

The logo for Knoxville Locomotive Works (KLW) features the letters 'KLW' in a bold, white, sans-serif font. The letters are set against a dark green rectangular background that has a yellow border. The background of the entire page is a dark grey with faint white line drawings of various mechanical and electrical components, including panels, switches, and gauges.

KLW

Locomotive Specification

Buyer Name

KLW DC/AC Locomotive



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1 Project Information

- 1.1 Customer: TBD
- 1.2 Locomotive Type: KLW DC/AC Locomotive Conversion
- 1.3 Quantity of Locomotive(s): 1
- 1.4 Frame: TBD
 - 1.4.1 TBD
- 1.5 Trucks: HTC-R [or HI-AD]
- 1.6 Contract Number: TBD
- 1.7 Purchase Order Number: TBD
- 1.8 Equipment Specification Revision:
- 1.9 Revision Date:
- 1.10 Specification Acceptance (Customer Initials): _____
- 1.11 Acceptance of Specification by KLW (KLW Initials): _____

2 Introduction

This Specification is approved for use by the _____, Engineering and Quality Assurance Departments.

The Federal Railroad Administration (FRA) issues numerous Notices of Proposed Rule Making (NPRM) which are reviewed by the industry. The locomotive manufacturer is to keep themselves aware of all required changes. The affected sections within this specification are to be covered and meet FRA requirements at the time the new rule takes effect. These changes will have to be incorporated, as required per the Code of Federal Regulation (CFR), at the time new requirements take effect. Commercial impact of these changes will need to be reviewed by the supplier and end-user for price effect to the equipment.

3 Specific Definitions

To avoid undue repetition, the following terms, as used in this specification, shall be construed as follows:

- a. AAR means Association of American Railroads.
- b. "Acceptable / successful delivery" means locomotive meet all requirements indicated herein for delivery and inspection.
- c. AISI means American Iron and Steel Institute.

- d. ASME means American Society of Mechanical Engineers.
- e. AWS means American Welding Society.
- f. CFR means Code of Federal Regulations.
- g. FRA means the Federal Railroad Administration.
- h. "Mechanically and operationally identical" means the chassis of the locomotive may differ while still meeting Specification parameters but engine and other mechanical and moving parts are identical between each locomotive. Spare parts for these units shall be interchangeable among the locomotive.
- i. _____ means the legal entity _____
- j. KLW means the Knoxville Locomotive Works, Inc.

4 Compliance

As applicable, the locomotive must satisfy the following:

- a. AAR Interchange Rules
- b. AAR Manual of Standards and Recommended Practices Section-M, Locomotive and Locomotive Equipment
- c. AISI standards
- d. ASME, Boiler and Pressure Code Section IX, Welding Qualifications
- e. AWS, D 15.1 - Railroad Welding Specification
- f. CFR, Title 49, Transportation
- g. FRA regulations
- h. The Official Railway Equipment Register

5 Work Required by the Specifications

Delivery destination for the locomotive is **City, State** and will be defined by **Buyer** to KLW at least 30 days prior to delivery availability from the Knoxville, Tennessee locomotive manufacturing facility. Seller shall be responsible for paying the cost for the transportation of the Locomotive by rail from Seller's site in Knoxville, Tennessee to Buyer's premises in **City, State**. Buyer shall assume responsibility for risk of loss for the Locomotive while in transport from Knoxville, Tennessee to the Buyer's premises in **City, State**. Buyer shall provide adequate insurance to cover such risk of loss thereafter at the project site until Seller has received full payments and applicable taxes for the Locomotive. Title to the Locomotive shall pass to Buyer upon receipt of full payment of the Purchase Price for the Locomotive plus applicable taxes.

