Branding and Sponsor Display

- Only logos of parts actually used in the build are permitted.
- No social media, usernames, IG tags, or handles.
- Decals limited to:

  - Drivetrain partners,
  - ECU/Hondata,
  - Suspension and brake component manufacturers,
  - Fabrication partners (if applicable).
- All branding must follow FIA placement principles:
  - Front bumper small sponsors,
  - Doors feature primary brand (kevxzr),
  - Rear quarter and hatch carry technical partners.

9.2.4 National Identity Elements

Two flags are included:

- **Vietnamese flag** (blue background, white star) placed on rear side glass.
- **Canadian flag** (blue background, white maple leaf) placed opposite side.

Both modified to match the program's blue/white livery palette.

9.2.5 Integration with Aero

The livery must fit the custom aero package (see subsystem *Aero Package & Bodywork Specification*):

- Koi curves should align with bumper vent geometry,
- Side skirt lines must not obscure sponsor logos,
- Rear wing endplates may carry subtle Koi scales or gradients.

9.2.6 Final Visual Principles

- Asymmetry embraced intentionally.
- No clutter; large color blocks only.
- Clean motorsport silhouette that still conveys personal identity.
- All updates documented in the Livery Subsystem Specification.

10 Master Bill of Materials (BOM)

This section provides a high-level bill of materials representing the entire EF/EK Civic AWD Time Attack Program. Detailed subsystem-level BOMs are contained within the corresponding subsystem documents.

The items listed here represent the major assemblies, consumables, and outsourced services required for full vehicle completion.

10.1 Major Assemblies

Subsystem	Component / Assembly	Qty
Engine	K24/K20 Frankenstein Long Block Core	1
	Forged Pistons + Rods (matched set)	1 set
	K20A2 Oil Pump Conversion Kit	1
	Timing Components (K20 chain, guides, gear)	1 set
Drivetrain	CR-V AWD Rear Differential (M4TA/MRVA)	1
	Custom Rear Axles (per spec)	2
	Custom Front Axles (per spec)	2
	Custom Driveshaft (2-piece AWD EK spec)	1
Chassis	Coilovers (Track-oriented, adjustable)	1 set
	Adjustable Arms/Bushings (full set)	1 set
	Reinforced Subframe Components	1 set
Braking	Big Brake Kit (Front)	1 set
	Upgraded Rear Brake Setup	1 set
	Stainless Steel Brake Lines	1 set
Safety	12-Point Chromoly Cage	1
	FIA Seat + 6-pt Harness	1
	Fire Extinguisher System	1
Electrical	Hondata K-Pro ECU	1
	Custom K-Series Harness (per wiring spec)	1
	Switch Panel (Ignition/Fuel/Acc/Start)	1
	Digital Cluster TFT Module	1
Aero	Custom Front Bumper + Splitter	1 set
	Side Skirts (aero-profiled)	1 set
	Rear Diffuser	1
	Wing w/ Custom Endplates	1
Interior	OEM+ Trim Components (modified)	1 set
	Sound System (amp + sub)	1 set
	Quick-Release Steering Wheel	1

Table 1: Master high-level BOM for EF/EK AWD Time Attack Program.

11 Cost Outline (High-Level Estimation)

This section provides placeholders for cost planning. Actual values depend on sourcing, machine shop quotes, and exchange rates. All subsystem documents also contain localized cost tables.

Category	USD	CAD	Actual (KC)
Engine Long Block Build	TBD	TBD	_____
AWD Drivetrain Components	TBD	TBD	_____
Custom Driveshaft	TBD	TBD	_____
Front & Rear CV Axles	TBD	TBD	_____
Chassis/Suspension Setup	TBD	TBD	_____
Brakes (Front & Rear)	TBD	TBD	_____
Safety (12-Point Cage, Seat, Harness)	TBD	TBD	_____
Electronics/ECU/Cluster	TBD	TBD	_____
Aero Package	TBD	TBD	_____
Interior/Branding/Livery	TBD	TBD	_____

Table 2: High-level cost overview for complete vehicle program.

12 Cross-Reference Index

This index links every major topic in the master summary to its corresponding detailed subsystem document for deeper technical review.

