IRONCLAD 53

Triple-deck hydraulic gooseneck

Engineering concept, preliminary plans and procurement BOM

Revision R0 | 1 October 2026 | Adam Louramore



53 ft overall concept. Three dual-wheel axles. Air ride and forward lift axle. 8 ft upper, 33 ft main and 12 ft tail. Positive mechanical locks, twin winches, Honda power, six cameras and a separate wiring branch.

Release status: concept and supplier RFQ only. Structural targets, actuator dimensions and tow envelopes need validation before fabrication.

01 Project basis and release status

IRONCLAD 53 - triple-deck hydraulic gooseneck. Revision R0, 1 October 2026. Owner: Adam Louramore / Ironclad Equipment Sales. This is the engineering concept baseline and supplier RFQ package. It includes preliminary calculations, layout plans and a procurement BOM. It is not released for fabrication or assigned a certified GVWR.

Preserve the full dream configuration: 53 ft overall concept length, 8 ft tilting upper deck, 33 ft tilting main deck with a 40,000 lb structural payload target, 12 ft hydraulic tail, three dual-wheel axles, air suspension and a forward lift axle. All requested lighting, cameras, winches, cargo track and wireless hydraulic controls are included.

Tow vehicles requested: existing F-350, possible future F-450. Neither vehicle is approved by this concept. Full-capacity service points toward a suitable commercial tow vehicle and connection. Pickup operation is a separate, reduced-load envelope requiring actual truck labels, scale tickets, geometry and hitch limits.

All capacities called targets or candidates below remain provisional. Manufacturer ratings apply only to their specified assemblies; they do not certify this custom trailer. Rendering proportions and visible hardware are illustrative. Dimensioned schematic sheets and calculations govern the concept.

02 Design decisions

System	R0 decision	Unresolved release requirement
Frame	Fixed chassis under independently tilting main deck	Beam sections, weld fatigue, torsion, axle mounting
Axles	Three Dexter D160 / DexAir 16K-class assemblies; 12 road tires	OEM approval of lift kit, axle spacing, track and brake controls
Main deck	Rear pivot at station 41 ft; front rises	40K payload load envelope and actuator geometry
Upper deck	Rear pivot at station 8 ft; front rises to match main slope	Truck cab sweep and 4K preliminary upper load target
Tail	Coaxial rear pivot on fixed rear crossmember; independent movement	14K single-machine traversal target; 10K carrying target
Transfer bridge	Captive telescoping / hinged plate; 24 in nominal span	Minimum supported overlap and point-load proof
Power	Honda iGX800 EFI; variable-flow or two-speed hydraulics	Engine/pump/compressor matching and thermal duty
Controls	Industrial hold-to-run wireless + wired pendant	Risk assessment, stop performance and fault testing
Wiring branch	New U.S. function-based system schematic	Actual connector, device ratings and harness release

03 Dimensions and station convention

Use x = 0 at the forward edge of the upper deck, increasing toward the tail. The nominal upper zone is x=0..8 ft, main x=8..41 ft and tail x=41..53 ft. These nominal zones sum to 53 ft; hinge clearances, bevels and bridge overlap reduce uninterrupted cargo surface. Do not add the bridge as another advertised deck length.

The hitch center is provisionally x=1.5 ft, beneath the upper platform. This is a calculation datum, not an approved neck setback. The 53 ft outside envelope must include any coupler housing, bumper or stored hardware projecting beyond the deck. Any clearance-driven change requires a revised overall dimension.

Nominal main deck height 42 in at normal ride height; upper rear pivot height 72 in. Width target 102 in maximum outside envelope including rub rails and fixed hardware. Main flat-frame ground clearance, tire-to-deck clearance at full jounce, and belly breakover require CAD verification.

Axle centers: x=29.5, 34.0 and 38.5 ft; 54 in spacing, 108 in outer spread. Main/tail pivot at x=41 ft gives 30 in clearance behind rear axle center before the hinge. Tail road overhang is substantial: rear axle to tail tip is 14.5 ft. Tail swing, axle ratings, rear guard geometry and fatigue must be examined.

Upper front corners have a swept radius of approximately 4.51 ft from the provisional hitch (sqrt(1.5^2+4.25^2)). A 72 in high upper deck cannot be assumed to pass over a pickup cab. Check cab, bed, tailgate, safety chains and loaded upper-deck contents through the full turn, pitch and roll envelope before committing neck geometry.

Parameter	Nominal
Overall external target	53 ft / 636 in
Upper zone	8 ft / 96 in
Main zone	33 ft / 396 in
Tail zone	12 ft / 144 in
Main width	102 in outside maximum
Main pivot height	42 in
Upper pivot height	72 in
Hitch station	1.5 ft provisional
Axle stations	29.5 / 34 / 38.5 ft

04 Kinematic solution and transfer bridge

With the main rear pivot at 42 in, the main front must rise 30 in to reach the upper rear pivot at 72 in. Required main transfer angle = asin(2.5/33) = 4.345 degrees. Front moves aft 33*(1-cos(angle)) = 1.138 in. This small arc gap is distinct from fabrication clearances and hardware recesses.

Keep the upper rear pivot fixed. Raise its front so the upper surface falls toward the rear at the same 4.345 degrees. Upper front rises 8*sin(angle) = 7.273 in. The upper deck and main deck now share a slope. This is the proposed solution to transferring small machines upstairs.

Bridge candidate: full usable-width traction plate, roughly 24 in long, on captive slides at upper rear edge; controlled extension 0..12 in with hinged floating toe. Engineer bearing overlap, torsion, edge stiffness and retention. Bridge must seat on reinforced main-deck pockets; it must not carry equipment on cylinder force or friction alone.

Transfer motion limits: target one machine at a time, at most 4,000 lb upper/bridge load pending validation. No machine straddles either articulation while any deck moves. Main and upper reach verified angle tolerance (initial target +/-0.25 degree), then bridge extends and engagement sensors confirm bearing. Close transfer only after bridge retracts and all cargo is clear.

For general main-deck tilt, the front may rise to a provisional 12 degrees: front elevation = 42+396*sin(12 deg) = 124.3 in. This is not a matching-upper-deck position. The bridge remains stowed. Main underside, cylinders and loaded equipment sweep must clear the fixed chassis and machinery bay.

Tail-down angle at nominal main height is asin(3.5/12) = 16.96 degrees. Its grounded tip is x=41+12*cos(angle)=52.48 ft. Air kneeling to a validated 36 in pivot height would reduce the tail slope to 14.48 degrees. Neither is a low-angle claim; check each machine approach and breakover geometry. A captive 24..36 in ground toe extension is a useful option, not part of the nominal 53 ft transport envelope.

05 Capacity definitions and weight budget

20 US short tons means 40,000 lb cargo. A 40K deck target is not a 40K GVWR. Preliminary tare planning range is 16,000..22,000 lb; the worked examples use 18,000 lb. These are engineering allowances, not measured weights. At 40K cargo, gross trailer mass is approximately 58K in the example.

Three 16K axles provide 48K component capacity when assembled exactly as approved. With a 9 ft outer spread, FHWA published bridge-table guidance gives 42,500 lb for the three-axle group. Check every consecutive axle group in the truck/trailer combination, all individual axles and actual routes; mechanical capacity is not road permission.

Tail target: traverse one machine up to 14K with the tail grounded and stabilizers deployed; carry up to 10K distributed on the locked horizontal tail. These are separate new-design targets. Diamond C reports 10K distributed lift/carry for its own 12 ft tail; that rating cannot be transferred to this design.

Upper target: 4K total payload, low-profile cargo only, with load-placement and height limits. Top deck cargo is carried mostly by the hitch. Keep upper deck empty for initial trials and any pickup envelope until a measured load model is approved.

Non-overlapping mass allowance	Low lb	High lb
Fixed chassis and neck	4500	6000
Moving main deck	2600	3500
Tail and ground toe	1400	2000
Upper deck and bridge	650	1000
Running gear, wheels, suspension	3300	4200
Hydraulic machinery, fuel, oil, tanks	1100	1700
Locks, legs and stabilizers	900	1500
Decking, anchors, wiring, lights, covers	1550	2100
TOTAL ESTIMATE	16000	22000

06 Load reactions and pickup feasibility

Flat trailer preliminary rigid-body model: hitch H=xh=1.5 ft; supported axle-group resultant A=34 ft with all axles down. For each mass Wi at longitudinal CG xi: Rh=sum[Wi*(A-xi)/(A-H)]; Ra=sum(Wi)-Rh. This does not determine individual air-suspension axle reactions or truck front/rear axle loads; those require actual suspension and truck geometry.