6 Technical Requirements/General Information

General Configuration Requirements

- a. Refurbished locomotive with DC/AC conversion.
- b. Emissions - Each locomotive shall be in compliance with the US EPA refurbished Locomotive Standards (40 CFR Parts 92 and 1033) and EPA certified as received.
- c. Enerpro charging system
- d. NYAB oil free air compressor availability.
- e. Locomotive weight is to be 430,000 LBS, +/- 3%.
- f. Starting tractive effort of 188k lbf +/- 3%

- g. Chassis is not to exceed a nominal 74 feet length, end sheet to end sheet.
- h. AAR standard type F alignment control couplers with type 390/391 alignment control draft gear to be inspected and free of defects. If defects are found, they will be replaced with new or requalified couplers of the same type.
- i. HTC-R [or HI-AD] trucks with single shoe brake rigging, high friction shoes, and outboard/inboard sanders
- j. Conform to AAR Plate-M clearance dimensions.
- k. AAR S-5506 Fuel tank. Fuel tank capacity shall be approximately 4,200 gallons. DEF tank shall be approximately 300 gallons when necessary.
- l. Traditional wide cab design per AAR Rules and Regulations as applicable to remanufactured locomotive.
- m. Traditional line haul car body (short hood end = "front").
- n. KLW shall provide three different manuals: 1. Operator's Manual; 2. Service & Maintenance Instructions Manual; 3. Parts Manual.
- o. KLW shall provide locomotive operator and maintenance training at location of delivery, as outlined in Section 18, "Training Requirements ". Training requirements include hands-on operations with on-site personnel.

7 MAINTENANCE

- 7.1 The locomotive will be designed to generally support a 184-day maintenance plan.
 - 7.1.1 Air, Fuel, and Oil filters are sized with capacities to allow for 184 days in typical usage between change-out. Fuel and air filters may need to be changed at 92-day intervals dependent on the quality of fuel being delivered to the project site and air ambient quality. Locomotives that apply for the 184 day inspection intervals must also complete 33 day mechanical inspection (Title 49 Part 229.23).

8 FRAME

- 8.1 The frame shall be stripped, steam cleaned, media blasted, and primed.
- 8.2 The frame shall be reinforced and ballasted as necessary to meet weight requirements and balance as outlined in the technical requirements of this specification.
- 8.3 End sheets will be repaired or replaced as needed and will be equipped with adjustable pilot plates.
Standard thickness ¼"
- 8.4 Step skirts and steps will be requalified and replaced as necessary (49CFR231.30).
- 8.5 Coupler pockets will be repaired or replaced as necessary and will be conformed to meet the draft gear requirements outlined in the technical requirements of this specification.
- 8.6 Qualified draft gears and couplers as outlined in the technical requirements of this specification shall be installed.
- 8.7 The frame shall be equipped with four jacking pads located at the longitudinal bolster centers on either side of the frame.

9 TRUCKS AND HANDBRAKE

Requalified three axle HTC-R or Hi-Ad trucks with the following features:

- 9.1 Axle/Gear/Wheel and Traction Motors
 - 9.1.1 New wheelset assemblies with "Fat 40" 41" wheelsets with a minimum 3" or better wheel.
 - 9.1.2 New CAF gear cases filled with Mobil SHC-634.
 - 9.1.3 Requalified or rebuilt GG axle bearing boxes.
 - 9.1.4 New TSA TMF 64-67-6 traction motors with new duckbills connections.
 - 9.1.5 All dog bones to be requalified.
 - 9.1.6 Requalified support bearings.
- 9.2 Brake Rigging and hand brake
 - 9.2.1 Requalified brake rigging, guides, and bushings with single shoe arrangement.
 - 9.2.2 Requalified 9 X 8 brake cylinders.
 - 9.2.3 New V-330 or equivalent hi friction brake shoes.
 - 9.2.4 An electric hand brake will be provided on the long hood end.
 - 9.2.5 Electric handbrake must be applied in order to self-load.
 - 9.2.6 Electric handbrake must not be wired hot all the time.
 - 9.2.7 Request to load with handbrake applied will result in trainline 2 (attendant call) and trainline 10 (wheelslip).
- 9.3 Springs and hardware
 - 9.3.1 Requalified coil and rubber pads.
 - 9.3.2 Requalified polymer pedestal liners to be installed.
 - 9.3.3 Requalified center bowl sleeve and retainer plate wear plate.
 - 9.3.4 Requalified traction motor blower boots to be installed.
 - 9.3.5 Qualified truck frame, center pin, steering beam, link assembly, and coil spring seats.

10 CAB

The standard steel fabricated wide body cab shall be requalified and located near the front-end of the locomotive main frame.

