

**PART E**

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**TECHNICAL REQUIREMENTS**

## PART E – SCOPE OF SERVICES

### TABLE OF CONTENTS

<b>E1</b>	<b>GENERAL .....</b>	<b>3</b>
<b>E2</b>	<b>SCOPE OF SERVICES .....</b>	<b>6</b>
<b>E3</b>	<b>CONFIGURATION CONTROL .....</b>	<b>13</b>
<b>E4</b>	<b>REPLACEMENT PARTS .....</b>	<b>13</b>
<b>E5</b>	<b>SPECIAL TOOLS .....</b>	<b>15</b>
<b>E6</b>	<b>TRANSPORT AND LIFTING .....</b>	<b>15</b>
<b>E7</b>	<b>AVAILABILITY OF ENGINES FOR OVERHAUL.....</b>	<b>16</b>
<b>E8</b>	<b>DOCUMENTATION .....</b>	<b>18</b>
<b>E9</b>	<b>REPAIR RECLAMATION .....</b>	<b>19</b>
<b>E10</b>	<b>WARRANTY .....</b>	<b>20</b>
<b>E11</b>	<b>QUALITY ASSURANCE .....</b>	<b>20</b>
<b>E12</b>	<b>SAFETY MANAGEMENT.....</b>	<b>21</b>
<b>E13</b>	<b>REPORTING, MONITORING, INSPECTION and RECORDS .....</b>	<b>21</b>
<b>Appendix EA1</b>	<b>REFERENCE DOCUMENTS.....</b>	<b>23</b>

## **PART E**

### **E1 GENERAL**

#### **E1.1 Introduction**

RailCorp owns a fleet of Xplorer, Endeavour and Hunter passenger railcars. The Xplorer fleet is operated and controlled by CountryLink; the Endeavour and Hunter railcars are operated by CityRail. Maintenance and servicing of all cars is performed and managed by RailCorp's Asset Management Group, Rolling Stock Division.

The fleet consists of 23 Xplorers, 28 Endeavours and 14 Hunter railcars. There are 10 Endeavours and 14 Hunter railcars based at the Endeavour Service Centre located at Brown Road, Broadmeadow providing CityRail services in the Hunter Valley. The balance of the fleet are based at the Xplorer Endeavour Service Centre located at 136 Railway Parade, Erskineville. During the term of this Contract, some or all the Endeavour railcars based at Broadmeadow could be redeployed to Sydney.

This document details the services to be carried out by the Contractor. Some of the services (valve & injector service and in situ top overhaul), for a period of time or from time to time will be carried out by RailCorp or as a joint service to the equipment between RailCorp and the Contractor.

#### **E1.2 The Equipment**

Each Xplorer/Endeavour railcar is fitted with one Cummins L10 auxiliary engine and one Cummins K19 traction engine.

Each Hunter railcar is fitted with one Cummins 6ISBe auxiliary engine and one Cummins QSK19 traction engine.

Maintenance of the Cummins engines and associated systems requires specialised staff and equipment as well as extensive knowledge of diesel engines in general and the Cummins series of engines fitted to the Xplorer, Endeavour and Hunter railcars. RailCorp requires an experienced companies to service the Cummins engines and associated control systems.

The engines are treated as modular units which can be removed from the railcar for servicing. The L10 and QSK19 traction engines when removed are removed with its frames, vibration dampers, double spring coupler, water hoses, pipes and brackets. The K19 and 6ISBe auxiliary engines are removed mounted in its enclosure complete with alternator and controls. The traction engine control panel for the Xplorer and Endeavour railcar when removed is removed separately from the engine and with its electrical harness. The modular engines are mounted to a travelling frame by RailCorp staff, prior to removal from site.

**Table E1 – Cummins Engine Matched to fleet type**

	Part No.	Xplorer	Endeavour	Hunter
Auxiliary engine	LT10@G	Y	Y	
	6ISBe-6I			Y
Traction engine	KTA-19-R	Y	Y	
	QSK19-R			Y
Traction engine control panel	KTA-19-R Control Panel	Y	Y	
	HRCECP			Y

The total pool of engines to support operation and maintenance of the fleet for K19 and L10 engines is 55 units of each, which includes 4 spare of each. For the QSK and 6ISBe engines there are 16 units of each, which includes 2 spare of each.

### **E1.3 Equipment Servicing**

The objective of any work on the engines is to:

- i. Maximise (and increase) the life expectancy of the engine.
- ii. Maximise life expectancy of the fleet.
- iii. Optimise availability and reliability of the fleet for the delivery of passenger services.
- iv. Support the RailCorp Xplorer Endeavour Service Centre and Endeavour Service Centre for the servicing of the Cummins equipment.

#### **E1.3.1 Overhaul**

The engines are overhauled as part of the fleet major periodic maintenance program.

E1.3.1.1 The Cummins L10 auxiliary engine and K19 traction engine overhaul schedules are based on hours run. The schedule for overhaul services under this scope of services are:

- Valve & injector service 1,500 hours after previous overhaul
- Top overhaul 7,500 hours
- General / Major Overhaul 15,000 hours
- General / Major Overhaul 30,000 hours

E1.3.1.2 The Cummins 6ISBe auxiliary engine servicing is based on hours run. The schedules for overhaul services under this scope of services are:

- Top overhaul every 5,000 hours
- Service exchange 10,000 hours
- General / Major Overhaul 20,000 hours

E1.3.1.3 The Cummins QSK19 traction engine overhaul servicing is based on hours run. The schedule for overhaul services under this scope of services are:

- Top overhaul every 6,000 hours
- General / Major Overhaul 18,000 hours

E1.3.1.4 The auxiliary engines are always removed for Top Overhaul and Major Overhaul. As there is considerable labour involved in removing a traction

engine, each engine is assessed prior to the Top Overhaul. Depending on the assessment results, Top Overhaul of traction engines is carried out while still attached to the railcar or with the engine removed and delivered to the Contractor - except the 6ISBe, the top overhaul for these units is carried out away from the railcar, on the floor at the Service Centre or delivered to the Contractor.

E1.3.1.5 The KTA19 Control Panel shall be overhauled every 3 years.

The HRCECP Control Panel forms part of the QSK19, therefore is incorporated into the QSK19 service and overhaul program.

From time to time there is also unscheduled out of course servicing required to the equipment in the form of repairs and other rectification activities.

From time to time there may also be modifications required to be carried out. This work will typically be carried out as part of either an overhaul or out of course service.

These could either be proposed by RailCorp or by the Contractor and be in the form of enhancements or improvements.

### **E1.3.2 On Call Support**

The Contractor shall provide 24 hour 7 days a week support to the Xplorer / Endeavour Service Centre and the Endeavour Service Centre as part of ensuring the on going reliability of the Xplorer, Endeavour and Hunter railcars. Refer to E2.7 On Call Support.

The Contractor shall provide Engineering Support continuously throughout the life of the Contract. Refer to E2.8 Engineering Support.

### **E1.4 Interpretation**

In this Technical Requirements words and expressions will have the meanings assigned to them below:

<i>6ISBe</i>	Cummins 6ISBe-61 auxiliary engine as fitted to Hunter railcars.
<i>APSU</i>	Auxiliary Power Supply Unit comprising diesel engine and alternator directly coupled together.
<i>ECM</i>	Engine Condition Monitoring system
<i>EFC</i>	Electronic Fuel Control
<i>K19</i>	Cummins KTA-19-R diesel traction engine as fitted to Xplorer and Endeavour railcars, modified to use step timing control.
<i>L10</i>	Cummins LT10 auxiliary engine as fitted to Xplorer and Endeavour railcars.
<i>OEM</i>	Original Equipment Manufacturer.
<i>overhaul</i>	overhaul used on its own refers to both Top Overhaul and Major Overhaul.
<i>PN</i>	Part Number
<i>QSK19</i>	Cummins QSK19-R traction engine as fitted to Hunter railcars.

The reference documents may refer to “the Principal or Principal’s Representative”, often in the context of consultation over assessment of components for reuse or replacement. For the purpose of this Technical Requirements any reference to the Principal or Principal’s Representative shall mean “the Engineer” or “the Engineer’s Representative” as defined in Part C, the General Conditions of Contract.

## **E2 SCOPE OF SERVICES**

The Scope of Services are for the servicing of Xplorer, Endeavour and Hunter railcar traction engines, auxiliary engines and traction control system as listed in Clause E1.2.

The duration of the contract is for one (1) complete overhaul cycle for the engines, equating to four (4) years, with two (2) options to extend the Contract each for a further two (2) years. The options to extend, subject to Contractor performance, would allow the contract to cover two (2) overhaul cycles and the associated warranty period and encourage the Contractor to take some initiative in developing improvements in the engineering and workshop processes.

The services together with any additional services required after approval by the Engineer, shall be carried out in accordance with the RFT and its reference documents, relevant Australian Standards, industry codes of practice and Statutory Authority requirements.

These Technical Requirements cover the services required under this Contract herein referred to as the “Services”.

### **E2.1 Services Included**

The Contractor shall:

- (a) Maintain and manage a suitable stock of the mandatory and on condition spare parts at its workshop;
- (b) Supply and maintain all tools and equipment required to carry out the Services;
- (c) For services not performed in situ:
  - transport the engines from the RailCorp nominated Service Centre to the Contractor’s workshop mounted on a travelling frame, (which remains the property of RailCorp).
  - Remove the travelling frame and store until required by the Engineer. If not required by the Engineer earlier, then re-attach to a completed engine and return to the RailCorp nominated Service Centre.
  - Fit K19 and QSK19 Traction engines to the raft with water pipes, brackets, hoses, vibration dampers and double spring coupler. The engine and raft are to be made up as a complete raft package with no additional parts or brackets required to be assembled by either the Contractor or RailCorp prior to attachment to the railcar.
  - Refit the serviced engine to a travelling frame and return to the RailCorp nominated Service Centre.
- (d) For services carried out in situ,
  - Remove all covers to access components on the engines; and

- Replace all covers on completion of work.

Note – The Contractor may be required to work along side RailCorp staff for the provision of the service.

- (e) Carry out services as required, included servicing of all rotatable parts, in accordance with the Technical Requirements. Supply all labour, parts and materials, as required for the relevant service.
- (f) Carry out all inspections required by the Technical Requirements and recommend to RailCorp any additional works required as a result of inspections.
- (g) Carry out any additional works as directed by RailCorp.
- (h) Provide engineering support to RailCorp throughout the life of the Contract.
- (i) Provide all written reports as required by the Technical Requirements, including strip down, build, test and commissioning reports.
- (j) On completion of each service, carry out all prescribed tests and provide a certificate of completion as referred to in the reference documentation as referred to in the reference documentation.
- (k) Carry out in-situ valve and injector service when each overhauled engine has run for 1,500 Hours. Supply all labour, parts and materials, as required.

## **E2.2 Services Excluded**

The following services are excluded

- (a) Supply of travelling frames;
- (b) Servicing doubling spring coupler; and
- (c) Servicing fire detection and suppression systems. Except for the L10, which shall require the fire detection and suppression system serviced.

## **E2.3 Overhaul**

The Contractor shall carry out the services requested by RailCorp in accordance with the instructions and reference documentation for the services.

### **E2.3.1 Valve & injector service**

The valve and injector service for the L10 and K19 shall always be carried out with the engine attached to the railcar.

Provision of this service by the Contractor shall be at the Xplorer Endeavour Service Centre only.

### **E2.3.2 Top Overhaul**

Top overhaul of the K19 and L10 engines shall be as specified in Instructions DSS 5131 or EWI055 as appropriate and includes the overhaul of injectors and ancillary equipment such as turbochargers, starter motors, fuel pumps and any additional works as directed by the Engineer.

#### **E2.3.2.1 K19 Traction Engines**

There are two options for the top overhaul of traction engines – either still attached (in situ) or removed from the railcar.

Top overhaul in situ is as described in EWI055 and summarised below:

- Dismantling engine sufficiently to remove turbos and access valve gear
- Replace starter motor with reconditioned exchange starter motor
- Inspect and adjust valve clearances as necessary
- Replace injectors with reconditioned exchange injectors
- Replace STC valve, where fitted
- Replace fuel pump with reconditioned exchange fuel pump
- Reassemble using new and reconditioned parts and gaskets and test
- Engine run and stall test (if top overhaul performed “in situ” with assistance of RailCorp technicians)
- Provide a report on the service and the equipment tests performed.

A full top overhaul to be carried out at the Contractor workshop, shall be as described in DSS 5131 and summarised below:

- Dismantle engines sufficiently to carry out the work
- Replace the following parts with new parts:
  - All gaskets and seals for components removed from engine
  - All Wet Filters
  - KTA19 crankcase breather. Replaced with Mann & Hummel type Cummins PN 3281592
  - Engine Oil (SAE15W40)
- Replace the following parts with reconditioned/overhauled parts:
  - Cylinder Heads
  - Jacket Water Pump
  - Turbocharger
  - Injectors
  - Fuel Pump (fitted with new shutdown solenoid)
  - Starter Motor (Delco Remy PN 50MT 3603868PPX) & auxiliary start solenoid.
  - Oil Control Valve PN3056564rx (STC engines only)
  - Reassemble engine, paint and test.
- The K19 shall be returned as a complete raft with all hoses, pipes, dampers, fuel inlets and return hoses, vibration dampers and double spring coupler adapter ring.

### **E2.3.2.2 L10 Auxiliary Engines**

A full top overhaul shall be as described in DSS 5131 and summarised below:

Inspect and record valve clearance prior to removal of rocker gear and injector.

- Dismantle engines sufficiently to carry out the work
- Replace the following parts with new parts:
  - All gaskets and seals for components removed from engine
  - All Wet Filters
  - Replace L10(R)G crankcase breather with Mann & Hummel type Cummins. Use adaptor Cummins PN CSP02412.
  - Engine Oil (SAE15W40)
- Replace the following parts with reconditioned/overhauled parts:
  - Cylinder head
  - Jacket Water Pump

- Turbocharger
- Belt tensioner
- Injectors
- Fuel Pump and EFC Actuator (fitted with new shutdown solenoid)
- Starter Motor (Delco Remy PN 3604321X) & auxiliary start solenoid.
- LT10 crankshaft rear seal. Replace as per Cummins parts topic 99T1-10.
- Reassemble, paint and test.
- In addition, the Contractor shall check and service the fire detection and suppression system wiring and probes as required.