Use assumed tare 18K at x=26 ft. Empty hitch reaction is 4,431 lb and axle reaction 13,569 lb. Lift the forward axle and assume remaining axle-group resultant x=36.25 ft: empty hitch rises to 5,309 lb. Do not authorize empty F-350 towing from trailer gross weight alone.

Worked heavy load: cab TB260 12,645 lb at assumed CG x=17.6 ft; cab TL12V2 13,190 lb at assumed CG x=33.85 ft. Cargo 25,835 lb, gross 43,835 lb, hitch approximately 10,873 lb and trailer axle group 32,962 lb. Published operating weights are planning inputs; buckets, thumbs, fuel, tracks and transport configuration require scale verification. The TL12V2 is the conservative named variant for the rendering; the user has not specified TL12 model year.

The 43,835 lb example exceeds Ford's advertised best-case 40,000 lb F-450 gooseneck tow rating before accessory-weight refinements. That rating applies to a specified regular-cab 4x2 DRW high-output diesel/package combination. The example hitch load is also a serious pickup payload/GAWR constraint. No F-450 or F-350 approval is implied.

Worked small-machine visual load: three 4,400 lb mini excavators at assumed CG x=12.5,21,29.5 ft; one 2,200 lb mini skid at x=37 ft and one 2,200 lb mini skid at upper x=4 ft. Gross 35,600 lb; hitch approximately 11,538 lb. This shows why the upper deck needs a real load map even when gross weight is below an advertised tow rating.

40K main-deck distributed cargo at x=24.5 ft gives example gross 58K, hitch 16,123 lb and axle group 41,877 lb. This is close to the bridge-table group limit and requires a rated commercial connection and suitable truck. Any nose-biased point load, extra tare or different suspension equalization changes the result.

Pickup envelope is gated by the minimum of actual tow rating, GCWR minus actual truck weight, available truck GVWR/GAWR/tire margins, coupler/hitch GTW and vertical rating, trailer certification, axle-group limits and cargo placement. If the dream chassis is too heavy even empty, build a separately engineered lighter derivative; do not fake compatibility by moving cargo until the hitch is unloaded.

Example / all assumed CGs	Gross lb	Hitch lb	Axle group lb
Empty, 3 axles down	18000	4431	13569
Empty, front axle up	18000	5309	12691
TB260 cab + TL12V2 cab	43835	10873	32962
Three minis + two mini skids	35600	11538	24062
40K main cargo at x=24.5	58000	16123	41877

07 Frame, hinges and structural load paths

Fixed chassis carries the neck, running gear, stabilizers and machinery. Moving main deck transfers road loads through engineered landing saddles, shear keys and positively locked restraints into the fixed chassis. Tail loads enter a shared rear hinge crossmember supported by both main chassis rails. The upper deck feeds a dedicated neck load path; it is not welded casually onto the cab-clearance structure.

Preliminary material family: weldable structural steel specified by the engineer, with certified plate for hinge lugs and locking shoes, machined pins with replaceable bushings and protected grease points. Beam flange/web thicknesses, pin diameters, lug spacing and weld sizes are deliberately not released at R0. Raw beam cut lengths in the BOM are zone lengths, not a shop cut list.

Analyze bending, lateral torsion, local track loading, braking, cornering, road shock, winch reaction, anchor pull, rear overhang fatigue and one-sided loading. Do not rely on a simple uniformly distributed 20-ton beam calculation. Track pressure, wheel/track entry impact and tiedown pull introduce local loads.

Anchor slots go in engineered replaceable outer anchor rails or reinforced diaphragms. Do not flame-cut chain slots into primary beam tension flanges. Use radiused openings, adequate ligament and accessible welds. Rub rails and stake pockets are cargo restraints only when explicitly designed and rated as such.

Stabilizer feet at rear pivot and twin hydraulic landing gear provide a stationary support polygon. Ground-bearing capacity and possible hitch uplift during loading must be evaluated. Keep coupled to a properly braked truck when required by the approved loading plan; landing gear and chocks do not substitute for a loading-stability analysis.

08 Actuator force calculation: the 20-ton tilt problem

Worst illustrative main moment about rear pivot: 40K concentrated at the front of a 33 ft deck gives 1,320,000 ft-lb. Add a 4K moving-deck allowance at 16.5 ft: total 1,386,000 ft-lb, before dynamic, friction and design margins. Actual moving mass is to be measured.

Two 8 in bore cylinders at 3,000 psi create about 301,593 lb total ideal extension force. With an illustrative mechanical efficiency of 0.85, the required effective perpendicular lever arm for that front-loaded case is 5.41 ft. This is difficult beneath a 42 in deck and cannot be assumed from a pretty rendering.

For 40K payload at x=24.5 ft, payload moment is 660,000 ft-lb and deck allowance 66,000 ft-lb. Required effective arm for the same cylinders is 2.83 ft before final margins. At x=20 ft it rises to 3.53 ft. A deck may carry 40K yet have a much narrower powered-tilt load envelope.

Design candidate is a rear-pivot deck driven through synchronized bellcranks / scissor linkage with twin custom cylinders. Linkage must maintain positive mechanical advantage at startup and throughout stroke. Candidate bore range 8..10 in is for engineering comparison only. A direct shallow-angle ram may be inadequate. Final bore, rod, stroke, trunnions, column buckling, pin bearing and mounting welds require kinematic force curves.

Illustrative stroke-volume check only: two 8 in bore cylinders with 45 in extension need approximately 19.6 gallons into cap ends; at 8 GPM this takes 147 seconds ideally. That is not an approved cylinder stroke. Regenerative or staged circuits must not sacrifice load control. Angle feedback and individual-cylinder balancing are required to prevent deck racking.

09 Mechanical locks and service support

Use a positive load-bearing architecture rather than a claim of the industry's single best lock. Each system needs hardened load seats, captive pins or wedges, independent left/right engagement sensing and visible indicators. Hydraulic valves prevent uncontrolled motion during operation; mechanical seats and locks carry road loads.

Tail road position: paired tapered landing shoes seat on reinforced rear chassis pockets. Captive double-shear pins prevent upward release, with protected retainers and spring-biased engagement where geometry permits. Lift the tail just enough to unload pins before retracting. Recheck both sides before lowering. Do not support a 10K tail load only on cylinder pressure.

Main flat position: multiple chassis saddles carry vertical load; front and rear shear keys resist longitudinal/lateral loads; paired positive locks restrain uplift. Upper flat position: neck-mounted saddles, rear hinge retention and paired positive restraints. Bridge stowed position: captive latch plus secondary retaining feature.

Service access: pinned rated maintenance props for main, upper and tail, each installed from outside the crush zone. Props are separate from road locks. Use lockout, pressure release and load removal before entry. Design prop attachment so accidental hydraulic commands cannot eject the prop.

Cylinder-mounted counterbalance/load-holding valves on every load-driven circuit, controlled hose-burst response and protected hose routing remain essential. An electrical emergency stop must arrest motion without releasing a loaded deck; turning every valve off indiscriminately can create unsafe pressure transients.

10 Hydraulic power unit and machinery bay

Preferred engine candidate: Honda iGX800 EFI with electric starting and electronic speed control. Manufacturer lists 24.9 net hp at 3,600 rpm. Enclosed installation, ambient heat and accessory loads reduce usable hydraulic power; reserve an initial 22 hp shaft budget before detailed cooling and alternator studies.

Pump candidate: 12 GPM maximum at low pressure, approximately 8 GPM working flow at 3,000 psi for deck operations, via suitable variable-displacement or automatically unloaded staged arrangement. Hydraulic hp = psi*GPM/1714. At 3,000 psi and 12 GPM, required hydraulic power is 21.0 hp and estimated pump input at 85% efficiency is 24.7 hp, leaving virtually no engine margin. Do not call this a 12 GPM / 3,000 psi simultaneous duty system.

At 3,000 psi and 8 GPM, hydraulic power is 14.0 hp and estimated input 16.5 hp. At VMAC H40 reference operating point 2,345 psi and 9 GPM, hydraulic power is 12.3 hp and estimated input 14.5 hp. Operate the compressor separately from heavy deck or winch motion. Actual engine torque curve, pump speed ratio and compressor startup need supplier matching.