- 10.1 Control Stand
 - 10.1.1 Requalified desktop control stand.
 - 10.1.2 Requalified controller with dynamic brake selector.

- 10.1.3 Requalified horn valve.
- 10.1.4 Requalified sand and bell switch.
- 10.1.5 New engineer interface desktop screens (Air brake gauges and ammeter built within)
- 10.1.6 New or requalified Pulse speedometer in main electrical cabinet and conductors desktop
- 10.1.7 New Crew Alerter mounted atop the stand
- 10.1.8 Requalified indicator light cluster.
- 10.1.9 Requalified or new slide switches
- 10.1.10 Requalified or new AESS reset switch
- 10.1.11 Enclosure to include power and antenna cords. Sinclair low profile "ice skate" (aka "shark fin") antenna to be applied to cab roof within plate M requirements.
- 10.1.12 Requalified or new head light rotary control switch (center off, dim, and bright selection toward end switch is rotated towards with master on/off slide switch for each respective end).
- 10.1.13 Ditch lights shall be controlled by the headlight rotary control switch and shall be on when the headlights are on bright.
- 10.1.14 12VDC inverter.

10.2 Cab Seats

- 10.2.1 Two (2) mid-back seats with armrests mounted as follows:
 - 10.2.1.1 One (1) seat in the engineer's position.
 - 10.2.1.2 One (2) seat on the Conductor's side.

10.3 Cab Amenities (Cab layout to be approved by customer)

- 10.3.1 Clean Cab conformance standards
- 10.3.2 LED cab lights will include engineers and conductor's reading lights.
- 10.3.3 Emergency brake valve to be applied on the conductor's side of the cab.
- 10.3.4 New first aid kit (P/N HPI10PWLSL or equivalent).
- 10.3.5 FRA cab card and daily inspection card holder.
- 10.3.6 Fuse Holder.
- 10.3.7 New 20.5LB type ABC fire extinguisher and bracket.
- 10.3.8 Two (2) coat hangers.
- 10.3.9 Cab door cushion pads.
- 10.3.10 Cab door closure bars.
- 10.3.11 Flexible hinge guard on cab doors.
- 10.3.12 Padded sun visors.
- 10.3.13 Microwave with power inverter

10.4 Cab Flooring/Ceiling

10.4.1 Cab flooring to be rubber mat laminate trimmed in aluminum.

10.4.2 Ceiling material to be perforated metal.

10.5 Cab Awnings/Wind Deflectors/Doors/Windows/Wipers

10.5.1 Two (2) metal folding awnings shall be provided, one on each side of the locomotive cab.

10.5.2 Four (4) wind deflectors with full length mirrors shall be provided, two on each side of the locomotive cab.

10.5.3 Aluminum type cab doors to be applied on long hood. Short hood and interior door to stay original center cab entrance. The short hood door shall have the locking mechanism on the exterior of the door, which can be secured with a padlock. Both the front and rear cab doors shall have provisions to lock the doors from inside of the cab. A latch design will also be made available to hold both doors open.

10.5.4 Window Glass will be high impact front and rear window material and glazing according to FRA 49 CFR 223. Sliding sash windows to have Type II unitized with armrests.

10.5.5 All six wiper position to have new electric wiper motors with protective covers. Arms & blades will be new.

10.6 Nose

10.6.1 LED lighting

11 S-5506 FUEL TANK

11.1 Bottom of fuel tank to top of rail shall comply with CFR 49 requirements.

11.2 Fuel tank will have approximately 4,200-gallon diesel fuel capacity. It shall include an approximately 100-gallon capacity internal retention tank for collection of effluents which will be routed from the frame sump. An approximately 300 gallon DEF tank shall be applied when necessary.

11.3 Two Snyder Twist Lock fuel filler necks to be installed, one on each side of the fuel tank.

12 CAR BODY

12.1 Car body will be new construction including roof hatches and doors and will house the engine-alternator assembly, accessory drive assembly, compressor assembly, coolant expansion tank, and all necessary blowers and filters.