### **E2.3.2.3 QSK 19R Traction Engine**

There are two options for the top overhaul of traction engines – either in situ or removed from the car. Both options are summarised below:

- Download ECM and review active fault codes.
- Review engine service history.
- Dismantling engine sufficiently to remove turbos and access valve gear.
- Inspect and record valve clearances to determine any valve seat recession prior to removal of rocker gear & injector. Adjust valve clearance on completion.
- Replace agreed parts.
- Charge air cooler leak down test to air radiator specifications.
- Engine static run and stall test on completion of work. (When performed in situ this should be in conjunction with RailCorp technicians.) This is to look for correct start up and run coolant and oil leaks; response to throttle command; and stall check.
- Visual inspection of all external pipes, hoses and harnesses.
- Report to be completed for each engine including service and check sheets.
- Down load to be taken and inactive fault records to be cleared.

The top overhaul shall include replacement of the following parts with new/reconditioned parts:

- Water pump – Reconditioned Exchange
- Turbocharger – Reconditioned Exchange
- Starter Motor – Reconditioned Exchange
- Injectors – Reconditioned Exchange
- Fuel Pump – Reconditioned Exchange
- Vibration dampers. – Reconditioned Exchange
- Crankcase Breathers – New
- Charge Air Cooler Hoses & Clamps – New
- Rocker Cover Gaskets - New

### **E2.3.2.4 6ISBe Auxiliary Engine**

The 6ISBe will be removed by RailCorp to carry out the services and may, subject to agreement by RailCorp, be serviced at the RailCorp Service Centre.

At the time of writing this Technical Requirements, it is expected that top overhaul of the 6ISBe will take place on the floor of the Service Centre.

A full top overhaul is summarised below:

- Download ECM and review active fault codes;
- Review engine service history;
- Replace agreed parts;
- Dismantle engines sufficiently to carry out the work;
- Inspect and record valve clearances to determine any valve seat recession. This is to be carried out prior to removal of rocker gear and injector. Adjust valve clearance upon completion.
- Visual inspection of all external pipework, hoses and harnesses.
- APSU static run & load test check, using railcar load on completion of work.
- Report to be completed for each engine including service and check sheets.

The top overhaul shall include replacement of the following parts with new/reconditioned parts:

- Water Pump – Reconditioned Exchange
- Thermostat - New
- Fan Hub - New
- Belt Tensioner - New
- Belt - New

### **E2.3.3 Major Overhaul**

The Major Overhaul is the complete overhaul of the engine and its major components as detailed in the reference documents and this Technical Requirements including:

- Disassembly of the equipment as far as is necessary to replace mandatory components or carry out required inspections of parts to be reused or replaced on condition.
- Disassembly and overhaul of all sub-assemblies including the after cooler assembly.
- Inspection of components and reporting of condition including recommendations for additional works where necessary.
- Replacement of any items due for replacement before the next Major Overhaul.
- Re-assembly of the equipment, incorporating all the new mandatory spare parts.
- For the L10 check and service the fire detection and suppression system wiring and probes as required.
- Any additional works directed by the Engineer.
- Fill with new engine oil (SAE15W40)
- Testing and certification.

### **E2.3.4 KTA19 Control Panel**

The K19 Control Panel shall be overhauled every three (3) years. Contractor shall:

- a) Transport the control panel from the RailCorp nominated Service Centre to the Contractor's workshop for overhaul.
- b) Overhaul the control panel.

- c) After overhaul, return the control panel to the RailCorp nominated Service Centre and function test on as railcar nominated by RailCorp.
- d) On completion of the function test, the railcar shall be returned to pre-function test condition and operational.
- e) The Contractor shall provide a certificate of completion that shall include certification that the serviced control panel, harness and plug have been fully overhauled and tested satisfactorily. The completion certificate shall also certify that the railcar used to perform the function tests has been reconnected and returned to pre-function test condition.

#### **E2.4 Inspection and Re-use of Components**

All engine components / parts that are removed during engine disassembly, and are to be reused in the service, shall be inspected in accordance with the OEM Workshop Manuals.

Inspection sheets shall be completed and supplied to the RailCorp Representative on completion of the service. Inspection sheets shall show condition, dimensions, clearances and tolerances of components.

Inspection sheets shall indicate components that exceed manufacturer's tolerances and/or cannot be reused.

Replacement of components which cannot be reused shall be in accordance with E4 – Replacement Parts and E9 – Repair Reclamation.

Engine components that have been serviced shall be noted on the assembly inspection sheets.

RailCorp may elect to supply rotatable and non rotatable parts/components to the Contractor from the Purchaser's store. RailCorp may then elect that the Contractor replenish the store of issued parts/components. The Contractor shall be responsible for maintaining and obtaining access to sufficient float of exchange components to ensure an agreed service turnaround times are met.

#### **E2.5 Testing**

The Contractor shall test all overhauled equipment in accordance with the reference documentation –

- i) For K19 engines, refer to EI DSS 5144;
- ii) For L10 engines, refer to DSS 5145;
- iii) For QSK19 engines, refer to Cummins shop manual group 14, bulletin 3666232 & engine performance curve FR-4265;
- iv) For ISBe 5.9 engines, refer to Cummins operation & maintenance manual group 14, bulletin 3666397 & engine performance curve for 6ISBe.

The Contractor shall provide 24 Hours notice to RailCorp prior to testing.

Failure to attend testing by the Engineer shall not affect the Contractor's obligations under warranty or defects liability.

A copy of all test reports and associated documentation shall be issued with the serviced equipment.

## **E2.6 Modification**

From time to time RailCorp may introduce modifications to equipment to improve service life, to rectify a design fault or change the design to maintain a long-term supply of spare parts. When this occurs RailCorp will request the Contractor to supply a price for the modification in accordance with Clause 20 of Part C.

RailCorp will amend and re-issue the relevant reference documents as required to reflect any changes.

From time to time the Contractor may identify an alternative way of managing the service of individual components of equipment. The Contractor shall initially discuss the proposed modification with the Engineer's Representative. If the modification is considered feasible (e.g. improved service life, reduced service costs, reduced spare part usage), the Contractor will formally present the proposal to the Engineer's Representative who will respond within 30 days of the request.

RailCorp will amend and re-issue the reference documents as required to reflect any agreed changes.

## **E2.7 On Call Support**

The Contractor shall provide 24 hour 7 days a week support to the Xplorer / Endeavour Service Centre and the Endeavour Service Centre as part of ensuring the on going reliability of the Xplorer, Endeavour and Hunter railcars.

The Contractor shall have sufficient suitably qualified and skilled people available to attend the respective Service Centre within 2 hours. The number of suitable people and where they are located shall allow for the management of sick leave, annual leave, fatigue and other issues that effect availability of Contractor staff.

Note that the Endeavour Service Centre primary hours of operation are Monday to Friday between 0600 and 1630 hours. Therefore on call support required outside these hours is infrequent.

In addition the Contractor shall provide repair and fault rectification services at RailCorp outlying terminal locations, being where trains terminate or are stabled before returning to either Sydney or Newcastle. The terminal locations are:

Armidale

Bomaderry

Broken Hill

Canberra

Moree

Moss Vale

Wollongong

The support to outlying locations will require the Contractor to attend, diagnose and remedy faults while the equipment remains attached to the railcar and before the railcar is timetabled to return to passenger services.

## **E2.8 Engineering Support**

### **E2.8.1 OEM Support**

The Contractor shall supply RailCorp three (3) copies of all Technical Service Bulletins and correspondence issued by the replacement parts manufacturer relevant to the Services for the purpose of updating the Technical Requirements and for performance monitoring of the equipment.

Modifications are only to be carried out by the Contractor after receipt of an update of the Technical Requirements to cover such Services.

### **E2.8.2 Other Engineering Support**

The Contractor shall provide engineering support for the duration of the Contract. The Contractor shall manage with and / or on behalf of RailCorp engineering issues including -

- a) Identification of parts and equipment faults and investigating suitable solutions;
- b) develop and implement systems to monitor and track equipment and components;
- c) review and investigate equipment and component performance and trends;
- d) review failure modes and options for repair and improvements;
- e) monitor and implement improvement initiatives; and
- f) identify, implement and monitor rail safety improvements and initiatives.

## **E3 CONFIGURATION CONTROL**

A number of modifications have been made to the equipment since the original purchase.

On the first occasion any item of equipment is received by the Contractor for servicing, the Contractor shall inspect the equipment and provide a report listing the equipment current modification status. Following RailCorp approval / endorsement of the modification the Contractor shall ensure the relevant Cummins Parts Lists are updated.

NOTE: Cummins Parts Lists are updated to reflect modifications as they are carried out and reflect the parts required for the equipment, inclusive of all currently approved modifications.

## **E4 REPLACEMENT PARTS**

The replacement parts used in the overhaul shall be genuine OEM replacement parts obtained through an accredited agent in Australia for the engines and other equipment described in the Technical Requirements. The accredited agent shall supply back-up, advisory and support services acceptable to RailCorp.

Supply of alternative and non OEM replacement parts may be approved for use by the Engineer's Representative, subject to sufficient evidence being produced by the Contractor that the replacement parts are OEM approved parts and are equal to or superior to the genuine replacement parts and that back-up, advisory and

support services, acceptable to RailCorp, are available from the alternative spare parts supplier.

From time to time RailCorp may elect to provide genuine replacement parts from its own stocks. The Contractor shall use the RailCorp replacement parts if they are suitable for inclusion in the Services.

#### E4.1 Mandatory Parts

The following Table E4 – Mandatory Parts identifies the parts that are expected to be supplied and installed at the respective service types. The OEM (Cummins) has prepared kits containing all the parts required for the Top and Major overhaul services. Only the Cummins kit numbers are listed.

The Contractor shall also supply and install other parts requiring replacement as required and as directed by the Engineer.

**Table E4 - Mandatory Parts**

Engine Type	Service Type	DESCRIPTION	Cummins PART NO.
K19-STC	TOP	Complete kit of mandatory parts for K19-STC Top overhaul	CSP02292
K19-STC	In-Situ TOP	Complete kit of mandatory parts for K19-STC (In-Situ) Top overhaul	EWI 055
K19-STC	15,000 Hour Overhaul	Complete kit of mandatory parts for K19-STC Top overhaul PLUS Additional mandatory parts for K19 15,000 Hour Overhaul including K19 Cylinder Liners (6)	CSP02292  CSP02291
K19-STC	30,000 Hour Overhaul	Complete kit of mandatory parts for K19 15,000 Hour Overhaul as above including oil pump, scavenge oil pump, exhaust manifold & After cooler element.	CSP02291 CSP02292 CSP03618
K19	15,000 Hour	STC Conversion Kit PLUS Complete kit of mandatory parts for K19 15,000 Hour Overhaul as above	CSP02295  CSP02291 CSP02292
K19	TOP	Complete kit of mandatory parts for K19 Top overhaul	CSP02296
L10	TOP	Complete kit of mandatory parts for L10 Top overhaul	CSP02293
L10	15,000 Hour	Top Overhaul parts PLUS	CSP02293

Engine Type	Service Type	DESCRIPTION	Cummins PART NO.
	Overhaul	Additional kit of mandatory parts for L10 15 000 Hr Overhaul	CSP02294
L10	15000 Hour and 30,000 Hour	Complete kit of mandatory parts for Alternator Overhaul	Cummins Onan Generator & Controls Service Manual
6ISBe	TOP	Complete kit of mandatory parts for 6ISBE Top overhaul	CPL 8526(midlife)
6ISBe	20, 000 Hour Overhaul	Complete kit of mandatory parts for 6ISBe 20,000 Hr Overhaul Complete kit of mandatory parts for alternator overhaul	CPL 8526 (G-overhaul) Newage UCH-027&CSP 00041
QSK19	TOP	Complete kit of mandatory parts for QSK19 Top overhaul	CPL 2927(midlife)
QSK 19	18,000 Hour Overhaul	Complete kit of mandatory parts for QSK19 18,000 Hour Overhaul.	CPL2927 (G-overhaul)

#### **E4.2 Spare Parts**

The Contractor shall ensure it maintains sufficient pool of spare parts to support delivery of the requirements under these Technical Requirements.

#### **E5 SPECIAL TOOLS**

The Contractor shall obtain and maintain in good working condition for the duration of the Contract sufficient quantity of all special tools and fittings listed in the relevant sections of the Reference Documents together with any tools the Contractor considers necessary to carry out the requirements under these Technical Requirements at its Workshop and at RailCorp locations.

#### **E6 TRANSPORT AND LIFTING**

Lifting and movement of the engines at RailCorp Service Centres will be carried out by or arranged by RailCorp.

The Contractor shall arrange at its own cost the transportation of engines and engine components / parts between RailCorp and the Contractor's workshop. Engines removed from the RailCorp site are at the completion of the Service to be returned to the same Purchaser Service Centre, unless stated otherwise by RailCorp.

Prior to being transported, RailCorp will place the engines and equipment in a suitable travelling frame, remove excess rubbish and generally make good for transporting to the Contractor's workshop.

RailCorp will place the equipment on the Contractor arranged transport for dispatch to the Contractor and remove from transport upon return to the Purchaser Service Centre. The Contractor shall ensure the proper securing of the equipment to the transport.

To assist the Contractor make arrangements for appropriate handling of the engines, the following table contains indicative weights for each type of engine. Refer to the OEM specifications referred to by this Technical Requirements for other measurements.

**Table E6 - Cummins Engines – Indicative Weights**

	Part No.	Weight
Auxiliary engine	LT10®G	2,420 kg with enclosure & travelling frame
	6ISBe-6l	2,600 kg with enclosure and raft
Traction engine	KTA-19-R	2,150 kg with travelling frame
	QSK19-R	2,950 kg with raft
Traction engine control panel	KTA-19-R Control Panel	25 kg with harness
	HRCECP	25 kg

## **E7 AVAILABILITY OF ENGINES FOR OVERHAUL**

The frequency of component periodic servicing is listed in Clause E1.3 in terms of hours run. The normal component usage for the K19 and L10 is 400 Hrs/month consequently component services come due approximately:

	K19	L10
Top Overhaul	18 months	23 months
Major Overhaul	36 months	46 months

Valve and injector service 3-5 months after previous overhaul.

The 6ISBe auxiliary and QSK19 traction engines have not been in sufficient service to accurately determine the frequency in months. At the time of writing this specification engine operating hours for the 6ISBe is 60 hours per week and QSK19 is 90 hours per week, therefore suggesting the following:

	6ISBe	QSK19
Top Overhaul	19 months	15 months
Service Exchange	38 months	
Major Overhaul	76 months	45 months

Out of course (unscheduled) work may be required at any time and is carried out on an irregular basis.

