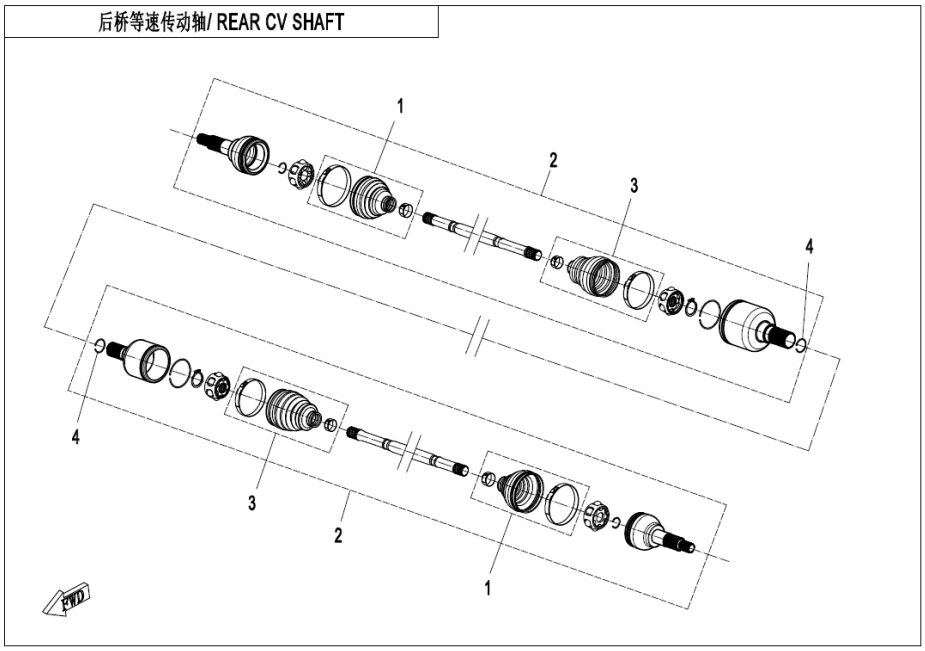
ENGINEERING SPECIFICATION DOCUMENT

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



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Contents

1 Purpose

This document provides the geometric, structural, and mechanical requirements for integrating a rear differential and rear axle system into the 1988–1991 Honda Civic EF chassis using CR-V AWD components. The goals are:

- Design a fully functional, rigid, and serviceable diff cradle.
- Integrate CR-V / RT4WD rear differential into the EF chassis.
- Specify rear axle spline interfaces, lengths, and strength requirements.
- Create a complete engineering reference for fabrication and testing.

2 System Overview

2.1 Rear Differential Options

Two main donor options are considered:

- **Honda CR-V RD1/RD7** (2002–2011)
- **Honda Civic Wagon RT4WD rear differential**

The CR-V rear differential is preferred due to improved availability, strength, and aftermarket support.

2.2 Rear Suspension Configuration

- OEM EF rear trailing arms retained for simplicity.
- EF rear hubs replaced with AWD-compatible knuckles:
  - CR-V knuckles, or
  - RT4WD wagon knuckles.
- Custom mounts required to adapt knuckle geometry to EF trailing arm pick-up points.

2.3 Diff Cradle Concept

The rear differential is mounted using a three or four-point cradle constructed from high-strength tubing and plate steel. Requirements:

- Rigid mounting to prevent pinion angle change under load.
- Compatible with vehicle underbody clearance and exhaust.
- Serviceability: removal of diff without pulling the cradle.
- Correct pinion angle alignment with front driveshaft.

3 Differential Interfaces

3.1 CR-V Rear Differential

Key specifications:

- **Input Spline:** 27-spline pinion input (CV-style driveshaft coupling).
- **Output Spline:** 28-tooth rear axle outputs (varies slightly by year, must be verified on donor).
- **Mounts:** Typically two side bushings + single rear bushing (3-mount structure).

- **Final Drive:** 2.533–4.437 depending on CR-V model year.