12.2 The interior of the car body shall be equipped with a new 20.5LB type ABC fire extinguisher and bracket.

12.3 Handrails will be provided on all exterior walkways.

12.4 MU crossover platforms, safety chains, break-away bars, and break-away links.

12.5 Carbody and carbody doors to be 3/16" thick

13 EXTERIOR LIGHTS AND NUMBER BOARDS

- 13.1 Step lights shall be LED and will be located to illuminate each corner switching step.
- 13.2 Platform lights shall be LED and be located at the base of the long hood nose, the end of the long hood traction motor blower duct, and the stairwell at the short hood entrance to the cab.
- 13.3 Ground lights shall be LED and will be positioned under the frame on either side of the cab near the centerline of the sliding sashes.
- 13.4 Two number boards on the of the short hood end of the cab shall have black on white lettering and be illuminated by LED lighting. Long hood to be marked with number stencils on upper section of nose.
- 13.5 Headlights shall be Halogen (75VDC each).
- 13.6 Ditch lights shall be Halogen (75VDC each). The ditch lights will be steady burn only and will illuminate on the end toward which the direction lever this thrown and when that end's headlight is also selected to the bright setting. A slide switch will be included on the control stand to turn power on and off to the ditch light system.

14 AIR SYSTEM (MU Equipped)

- 14.1 Air Brakes
 - 14.1.1 Air brake system with rebuilt components.
 - 14.1.2 Brake pipe angle cocks will be non-vented.
 - 14.1.3 Independent brake valve pressure set for 72 psi.
 - 14.1.4 Automatic and independent brake exhaust will be vented to a position below the cab floor.
 - 14.1.5 Instantaneous PC knockdown to idle & unload during emergency application. PC knockdown to idle during overspeed.
- 14.2 Air Compressor
 - 14.2.1 New NYAB oil free air compressor.
 - 14.2.2 Air compressor will be adjusted to maintain nominal 140 psi main reservoir pressure.
 - 14.2.3 Air compressor will provide a nominal displacement at idle operating rpm and maximum operating rpm.
- 14.3 Main Reservoirs, Filtration, Drain Valves, and Safety Valve

- 14.3.1 Unit will be equipped with two main reservoirs.
- 14.3.2 Four main reservoir manual/automatic drain valves (Salem 880 Series) shall be provided, one per reservoir. The drain valve exhaust will be directed to prevent “ballast blowing” and will be exhausted away from personnel.
- 14.3.3 A safety valve set at a nominal 148 PSI will be provided to protect the main reservoirs from over pressure.

14.4 Cut-out Cocks

- 14.4.1 Standard ball-type cut-out cocks shall be fitted in the auxiliary supply lines to the:
 - 14.4.1.1 Horn
 - 14.4.1.2 Front-end sand system
 - 14.4.1.3 Rear-end sand system
 - 14.4.1.4 Truck cut-out cocks

15 Audible Warning Devices

15.1 Horn and Bell

- 15.1.1 The horns will be Nathan K3LA type or equivalent and will be located on the car body near the center of the long hood within the Plate M requirements. The bell will be Graham-White Electronic Series 373 or equivalent.

16 SANDING

16.1 Control

- 16.1.1 Manual sand will be applied to the outboard axles in the direction of movement (reverser position).
- 16.1.2 Automatic sanding and air blaster for wheel adhesion in direction of travel.
- 16.1.3 During testing at 0 MPH, sand will be applied for a maximum of 60 seconds in the direction that the reverser is thrown and the manual sand switch is activated.

16.2 Sand Traps, Fillers, and Boxes

- 16.2.1 A total of eight sand traps with rotary shutoff valves.
- 16.2.2 Sand fill on the short hood end shall be on top of the nose.
- 16.2.3 Sand fill on long hood end shall be accessible from walkway.
- 16.2.4 Sand boxes with wash out panels at each end with a nominal 15 cubic feet capacity provided (maximized as much as practical).

17 MULTIPLE UNIT CONTROL

Multiple unit control is provided. The following modifications / features are provided:

17.1 Receptacle

- 17.1.1 Single 27-point receptacle at each end with AAR standard pin assignments.
- 17.1.2 Two "Dummy" receptacles to be provided at each end.

17.2 Walkway Ramps

- 17.2.1 Fixed walkway and hand railing provided on both ends with provision to secure MU cables under walkway.
- 17.2.2 Chains with breakaway links to be installed.