The forecast frequency at which engines and equipment are to be serviced is not guaranteed by RailCorp to be strictly in line with the above nominated frequencies. Currently there is one (1) top and one (1) major overhauled K19 every 3 weeks and one (1) top and one (1) major overhauled L10 every 4 weeks.

The first pair of QSK19 had its first top overhaul July 2008. Subsequent pairs of QSK19 are due to be released for top overhaul as follows:

August 2008

August 2008

September 2008

October 2008

December 2008

February 2008.

The first QSK19 major overhaul is then forecast to be in January 2011.

The 6ISBe was forecast to have its first pair of engines released for Top Overhaul July 2008, with subsequent engines forecast to be released as follows, noting the 6ISBe may not always be released in pairs.

August 2008

September 2008

October 2008

December 2008

January 2009

March 2009

The first Major Overhaul of 6ISBe engines is forecast to be in 2013.

The through put of engines through the maintenance regime is and will be influenced by several variables which the Contractor shall take into account. The Contractor shall ensure adequate resources and parts are planned for the delivery of the Contract.

- i) The need for fleet availability to operate the CountryLink and CityRail timetable for provision of country and suburban/intercity passenger services respectively. (Operational Requirements).
- ii) Availability of spare engines to replace engines removed for servicing.
- iii) Fluctuations to the fleet component change out program could cause the engine servicing to either be slowed to nil or very few engines or accelerated.
- iv) The Hunter fleet has been in service for less than one maintenance cycle. While the supplier of the new railcars has stipulated a broad maintenance regime for the railcars and associated equipment, until the equipment has been inspected at the first major service, the maintenance regime, scope and frequency can not be accurately validated / qualified. For example the 5,000 hour and 6,000 hour top overhaul may be able to be carried out less frequently.

- v) The Contractor shall work with RailCorp to achieve constant improvement of the engines and servicing required which will also potentially reduce the frequency engines are serviced.

The Contractor shall deliver the serviced equipment within the time mentioned as Days for Delivery in the Schedules.

The rotatable pool of parts shall be completely refurbished and available in sufficient time so as not to delay the overhaul of subsequent engines.

## **E8 DOCUMENTATION**

### **E8.1 Reference Documents**

The services, and any additional services required after approval by the Engineer, shall be carried out in accordance with the Technical Requirements, relevant Australian Standards, industry codes of practice, Statutory Authority requirements, the manufacturer's Operating and Maintenance Instructions including the documents listed in Appendix EA1.

### **E8.2 Delivery Advice**

RailCorp shall provide a delivery advice with each piece of equipment made available for servicing under the Contract. The delivery advice will indicate

- the equipment serial number
- description of the service required
- a brief condition report, including any known faults or abnormal operating conditions experienced in service.

### **E8.3 Service Documentation**

The Contractor shall provide the following documentation with each piece of serviced equipment -

- listing of parts replaced;
- delivery docket, clearly showing the serial number;
- listing the reconditioned parts installed, identified, where available, by serial numbers;
- listing the reconditioned parts removed from the equipment, identified where available by serial numbers;
- a condition report including any measurements taken and details of any non-mandatory parts replaced;
- details of any parts replaced because replacement was due before next overhaul.
- A copy of all test reports and associated documentation shall be issued with the completed serviced equipment.
- certificate of completion confirming all works have been carried out in accordance with the Technical Requirements, and as directed.
- any documentation or reports as required in other parts of the Technical Requirements;
- details of all modifications to the equipment carried out as part of the service.

For services provided at a Service Centre, the Contractor shall provide the following additional documentation:

- Prior to carrying out the service – Safe Work Method Statement (SWMS) and Safe Work Instruction (SWI); tick sheets applicable for the service; and detailed documentation of the services to be carried out.
- At the completion of the service and prior to leaving the Service Centre – tick sheets for the applicable service completed and signed. The tick sheets and detailed documentation are to be in a consistent format that is to be applied from service to service.

At the completion of each out of course service, the Contractor shall provide a comprehensive report with all the details as if it were a planned service together with details of what has been addressed, rectified, repaired and or modified.

All documentation generated by the Contractor in relation to the Services carried out under this Contract, shall remain the property of RailCorp and may not be copied or distributed in any form to any other party, including the original equipment manufacturer, without the prior, written approval of RailCorp.

#### **E8.4 Monthly Reporting**

The Contractor shall provide a report, on a monthly basis, of the Contract progress including the services provided, status of parts held and ordered, modifications in progress, technical issues and delivery program.

#### **E9 REPAIR RECLAMATION**

Any repair or reclamation outside the scope of or not covered by the Technical Requirements is subject to approval of RailCorp prior to commencement of repair. (This includes the supply and installation of any additional replacement parts not included in the Mandatory Parts list.)

All discarded and/or used components remain the property of RailCorp and shall be retained by the Contractor, suitably tagged for the attention of the Engineer's Representative, until advised by the Engineer that the parts may be disposed of.

The Contractor shall dispose of all discarded and/or used components in a manner which satisfies all applicable legislation and regulations.

Should any of the RailCorp's components be sold, any proceeds of the sale shall be credited to RailCorp.

The Engineer's Representative will check discarded and used components to ensure that such components should have been replaced. In the event that, in the opinion of the Engineer's Representative, a component should not have been replaced, payment for the replacement components will be withheld from the Contractor.

## **E10 WARRANTY**

### **E10.1 Services Warranty**

The Contractor shall provide 12 month warranty for each piece of equipment serviced for both workmanship and parts. The warranty period shall commence when the serviced equipment is fitted to a railcar.

Faults and failures identified in service or at a Service Centre shall be responded to by the Contractor within 2 hours of notification by RailCorp.

The Contractor shall be responsible for all repair or replacement costs required to rectify any fault.

Should the equipment need to be returned to the Contractor's workshop to effect repairs, the Engineer's Representative will organise for the removal and replacement of the defective equipment and transport, at the Contractor's cost, to the Contractor's workshop for repair/replacement at the Contractor's cost. The Contractor will return the repaired/replacement equipment within 10 working days.

### **E10.2 Warranty Reports**

All warranty work is to be comprehensively documented by the Contractor. Documentation is to be in a standard / consistent format. It is to:

- i) Record whether the warranty claim is accepted or rejected;
- ii) Detail the cause;
- iii) Detail what has been done to remedy that fault and what is being done to prevent future instances of the fault recurring with that specific unit or other units.

### **E10.3 Hunter New Railcar Warranty**

The Hunter railcars have recently been delivered to RailCorp. The railcar manufacturer, United Group Rail will continue to be responsible for the warranty on the railcars and the attached equipment for a period of 24 months. Subject to the faults identified, rectification of the faults may be the responsibility of United Group Rail.

### **E10.4 L10 and K19 Existing Warranty**

The L10 and K19 engines are currently being serviced by two (2) suppliers: Cummins and United Group Rail Fleet Services. These services are subject to a service warranty period. Subject to the nature of any faults identified during the remainder of this service warranty period, the existing service supplier may be responsible for rectification of the fault.

## **E11 QUALITY ASSURANCE**

The Contractor shall supply proof of accreditation to AS3902 or of working within the standards as set down for AS3902.

The Contractor shall be subject to regular quality audits by the Engineer's Representative at which the Contractor shall make available all equipment calibration certificates, documentation of parts authenticity, proof of adherence to

the Technical Requirements, quality of workmanship and any other information required by the Engineer.

## **E12 SAFETY MANAGEMENT**

Equipment serviced under this Contract is to be installed in a rail vehicle, the operation of which is governed by the Rail Safety Act 2002, as amended.

To assist RailCorp execute its obligations under the Act the Contractor shall ensure that its procedures effectively manage and control the way in which the Contractor -

- receives safety related information from RailCorp and ensures that it is actioned appropriately.
- collects information, including condition reports on components and inspections of services in progress, and ensures that any defects or faults are reported to RailCorp promptly and expeditiously, irrespective of cause.
- manages spare parts and other material supplies to ensure compliance with the Contract.
- manages the services carried out by any sub-contractors to ensure compliance with the Contract.

RailCorp will from time to time conduct audits and/or inspections of the Services to ensure compliance with the Contract.

Additional safety requirements are stipulated in Part D – Special Conditions.

### **E12.1 Safety Management Plan**

The Contractor is required to have a safety management plan in place for the Services, including fault rectification services, to be carried out at Service Centres and outlying Terminal locations.

As part of the offer sample Safe Work Method Statements (SWMS) and Safe Work Instructions (SWI's) are to be provided.

SWMS and SWI's shall be prepared and submitted to RailCorp by the Contractor for each location and type of service to be carried out prior to the respective services being provided.

### **E12.2 Accreditation**

All Contractor representatives who may be called upon to assist with the provision of the Services at a Service Centre or outlying terminal location shall complete the Rail Industry Safety Induction (RISI) and a contractor site specific induction for all sites those representatives may attend.

## **E13 REPORTING, MONITORING, INSPECTION and RECORDS**

### **E13.1 Reporting**

The Contractor shall have regular, formal, liaison with RailCorp. These shall be every month in the first year of the Contract. Then every two months for the remainder of the Contract.

Issues affecting or potentially affecting delivery of the Services shall be notified to RailCorp within 14 calendar days of the issue becoming identifiable. This period shall be no more than the period remaining of the allowed time to effect the service, to a maximum of 14 calendar days.

### **E13.2 Monitoring**

The Engineer's Representative shall have the right at any time to inspect any part of the Service as it is being performed. The Contractor shall provide sufficient safe and proper facilities for such inspection. No inspection by RailCorp shall relieve the Contractor of any of its responsibilities or liabilities hereunder.

### **E13.3 Inspection**

RailCorp shall have the right to reject any item of service found in his opinion, to be of inferior quality or to contain faulty workmanship or in any way not in accordance with the requirements of the Contract and may order the Contractor to remedy or replace any such items.

Any work to be performed by the Contractor resulting from inspection and rejection shall be carried out at the Contractor's cost and must be completed without delay.

### **E13.4 Records**

The Contractor shall maintain a log in an electronic format (*MS Office product. e.g. Excel or MS Access*) of all services and modifications to the equipment and its components. This log is to match the equipment item and component serial number against the Service or modification description, including date of work done or extra Services as requested by RailCorp, including the specification number or instruction that the service was done to. The Contractor shall prepare an initial record for each equipment item as it is received for a service. This initial record will detail the initial modification status of the item of plant.

This log will also include those parts replaced *on condition* and items that are required to be replaced at intervals more frequent than between each overhaul.

This log is to be forwarded to RailCorp on a 6 monthly basis and the complete log handed to RailCorp on completion of the initial Contract and subsequently at the completion of any extension period.



<b>Rolling Stock Engineering &amp; Planning - Standard/Instructions</b>	
<b>DSS 5131</b>	Xplorer/Endeavour Cummins KTA-19-R & LT10(R)G Engines 7,500 hour Top Overhaul Specification.
<b>EI DSS 5140</b>	Xplorer/Endeavour Cummins KTA-19-R2 & LT10(R)G Engines 15,000/30,000 hour General Overhaul Specification.
<b>DSS 5141</b>	Xplorer/Endeavour Cummins KTA-19-R & LT10(R)G Engines 1,500 hour Service Specification.
<b>DSS 5144</b>	Xplorer/Endeavour Cummins KTA-19-R Traction Engines Procedure for Acceptance Testing Subsequent to Overhaul.
<b>DSS 5145</b>	Xplorer/Endeavour Cummins LT10(R)G Auxiliary Engines Procedure for Acceptance Testing Subsequent to Overhaul.
<b>EWI 000</b>	Safety requirements for working on trains at XESC Eveleigh and ESC Broadmeadow.
<b>EWI 004</b>	Auxiliary Engine Calibration.
<b>EWI 006</b>	Traction and Auxiliary Engine A11 Card Link Settings.
<b>EWI 018</b>	Traction engine 1,500 hour service.
<b>EWI 020</b>	Traction engine stall test.
<b>EWI 055</b>	Traction Engine 7,500 Hour Service.
<b>Trial TR0017</b>	KTA-19-R Modified Top Overhaul Procedure

#### **Bombardier (formerly ABB) documents**

<b>Drawing 495 027790</b>	Schematic Diagram – Alternator and Shore Supply.
<b>Drawing 495 027860</b>	Traction Engine Control.

<b>Cummins documents</b>	<b>NOTE:</b> the documentation listed below is not available from RailCorp.
	<b>KTA19 &amp; LT10</b>
<b>Bulletin No. 3810263-00</b>	K19 Series Engines Shop Manual
<b>Bulletin No. 3810307</b>	K19 Series Engines Troubleshooting and Repair Manual
<b>Manual 3810259.00</b>	Specification Manual KTA19

<b>CPL 1190</b>	Control Parts List for KTA-19-R2 engines.
<b>CPL 2291</b>	Control Parts List for KTA-19-R2 engines.
<b>CPL 2292</b>	Control Parts List for KTA-19-R2 engines.
<b>CPL 2295</b>	Control Parts List for KTA-19-R2 engines.
<b>CPL 1430</b>	KTA Critical Parts List
<b>Reference 10 QSP 4.09.21</b>	KTA19 Ryton Governor Modification
<b>Reference 10 QSP 4.09.22</b>	K19 Engine Rewiring
<b>Reference 10 QSP 4.09.23 &amp; SRA EMD032</b>	Replacement of Traction Engine 94/98 Temperature Switch
<b>Reference Service Parts Topic 99TI-10</b>	Crankshaft & Accessory Drive Seals
<b>Reference Service Parts Topic 01T8-7</b>	KTA19 Water Pump Changes
<b>Drawing 10-14-71</b>	Traction Engine Wiring Cummins KTA19R
<b>Bulletin No. 3379347-07</b>	L10 Series Engines Shop Manual
<b>Bulletin No. 3379347-07</b>	L10 Series Engines Internal Damper Models Shop Manual
<b>Bulletin No. 3810246</b>	L10 Series Engines Troubleshooting and Repair Manual
<b>No reference</b>	Generator and Controls Service Manual
<b>Bulletin 3379231-03</b>	Magnetic Pickups.
<b>Manual 3810315.02</b>	Specification Manual LT10
<b>No reference</b>	Stamford Installation, Service and Maintenance Manual
<b>CPL 882</b>	Control Parts List for LT10(R)G engines.
<b>Schematic 2406-P-08</b>	Electrical Schematic
<b>Schematic 2406-P-09</b>	Electrical Schematic
<b>210WSS0001</b>	K19 Control Panel Refurbishment
	<b>QSK-19</b>
<b>Bulletin 3666113</b>	Troubleshooting & Repair Manual Fuel system Vol 1 & 2
<b>Bulletin 3666232</b>	Shop Manual
<b>Bulletin 3666098</b>	Troubleshooting & Repair Manual Vol 1 & 2
<b>Bulletin 3666120</b>	Operation & Maintenance Manual
<b>Bulletin 367199</b>	Parts Manual
<b>Bulletin 3666231</b>	Centinel Master Repair Manual

<b>No reference</b>	QSK-19 Control Panel repair guide.
	<b>ISBe 5.9G</b>
<b>Bulletin 3666397</b>	Operation & Maintenance manual ISBe 5.9 engine
<b>Bulletin 4021271</b>	Service Manual ISBe Engine Volume 1 & 2
<b>Bulletin 3666194</b>	Troubleshooting and Repair Manual Electronic Control System Volume 1 & 2
<b>Bulletin 4056497</b>	Parts Manual ISBe 5.9
	<b>R131 DIDA Diesel Generator Set</b>
<b>Bulletin CSP00040</b>	Operation and Maintenance Manual
<b>Bulletin UCH-027</b>	Newage International Installation and Service manual
<b>CSP00041</b>	Spare parts catalogue

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**HAZARD CODE:**

**PRACTICES & PROCEDURES  
MANUAL REFERENCE  
Volume 6, Section H .**

**CONFIGURATION CODE:**

**TITLE: XPLORER/ENDEAVOUR CUMMINS KTA-19-R & LT10(R)G ENGINES 7,500-HOUR  
TOP OVERHAUL SPECIFICATION**

**CARS or EQUIPMENT AFFECTED:**

CUMMINS KTA-19-R & LT10(R)G ENGINES

**SUMMARY/BACKGROUND:**

This Standard/Instruction shall be used in conjunction with the Original Equipment Manufacturer (OEM) Manuals for the 7,500-hour overhaul of Cummins KTA-19-R & LT10(R)G Engines for Xplorer/Endeavour Railcars.