Bay concept envelope: 72 in wide x 36 in fore/aft x 30 in high, centered between landing gear in the neck transition before the main deck. This bay occupies vertical/under-neck space within the 53 ft envelope. Verify it does not invade truck rear clearance, main-deck lift sweep or winch line path. Bay size may need growth after actual packaged CAD.

Provide vented removable panels, guarded exhaust directed away from truck and operators, flame-resistant heat shield, service isolation, fuel shutoff, spill tray, extinguishing provision and corrosion-resistant fasteners. Avoid a sealed toolbox around an air-cooled Honda. Cooler airflow must discharge outside the bay without recirculation.

Reservoir candidate: 40 gallon shell with approximately 30 gallon working fill, baffles, diffuser, level/temperature indicator, filtered breather and drain. Target 10 micron return filtration with clog indicator; final cleanliness rating follows valve/pump makers. Cooler allowance 25..40K BTU/h subject to a thermal duty calculation and ambient-temperature test. Relief flow is not a continuous operating mode.

Use separate motor and cylinder manifold galleries where needed. Winch motor circuits require manufacturer brake sequencing, anti-cavitation and cross-port relief; load-bearing deck circuits require local holding valves. No tee fitting should defeat the compressor's control manifold. Use a full-flow diverter with proven neutral/unload state to select compressor or actuation service.

11 Hydraulic circuit and valve inventory

Circuit ID	Function	Candidate hardware / requirement
H01	Main deck twin cylinders	Proportional DA valve; cylinder-local holding valves; synchronized position feedback
H02	Tail twin cylinders	Proportional DA valve; controlled lowering and two holding valves
H03	Upper deck twin cylinders	Proportional DA valve; constrained transfer angle
H04	Bridge extension	DA valve; relief-limited force; seat and stow sensors
H05 / H06	Left / right landing gear	Independent control, simultaneous option with feedback
H07 / H08	Left / right rear stabilizers	Controlled seating, holding valves, load/position sensing
H09	Main 20K-class hydraulic winch	Motor spool matched to winch brake; relief and rated fairlead
H10	Upper 8K-class hydraulic winch	Motor spool; force limited to upper/bridge support envelope
H11	Compressor supply	Full-flow selector; OEM H40 control manifold
H12..H17	Six deck-lock release mechanisms	Low-volume circuit with pressure reduction; each engagement sensor
H18	Optional ground toe	Actuation/latch only; separately engineered load support

12 Hoses, fittings and moving-joint routing

Preliminary concept sizes: pump-to-selector and high-flow motor feed 3/4 in class; high-flow return 1 in class; deck cylinder work lines 1/2..3/4 in class; low-flow lock lines 1/4 in class. These are velocity/pressure-drop starting points, not order sizes. At 8 GPM, a 3/4 in ID line is about 5.8 ft/s; at 12 GPM about 8.7 ft/s. Size with measured route lengths, cold viscosity and component limits.

Use pressure-rated assemblies, fittings and seals compatible with selected oil, temperature and pressure including spikes. Proposed work pressure 3,000 psi does not establish every component's pressure rating. Ports and adapters are finalized from manufacturer CAD; the BOM avoids fake universal part numbers.

Run fixed hard lines inside protected service channels on the chassis. At main, upper and tail pivots use guarded flexible loops or energy chains with full-stroke bend-radius allowance. Place holding valves as close to cylinder ports as practical so the hose is not the load-retention boundary. Avoid rubbing hoses through chain slots or against tire sweep.

Keep hydraulic work lines separate from road-brake hard lines and electrical loom. Provide bulkhead labels, abrasion sleeves at contact risks, restrained fittings, inspection access and drainage. Do not mix road-brake fluid plumbing with hydraulic lift oil.

13 Winches and cable management

Main winch candidate: Ramsey RPH/Helios 20K-class hydraulic planetary family with manufacturer-approved holding brake. Mount near the main deck nose with its reaction tied to both chassis rails. Upper winch candidate: Ramsey H-246 8K-class or appropriate industrial equivalent, located in a protected upper forward recess.

Actual line speed and pull depend on motor flow, pressure and cable layer. First-layer 20K is not 20K on every layer. Select drum, cable diameter/length, fairlead, fleet angle and duty from the current manual. A winch is not a crane and does not replace road tiedowns.

Use separate retractable fairleads and positive line-routing gates to avoid rubbing a cable on moving deck hinges. Clear the cable from all bridges before deck movement. Provide low-speed creep for upstairs transfer with pull limit tied to the upper and bridge load envelope.

Illustrative rolling pull: F=W*(sin(angle)+mu*cos(angle)). At 17 degrees with mu=0.08, F is about 0.369*W, before breakout and losses. A 14K rolling machine needs about 5.2K lb in this simplified model. Seized tracks, a snag, deep soil or a doubled line change both pull and mounting reactions. Engineer fairlead/support structure for worst permitted reaction.

14 Air suspension, lift axle and onboard air

Dexter D160 is a useful primary candidate because its published system supports air suspension, triple axle layouts, hydraulic disc brakes and dual wheels. A front lift conversion is not automatically approved. Ask Dexter for a rated liftable variant or an approved integrated package before buying axles. Hendrickson liftable families illustrate alternate approaches; do not graft an unmatched lift mechanism onto a D160 beam.

Use all three axles down for loaded road operation and all deck movement. Lift only on command after low-load verification, speed/state interlocks and a truck hitch-load check. Load-estimating air pressure must be calibrated against scales and suspension geometry. Loss of controller power should command axle-down or hold a validated safe state; pneumatic plumbing must prevent abrupt uncontrolled axle movement.

Air supply candidate: VMAC H40 hydraulic rotary screw package, sized for 25..40 CFM class service plus suspension charging. Its current product page lists 9..12 GPM hydraulic supply and a minimum 6 gallon receiver recommendation. Specify two purpose-built 10 gallon receiver tanks as a starting layout: protected suspension reserve and service-air reservoir, with check/priority valves and independent drains.

Add aftercooler/dryer appropriate to duty, pressure switch, pressure protection, certified receiver relief valves, regulator and service hose reel. Setpoints are selected with the suspension/receiver manufacturers; 120..150 psi is a planning range, not a license to set any tank or air spring to 150 psi.

Install a smaller automatic 12/24 V maintenance compressor that can maintain parked suspension reserve without starting the Honda. Include emergency external fill port. Service air cannot exhaust the protected suspension reserve. Because road brakes are EOH hydraulic, suspension-air loss is not brake-air loss; it can still cause ground-clearance and handling problems.

Independent rear stabilizers carry loading reactions. Suspension dump / kneel must be deliberately enabled only on firm level support, with adequate tire/deck clearance and no axle movement while personnel are in a pinch zone.

15 Road brakes and brake independence

Road braking uses a matched 12 V electric-over-hydraulic actuator and six hydraulic disc wheel-end brake assemblies. All three axles have brakes. D160/actuator supplier must approve total caliper displacement, line length, pressure, response, duty and brake-controller compatibility. A generic actuator advertised for three light axles is not automatically sufficient for three 16K axles.

Disc systems often use a 1,600 psi class actuator, but use the exact wheel-end and actuator specifications. Do not reuse lift-system pressure or oil. Brake lines get DOT-appropriate tubing/flex hoses, guarded axle-drop loops and separately routed fittings. Confirm ABS requirements and an integrated solution at this trailer's final classification and GVWR.

Keep a dedicated brake/breakaway battery, charging path and disconnect arrangement that cannot be disabled by the house/master light switch. Breakaway must operate with engine off, empty house battery, failed wireless remote and truck disconnected. Battery size and required hold duration follow the approved braking system and applicable rules.

Wireless control governs stationary hydraulic machinery only. It must never modulate the service brakes. Truck brake-controller signal and dedicated breakaway switch are hardwired. Include diagnostic indication and physical mechanical parking/anti-roll provisions approved by the axle maker, plus correctly sized wheel chocks.

16 Cargo anchors, rails and decking

Provide two recessed longitudinal cargo-track lanes on each of upper, main and tail decks: 106 ft nominal total (2*53), subject to hinge cutbacks and local machining. Use a load-rated manufacturer system with fittings matched to the rail. Light cargo track serves light cargo; equipment chains attach to separately rated frame anchors.