18 ELECTRICAL SYSTEM

18.1 Detail of Electrical System

- 18.1.1 All wiring and cabling to be new Exane.
- 18.1.2 Electrical cabinet with interiors to be painted white
- 18.1.3 Electrical equipment in cabinet to be new or rebuilt, including reverser contactors, power contactors, battery switch, and breaker switch panel. LED lighting inside electrical cabinet. Low voltage carrying relays and current rectifiers to be new or rebuilt.
- 18.1.4 110 VAC outlet with USB port inside the electrical cabinet (cab side).
- 18.1.5 All temperature and pressure sensors new.
- 18.1.6 Provision to lockout handbrake breaker.

18.2 Batteries

- 18.2.1 New batteries for the 64V system.

18.3 Battery Charging

- 18.3.1 Rebuilt Auxiliary Alternator to provide charging to the 64V system. 18 KW will be available at all engine speeds.

18.4 Ground Relay Reset

18.4.1 Automatic ground relay reset provided with fault logging.

18.5 Microprocessor Control System

18.5.1 The Microprocessor will control the following contactors:

Power Contactors, Reverser Contactors, Engine Starting and Shutdown control, Traction Motor Cut Out, Ground Relay Reset, and Load Shedding contactors.

18.6 Monitor and Display Parameters

18.6.1 The Microprocessor will monitor and display the following functions:

Alternator voltage, all Traction Motor Current, Throttle Notch, Power Contactor Position, Reversing Switch Position, Battery Charging Voltage and Current, Engine Status, Essential Train-line Status, Total Horsepower, Locomotive Speed, Main Reservoir Pressure, Warning: Movement in Direction Opposite of Reverser Selection, Megawatt hours, Starts per day, and Sanding Status.

18.7 Battery Saver

18.7.1 Unit will be equipped with a battery saving for 64 Volt system.

18.8 Systems Control

18.8.1 The Microprocessor will control the following systems:

Wheel Slip Detection and Correction, Traction Power Regulation, Engine Controls, and Sanding.

18.9 Fault Monitoring

18.9.1 The Microprocessor will log everything it monitors, not limited to the following fault conditions:

Ground Fault, Over-Current, Traction Motor Open Circuit, Contactor or Relay Fault, Battery Charging Failure, Air System Pressure Failure, and Engine Fault Codes.

18.10 Fault Log Snapshot

18.10.1 The Microprocessor will "Snapshot" everything it monitors, not limited to the following parameters with a fault log:

Traction Horsepower, Throttle Notch, Speed, Traction Motor Current, Power Contactor Status, Reverser Contactor Status, Alternator Current, Battery Charging Voltage, Train-line Status, Sanding Status.

18.11 Traction Motor Cut Out

- 18.11.1 The control system will provide individual traction motor cut-out via the control system touch screen.
- 18.11.2 Remote monitoring equipped
- 18.11.3 Locomotive to include CHMM (Crash Hardened Memory Module).

18.12 Automatic Engine Start Stop

The Locomotive will be equipped with an AESS system with parameters which meet current AAR specs.

DISCLAIMER – KLV recommends all end users to have a handbrake test procedure implemented. AESS parameters will monitor speed when handbrake is applied and restart the engine but a short period of time will be required to charge the air brake system.

19 PAINTING AND STENCILING

- 19.1.1 Paint specifications shall conform to AAR standards for locomotives.
- 19.1.2 Primer shall be one coat of primer.
- 19.1.3 Finish paint shall be two coats.
- 19.1.4 Painting shall be completed with one coat of clearcoat.
- 19.1.5 Paint scheme, lettering, and fonts shall be provided by customer.
- 19.1.6 Interior of car body and components to be painted suede grey.
- 19.1.7 Interior of cab and under cab floor to be painted suede grey.
- 19.1.8 Control stand to be painted flat black or coated with Rhino Lining.
- 19.1.9 Required decals shall be applied.

20 TESTS

- 20.1 Cab noise shall conform to Title 40 Part 229.121 and be documented.
- 20.2 Horn will comply with Title 49 Part 229.129 and will be documented.
- 20.3 The following performance tests will be conducted and documented:
 - 20.3.1 Perform load test at each throttle position with the highest throttle position achieving alternator rated output for a minimum of 2 hours. The engine shall make rated traction horsepower (+/-5%).
 - 20.3.2 Locomotive System Commissioning.