**SAFETY REQUIREMENTS:**

Ensure all workshop and OEM safety requirements are followed.

**DESCRIPTION:**

This Standard/Instruction sets the minimum technical requirements, procedures, tests and qualifications necessary for the 7,500-hour overhaul of Cummins KTA-19-R and LT10(R)G Engines which are used on Xplorer/Endeavour railcars.

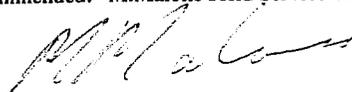
It is to be used in conjunction with the Manufacturer's Maintenance Instructions, drawings and technical information listed herein, for these Cummins Engine types.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT**

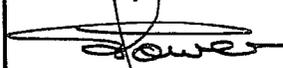
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**NOTE: This Engineering Instruction is a controlled copy when 'COPY NO' is in RED**

Prepared By: B.Wooldridge Engineer Traction Systems & Bogies  
Ammended: M.Malone Field Service Officer



Authorised By: Geoff Power



**02 FEB 04**  
Manager Quality and Technical Support

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

**CONTENTS**

<b>CLAUSE No.</b>	<b>CLAUSE</b>	<b>PAGE No.</b>
1	GENERAL CLAUSES	3
2	REPLACEMENT PARTS	5
3	REPAIR PROCEDURES	6
4	MODIFICATIONS/UPGRADES - <i>ONCE-OFF REPLACEMENTS</i>	10
5	TESTING	13
6	PAINTING	14
7	STORAGE	14
8	TECHNICAL DATA	15
9	REFERENCES	19

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

**1. GENERAL CLAUSES**

**1.1 Scope**

1.1.1 This Standard covers the technical requirements and qualifications necessary for the 7,500-hour top overhaul of Cummins KTA-19-R & LT10(R)G Engines used on Xplorer and Endeavour railcars.

1.1.2 The Contractor shall supply management expertise, technology, labour, equipment and plant to ensure Cummins KTA-19-R & LT10(R)G Engines satisfy performance requirements and operate within the manufacturer's specification for a period of not less than 7,500 engine hours following inspection, overhaul and testing.

1.1.3 The scope includes, but is not limited to:

- (i) Disassembly, Cleaning and Inspection
- (ii) Overhaul and Assembly (including parts replacement)
- (iii) Testing
- (iv) Painting, Storage and Transportation

**1.2 Description of Engines**

**1.2.1 KTA-19-R Engine**

The Cummins KTA-19-R Engine is part of a traction package used on Xplorer/Endeavour Railcars. The traction package, mounted beneath the railcar underframe, consists of one Cummins KTA-19-R engine per car driving a Voith T311r turbo transmission unit by means of a cardan shaft.

Cummins KTA-19-R Engine is a 6 cylinder in-line horizontal (75° tilt), 19 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged and aftercooled, with a continuous rating of 353 kW. The engine is controlled by an electronic control card, with maximum governed speed of 2150 RPM, and idle speed of 625 RPM. Engine protection equipment using various sensors wired to the control card, indicate water temperature, oil pressure, water pressure and engine overspeed.

**1.2.2 LT10(R)G Engine**

The Cummins LT10(R)G Engine is part of an auxiliary engine alternator set used on Xplorer/Endeavour railcars. An engine alternator set, also mounted beneath the Railcar underframe, consists of one Cummins LT10(R)G engine coupled to a 124 kW/155 kVA Stamford UCI274F2 alternator, and provides auxiliary 415 V 3 phase, 50 Hz supply.

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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**08/12/2003**

**ISSUE: 03**

Cummins LT10(R)G Engine is a 6 cylinder in-line horizontal, 10 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged. The engine speed of 1500 RPM is controlled by a Cummins electronic governor.

The engine, alternator and control equipment are all mounted within the one enclosure. An electric 415 V AC fan within the enclosure provides ventilation.

**1.3 Quality Requirements**

1.3.1 The Contractor shall operate a quality system conforming to the requirements of AS NZS ISO 9001:2000.

1.3.2 It is preferred that the Contractor be registered under the Standards Australia accreditation scheme of quality systems or with an equivalent recognised authority.

**1.4 Sub-Contracted Work**

1.4.1 The Contractor shall notify the Principal's Representative when the services of a Sub-Contractor will be used.

1.4.2 The requirement of Clause 1.5.1 applies to components which are to be tested, manufactured, repaired, reconditioned or supplied by a company or persons other than the Contractor.

1.4.3 The Contractor shall ensure that Sub-Contractors comply with the relevant requirements of this Standard.

**1.5 Modifications**

1.5.1 Future modifications shall only be carried out by the Contractor after receipt of:

- (i) an amendment of the appropriate Section/Clause of this Standard, or
- (ii) a letter of approval from the Principal's Representative to cover such work.

**1.6 Non-Standard Repairs**

1.6.1 Any repair or reclamation outside the scope of, or not covered by, this Standard is subject to approval of the Principal's Representative prior to commencement of repair/reclamation.

**1.7 Technical Records**

1.7.1 On return of an overhauled Engine the build records and testing results are to be made available to the Principal's Representative.

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**EI DSS 5131**

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**08/12/2003**

**ISSUE: 03**

1.7.2 The Contractor shall develop appropriate inspection, assembly and test report sheets for use with this Standard.

**1.8 Information Requirements**

1.8.1 Information required from the Contractor shall be compiled and forwarded to the Principal's Representative.

1.8.2 The following information is required from Tenderers or the Contractor.

- (i) One copy of the Contractor's quality plan which will be used for the top overhaul of the Engine.
- (ii) One copy of the quality plan covering the work carried out by the Contractor's Sub-Contractor(s).
- (iii) Supply information as required by the Tender Schedule.
- (iv) Changes to information previously provided under this Clause.

**2. REPLACEMENT PARTS**

2.1 The replacement new or reconditioned exchange parts used in the overhaul, or intermediate repairs, shall be genuine parts obtained through the accredited agent in Australia or directly from the manufacturer (O.E.M).

2.2 Alternate supply of replacement parts may be approved, subject to evidence being produced by the supplier that the replacement parts are equal to, or superior to, the genuine replacement parts.

**2.3 Mandatory Replacement Parts**

2.3.1 The following components on KTA-19-R and LT10(R)G Engines shall be replaced with new parts.

- KTA 19 Water temperature thermostat. Replaced with 168 deg F and seal Cummins PN 4009478 & 3099133
- All gaskets and seals for components removed from engine
- All Wet Filters
- KTA19 crankcase breather. Replaced with Mann & Hummel type Cummins PN 3281592
- Engine Oil

# ENGINEERING INSTRUCTION

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08/12/2003

ISSUE: 03

2.3.2 The following KTA-19-R Engines (standard & STC) components shall be replaced with reconditioned exchange units.

- Cylinder Heads
- Jacket Water Pump
- Turbocharger
- Injectors
- Fuel Pump (fitted with new shutdown solenoid)
- Starter Motor (Delco Remy PN 3604321X) & auxiliary start solenoid.
- Oil Control Valve PN3056564rx (STC engines only)

2.3.3 The following LT10(R)G Engine components shall be replaced with reconditioned exchange units.

- Cylinder Head
- Jacket Water Pump
- Turbocharger
- Injectors
- Fuel Pump and EFC Actuator (fitted with new shutdown solenoid)
- Starter Motor (Delco Remy PN 3604321X) & auxiliary start solenoid.

### 2.4 Optional Parts

2.4.1 Parts that exceed the Manufacturer's tolerances, or cannot be reused shall be replaced.

2.4.2 The full Parts List for KTA-19-RR engines is available through Cummins Control Parts List (CPL) No. 1190 & 1430 (STC).

2.4.3 The full Parts List for LT10(R)G engines is available through Cummins Control Parts List (CPL) No. 882.

## 3. REPAIR PROCEDURES

### 3.1 Disassembly

#### 3.1.1 *KTA-19-R Engine Disassembly*

3.1.1.1 The Cummins Engine Rebuild Stand Part No. 3375194 shall be used for Engine Top Overhaul procedures.

3.1.1.2 KTA-19-R Engine shall be disassembled in accordance with Cummins K19 Series Engines Shop Manual, for removal and disassembly of engine components.

3.1.1.3 Ensure quick connect coolant test point fitted to coolant pressure switch is not removed.

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08/12/2003

ISSUE: 03

**3.1.2 *LT10(R)G Engine Disassembly***

- 3.1.2.1 The Cummins Engine Rebuild stand Part No. 3375194 shall be used for Engine Top Overhaul procedures.
- 3.1.2.2 LT10(R)G Engine and Alternator shall be removed from Engine enclosure. All retaining bolts, nuts and washers shall be kept together.
- 3.1.2.3 LT10(R)G Engine & Alternator shall be separated in accordance with Section 6 of Cummins-Onan Generator and Control Service Manual.
- 3.1.2.4 The Engine shall be disassembled in accordance with Cummins L10 Series Engines Shop Manual, for removal and disassembly of engine components.
- 3.1.2.5 In particular, the auxiliary main contactor and shore supply switch shall be thoroughly cleaned of all traces of internal dust.

**3.2 *Cleaning***

- 3.2.1.1 A clean work environment shall be used for the top overhaul of Cummins KTA-19-R and LT10(R)G Series Engines.
- 3.2.1.2 General cleaning guidelines detailed in Cummins K19 and L10 Series Engines Shop Manuals shall be followed, except where specific cleaning instructions are included in the procedures of these manuals.
- 3.2.1.3 KTA-19-R and LT10(R)G Engine components to be reused shall be cleaned in accordance with clause 3.2.1.2.

**3.3 *Inspection***

- 3.3.1 Inspection sheets shall be completed and supplied to the Principal's Representative.
- 3.3.2 Inspection sheets shall indicate components that exceed manufacturer's tolerances, or cannot be reused.
- 3.3.3 The Principal's Representative shall approve all component repair or replacement unless stated otherwise.

**3.3.4 *KTA-19-R Engine Inspection***

- 3.3.4.1 Cummins KTA-19-R Engine components that are removed during Engine disassembly, and are to be reused in Engine top overhaul, shall be inspected in accordance with Cummins K19 Series Engines Shop Manual.

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

- 3.3.4.2 Inspect existing four (4) off turbo mounting bolts for damage. Broken or damaged studs shall be replaced.
- 3.3.4.3 Inspect condition of all flexible oil & coolant hoses including clamps. Replace any found damaged.
- 3.3.4.4 Inspect condition of dust shield fitted to starter motor. Replace if found damaged.
- 3.3.4.5 Inspect turbo riser visually for cracking & damage. Any riser found cracked & damaged shall be replaced.
- 3.3.4.6 Inspect condition of all engine mounted pressure switches for damage to wiring & fittings. Repair any damaged found.
- 3.3.5 ***LT10(R)G Engine Inspection***
- 3.3.5.1 Cummins LT10(R)G Engine components that are removed during Engine disassembly, and are to be reused in Engine top overhaul, shall be inspected in accordance with Cummins L10 Series Engines Shop Manual.
- 3.3.5.2 Alternator stator winding insulation shall be assessed by resistance check with megger in accordance with Section 5 of Cummins-Onan Generator and Control Service Manual.
- 3.3.5.3 Anti Vibration mounts shall be inspected for security. Broken or worn vibration mounts shall be replaced.
- 3.3.5.4 Generator enclosure shall be inspected, including insulation, internal and external integrity of doors, locks and baffles. Components which cannot be reused shall be replaced.
- 3.3.5.5 Inspect condition of all flexible oil & coolant hoses including clamps. Replace any found damaged.
- 3.4 **Assembly**
- 3.4.1 Components shall be qualified before reuse and this recorded on assembly inspection sheets. Parts replaced as mandatory require a check that they have been replaced.
- 3.4.2 ***KTA-19-R Engine Assembly***
- 3.4.2.1 KTA-19-R Engine assembly shall be in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual.
- 3.4.2.2 Crankshaft end float shall be checked in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual.