Provide 4 in strap slider rails along both sides of all three zones. At maximum 40 in spacing, planning station counts including end locations are 4 per side upper, 11 per side main and 5 per side tail: 40 strap stations total. Final stations may be relocated around locks, hinges and tires while preserving access. Add edge protectors and positive strap stowage.

Initial anchor target: 24 heavy frame-tied D-rings total: 16 main, 4 tail, 4 upper, with upper rings separately limited by neck capacity. Add 24 reinforced chain-slot modules, primarily along the main rails. Target WLL is assigned from directional anchor proof and load path, not from ring size alone.

TB260/TL12 loads individually over 10K require heavy-equipment securement planning. FMCSA guidance calls for at least four tiedowns for wheeled/tracked heavy equipment plus appropriate securement of accessories. Check aggregate WLL, direction and all accessory restraint; do not count the winch cable as a tiedown.

Deck surface candidate: serviceable treated hardwood or engineered plank center, reinforced steel traction lanes at tire/track paths, sealed recessed-track drainage and bolt-access panels. Ground-contact tail/toe receives replaceable serrated traction grating. Pick plate/plank sizes only after local track pressure and axle-entry calculations.

17 Lighting inventory and camera placement

Item	Quantity target	Placement / control
Road stop/turn/tail groups	4 groups	Protected rear beam; approved visibility and mounting
Rear identification lamps	3	Center rear cluster for wide trailer
Front/rear clearance lamps	4	Outer corners; required color by position
Side road markers	20	About 10 per side; legal road-lighting plan governs
Plate lamp	1	Protected rear license location
Flush load floods	8	Four per side, aim inward/down; stationary enable
Underdeck service floods	6	Bay, legs, axle service areas; separately switched
Tail/loading floods	4	Shielded ramp hinge and underside aiming at ground
Portable magnetic floods	4	Tethered removable pods; charged in flush stow lockers
Amber warning modules	8	Rear four / side four; approved emergency/loading use
Rear backup camera	1	Center rear, guarded lens with cleanout access
Upper-side down/back cameras	2	Left/right upper outer rear corners
Upper cargo camera	1	Upper forward frame, aims rear/down
Main cargo overview	1	Protected neck, watches main deck and chains
Tail/bridge loading camera	1	Views hinge/bridge clearances; no safety interlock credit

18 Electrical architecture and energy budget

Separate three domains: 12 V road lighting and brakes; 24 V house lighting/cameras/control; engine start/engine ECU supply per Honda. Use a documented ground/bond plan, dedicated return conductors and protected chassis bonds. Wireless/video failure does not disable road lighting or breakaway braking.

House battery candidate 24 V 100 Ah (2.4 kWh nominal), with protected BMS, temperature monitoring and a main fuse placed close to the battery. If 12 V batteries are placed in series, both must explicitly permit series use. Charger/source chemistry must match. Initial 80% usable-energy assumption gives 1.92 kWh.

Loading-light budget: 8x25W overdeck + 6x15W underdeck + 4x25W ramp + 4x15W portable charging = 450 W. Cameras/control allowance 70 W gives 520 W full-use demand, or 21.7 A at 24 V. Ideal useful runtime is about 3.7 h at that load, before cold/aging/conversion effects. Road lights are on their separate circuit.

Honda charging coil is not a large house alternator. Keep its intended engine-start/ECU duties unless the engine package supplier approves more. Candidate house charging: shore charger, fused isolated truck DC-DC charger sized to actual available supply, optional 400W solar and a belt-driven alternator only after shaft/accessory-load analysis.

Every branch gets an individual fuse matched to conductor ampacity and device inrush. Preliminary branch current estimates do not establish final fuse sizes. Compute voltage drop using actual round-trip length, copper resistance and continuous load. For a 100 ft loop at 5 A, 12 AWG copper at roughly 1.59 ohm/1000 ft drops 0.795 V, about 6.6% of 12 V; a long lighting run may need larger wire or multiple feeds.

Use sealed automotive connectors, tinned copper where appropriate, junction boxes with drip loops, mechanical strain relief and abrasion protection. Camera data and antenna leads avoid high-current motor/actuator wiring. Use wired Ethernet/AHD or industrial video links along the trailer with a wireless truck bridge if wanted; consumer wireless alone is poor assurance over 53 ft of steel.

19 Wireless controls, sensors and state machine

Industrial radio candidate families include safety-oriented mobile-machine controls from established suppliers; choose a current supported system with hold-to-run, authenticated pairing, defined loss-of-link response, emergency stop and wired backup. This document does not claim a Performance Level or SIL. Establish the necessary architecture from a machinery risk assessment.

Inputs: speed/parked verification; truck coupling status; all deck angles; bridge extended/stowed/seated; left/right lock engagement; landing-leg and stabilizer positions/loads; axle-up/down; air pressure; hydraulic pressure/temperature/level; battery voltage and optional payload/axle load sensors.

Outputs: proportional valve commands, enable/unload valve, engine start/stop permission, controlled RPM request, lock-release valves, air compressor request, axle-lift request and separate loading-light modes. Brake-controller and breakaway circuits bypass the motion controller.

ROAD state requires main/upper/tail locked, bridge stowed, legs/stabilizers retracted, loose lamps stowed and correct suspension ride state. Motion commands inhibited at road speed. EMPTY LIFT is a substate with calibrated load and hitch checks; it is not a default because the trailer is empty.

PREPARE LOADING requires stationary confirmation, firm level support, wheels/chocks and stabilizer placement according to the approved support plan. TAIL DOWN then MAIN LOAD or TRANSFER ALIGN follow. TRANSFER ALIGN verifies angle match and bridge bearing before granting creep winch movement.

Loss of radio: stop commanded movement and hold all loaded structures using local valves; a restart requires deliberate re-enable and fresh command. A stuck valve, sensor disagreement or one-sided deck motion triggers a safe stop with retained support. Camera pictures do not prove the bridge is seated. Use hard sensor confirmation and visible checks.

The remote has one deliberate active motion mode, labeled deck selection, proportional slow/fast command, lock-release hold and E-stop. Do not combine a deck unlock and uncontrolled lowering in one unlabeled button. Logs capture commands, sensed state, faults and completed lock confirmation for the OS service record.

20 Operating sequence and failure cases

Step	Required action	Failure response
1	Park, inspect ground/clearance, establish support/chocks	Abort if support or truck hitch reactions are unknown
2	All axles down; suspension at loading state	Inhibit motion on axle/suspension disagreement
3	Unload tail locks, release, lower tail under control	Local holding valves retain load on hose/radio fault
4	For main loading choose validated tilt angle and load envelope	Stop on asymmetric cylinder travel
5	For upstairs transfer align main and upper near 4.345 deg	Bridge remains retracted until both angles verified
6	Extend bridge; verify both bearing seats; move one small machine	Stop winch on overload or bearing loss
7	Secure upper load; clear bridge and articulation; retract bridge	Do not tilt with machine straddling joint
8	Return upper/main/tail onto seats; confirm each road lock	Road-ready remains blocked if any side fails
9	Retract support hardware, stow lamps, inspect brakes and chains	Manual inspection before movement
10	Measure truck/trailer axle loads for first load map trials	Reduce load or change tow vehicle if any limit exceeded

21 Loaded layout plans

Heavy rendering: one nice enclosed-cab TB260 and one enclosed-cab TL12V2 on the main deck, upper and tail empty. Published transport lengths approximately 18 ft 2.5 in and 13 ft 3.3 in sum to about 31.48 ft. Only 1.52 ft remains in a 33 ft nominal zone before hinge clearances and accessory changes. A real fit needs measured transport dimensions, machine orientation, bucket placement and safe separation.

Example footprint on main: TB260 from x=8.5 to 26.71 ft; TL12V2 from x=27.21 to 40.49 ft. CGs used earlier are assumptions inside those footprints. The heavy visual is a commercial-tow concept and is not an F-450-approved scene.

Mini fleet rendering: three small tracked excavators on main, one stand-on mini skid on main, one compact stand-on mini skid upstairs. Assumed main lengths 8 ft each plus a 6 ft skid with spacing fit within 33 ft only if measured boom/bucket configurations match. Upper mini skid assumed 6 ft footprint. Small-machine masses are placeholders until OS records and actual scales confirm.