21 LOCOMOTIVE SUPPORTIVE DOCUMENTS AND UMLER REGISTRATION

21.1 Following delivery of the locomotive to the project site in **City, State**, KLW shall provide complete locomotive Documentation Packages to designated customer personnel. The informational content will be supplied in the format of: One (1) reproducible electronic copy and one (1) physical copy.

The Documentation Packages provided will include:

- Copy of blue card
- Copy of cab level noise test
- Copy of horn test
- Copy of load test
- Copy of periodic inspection check off
- Plate M dimensions
- Scale weight sheet
- Photos (front, rear, conductor's side, and engineer's side views)
- Major Component Serial Number Matrix

21.2 KLW shall provide a quantity of one (1) each of the following manuals and schematics (in hard copy or digital format):

- Parts Catalog
- Service Manual & Maintenance Manual
- Operator Manual
- Wiring Diagram/ Electrical Print
- Air Brake Diagram
- Air Brake Maintenance Manual
- Air Brake Troubleshooting Guide

21.3 KLW shall assist in registering the locomotive data in the AAR Universal Machine Language Equipment Register (UMLER) System for interchange movements and ownership. KLW will install AEI transponder tags.

22 FINAL ACCEPTANCE

22.1 Final and successful acceptance will be considered on the date of interchange at the customer's location in **City, State**.

22.2 KLW will power on each locomotive in the presence of the customer's personnel and/or its designees prior to acceptance. Customer shall verify Specification compliance at the point of final acceptance and confirm acceptance to KLW. Any locomotive not meeting commissioning acceptance will be the responsibility of KLW for corrective action and repair(s).

22.3 At Final Acceptance inspection, the following inspection checklist shall apply:

- 22.3.1 General overall appearance is clean and structurally correct as originally designed.
- 22.3.2 Structural damage is non-existent.
- 22.3.3 Unit is free from any corrosion or oxidation.
- 22.3.4 Unit is properly stenciled according to specification.
- 22.3.5 Hood, doors, and end arrangements conform to standards and operate properly.
- 22.3.6 The underframe (including coupler pockets) shall be damage-free, structurally intact, and have legible manufacturer's builder plates.
- 22.3.7 Check coupler knuckle for proper operation and condition.
- 22.3.8 Check air brakes for proper operation.
- 22.3.9 Check wheels.
- 22.3.10 Start and check for leaks.
- 22.3.11 Run locomotive at multiple throttle settings, loaded, for a given duration, followed by shutdown and temperature check.
- 22.3.12 Locomotive shall operate for two hours performing the customer's general operations which may include but not be limited to: switching, hauling freight, setting out cars, and picking up cars.

23 TRAINING REQUIREMENTS

- 23.1 KLV shall provide on-site operator, hands-on maintenance, service, and troubleshooting training to customer's personnel for 2 days.
- 23.2 Training shall be scheduled to be held on a mutually agreed upon date at the customer's specified location or locations after the applicable delivery.

24 SPARE PARTS

- 24.1 A recommended spare parts list shall be provided.

25 QUALITY ASSURANCE & WARRANTY FOR BREAKDOWN / MALFUNCTION OR DAMAGE

- 25.1 Quality Assurance Plan



25.1.1 Within thirty (30) days of Contract Award, KLV shall provide documentation which describes how it intends to ensure the final product meets or exceeds the Specifications herein.

25.2 Warranty

25.2.1 KLV shall guarantee that its products will meet all applicable specifications and other specific product and work requirements including those for performance of this Contract and will be free from defects in materials and workmanship.

25.2.2 Specific warranty details are included in the contract under separate exhibit.

26 SAFETY PROVISIONS

26.1 All work performed by KLV will follow all OSHA standards.

26.2 KLV personnel and its contractors shall meet site specific requirements for entry. Any safety training expense required by buyer for seller entry or access to property will be the responsibility of the buyer.

27 WARRANTY

27.1 Specific warranty details are included in the contract under separate exhibit.