3.2 RT4WD Wagon Rear Differential

Compatibility Notes:

- Slightly weaker than CR-V diff.
- Different axle spline count.
- Better direct compatibility with Wagon knuckles.

4 Rear Differential Cradle Design

All cradle work is performed as **custom hand fabrication** in-house. No machine shop involvement is required, except optionally for bushing sleeves or laser-cut tabs.

4.1 Material Selection

- **Tubing:** 1.25" x 0.083" wall DOM steel (or 4130 chromoly).
- **Plate:** 3/16" or 1/4" steel for mounting tabs and diff saddles.
- **Hardware:** Grade 10.9 metric bolts for all structural fasteners.

4.2 Cradle Mounting Points

- Left/right frame rails (boxed reinforcement required).
- Upper shock towers (optional triangulation).
- Rear subfloor crossmember reinforcement.

4.3 Pinion Angle Specification

- Target angle: 1.0°–2.0° downward (relative to driveshaft) for driveline alignment.
- Angle should remain within tolerance through typical suspension travel.

4.4 Cradle Dimensional Table (To Be Completed After Mock-Up)

Dimension	Target [mm]	Final Measured (KC)
Cradle width (rail-to-rail)	650–720	_____
Front diff mount to rear mount spacing	240–300	_____
Diff pinion height from floorpan	100–140	_____
Driveshaft centerline offset (L/R)	0	_____

Table 1: Rear diff cradle preliminary geometry.

5 Rear Axle Specification

5.1 Design Philosophy

- Use CR-V / RT4WD rear axle geometry as a sanity-check reference only.

- Determine final lengths from the actual EF chassis mock-up with the diff and knuckles installed.
- Maintain safe plunge margins at static ride height, full droop, and full compression.

5.2 Spline Interfaces

Location	Spline Count	Notes
Differential Output (CR-V)	**TBD (approx. 28)**	Must be verified on donor diff
Rear Hub Input (CR-V/RT4WD)	**TBD (26–28)**	Depends on chosen knuckle/hub
Outer Hub (EF original)	N/A	EF rear hubs not used

Table 2: Rear axle spline interface summary (values to be verified).

5.3 Measurement Procedure (On-Car Mock-Up)

For each rear side:

1. Install the chosen rear knuckle and hub on the EF trailing arm using your final mount geometry.
2. Install the CR-V / RT4WD rear differential in the custom cradle at the target pinion angle.
3. Install inner CV stubs fully into the differential (snap rings seated).
4. With suspension at **static ride height** (springs or simulated with jacks under the arm), measure the **centre-to-centre distance** between:
   - The plunge centre of the inner CV, and
   - The plunge centre of the outer CV.
5. Define the compressed axle length L_{comp} so the inner joint uses roughly 30–40% of available plunge at ride height.
6. Repeat at:
   - Full droop (trailing arm at lowest usable angle), and
   - Full bump (simulated compression),

   to confirm that:
   - The axle does not bottom out the inner or outer joint.
   - The axle does not risk pulling out of the inner cup at droop.

5.4 Axle Length and Plunge Margin (To Be Measured)

Side	L_{comp} [mm]	Plunge Reserve (Droop) [mm]	Plunge Reserve (Bump) [mm]
Left Rear	**TBD**	**TBD**	**TBD**
Right Rear	**TBD**	**TBD**	**TBD**

Table 3: Rear axle compressed lengths and plunge margins (to be populated after mock-up).

5.5 Estimated Axle Lengths (Design Window)

Using existing AWD EF/EG builds and CR-V rear track width only as a starting point:

Side	Design Range [mm]	Target [mm]	Final (KC)
Left Rear	410–460	**TBD**	_____
Right Rear	440–500	**TBD**	_____

Table 4: Estimated rear axle length windows based on EF packaging and donor data.

5.6 Axle Strength Requirements

- **Power Target:** 400–700 whp future-proof.
- **Axle Material:**
  - 4340 chromoly or 300M for high-power applications.
  - Heat-treated per driveline vendor recommendations for AWD track use.
- **Joint Types:**
  - Inner: plunging joint (tripod or Rzeppa) to accommodate suspension travel.
  - Outer: fixed Rzeppa-style joint at the hub.