12.1 Subsystem Reference Mapping

- **Engine:** *K24/K20 Frankenstein Hybrid Engine — Long Block Engineering Specification*
- **Front Axles:** *Front CV Axle Integration — Honda Civic EF (1988–1991) & CR-V K-Series AWD Transmission*
- **Rear Axles & Differential:** *Rear Differential Cradle & Axle Integration — Honda Civic EF (1988–1991)*
- **Driveshaft:** *AWD Driveshaft Specification — Honda Civic EK (1996–2000)*
- **Chassis & Alignment:** *EF/EK Civic Time Attack Program — Chassis, Suspension & Alignment Specification*
- **Electrical, ECU, Start System:** *K-Series Wiring, ECU Integration & F1-Style Start System*
- **Aero:** *EF/EK Civic Time Attack Program — Aero Package & Bodywork Specification*
- **Safety:** *EF/EK Civic Time Attack Program — Safety, 12-Point Cage, Seating & Fire System Specification*
- **Interior & Livery:** *Vehicle Aesthetic, Interior & Livery Specification — Civic EF/EK AWD Time Attack Program*
- **Digital Instrument Cluster:** *Digital Instrument Cluster Development Program — Universal TFT-Based Platform*

13 Master Document Change Log

- **v1.0** — Initial creation of master summary structure.
- **v2.0** — Integrated engine, drivetrain, chassis, electrical, and safety documents.

- **v3.0** — Added aero, interior, livery, and brand identity sections.
- **v4.0** — Finalized cross-reference index and high-level BOM.

14 Notes & Future Work

- Populate torque values (waiting on OEM/ARP references).
- Add dyno graphs once engine tuning is complete.
- Update livery visuals once the CAD aero package is finalized.
- Replace cost placeholders with actual expenditures.
- Add final alignment sheets and track testing results.

15 Program Closing Statement

The EF/EK Civic AWD Time Attack Program represents a complete ground-up engineering effort executed with the fabrication standards, documentation structure, and technical depth expected in professional motorsport.

This master summary consolidates all major subsystems—including engine, drivetrain, chassis, electrical, aero, safety, interior, and brand identity—into a unified high-level specification that defines:

- program intent,
- cross-system compatibility,
- design constraints,
- and all outsourced fabrication dependencies.

The individual subsystem documents contain detailed engineering analysis, CAD references, component-level breakdowns, wiring diagrams, and machining requirements. Together, they provide full reproducibility of the vehicle program.

This car is expected to operate in high-stress environments including:

- time attack competitions,
- extended track sessions,
- high-temperature braking cycles,
- future forced-induction testing,
- and continuous aerodynamic load.

The program is designed not only to achieve competitive lap times but also to reflect the personal brand and engineering capability of its designer, **Kevin Caldwell (kevxzr)**, in pursuit of future opportunities within high-level motorsport engineering environments.

16 Technical Disclaimer

This document is intended for advanced technical use only. All fabrication, wiring, machining, tuning, and installation procedures should be performed by:

- certified welders,
- experienced machinists,
- licensed mechanics,
- or trained motorsport technicians.

Improper assembly or deviation from the specification may result in mechanical failure, injury, or vehicle damage. All torque values, material selections, and component interfaces must be verified against OEM Honda service data and reputable aftermarket engineering standards.

Neither this document nor its subsystems constitute a guarantee of performance. Track use is inherently dangerous and performed at the operator's risk.

17 Engineering Responsibility Notes

- Measurements provided in subsystem documents must be validated during mock-up.
- Machine shop work (boring, honing, decking, balancing) must be documented with measurement sheets.
- All custom driveline components (driveshaft, front/rear axles) must be verified for runout and plunge travel.
- All electrical systems must be fused, loomed, and strain-relieved.
- All aero components must be load-tested before use at speed.
- All safety systems (cage, seat, harness, extinguisher) must comply with track regulations.

These notes establish the minimum engineering diligence required to ensure vehicle integrity and driver safety.

Document Footer

Document Title: EF/EK Civic AWD Time Attack Program — Master Summary
Prepared By: Kevin Caldwell (kevxzr)
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This document integrates the full engineering suite for the AWD Civic Program and serves as the controlling reference for all subsystem documents.

"Designed with intention. Built with precision. Documented for reproduction."