Do not put the TB260 or TL12 on the upper deck. Do not carry a 13K TL12 on a tail with a preliminary 10K carrying target. Loaded road travel has every platform horizontal and mechanically locked, with front axle down. Check roof/bucket height above the 72 in upper deck and the complete road-height limit.

22 Procurement strategy and budget allowances

The CSV BOM lists system quantities and engineered requirements. Entries labeled candidate require supplier acceptance; fabricated entries need released drawings. Hoses, wire, hardware and steel allowances are estimating quantities. No final cut list or purchase-ready fastener/pin schedule is issued before structural sizing.

R0 planning allowances, not vendor quotes: frame/moving decks 28..45K USD; running gear/lift/brakes/tires 22..35K; hydraulic engine/pump/winches/cylinders/manifolds 20..35K; compressor/air supply 6..12K; electrical/control/cameras/lighting 8..16K; anchors/finish/guards 5..10K. Material/subassembly subtotal roughly 89..153K. Individual BOM allowances may differ as scope is refined.

Engineering and testing allowance 15..35K; custom fabrication 600..1,000 hours at an illustrative 100 USD/h = 60..100K; contingency 15..25% on the defined procurement/fabrication scope. This can readily become a 190..350K one-off project. A specialist trailer manufacturer may improve integration and price. Quotes, in-house labor and design simplification decide the real budget.

Buy complete rated running gear and brakes as a package. Design the rest around validated tire clearance and suspension height. Do not buy loose axles first then discover the lift/suspension/EOH combination cannot be approved. Obtain matching CAD and rated mount loads before frame release.

23 Engineering release gates and prototype plan

Gate	Deliverable / evidence
G1 Truck and connection	Actual F-350/F-450 VIN/config labels; hitch install spec; commercial truck alternative; scale weights
G2 Geometry	3D assembly; 53 ft envelope; turn/pitch/roll cab sweep; tire jounce; all deck swept volumes
G3 Structure	Load matrix; beam/local/anchor/hinge/pin calculations; fatigue assessment; qualified weld procedures
G4 Hydraulics	Actuator force vs angle/stroke; buckling; pressure-spike and hose-burst response; heat balance
G5 Running gear	OEM D160/DexAir lift acceptance; tire/wheel match; axle load sharing; lift logic
G6 Braking	EOH system validation, ABS/classification, controller compatibility, breakaway and stopping tests
G7 Controls	Fault tree; safety architecture; single-fault tests; loss-of-link/stuck valve/sensor disagreement
G8 Certification	Applicable FMVSS/label/VIN/state title, rear guard, road lamps and route assessment
G9 Prototype	Empty motion, ballasted incremental loads, independent calibrated reactions, lock proof and NDT
G10 Release	Rated load map by deck/state, inspected drawings, torque/weld schedule, user/service manuals

24 Florida use and transport classification

Florida 316.515 distinguishes straight-truck/trailer combinations from truck-tractor/semitrailer combinations. The statute lists 68 ft overall for a straight truck with trailer and specific longer-semitrailer conditions. A pickup gooseneck must not be assumed to receive the same length treatment as a commercial tractor/semitrailer.

The published 2025 statute allows some semitrailers over 48 ft up to 57 ft under conditions including kingpin-to-rear-group geometry and rear underride protection. Confirm current classification and route application with FDOT/state authority for the actual build. A 53 ft trailer plus a pickup could create an overall-length issue even before weight.

Final rear guard must work with the tail-down mechanism. A folding/retracting guard needs positive road-position retention and a valid compliance assessment. The rear guard cannot be merely omitted because it interferes with loading. Required road lamps/reflectors remain visible and operational with the tail locked for travel.

At this size, evaluate commercial registration, brake standards, licensing and route/bridge constraints for the actual use. This report identifies design inputs; it does not issue a legal route approval.

25 Supplier RFQ questions and next decisions

Recipient / decision	Exact question
Dexter or rated package supplier	Can you supply three D160 dual-wheel hydraulic-disc / DexAir axles with an approved forward lift axle at 54 in centers, plus matched EOH/ABS? Supply drawings, mount loads and pressure/volume requirements.
Hydraulic integrator	Can the iGX800 package support 8 GPM at 3K plus 9 GPM H40 mode, with no heavy simultaneous demand and required cooling?
Structural trailer engineer	Can 40K main payload be carried and tilted in the proposed 33 ft rear-pivot layout, and what CG/point-load restrictions are required?
Cylinder supplier	Quote cylinders only after force/stroke/column curves, mounting geometry and duty are supplied.
Trailer builder	Quote complete fabrication/certification with a 53 ft external envelope and three separately locking decks.
Owner decision	Choose full heavy-haul dream baseline or additionally develop a lower-tare pickup derivative.
Owner measurement	Truck hitch-to-cab/tailgate clearances; actual truck labels; machine footprints/weights; desired upper cargo maximum.

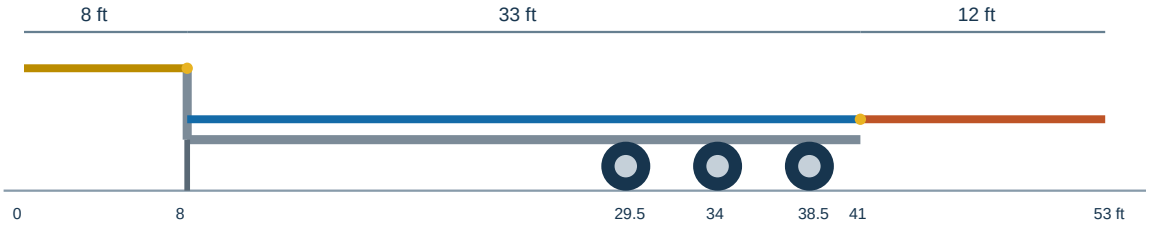
26 Source register

ID	Primary source / accessed 1 Oct 2026
S1	Dexter D160: https://www.dextergroup.com/d160
S2	Honda iGX800: https://engines.honda.com/models/model-detail/igx800
S3	VMAC H40: https://www.vmacair.com/product/hydraulic-driven-air-compressors/40-cfm-hydraulic-air-compressors
S4	Ford F-450: https://www.ford.com/trucks/super-duty/2026/models/f-450-xl/
S5	FHWA bridge formula: https://ops.fhwa.dot.gov/freight/publications/brdg_frm_wghts/index.htm
S6	Florida 316.515: https://www.flsenate.gov/laws/statutes/2025/316.515
S7	Takeuchi TB260 weight: https://www.takeuchiglobal.com/en/products (manufacturer product listing); archived U.S. brochures may have moved.
S8	Takeuchi TL12V2 dimensions/weight: https://www.takeuchi-mfg.co.uk/tl12v-2-compact-loader/ (UK configuration; verify actual U.S. transport setup).
S9	FMCSA securement: https://www.fmcsa.dot.gov/regulations/cargo-securement/cargo-securement-rules
S10	Ramsey RPH20K: https://www.ramseyindustries.com/ramseywinch/product/rph-20000/
S11	Ramsey H-246: https://www.ramsey.com/product/h-246/
S12	Diamond C FAQ: https://www.diamondc.com/faq/
S13	NHTSA manufacturer portal: https://vpic.nhtsa.dot.gov/mfrportal/
S14	Hendrickson liftable comparison: https://www.hendrickson-intl.com/products/intraax/intraax-aal