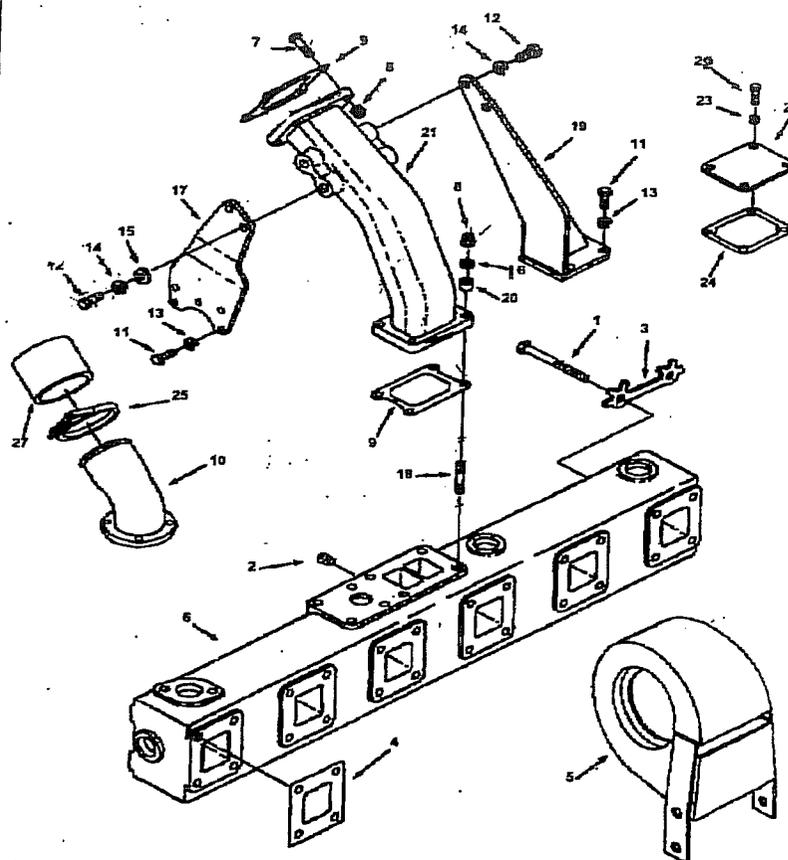
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**ISSUE: 03**

- 3.4.2.3 Valve and injector adjustment shall be in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual.
- 3.4.2.4 Fuel Pump calibration shall be in accordance with Cummins Bulletin No. 3379084, PT Fuel Pump Rebuilding and Calibration Instructions.
- 3.4.2.5 Fuel solenoid fuel block shall be removed and thoroughly cleaned of all traces of internal debris.
- 3.4.2.6 Turbo mounting cap screws (Item 7 PN3016181) to be reused on assembly if not damaged.
- 3.4.2.7 Turbo mounting cap screw lock nut (Item 8 PN3016182) to be replaced on assembly.
- 3.4.2.8 Turbo high riser bracket Cap Screw (Item 12 PN 206488) to be replaced on assembly.
- 3.4.2.9 Turbo high riser bracket Cap Screw lock washer (Item14 PN S-608) to be replaced on assembly.



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**EI DSS 5131**

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08/12/2003

ISSUE: 03

**3.4.3 *LT10(R)G Engine Assembly***

- 3.4.3.1 LT10(R)G Engine assembly shall be in accordance with procedure 00-02 of Cummins L10 Series Engine Shop Manual.
- 3.4.3.2 Crankshaft end float shall be checked in accordance with procedure 00-02 of Cummins L10 Series Engine Shop Manual.
- 3.4.3.3 Valve and injector adjustment shall be in accordance with procedure 00-02 of Cummins L10 Series Engines Shop Manual.
- 3.4.3.4 Lube oil scavenge pump shall be fitted with Viton type "O" rings Cummins PN 3252342.
- 3.4.3.5 Ensure flywheel magnetic speed probes & flywheel housing magnetic plug are clean on assembly.
- 3.4.3.6 LT10(R)G Engine and Alternator shall be assembled in accordance with Cummins-Onan Generator and Controls Service Manual.

**4. MODIFICATIONS/UPGRADES - *ONCE-OFF REPLACEMENTS***

The following Cummins KTA-19-R and LT10(R)G Engines modifications/upgrades that have not been completed on Xplorer/Endeavour railcar engines, shall be performed by the Contractor as part of the 7,500-hour top overhaul.

**4.1 KTA-19-R Engine Modifications/Upgrades - *ONCE-OFF REPLACEMENTS***

- 4.1.1 Original oil filler cap shall be replaced with an approved Cummins positive sealing screw type filler cap PN 107981.
- 4.1.2 All engine control wiring other than Radox 125 polyamide sheath shall be replaced with Radox 125 polyamide sheath cable with additional spiral wrap for mechanical protection.
- 4.1.3 Dust hole shall be drilled in starter motor bell housing. An approved starter motor dust shield shall be fitted to engine.
- 4.1.4 An approved fuel filter protection plate shall be fitted.
- 4.1.5 Auxiliary start solenoid shall be relocated or have protection provided to eliminate damage due to ballast strike.
- 4.1.6 Original flexible rubber engine coolant hoses shall be replaced with Cummins silicone type hoses.

## ENGINEERING INSTRUCTION

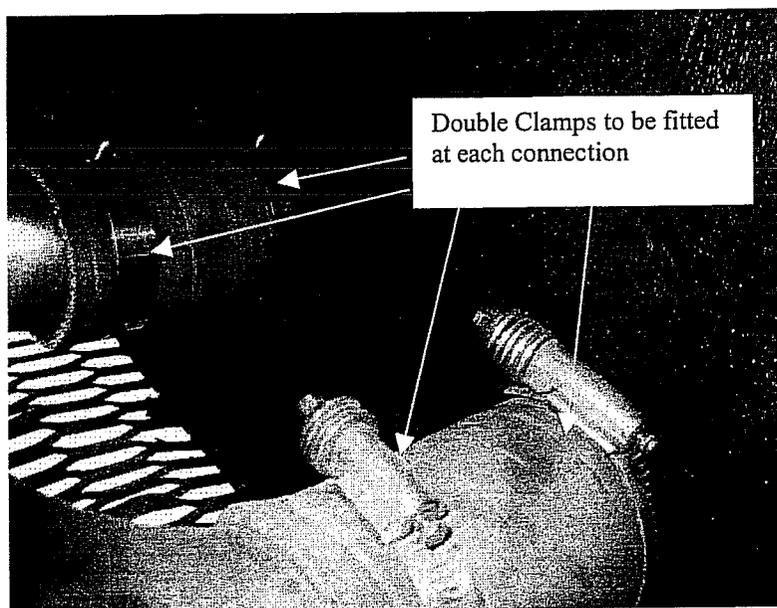
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08/12/2003

ISSUE: 03

- 4.1.7 Original engine stone guard shall be replaced with an approved engine stone guard.
- 4.1.8 All wiring to be rerouted, as required by the Principal's Representative.
- 4.2 LT10(R)G Engine Modifications/Upgrades - *ONCE-OFF REPLACEMENTS***
- 4.2.1 The existing inline connectors used for fire probe wiring shall be replaced with an accessible junction box of approved design.
- 4.2.3 Install magnetic sump plug in an approved position in the flywheel housing.
- 4.2.4 Seal the control box panel top joints with Sikaflex to prevent entry of dust.
- 4.2.5 All engine control wiring other than Radox 125 polyamide sheath shall be replaced with Radox 125 polyamide sheath cable with additional spiral wrap for mechanical protection, as required.
- 4.2.6 Original flexible rubber engine coolant hoses shall be replaced with Cummins silicone type hoses.
- 4.2.7 Each hose to pipe connection from & to water pump shall have double hex drive hose clamps fitted, Cummins PN 3922849 (see figures 1, 2 & 3). Each clamp shall be orientated so access for tightening can occur from access hatch (see figure 2).



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ISSUE: 03

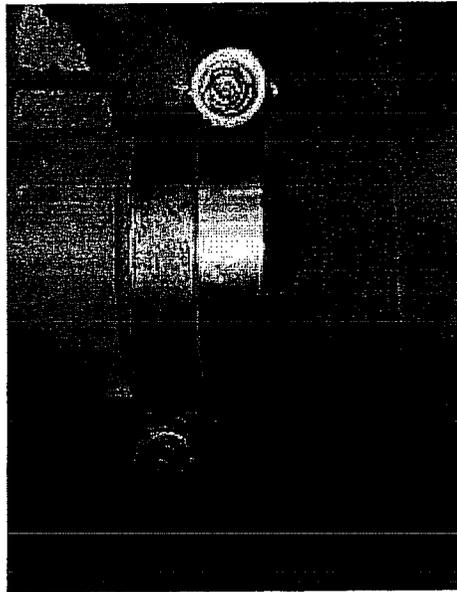


Fig 2  
Typical Arrangement of  
double claps

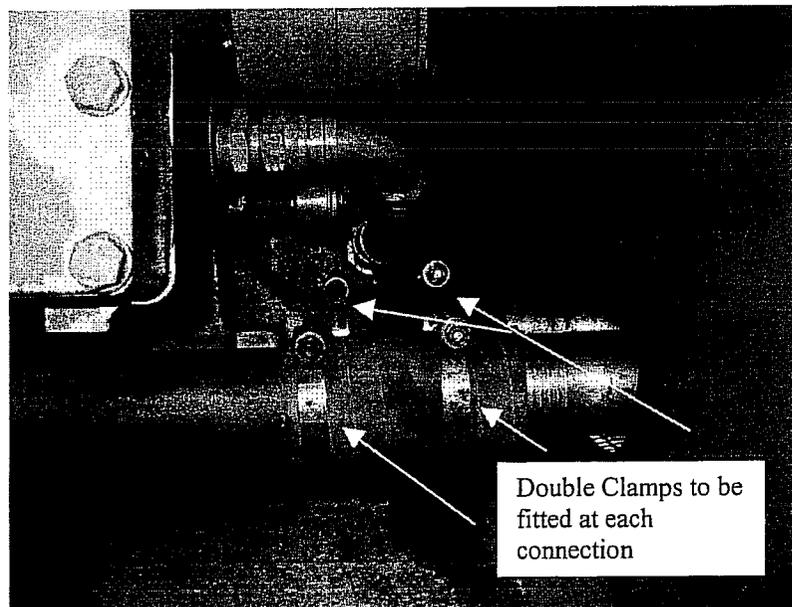


Figure 3

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**EI DSS 5131**

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**08/12/2003**

**ISSUE: 03**

**5. TESTING**

**5.1 KTA-19-R Engine Dynamometer Testing**

5.1.1 KTA-19-R Engine testing shall be performed using an engine dynamometer, to run-in and performance check rebuilt engines.

5.1.2 KTA-19-R Engines shall be tested in accordance with procedure 19-4-14-01 of Cummins K19 Series Engines Shop Manual and Diesel Services Support Standard/Instruction DSS 5144.

5.1.3 Test results shall be recorded on Test Sheets and supplied to the Principal's Representative.

5.1.4 Operation of the following Engine Protection equipment shall be checked and the points set in accordance with Cummins-Onan Service Manual:

- Water Temperature
- Oil Pressure
- Water Pressure
- Engine Overspeed

**5.2 LT10(R)G Engine-Alternator Load Testing**

5.2.1 LT10(R)G Engine-Alternator shall be load tested on a resistive load in accordance with Cummins-Onan Generator and Controls Service Manual.

5.2.2 LT10(R)G Engine-Alternator shall be tested in accordance with Cummins-Onan Generator and Controls Service Manual and Diesel Services Support Standard/Instruction DSS 5145.

5.2.3 Electronic Governor and other setpoints shall be checked in accordance with Section 5 of Cummins-Onan Generator and Controls Service Manual and Diesel Services Support Standard/Instruction DSS 5145.

5.2.4 Operation of the following Engine Protection equipment shall be checked and the points set:

- Water Temperature
- Oil Pressure
- Water Pressure
- Engine Overspeed

5.2.5 Operation of ventilation fan shall be checked.

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

**6. PAINTING**

**6.1 KTA-19-R Engine Painting**

6.1.1 KTA-19-R Engine shall be painted in accordance with procedure 19-4-14-04 of Cummins K19 Series Engines Shop Manual, to colour of "Onan Green" (Munsell Number 1.5BG 4.38/6.5).

**6.2 LT10(R)G Engine & Enclosure Painting**

6.2.1 LT10(R)G Engine shall be painted in accordance with procedure 14-06 of Cummins L10 Series Engines Shop Manual, to colour of Cummins Beige .

6.2.2 Enclosure shall be painted to colour of "Onan Green" (Munsell Number 1.5BG 4.38/6.5).

**7. STORAGE**

**7.1 Short Term Storage**

7.1.1 If KTA-19-R engines are stored for a short term (1-6 months), they shall be stored in accordance with procedure 19-04-14-05 of Cummins K19 Series Engines Shop Manual.

7.1.2 If LT10(R)G engines are stored for a short term (1-6 months), they shall be stored in accordance with procedure 14-07 of Cummins L10 Series Engines Shop Manual.

**7.2 Long Term Storage**

7.2.1 For long term storage (6-24 months) of KTA-19-R engines, procedure 19-04-14-05 of Cummins K19 Series Engines Shop Manual shall be followed.

7.2.2 For long term storage (6-24 months) of LT10(R)G engines, procedure 14-08 of Cummins L10 Series Engines Shop Manual shall be followed.

**7.3 Transportation**

7.3.1 KTA-19-R Engines shall have all external piping sealed from external moisture, dust and dirt, for the purpose of transportation.

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

**8 TECHNICAL DATA**

**8.1 KTA-19-R ENGINE SPECIFICATIONS**

**8.1.1 General Engine Data**

Configuration No.	D193078RX02 D193087RX02(STC)
General Specification Bulletin No.	3885046
Control Parts List (CPL) No.	1190 1430(STC)
Performance Curve	P-4527-A P-4783(STC)
Installation Diagram	3235371
Power Rating - maximum	380kW (510 HP) @ 2000 RPM
Continuous Power Rating (Applicable to SRA)	352 kW (472 HP) @ 1800 RPM STC 485kW @ 2100 RPM
Engine Speed	
Overspeed (RPM)	2550
Standard Rating (RPM)	2100
Maximum Governed Speed (RPM)	2150
Idling Speed (RPM)	625
High Idle Set Point	1400
Bore and Stroke	159 mm [6.25 in.] x 159 mm [6.25 in.]
Displacement	18.9 litres [1150 cu. in.]
Compression Ratio	14.5 or 15.5:1
Firing Order	1-5-3-6-2-4
Engine Weight (With Standard Accessories)	
Dry Weight	1720 kg [3800 lb] Maximum 2088Kg (STC)
Wet Weight	1800 kg [3965 lb] Maximum 2150Kg(STC)

**8.1.2 Air Induction System**

Maximum allowable turbocharged intake restriction      64 cm H<sub>2</sub>O [25 in. H<sub>2</sub>O]

**8.1.3 Oil System**

Oil Grade      15W/40

Oil Pressure

    At idle (minimum allowable)      138 kPa [20 psi] min.