5.7 Boots and Lubrication

- Use high-temperature rear CV boots suitable for continuous track operation.
- Fill joints with high-moly CV grease per joint manufacturer specification.
- Verify boot clearance at full droop and bump to avoid contact with trailing arms, springs, or exhaust.

6 Manufacturing Package

6.1 Items to Provide for Cradle Fabrication

- Chosen rear differential model and year.
- Chosen rear knuckle / hub model (CR-V or RT4WD).
- Target pinion angle and diff height relative to floorpan.
- Cradle mounting widths and tab locations on EF chassis.
- Expected wheel horsepower and intended usage (track / street).

6.2 Items to Provide for Rear Axle Vendor

- Differential: CR-V or RT4WD rear diff model/year and confirmed output spline count.
- Knuckles/hubs: CR-V or RT4WD knuckle model/year and hub spline count.
- Measured L_{comp} for left and right rear axles (see Section 5).
- Required plunge margins (droop/bump).
- Desired axle material (4340 / 300M) and target power level.
- Whether OEM donor joints will be supplied or if the vendor should source all components.

6.3 Example Text Block for Vendor

> "Build a pair of custom rear CV axles for a 1988–1991 Honda Civic EF track car using a Honda CR-V rear differential and CR-V/RT4WD rear knuckles. Inner joints must

be compatible with the selected rear differential outputs, and outer joints must fit the chosen rear hubs without modification. Shaft lengths, compressed length targets, and plunge margins are specified in the attached measurement table."

7 Cost Estimates

7.1 Rear Diff Cradle Fabrication Cost

- Custom cradle (DIY materials): $150–$350 CAD.
- If outsourced to a fabrication shop: $450–$1,200 CAD (labour + materials).
- Powdercoat (optional): $100–$200 CAD.

7.2 Rear Axle Cost Estimates

Axle Option	**Cost [USD]**	**Cost [CAD]**	**Actual Paid (KC)**
Custom Axles (DSS / similar)	$800–$1,400	$1,080–$1,890	_____
Mixed OEM Hybrid	$250–$350	$330–$475	_____
CR-V / RT4WD Donor Axles	$90–$120	$125–$160	_____

Table 5: Rear axle cost references for budgeting (values approximate).

8 Custom Fabrication Cost Summary

Item	Estimated Cost Range (CAD)	Final Cost (CAD)
DOM Tubing (Cradle)	$80–$150	_____
Steel Plates + Tabs	$40–$90	_____
Welding Supplies (Wire, Gas)	$20–$50	_____
Rear Axle Hybrid Components	$120–$250	_____
Custom Rear Axle Fabrication (Shop)	$200–$450	_____
Bushings / Sleeves	$30–$80	_____
Hardware (Bolts, Nuts, Spacers)	$15–$35	_____
Total Estimated	**$505–$1,105**	_____

Table 6: Fabrication cost ranges with blank fields for final values.

9 Validation and Testing

9.1 Static Checks

- Confirm diff pinion angle within target tolerance.
- Confirm no interference with exhaust, floorpan, trailing arms, or sway bar.
- Verify rear axle plunge at static, droop, and bump positions.

9.2 Dynamic Testing

- Low-speed straight-line test to check for binding or knocking.

- Medium-speed test including sweepers to check for vibration under lateral load.
- Higher-load acceleration tests only after initial checks show no issues.

9.3 Post-Test Inspection

- Inspect CV boots for tears, contact marks, or clamp movement.
- Check for grease leakage at inner and outer joints.
- Inspect cradle welds and mounting points for cracks or witness marks.

10 Future Revisions

- Integration of EF-to-CR-V / RT4WD rear knuckle adapter drawings.
- Optional rear sway bar and exhaust clearance revisions.
- Updated axle length and plunge tables after final mock-up.
- Final cradle and rear axle drawing package (2D + 3D).