P01 deck geometry

P01 | Deck geometry and operating states

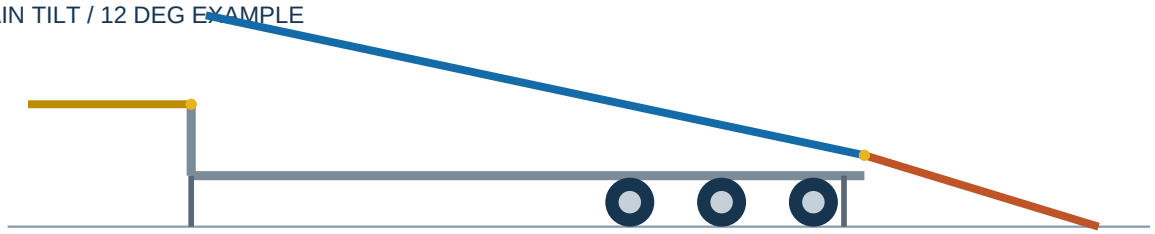
ROAD / LOCKED



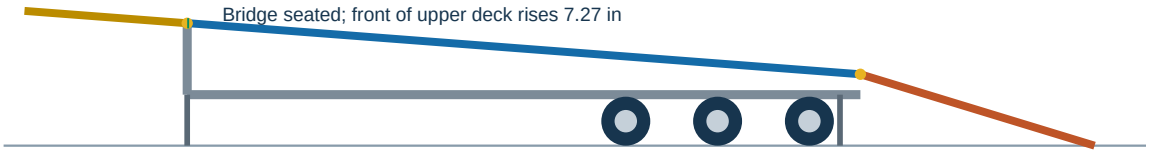
TAIL DOWN



MAIN TILT / 12 DEG EXAMPLE



UPPER TRANSFER / 4.345 DEG

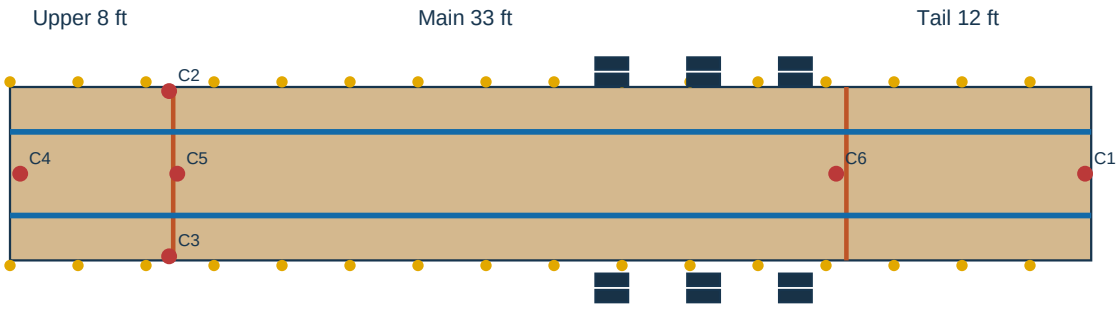


Concept dimensions only. Hinges, cylinder linkage, cab clearance and load ratings require engineering release.

Schematic concept drawing. Dimensions and topology define the R0 concept; component sizes and construction details remain unreleased.

P02 top layout

P02 | Equipment, light and cargo-track plan



Blue: two recessed track lanes per deck. Yellow: strap stations, approximately 40 in maximum spacing.

Red C1 rear; C2/C3 upper side down/back; C4 upper cargo; C5 main cargo; C6 bridge/tail overview.

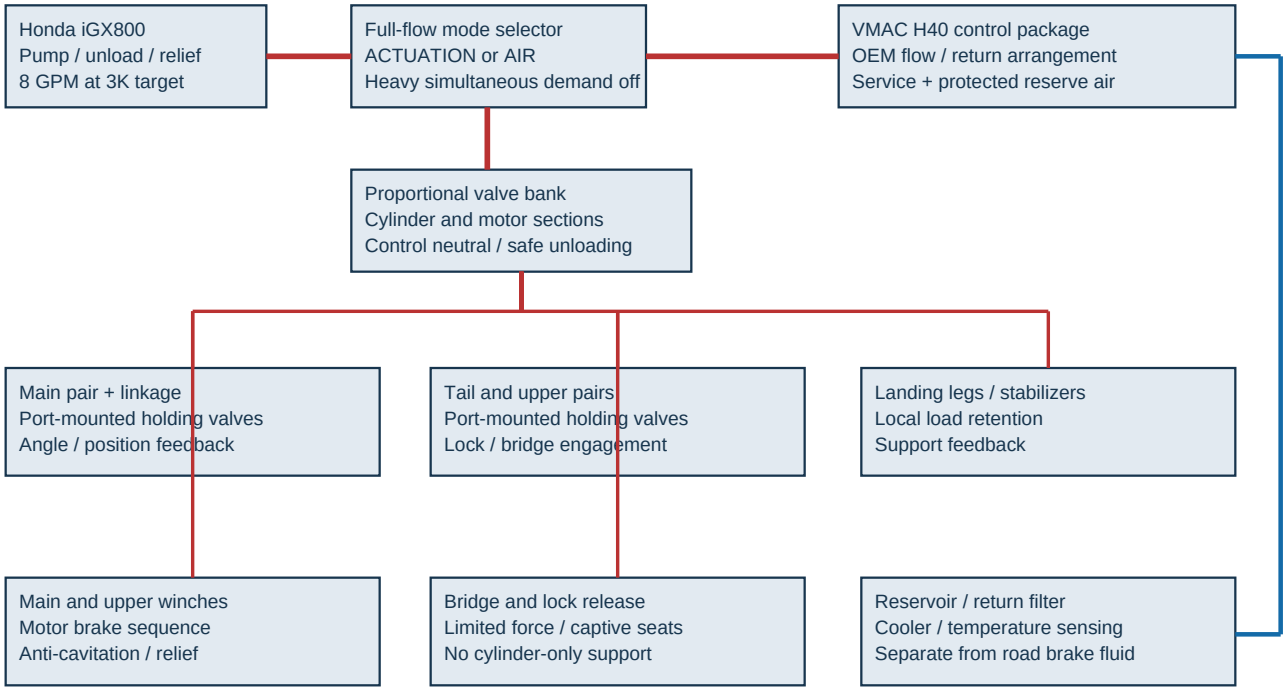
12 road tires: 3 axles x 2 ends x 2 tires. Wheel track/clearance shown schematically, not order dimensions.

All fixed hardware stays inside the approved 102 in envelope. Road lamps separate from loading floods.

Schematic concept drawing. Dimensions and topology define the R0 concept; component sizes and construction details remain unreleased.

P03 hydraulics

P03 | Hydraulic architecture - functional concept



Red paths are pressure selection topology, blue path represents return. Actual ISO valve symbols and port map are unreleased.

All loads need locally engineered retention. Synchronization, return backpressure and compressor mode require supplier validation.

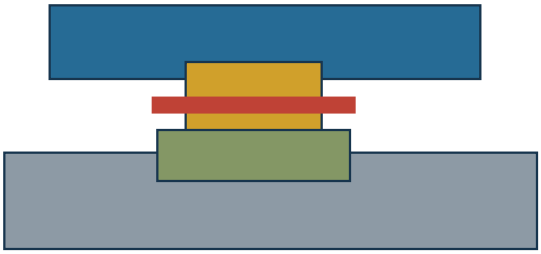
Road brakes are an independent EOH brake-fluid circuit; wireless control never operates service brakes.

Schematic concept drawing. Dimensions and topology define the R0 concept; component sizes and construction details remain unreleased.

P04 mechanical locks

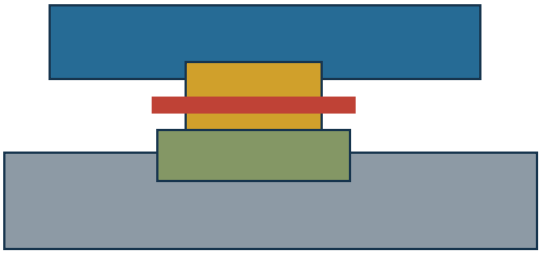
P04 | Positive mechanical lock and load-seat concept

TAIL ROAD LOCK



Deck lands on reinforced seat / saddle.
Captive pin restrains release in double shear.
Both sides sensed; unload before unlock.