    At no load governed speed      345 kPa [50 psi] min.

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

Oil Filter Capacity

Bypass Filter 2.8 litres [0.62 gal.]

Full Flow Filter 3.5 litres [0.77 gal.]

Total System Capacity 73 litres (excluding bypass filter)

**8.1.4 Cooling System**

Coolant Capacity (engine only) 30 litres [6.6 gal.]

Standard modulating thermostat range 80-90 °C [175-195 °F]

Maximum coolant cylinder block pressure (pressure cap removed) 275 kPa [40 psi]

Maximum allowable top tank temperature 95 °C [203 °F]

Minimum recommended top tank temperature 70 °C [158 °F]

Minimum recommended pressure cap 28 kPa [4 psi]

**8.1.5 Exhaust System**

Maximum allowable back pressure imposed by piping and silencer 75 mm Hg [3 in. Hg]

Exhaust pipe size (normally acceptable inside diameter)  
for KT and KTA 127 mm [5 in.]

**8.1.6 Fuel System**

Engine governing system Cummins PT Fuel Pump

Maximum allowable restriction to pump:  
With clean filter 100 mm Hg [4 in. Hg]

With dirty filter 200 mm Hg [8 in. Hg]

Maximum allowable fuel return line restriction 63 mm Hg [2.5 in. Hg]

Maximum allowable fuel return line restriction  
with check valves and/or overhead tanks 165 mm Hg [6.5 in. Hg]

**8.1.7 Electrical System**

**Battery Size**

**Ambient Temperature**

	18 °C [0 °F]		0 °C [32 °F]	
	Cold Cranking Amperes	Reserve Capacity* Amperes	Cold Cranking Amperes	Reserve Capacity Amperes
24 Volt**	900	320	640	240

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

\* The number of plates within a given battery size determine the reserve capacity. Reserve capacity determines the length of time sustained cranking can occur.

\*\* Per battery (two 12-volt batteries in series) CCA ratings are based on -18 °C [0 °F].

Maximum allowable resistance of starting circuit

With 12-volt starter - Ohms

Not recommended

With 24-volt starter - Ohms

0.002

**8.2 LT10(R)G ENGINE SPECIFICATIONS**

**8.2.1 General Engine Data**

Configuration No.	D342083UXOZ
Control Parts List (CPL) No.	881
Performance Curve	9257

Engine/Alternator Rating	
ISO Conditions	124 kW/155 kVA at 0.8 pf
Site Conditions	118.5 kW/148 kVA at 0.8 pf

Engine Speed @ Maximum Output	
Governed Speed (RPM)	1500
Overspeed (Hz)	59

Bore and Stroke	125 mm [4.921 in.] x 136 mm [5.364 in.]
-----------------	---

Displacement	10 litres [611 cu. in.]
--------------	-------------------------

Compression Ratio	17.0:1
-------------------	--------

Firing Order	1-5-3-6-2-4
--------------	-------------

Engine Weight (With Standard Accessories)	
Dry Weight	876 kg [1930 lb]
Wet Weight	922 kg [2030 lb]

Crankshaft Rotation - (viewed from the front of the engine)	Clockwise
---	-----------

**8.2.2 Air Induction System**

Maximum allowable Intake Restriction  
with Clean Air Filter Element:

Heavy Duty Dry Type Cleaner	38 cm H <sub>2</sub> O [15 in. H <sub>2</sub> O]
-----------------------------	--

Maximum allowable Intake Restriction  
with Dirty Air Filter Element

	64 cm H <sub>2</sub> O [25 in. H <sub>2</sub> O]
--	--

**8.2.3 Lubricating Oil System**

Oil Grade	SAE 15W40
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Oil Pressure - Low idle (Minimum Allowable)	70 kPa [10 psi]
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**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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**08/12/2003**

**ISSUE: 03**

At 1300 RPM or Torque Peak (Minimum Allowable)	207 kPa [30 psi]
Oil Capacity of Standard Engine	
Bypass Filter	2.8 litres [0.62 gal.]
Full Flow Filter	3.5 litres [0.77 gal.]
Oil Pan	
- Automotive (High-Low)	26.5 to 19 litres [6 to 4.2 gal.]
* Total System Capacity including Bypass Filter	34 litres [7.5 gal.]
If an oil pan spacer is used, the total lubricating system capacity is increased by	7.6 litres [1.7 gal.]

**8.2.4 Cooling System**

Coolant Capacity (engine only)	11 litres [2.4 gal.]
Standard Modulating Thermostat Range	82-93 °C [175-195 °F]
Maximum Coolant Cylinder Block Pressure (pressure cap removed)	
Closed Thermostat	275 kPa [40 psi]
Maximum allowable top tank temperature	100 °C [212 °F]
Minimum recommended top tank temperature	70 °C [158 °F]
Minimum recommended pressure cap	50 kPa [7 psi]

**8.2.5 Exhaust System**

Maximum allowable back pressure imposed by piping and silencer	75 mm Hg [3 in. Hg]
Exhaust pipe size (normally acceptable inside diameter) for KT and KTA	127 mm [5 in.]

**8.2.6 Fuel System**

Engine Governing System	Cummins PT Fuel Pump with EFC Control
Maximum allowable restriction to pump:	
With clean filter	100 mm Hg [4 in. Hg]
With dirty filter	200 mm Hg [8 in. Hg]
Maximum allowable fuel return line restriction	63 mm Hg [2.5 in. Hg]
Maximum allowable fuel return line restriction with check valves and/or overhead tanks	165 mm Hg [6.5 in. Hg]

**ENGINEERING INSTRUCTION**

**EI DSS 5131**

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08/12/2003

ISSUE: 03

**8.2.7 Electrical System**

Battery Size		Ambient Temperature	
18 °C [0 °F]		0 °C [32 °F]	
Cold	Reserve	Cold	Reserve
Cranking	Capacity*	Cranking	Capacity
Amperes	Amperes	Amperes	Amperes
24 Volt**	900	320	640
			240

\* The number of plates within a given battery size determine the reserve capacity. Reserve capacity determines the length of time sustained cranking can occur.

\*\* Per battery (two 12-volt batteries in series) CCA ratings are based on -18 °C [0 °F].

Maximum allowable resistance of starting circuit

With 12-volt starter - Ohms

With 24-volt starter - Ohms

Not recommended  
0.002

**9 REFERENCES**

9.1 The following Manufacturer's Manuals & Service Publications shall be referred to for the overhaul of Cummins KTA-19-R and LT10(R)G Engines:

- Cummins K19 Series Engines Shop Manual, Bulletin No. 3810263-00.
- Cummins L10 Series Engines Internal Damper Models Shop Manual, Bulletin No. 3379347-07.
- Cummins-Onan Generator and Controls Service Manual.

PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT

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<b>RAILCORP - ROLLING STOCK DIVISION ENGINEERING and PLANNING</b>	RailCorp Control Copy No.	Page 1 of 20
<b>ENGINEERING INSTRUCTION EI DSS 5140</b>		11 December 2006 VERSION: 4.0
<p align="center"><b>TECHNICAL MAINTENANCE CODE: RE01 -1800000-EI</b></p>		

**Title:**

XPLORER/ENDEAVOUR CUMMINS KTA-19-R2 & LT10(R)G ENGINES 15,000/30,000-HOUR GENERAL OVERHAUL INSTRUCTION

**Applicability:**

CUMMINS KTA-19-R2 & LT10(R) G ENGINES

**Reason for Instruction:**

This overhaul instruction shall be used in conjunction with the Original Equipment Manufacturer (OEM) Manuals for the 15,000/30,000-hour overhaul of Cummins KTA-19-R2 & LT10(R)G Engines for Xplorer/Endeavour Railcars.

**Safety Requirements:**

Ensure all workshop and OEM safety requirements are followed as outlined in Introduction of Cummins K19 & L10 shop manuals.

**Tools and Test Equipment:**

As outlined in K19 & LT10 Series Engines Shop Manual Bulletins No 3810263-00 & 3379347-07

**Description:**

This overhaul instruction sets the minimum technical requirements, procedures, tests and qualifications necessary for the 15,000/30,000-hour overhaul of Cummins KTA-19-R2 and LT10(R)G Engines which are used on Xplorer/Endeavour railcars.

It is to be used in conjunction with the Manufacturer's Maintenance Instructions, drawings and technical information listed herein, for these Cummins Engine types.

**NOTE:** This Engineering Instruction is a controlled copy when 'COPY NO' is in RED

Reviewed by: (Relevant Principal Engineer) Name: <u>WILLIAM B. MEGAW</u> Signature: <u>[Signature]</u> Position: <u>Principal Engineer</u> Date: <u>22/12/06</u>	Approved by: Chief Engineer Rolling Stock Name: <u>B. Pearce</u> Signature: <u>[Signature]</u> Date: <u>15/12/07</u>
---	---

Authorised for issue: Configuration Standards & Audit Manager

Name: G. NEASMITH Signature: [Signature] Date: 16/02/07

167

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 2 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**CONTENTS**

<b>CLAUSE No.</b>	<b>CLAUSE</b>	<b>PAGE No.</b>
<b>1</b>	<b>GENERAL CLAUSES</b>	
	Description of Engines	
	KTA19r2 .....	3
	LT10 .....	3
	Technical records .....	3
<b>2</b>	<b>REPAIR PROCEDURES</b>	
	KTA-19-R2 engine disassembly .....	4
	LT10-R-G engine disassembly .....	4
	Cleaning .....	4
	KTA-19-R2 engine inspection .....	5
	LT10-R-G engine & alternator inspection .....	5
	KTA-19-R2 engine component servicing & overhaul .....	6
	LT10-R-G engine component & alternator servicing/overhaul .....	7
	Replacement parts .....	7
	KTA-19-R2 engine assembly .....	11
	LT10-R-G engine assembly .....	13
<b>3</b>	<b>TESTING</b>	
	KTA-19-R2 engine dynamometer testing .....	14
	LT10-R-G engine-alternator load testing .....	14
<b>4</b>	<b>PAINTING</b>	
	KTA-19-R2 & LT10-R-G engine painting .....	15
<b>5</b>	<b>STORAGE</b>	
	Short term storage .....	15
	Long term storage .....	15
<b>6</b>	<b>TECHNICAL DATA</b>	
	KTA-19-R2 engine .....	16
	LT10-R-G engine .....	18
<b>7</b>	<b>REFERENCES</b> .....	20

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 3 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**1 GENERAL CLAUSES****1.1 DESCRIPTION of ENGINES****1.1.1 KTA-19-R2 ENGINE**

The Cummins KTA-19-R2 Engine is part of a traction package used on Xplorer/Endeavour Railcars. The traction package, mounted beneath the railcar underframe, consists of one Cummins KTA-19-R2 engine per car driving a Voith T311r turbo transmission unit by means of a cardan shaft.

Cummins KTA-19-R2 Engine is a 6 cylinder in-line horizontal (75<sup>0</sup> tilt), 19 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged and aftercooled, with a continuous rating of 400 kW. The engine is controlled by an electronic control card, with maximum governed speed of 2150 RPM, and idle speed of 625 RPM. Engine protection equipment using various sensors wired to the control card, indicate water temperature, oil pressure, water pressure and engine overspeed.

The Engine consists of diesel engine, protection equipment (including sensors), electrical wiring and engine control panel.

**1.1.2 LT10(R)G ENGINE**

The Cummins LT10(R)G Engine is part of an auxiliary engine alternator set used on Xplorer/Endeavour railcars. An engine alternator set, also mounted beneath the Railcar underframe, consists of one Cummins LT10(R)G engine coupled to a 124 kW/155 kVA Stamford UCI274F23 alternator, and provides auxiliary 415 V 3 phase, 50 Hz supply.

Cummins LT10(R)G Engine is a 6 cylinder in-line horizontal, 10 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged. The engine speed of 1500 RPM is controlled by a Cummins electronic governor.

The engine, alternator and control equipment are all mounted within the one enclosure. An electric 415 V AC fan within the enclosure provides ventilation.

**1.2 TECHNICAL RECORDS**

1.2.1 The overhauler shall develop RailCorp approved inspection, assembly and test report sheets for use with this Instruction.

1.2.2 On return of an overhauled Engine the inspection, assembly and test sheets are to be made available to the Principal's Representative.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 4 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**2 REPAIR PROCEDURES**

**2.1 DISASSEMBLY**

**2.1.1 KTA-19-R Engine Disassembly**

2.1.1.1 KTA-19-R2 Engine shall be disassembled in accordance with Cummins K19 Series Engines Shop Manual, for removal and disassembly of engine components:

**2.1.2 LT10(R)G Engine Disassembly**

2.1.2.1 LT10(R)G Engine and Alternator shall be removed from Engine canopy. All retaining bolts, nuts and washers shall be kept together.

2.1.2.2 LT10(R)G Engine and Alternator shall be separated in accordance with Section 6 of Cummins-Onan Generator and Control Service Manual.

2.1.2.3 The Engine shall be disassembled in accordance with Cummins L10 Series Engines Shop Manual, for removal and disassembly of engine components.

**2.2 CLEANING**

2.2.1 A clean work environment shall be used for the overhaul of Cummins KTA-19-R2 and LT10(R)G Series Engines.

2.2.2 General cleaning guidelines detailed in Cummins K19 and L10 Series Engines Shop Manuals shall be followed, except where specific cleaning instructions are included in the procedures of these manuals or outlined elsewhere in this instruction.

2.2.3 KTA-19-R2 and LT10(R)G Engine components to be reused shall be cleaned in accordance with clause 3.2.1.2.

2.2.4 LT10 canopy & control cubicle shall be cleaned to remove all traces of dirt & oil.

**2.3 INSPECTION**

2.3.1 Inspection sheets shall be completed and supplied to the Principal's Representative. Inspection sheets shall show condition, dimensions, clearances and tolerances of components.

**ENGINEERING INSTRUCTION**

11 December 2006

**EI DSS 5140**

VERSION: 4.0

2.3.2 Inspection sheets shall indicate components that exceed manufacturer's tolerances, or cannot be reused.

2.3.3 The Principal's Representative shall approve all component repair or replacement unless stated otherwise.

**2.3.4 KTA-19-R2 Engine Inspection**

2.3.4.1 Cummins KTA-19-R2 Engine components that are removed during Engine disassembly, and are to be reused in Engine overhaul, shall be inspected in accordance with Cummins K19 Series Engines Shop Manual.