MAIN / UPPER ROAD LOCK



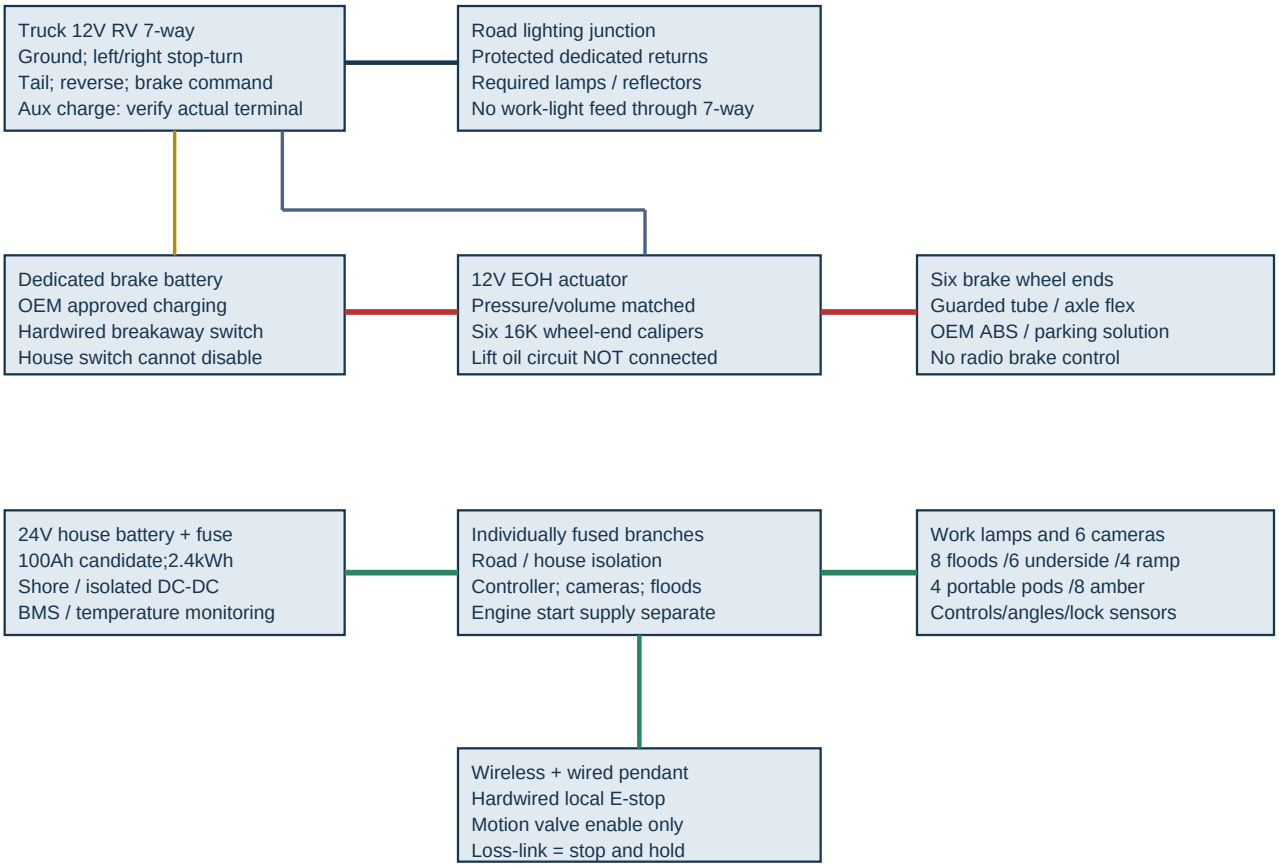
Deck lands on reinforced seat / saddle.
Captive pin restrains release in double shear.
Both sides sensed; unload before unlock.

Concept only: no pin diameter, lug thickness, weld size or load rating is released. Maintenance props are separate.

Schematic concept drawing. Dimensions and topology define the R0 concept; component sizes and construction details remain unreleased.

W01 US system architecture

W01 | Ironclad 53 wiring branch - U.S. functional architecture



This is a system branch, not a universal pin-position diagram. Use molded terminal functions and the exact harness manual.

Final conductor gauge/fuses require actual load, route length, device inrush and voltage-drop calculations.

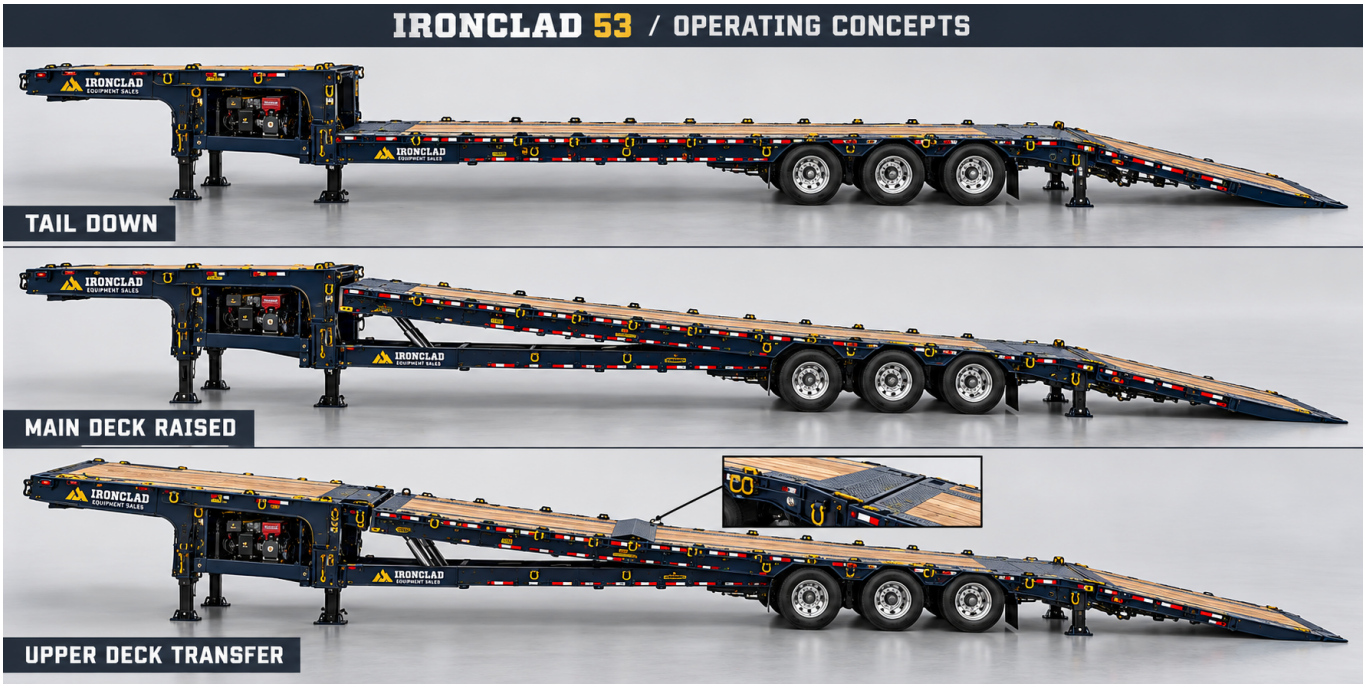
Schematic concept drawing. Dimensions and topology define the R0 concept; component sizes and construction details remain unreleased.

Six-angle empty trailer concept



Illustrative rendering. Perspective, proportions, visible cylinders and anchor arrangements are not fabrication geometry. Use the measured R0 schematic and load calculations. Loaded renderings do not approve any tow vehicle.

Requested hydraulic operating states



Illustrative rendering. Perspective, proportions, visible cylinders and anchor arrangements are not fabrication geometry. Use the measured R0 schematic and load calculations. Loaded renderings do not approve any tow vehicle.

Mini fleet and enclosed-cab TB260 / TL12V2



Illustrative rendering. Perspective, proportions, visible cylinders and anchor arrangements are not fabrication geometry. Use the measured R0 schematic and load calculations. Loaded renderings do not approve any tow vehicle.

Empty lift axle and night loading



Illustrative rendering. Perspective, proportions, visible cylinders and anchor arrangements are not fabrication geometry. Use the measured R0 schematic and load calculations. Loaded renderings do not approve any tow vehicle.

Appendix: 87-line procurement BOM

CSV companion retains quantities, units, specifications, release status and source fields. Quantities marked allowance are preliminary. No fabricated member, cylinder or mounting pin is purchase-ready until engineering release.

ID	Item	Qty / unit	Requirement
FR01	Fixed main chassis rail set	1 assembly	33 ft zone; engineered section and neck load path
FR02	Gooseneck / upper support weldment	1 assembly	8 ft upper zone; verified cab/bed swept clearance
FR03	Main tilt deck rail set	1 assembly	33 ft nominal; 40K load envelope; saddle/shear-key load path
FR04	Main deck crossmembers	34 allowance	About 12 in spacing; final count and section from track loading
FR05	Hydraulic tail weldment	1 assembly	12 ft; 14K traversal / 10K carry design targets
FR06	Tilting upper platform	1 assembly	8 ft; 4K provisional load target
FR07	Telescoping transfer bridge	1 assembly	24 in plate; 0..12 in extension; captive slide and seated toe
FR08	Replaceable ground toe	1 option	24..36 in extension; road stow latch; does not enlarge transport envelope
FR09	Pivot / hinge assemblies	3 sets	Main/tail coaxial concept; upper rear hinge; sizes unreleased
FR10	Decking and traction lanes	451 sq ft allowance	53x8.5 ft nominal; includes upper; hinge gaps reduce actual area
FR11	Machinery bay enclosure	1 assembly	72x36x30 in candidate; vented, removable, guarded exhaust
FR12	Rear road guard	1 assembly	Compatible with tail travel; positive road latch; compliance review
RG01	D160 16K axle / hydraulic disc / DexAir package	3 assemblies	Dual-wheel compatible; hubface and mount centers by OEM
RG02	Forward axle lift mechanism	1 assembly	Approved for selected suspension; NOT a generic retrofit
RG03	Dual-wheel tires and wheels	12 sets	Matched OEM hub pattern; adequate dual-load rating at specified pressure

Procurement BOM (continued)

ID	Item	Qty / unit	Requirement
RG04	Spare tires and wheels	2 sets	Same as road wheels; crane/handling plan
RG05	TPMS sensors	14 units	12 road + 2 spare; remote display compatible
RG06	Ride-height / air management	1 system	Load-calibrated pressure sensing; dump and lift interlocks
BR01	EOH hydraulic brake actuator	1 matched system	12V; six 16K wheel-end calipers; volume/pressure/response approved
BR02	Brake tube / flex / fittings	1 route kit	Separate brake-fluid system; full axle-drop loops; ABS decision
BR03	Breakaway battery / charger / switch	1 kit	Independent from house shutdown; OEM battery sizing and hold time
BR04	OEM-compatible parking provision	1 system	Matched wheel-end design; chocks supplement
BR05	Heavy wheel chocks	4 units	Sized for actual dual wheels and loading conditions
HY01	Honda iGX800 EFI engine	1 unit	24.9 net hp at3600; electric start; vented package
HY02	Pump and shaft coupling	1 assembly	12 GPM max low pressure / 8 GPM at3K target; verify torque
HY03	Hydraulic reservoir	1 unit	40 gal shell /30 gal working allowance; baffles/filter/breather
HY04	Hydraulic cooler	1 system	25..40K BTU/h allowance; final heat balance; 24V fan
HY05	Return filter	1 assembly	10 micron starting target; clog indicator; final maker cleanliness
HY06	Main deck cylinders	2 custom units	8..10 in bore comparison ONLY; rod/stroke/linkage not released
HY07	Main deck synchronizing linkage	1 assembly	Bellcrank/scissor geometry; effective arm force curves

Procurement BOM (continued)

ID	Item	Qty / unit	Requirement
HY08	Tail cylinders	2 custom units	Force/stroke from14K traversal and loaded tail envelope
HY09	Upper deck cylinders	2 custom units	4K target;7.273 in front rise at transfer; sweep validation
HY10	Bridge cylinder	1 custom unit	Low-force extension; plate bearings carry payload
HY11	Hydraulic landing legs	2 assemblies	Full hitch/support reaction envelope with holding valves
HY12	Rear loading stabilizers	2 assemblies	Near rear pivot; ground-bearing and side loading verified
HY13	Main hydraulic winch	1 unit	Ramsey20K-class; first-layer rating; mount designed to pull reaction
HY14	Upper hydraulic winch	1 unit	8K-class candidate; pull limited to upper/bridge envelope
HY15	Proportional actuation valve sections	8 sections	Main/tail/upper/bridge + independent legs/stabilizers
HY16	Motor valve sections	2 sections	Winches; brake-release/anti-cavitation sequencing
HY17	Compressor selector / control manifold	1 set	OEM full-flow supply; mutually exclusive heavy motion
HY18	Lock-release valve sections	6 allowance	Each side of three moving decks; confirm mechanism type
HY19	Cylinder-local load-holding valves	10 units allowance	Main2/tail2/upper2/legs2/stabilizers2; exact circuit by maker
HY20	Hydraulic hose / hard tube	250 ft allowance	Cut lengths after routing; pressure/temp/impulse rated
HY21	Fittings / clamps / sleeves	1 allowance	No purchase-ready port schedule until components frozen
HY22	Oil initial fill	35 gal allowance	Maker viscosity and cleanliness; includes lines/top-up

Procurement BOM (continued)

ID	Item	Qty / unit	Requirement
LK01	Main road lock / saddle set	1 set	Load seats + shear keys + paired positive uplift locks
LK02	Tail road lock set	1 set	Paired tapered shoes; captive double-shear pins; unload-before-release
LK03	Upper road lock set	1 set	Neck seats + paired positive locks
LK04	Maintenance props	3 sets	Rated captive supports for each deck, outside-zone installation
LK05	Bridge and portable-light stow latches	1 set	Secondary retention and road-ready indication
AR01	VMAC H40 hydraulic compressor	1 package	25..40CFM class;9..12GPM supply; verify selected model duty
AR02	Air receivers	2 units	10 gal each starting layout; certified tanks; protect suspension reserve
AR03	Maintenance electric compressor	1 unit	Auto parked reserve; electrical budget/rated pressure
AR04	Air priority/check/dryer/regulator	1 set	Suspension protected from tool demand; independent drain/relief
AR05	Service hose reel	1 unit	1/2 in class; length by actual service reach; shutoff
AR06	External emergency fill port	1 unit	Check valve and labels; protected connection
CA01	Recessed cargo track	106 ft nominal	Two longitudinal tracks across each deck zone; final hinge cutbacks
CA02	Cargo track fittings	24 units allowance	Matched track; stamped WLL and load-direction limits
CA03	4 in sliding strap stations	40 units allowance	Max about40in spacing; upper8/main22/tail10 total stations
CA04	Strap slider rails	106 ft nominal	Both edges of all zones; separate from cargo-track quantity

Procurement BOM (continued)

ID	Item	Qty / unit	Requirement
CA05	Heavy D-rings	24 units	16main/4tail/4upper; rating from entire frame path
CA06	Reinforced chain-slot modules	24 units	No primary flange cutouts; radiused openings
CA07	Rub rails / stake pockets	1 set	Within102in envelope; engineered attachment
CA08	Chains / binders / edge guards	1 securement kit	Final WLL and quantity by actual machines and tie geometry
EL01	24V100Ah house battery	1 assembly	2.4kWh nominal; approved BMS/chemistry; main fuse
EL02	House charging sources	1 set	Shore+isolatedDC-DC; optional400W solar; Honda start supply separate
EL03	Road-lighting / 7way harness	1 set	Function-tested U.S. RV7way; molded terminal names; exact model schedule
EL04	Sealed fuse/junction harness package	1 set	Protected circuits, dedicated returns, exact gauge calculation
EL05	Industrial wireless / wired control	1 system	Hold-to-run; local E-stop; loss-link safe hold; no brake radio control
EL06	Sensors and controller	1 system	Angles,lockengagement,bridgebearing,axle/air,pressure/temperature
LI01	Rear stop/turn/tail groups	4 groups	Road-approved arrangement and visibility
LI02	Rear identification lamps	3 units	Required spacing/visibility for wide trailer
LI03	Corner clearance lamps	4 units	Approved color/location
LI04	Side marker lamps	20 units target	About10each side; road requirements take precedence
LI05	License lamp	1 unit	Road-approved protected rear mount

Procurement BOM (continued)

ID	Item	Qty / unit	Requirement
LI06	Flush overdeck floods	8 units	25W planning each; inward/down stationary use
LI07	Underdeck floods	6 units	15W planning each; protected service positions
LI08	Tail/loading floods	4 units	25W planning each; protected downward throw
LI09	Magnetic portable light pods	4 units	15W charging allowance; tethered; flush lockers
LI10	Amber warning modules	8 units	Loading/emergency approved use; independent mode
VI01	Rear camera	1 unit	Guarded center rear; replaceable lens guard
VI02	Upper side cameras	2 units	Down/back left and right
VI03	Cargo / loading cameras	3 units	Upper cargo/main cargo/bridge-tail overview
VI04	Video recorder / display link	1 system	Wired trailer backbone; truck display bridge; no safety-interlock credit
FI01	Coating and corrosion package	1 lot	Blast/prime/topcoat; serviceable underbody; drainage
FI02	Reflective tape / labels / ID	1 lot	Required markings and rated labels after release
FI03	Hardware / guards / service access	1 lot	Final bolt grades/torques/welds via released drawings