2.3.4.2 Inspect for evidence of age validation dates for the following components:

- Oil pump
- Scavenge oil Pump
- Exhaust manifold
- Aftercooler Element

Components which have achieved 30,000 hours will require replacement & those components which cannot be validated for age shall be deemed to have achieved 30,000hrs

2.3.4.3 All engine mounted coolant pipework to be inspected for damage or excessive corrosion in accordance with Cummins KTA Series Engines Shop Manual.

**2.3.5 LT10(R)G Engine and Alternator Inspection**

2.3.5.1 Cummins LT10(R)G Engine components that are removed during Engine disassembly, and are to be reused in Engine overhaul, shall be inspected in accordance with Cummins L10 Series Engines Shop Manual.

2.3.5.2 All Anti Vibration mounts shall be inspected for security. Broken or worn vibration mounts shall be replaced. Ensure no excessive movement of mounted control panel.

2.3.5.3 The following canopy components shall be inspected for wear and/or damage: Components which cannot be reused shall be replaced.

- internal and external integrity of doors
- locks and baffles
- enclosure panelling & cable ducting.

2.3.5.4 All insulation & lagging will be replaced.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 6 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

- 2.3.5.5 Inspect & replace any Crompton control components seven (7) or more years old.
- 2.3.5.6 All engine mounted coolant pipework to be inspected for damage or excessive corrosion in accordance with Cummins L10 Series Engines Shop Manual.
- 2.3.5.7 Inspect all cables, sealing grommets and wiring for signs of abrasion & wear. Replace if necessary.
- 2.3.5.8 Shore supply socket shall be inspected for signs of arcing on the contact pins. Replace if necessary.
- 2.3.5.9 Inspect control wiring lugs for multiple connections. Rewire to ensure only a single connection per lug.
- 2.3.5.10 Inspect condition of the bearing housings, measuring and comparing wear limits in accordance with Newage AVK SEG instructions
- 2.3.5.11 Inspect for evidence of age validation date for ventilation fan blade. If date cannot be validated fan blade shall be deemed to have achieved 30,000hrs
- 2.3.5.12 Alternator AVR shall be inspected in accordance with Cummins Onan Generator and Controls Service Manual. (moved from alternator/servicing overhaul section)
- 2.3.5.13 Clean & inspect condition of magnetic sump plug in flywheel housing.
- 2.4 SERVICING/OVERHAUL**
- 2.4.1 Engine components that have been serviced/overhauled shall be noted on assembly inspection sheets
- 2.4.2 KTA-19-R2 Engine Component Servicing/Overhaul**
- 2.4.2.1 Aftercooler assembly shall be rebuilt in accordance with procedure 19-4-10-5 of Cummins K19 Series Engines Shop Manual.
- 2.4.2.2 Lube Oil Filter Head & adapter shall be serviced in accordance with procedures 19-4-07-07 & 19-4-07-08 of Cummins K19 Series Engines Shop Manual.
- 2.4.2.3 Injector and Valve Rocker Assemblies shall be serviced in accordance with procedure 19-4-03-02 of Cummins K19 Series Engines Shop Manual.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 7 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

2.4.2.4 Fuel solenoid fuel block shall be removed and thoroughly cleaned of all traces of internal debris. Measure resistance of all solenoids as outlined in Cummins K19 Series Engines Shop Manual.

**2.4.3 LT10(R)G Engine Component and Alternator Servicing/Overhaul**

2.4.3.1 Lube Oil Filter Head shall be serviced in accordance with procedures 07-05 & 07-06 of Cummins LT10 Series Engines Shop Manual.

2.4.3.2 Injector and Valve Rocker Assemblies shall be inspected in accordance with procedures 03-02 of Cummins LT10 Series Engines Shop Manual.

2.4.3.3 Alternator Stator (if to be re used) and Rotor Assemblies shall be steam cleaned and dried out in accordance with Cummins-Onan Generator and Control Service Manual.

2.4.3.4 Alternator Stator and Rotor assemblies shall be hot dipped in varnish. Upon curing of varnish, stator and rotor insulation shall be assessed by insulation resistance test in accordance with Cummins-Onan Generator and Control Service Manual & Newage AVK SEG requirements.

2.4.3.5 Alternator Rotor shall be balanced in accordance with Cummins-Onan Generator and Control Service Manual.

2.4.3.6 Alternator drive & non drive end bearings shall be replaced in accordance with Cummins-Onan Generator and Control Service Manual.

2.4.3.7 Alternator non drive end housing anti – creep “O” ring to be replaced in accordance with Cummins-Onan Generator and Control Service Manual.

2.4.3.8 Measure the alternator stator winding insulation resistance (IR) and record. Must be greater than 1.0MΩ. Replace stator if required.

2.4.3.9 Electrically repair alternator thermistor connections as necessary .

**2.5 REPLACEMENT PARTS**

2.5.1 The replacement new or reconditioned exchange parts used in the overhaul, or Intermediate repairs, shall be genuine parts obtained through the accredited agent in Australia or directly from the manufacturer (O.E.M).

2.5.2 Alternate supply of replacement parts may be approved, subject to evidence being produced by the supplier to the principals representative that the replacement parts are equal to, or superior to, the genuine replacement parts.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 8 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**2.5.3 MANDATORY REPLACEMENT PARTS**

2.5.3.1 The following components on KTA-19-R2 and LT10(R)G Engines shall be replaced with *new parts*.

COMPONENT	KTA19	LT10	PART NUMBER
Cylinder,Liner, Pistons & piston rings	•	•	As per Cummins CPL list No.1430 (KTA19r2) & CPL list No. 882 (LT10)
All Bearings & Bushes	•	•	As per Cummins CSP02291(KTA19r2) & CSP02293(LT10)
Camshaft, Cam Follower Rollers & Pins	•	•	As per Cummins CSP02291(KTA19r2) & CSP02293(LT10)
Water Temperature Thermostat 168 degree F & Seal	•	•	Cummins Part Numbers 4009478 (KTA 19r2) & 3076489 (LT10)
All Gaskets, Seals Flexible Oil & Coolant hoses	•	•	As per Cummins CSP02291, CSP02295 & CSP02292(KTA19r2) & CSP02293, CSP02294 & CSP02298(LT10)
All Oil, Fuel & Coolant filters	•	•	Lube Oil Filter LF3000, Fuel Filter FS1212 Coolant Filter
Fuel Pump Solenoid	•	•	As per Cummins CSP02291(KTA19r2) & CSP02293(LT10)
Crankcase Breather	•	•	Cummins Part Number 3281592
Viton "O" Rings On All Oil Pan Jumper Tubes		•	As per Cummins CSP02373, CSP02374, CSP02375 & CSP02376
Engine Oil	•	•	As Per Cummins Specification 15W40
All Temperature and Pressure Switches.	•	•	As per Cummins CSP02291 (KTA19r2) & CSP02294 (LT10)
KTA19 Oil level Sight Glass	•		Cummins Part Number 3008837
KTA19 Engine Wiring Harness	•		As per Cummins Procedure 10 QSP 4.09.22.
KTA19 Crankshaft Front Seal,	•		Cummins Part Number 3803994
KTA19 Crankshaft Rear seal	•		As per Cummins Parts Topic 99T1-10 March 99.
KTA19 Accessory Drive Shaft Seals	•		Cummins Part Number 380852 (fuel pump side) & Part Number 3016791 (drive side).
KTA19 Exhaust Hi Riser	•		Cummins Part Number 3628697
Exhaust Pipe Lagging		•	Cummins Part Number LT10RGINSEXT
All Coolant Hose Clamps	•	•	OEM "Constant Torque"
Air Induction Hose Clamps	•	•	OEM "T-Bolt"
Oil Filler Cap Screw Type Positive Sealing	•		Cummins Part Number ****

Table 1

ENGINEERING INSTRUCTION  
EI DSS 5140

11 December 2006

VERSION: 4.0

2.5.3.2 In conjunction with 2.5.3.1, the following KTA components are replaced at 30,000 hours only with new parts:

COMPONENT	KTA19	LT10	PART NUMBER
KTA19 Oil Pump	•		As per Cummins CPL list No.1190 (KTA19r)
KTA 19 Scavenge Oil pump	•		Cummins CSP03618.
KTA19 Exhaust Manifold	•		As per Cummins CPL list No.1190 (KTA19r)
KTA19 Aftercooler Element	•		Cummins Part Number 4910355

Table 2

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 10 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

2.5.3.3 The following LT10RG Engine Control Panel & alternator components shall be replaced with new parts.

COMPONENT	LOCATION	SUPPLIER/PART NUMBER
240 Volt Control Relays & Bases	Local control Panel	Crompton Instruments
24 volt DC control Relays & Bases	Local control Panel	Crompton Instruments
Engine Harness	Local control Panel	Cummins CSP03933
Door Seals	Canopy	
Heat Shrink On Main Cables	Alternator	
Magnetic Switch	Engine	Cummins Part Number 3050692
Engine Hour Meter	Local Control Panel	Cummins Part Number 302-0885
Alternator Bearings (drive & non drive end)	Alternator	Newage AVK SEG
"O" ring Anti Creep Non Drive End Housing	Alternator	Newage AVK SEG
Alternator Drive Coupling	Alternator	Cummins
Diodes & Varistors	Alternator	Newage AVK SEG
Ventilation Fan motor	Alternator	Cummins CSP03472
Main Output Contactor, Contacts And Coil	Behind local control panel	
Shore Supply Switch	Local Control Panel	Austsol C315AU5583 01ER
Main Supply Circuit Breaker	Local Control Panel	Heineman SK203 225
Shore Supply Circuit Breaker	Local Control Panel	HeinemanSK130H 100
Main Alternator Contactor	Local Control Panel	Telemcan LC1F185
Thermistors	Alternator	Newage AVK SEG
Insulation	Generator Enclosure	

Table 3

In conjunction with the above, the following components are replaced at 30,000 hours only:

COMPONENT	LOCATION	SUPPLIER/PART NUMBER
Ventilation Fan Blade	Alternator	Cummins Part Number 32412403

Table 3a

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 11 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

- 2.5.3.4 The following KTA-19-R2 and LT10 Engines components shall be replaced with Cummins ReCon parts.

COMPONENT	KTA19	LT10	PART NUMBER
Cylinder Heads	•	•	As per Cummins CPL list No.1430 (KTA19r2) & CPL list No. 882 (LT10)
Jacket Water Pump	•	•	As per Cummins CSP02292 (KTA19r2) & CSP02293 (LT10)
Turbocharger	•	•	As per Cummins CPL list No.1430 (KTA19r2) & CPL list No. 882 (LT10)
Fuel Injectors	•	•	As per Cummins CPL list No.1430 (KTA19r2) & CPL list No. 882 (LT10)
Fuel Pump	•	•	As per Cummins CSP02292 (KTA19r2) & CSP02293 (LT10)
Vibration Damper	•	•	As per Cummins CSP02291 (KTA19r2) & CSP02294 (LT10)
Connecting Rods	•	•	As per Cummins CSP02291 (KTA19r2) & CSP02294 (LT10)
Starter Motor	•	•	Delco Remy Cummins part number 3604321SX (LT10) & 3603868PX (KTA)
Oil Control Valve STC	•		As per Cummins CSP02292 (KTA19r2)

Table 4

## 2.6 ASSEMBLY

- 2.6.1 Components shall be qualified before reuse and this recorded on assembly inspection sheets. Assembly inspection sheets shall show condition, dimensions, clearances and tolerances of components used in Engine assembly. Parts replaced as mandatory require a validation that they have been replaced.
- 2.6.2 Ensure all components that are replaced at 30,000hrs are marked to identify installation date with month & year.
- 2.6.3 KTA-19- R2 Engine Assembly**
- 2.6.3.1 KTA-19-R2 Engine assembly shall be in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual & as outlined in Cummins CSP lists 02292, 02291 & 02295.
- 2.6.3.2 Crankshaft end float shall be measured in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

**Page: 12 of 20**

**ENGINEERING INSTRUCTION**

**11 December 2006**

**EI DSS 5140**

**VERSION: 4.0**

- 2.6.3.3 Install rocker lever assembly in accordance with procedure 19-04-00-02 of Cummins K19 Series Engines Shop Manual. Ensure fuel injector rocker lever is fitted with Hexagon Head adjusting screw, Cummins part number 3871310.
- 2.6.3.4 Valve and STC injector adjustment shall be in accordance with Cummins Service Parts topic 92T6-2.
- 2.6.3.5 All engine control wiring to be Radox 125 polyamide sheath cable with additional spiral wrap for mechanical protection.
- 2.6.3.6 Ensure quick connect engine sump drain fitting, consisting of pipe and quick connect fitting, Cummins part number J0502-0029, is fitted to the engine sump.
- 2.6.3.7 Fit Cummins/Dayco silicone hose to coolant system.
- 2.6.3.8 Re fit engine stone guard.
- 2.6.3.9 Ensure traction engine fuel non return valve has had the valve seat & spring removed.
- 2.6.3.10 Fit turbocharger with lube oil drain kit CSP03897.
- 2.6.3.11 New exhaust hi riser to be date stamped on installation.  
Ensure hi riser is fitted with:
- Mounting bolts; Cummins part number 206488
  - Spacers; Cummins part number 3027728.
- 2.6.3.12 Fit electronic alarmstat switches to thermostat housing as per RailCorp Xplorer Endeavour Engineering Modification EMD032.
- 2.6.3.13 Install Multiple throttling unit junction box as per Cummins reference 10QSP 4.09.22.
- 2.6.3.14 Connect the fuel pipework to Ryton governor & fuel pump as per Cummins reference 10 QSP 4.09.21.
- 2.6.3.15 Install water pump & ensure vent line is fitted as per Cummins parts topic 01T8-7.
- 2.6.3.16 Ensure the existing oil pressure circuit is wired to an approved "fail safe" system.
- 2.6.3.17 Ensure the conduit from junction box to low water pressure and low oil pressure switches shall be replaced with two separate conduit runs.

**ENGINEERING INSTRUCTION**

11 December 2006

**EI DSS 5140**

VERSION: 4.0

**2.6.4 LT10(R)G Engine Assembly**

- 2.6.4.1 LT10(R)G Engine assembly shall be in accordance with procedure 00-02 of Cummins L10 Series Engine Shop Manual.
- 2.6.4.2 Crankshaft end float shall be measured in accordance with procedure 00-02 of Cummins L10 Series Engine Shop Manual.
- 2.6.4.3 LT10(R)G Engine Alternator shall be assembled in accordance with Cummins-Onan Generator and Controls Service Manual.
- 2.6.4.4 Set magnetic pickups as per Cummins bulletin 3379231-03.
- 2.6.4.5 Ensure all relays are secured with retaining clips
- 2.6.4.6 Ensure all fire probes are not shorted to earth.
- 2.6.4.7 Fit Cummins Dayco silicone hose to coolant system.
- 2.6.4.8 Ensure magnetic sump plug is fitted in the flywheel housing.
- 2.6.4.9 Ensure fire probe wiring junction box is fitted.
- 2.6.4.10 Seal the control box panel top joints with Sikaflex to prevent entry of dust.
- 2.6.4.11 All engine control wiring to be Radox 125 polyamide sheath cable with additional spiral wrap for mechanical protection.
- 2.6.4.12 Each hose to pipe connection from & to water pump shall have "constant torque" hex drive hose clamps fitted, (see figure 1). Each clamp shall be orientated so access for tightening can occur from access hatch (see figure 2).

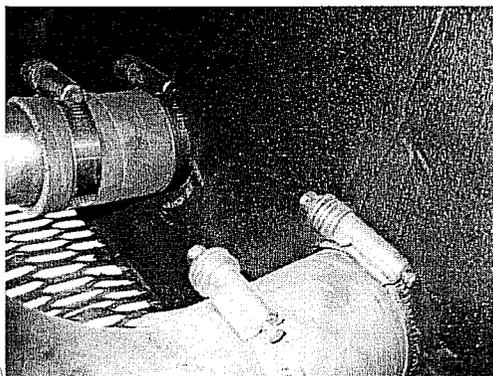


Figure 1

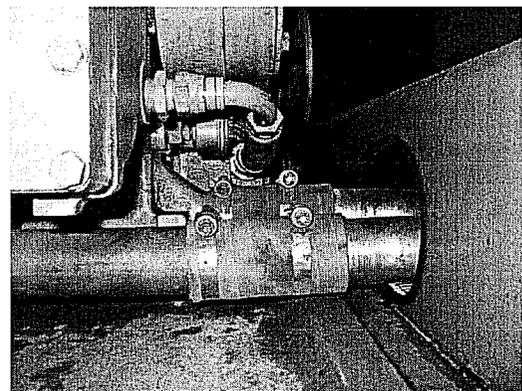


Figure 2

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 14 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**3. TESTING****3.1 KTA-19-R2 Engine Dynamometer Testing**

- 3.1.1 KTA-19-R2 Engine testing shall be performed using an engine dynamometer, to run-in and performance test rebuilt engines.
- 3.1.2 KTA-19-R2 Engines shall be tested in accordance with procedure 19-4-14-01 of Cummins K19 Series Engines Shop Manual and RailCorp engineering instruction DSS 5144.
- 3.1.3 Test results shall be recorded on Test Sheets and supplied to the Principal's Representative.
- 3.1.4 Operation of the following Engine Protection equipment shall be inspected and the points set:

Water Temperature.	Engine to idle 94c, shutdown 98c
Oil Pressure	80kpa
Water Pressure	35kpa
Engine Overspeed	2550

**3.2 LT10(R)G Engine-Alternator Load Testing**

- 3.2.1 LT10(R)G Engine-Alternator shall be load tested on a resistive load in accordance with Cummins-Onan Generator and Controls Service Manual.
- 3.2.2 LT10(R)G Engine-Alternator shall be tested in accordance with Cummins-Onan Generator and Controls Service Manual and RailCorp engineering & planning Instruction DSS 5145.
- 3.2.3 Electronic Governor and other setpoints shall be inspected in accordance with Section 5 of Cummins-Onan Generator and Controls Service Manual and RailCorp engineering & planning Instruction DSS 5145.
- 3.2.4 Operation of the following Engine Protection equipment shall be inspected and the points set in accordance with Section 5 of Cummins-Onan Generator and Controls Service Manual and RailCorp engineering & planning Instruction DSS 5145.
- Water temperature
  - Oil Pressure
  - Engine overspeed
- 3.2.5 Operation of ventilation fan shall be inspected.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 15 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**4 PAINTING**

**4.1 KTA-19-R2 ENGINE PAINTING**

4.1.1 KTA-19-R2 Engine shall be painted in accordance with procedure 19-4-14-04 of Cummins K19 Series Engines Shop Manual, to colour of Cummins Beige.

**4.2 LT10(R)G ENGINE PAINTING**

4.2.1 LT10(R)G Engine shall be painted in accordance with procedure 14-06 of Cummins L10 Series Engines Shop Manual, to colour of Cummins Beige.

4.2.2 LT10(R)G Engine Generator Enclosure shall be painted to colour of Cummins Beige.

**5 STORAGE**

**5.1 SHORT TERM STORAGE**

5.1.1 If KTA-19-R2 engines are stored for a short term (1-6 months), they shall be stored in accordance with procedure 19-04-14-05 of Cummins K19 Series Engines Shop Manual.

5.1.2 If LT10(R)G engines are stored for a short term (1-6 months), they shall be stored in accordance with procedure 14-07 of Cummins L10 Series Engines Shop Manual.

**5.2 LONG TERM STORAGE**

5.2.1 For long term storage (6-24 months) of KTA-19-R2 engines, procedure 19-04-14-05 of Cummins K19 Series Engines Shop Manual shall be followed.

5.2.2 For long term storage (6-24 months) of LT10(R)G engines, procedure 14-08 of Cummins L10 Series Engines Shop Manual shall be followed.

**5.3 TRANSPORTATION**

5.3.1 KTA-19-R2 Engines shall have all external piping sealed from external moisture, dust and dirt, for the purpose of transportation.

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 16 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**6 TECHNICAL DATA****6.1 KTA-19-R2 ENGINE SPECIFICATIONS****6.1.1 General Engine Data**

Configuration No.	D193078RX02
General Specification Bulletin No.	3885046
Critical Parts List (CPL) No.	1430
Performance Curve	P-4783
Installation Diagram	3235371
Power Rating - maximum	400KW @ 1850rpm $\pm$ 2%
Engine Speed	
Overspeed	2550 rpm
Standard Rating	2100 rpm
Maximum Governed Speed	2100 rpm
Idling Speed	650 rpm
High Idle Set Point	1400 rpm
Bore and Stroke	159 mm [6.25 in.] x 159 mm [6.25 in.]
Displacement	18.9 litres [1150 cu. in.]
Compression Ratio	14.5 :1
Firing Order	1-5-3-6-2-4
Engine Weight (With Standard Accessories)	
Dry Weight	2088 kg [3800 lb] Maximum
Wet Weight	2150 kg [3965 lb] Maximum

**6.1.2 Air Induction System**

Maximum allowable turbocharger	64 cm H <sub>2</sub> O [25 in. H <sub>2</sub> O]
-----------------------------------	--

**6.1.3 Lubricating Oil System**

Oil Grade	15W/40
Oil Pressure	
At idle (minimum allowable)	138 kPa [20 psi] min.
At no load governed speed	345 kPa [50 psi] min
Oil Filter Capacity	2.8 litres [0.62 gal.]
Bypass Filter	3.5 litres [0.77 gal.]
Full Flow Filter	
Total System Capacity	73 litres (excluding bypass filter)

**RAILCORP - ROLLING STOCK DIVISION**  
**ENGINEERING and PLANNING**

Page: 17 of 20

**ENGINEERING INSTRUCTION**

11 December 2006

**EI DSS 5140**

VERSION: 4.0

**6.1.4 Cooling System**

Coolant Capacity (engine only)	30 litres [6.6 gal.]
Standard modulating thermostat range	80-90 °C [168-175 °F]
Maximum coolant cylinder block pressure (pressure cap removed)	275 kPa [40 psi]
Maximum allowable top tank temperature	95 °C [203 °F]
Minimum recommended top tank temperature	70 °C [158 °F]
Minimum recommended pressure cap	28 kPa [4 psi]

**6.1.5 Exhaust System**

Maximum allowable back pressure imposed by piping and silencer 75 mm Hg [3 in. Hg] Exhaust pipe size (normally acceptable inside diameter) for KT and KTA 127 mm [5 in.]

**6.1.6 Fuel System**

Engine governing system	Cummins PT Fuel Pump
Maximum allowable restriction to pump:	
With clean filter	100 mm Hg [4 in. Hg]
With dirty filter	200 mm Hg [8 in. Hg]
Maximum allowable fuel return line restriction	63 mm Hg [2.5 in. Hg]
Maximum allowable fuel return line restriction with check valves and/or overhead tanks	165 mm Hg [6.5 in. Hg]

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 18 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**6.2 LT10(R)G ENGINE SPECIFICATIONS**

**6.2.1 General Engine Data**

Configuration No.	D342083UXOZ
Control Parts List (CPL) No.	881
Performance Curve	9257
Engine/Alternator Rating ISO Conditions Site Conditions	124 kW/155 kVA at 0.8 pf 118.5 kW/148 kVA at 0.8 pf
Engine Speed @ Maximum Output Governed Speed (RPM) Overspeed (Hz)	1500 59
Bore and Stroke	125 mm [4.921 in.] x 136 mm [5.364 in.]
Displacement	10 litres [611 cu. in.]
Compression Ratio	17.0:1
Firing Order	1-5-3-6-2-4
Engine Weight (With Standard Accessories) Dry Weight Wet Weight	876 kg [1930 lb] 922 kg [2030 lb]
Crankshaft Rotation - (viewed from the front of the engine)	Clockwise

**6.2.2 Air Induction System**

Maximum allowable Intake Restriction with Clean Air Filter Element: Heavy Duty Dry Type Cleaner	38 cm H <sub>2</sub> O [15 in. H <sub>2</sub> O]
Maximum allowable Intake Restriction with Dirty Air Filter Element	64 cm H <sub>2</sub> O [25 in. H <sub>2</sub> O]

**RAILCORP - ROLLING STOCK DIVISION  
ENGINEERING and PLANNING**

Page: 19 of 20

**ENGINEERING INSTRUCTION  
EI DSS 5140**

11 December 2006

VERSION: 4.0

**6.2.3 Lubricating Oil System**

Oil Grade	SAE 15W40
Oil Pressure - Low idle (Minimum Allowable)	70 kPa [10 psi]
At 1300 RPM or Torque Peak (Minimum Allowable)	207 kPa [30 psi]
Oil Capacity of Standard Engine	
Bypass Filter	2.8 litres [0.62 gal.]
Full Flow Filter	3.5 litres [0.77 gal.]
Oil Pan - Automotive (High- Low)	26.5 to 19 litres [6 to 4.2 gal.]
Total System Capacity including Bypass Filter	34 litres [7.5 gal.]

If an oil pan spacer is used, the total lubricating system capacity is increased by 7.6 litres [1.7 gal]

**6.2.4 Cooling System**

Coolant Capacity (engine only)	11 litres [2.4 gal.]
Standard Modulating Thermostat Range	82-93 °C [175-195 °F]
Maximum Coolant Cylinder Block Pressure (pressure cap removed)	
Closed Thermostat	275 kPa [40 psi]
Maximum allowable top tank temperature	100 °C [212 °F]
Minimum recommended top tank temperature	70 °C [158 °F]
Minimum recommended pressure cap	50 kPa [7 psi]

**6.2.5 Exhaust System**

Maximum allowable back pressure imposed by piping and silencer  
75 mm Hg [3 in. Hg] Exhaust pipe size (normally acceptable inside diameter)  
127 mm [5 in.]

ENGINEERING INSTRUCTION  
EI DSS 5140

11 December 2006

VERSION: 4.0

## 6.2.6 Fuel System

Engine Governing System	Cummins PT Fuel Pump with EFC Control
Maximum allowable restriction to pump:	
With clean filter	100 mm Hg [4 in. Hg]
With dirty filter	200 mm Hg [8 in. Hg]
Maximum allowable fuel return line restriction	63 mm Hg [2.5 in. Hg]

## 7 REFERENCES

7.1 The following Manufacturer's Manuals & Service Publications shall be referred to for the overhaul of Cummins KTA-19-R2 and LT10(R)G Engines:

- Cummins K19 Series Engines Shop Manual, Bulletin No. 3810263-00.
- Cummins L10 Series Engines Internal Damper Models Shop Manual, Bulletin No. 3379347-07.
- Cummins Specification Manual KTA19 3810259.00
- Cummins Specification Manual LT10 3810315.02
- Cummins-Onan Generator and Controls Service Manual.
- Stamford Installation, Service and Maintenance Manual.
- Cummins KTA Critical Parts List CPL 1430
- Cummins LT10 Critical Parts list CPL 0882
- Cummins reference 10 QSP 4.09.21 (KTA19 Ryton Governor Modification).
- Cummins reference 10 QSP. 4.09.22 (K19 Engine Rewiring).
- Cummins reference 10 QSP 4.09.23 & SRA EMD032 (Replacement of Traction Engine 94/98 Temperature switch).
- Cummins reference Service Parts Topic 99T1-10 (Crankshaft & Accessory drive seals).
- Cummins reference Service Parts Topic 01T8-7 (KTA19 Water pump changes).
- Cummins service bulletin 3379231-03 re magnetic pickups

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 1 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**TITLE:** XPLORER/ENDEAVOUR CUMMINS KTA-19-R &  
LT10(R)G ENGINES 1500-HOUR SERVICE  
SPECIFICATION

**VOLUME 6**  
**SECTION H**

**SUMMARY / BACKGROUND:**

This Standard/Instruction provides all the necessary procedures, technical specifications and test requirements for the 1500-hour service of KTA-19-R & LT10(R)G Engines for Xplorer/Endeavour Railcars.

**DESCRIPTION:**

This Standard/Instruction sets the minimum technical requirements, procedures, tests and qualifications necessary for the 1500-hour service of Cummins KTA-19-R and LT10(R)G Engines fitted to Xplorer/Endeavour railcars.

It is to be used in conjunction with the Manufacturer's Maintenance Instructions, drawings and technical information listed herein, for these Cummins Engine types.

PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT

CONTROLLED COPY No: 031

**HAZARD CODE:**

**NOTE:** Standard/Instruction DSS 5141.00 Replaces N/A  
Manager, Diesel Services Support

Which **MUST** be returned to

**Prepared By:**

*B. Wooldridge*

B. Wooldridge  
Engineer Traction Systems and Bogies

**Authorised By:**

*[Signature]*  
Manager Diesel Services Support  
11-11-97

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 2 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**CONTENTS**

<b>CLAUSE No.</b>	<b>CLAUSE</b>	<b>PAGE No.</b>
1	GENERAL CLAUSES	3
2	REPLACEMENT PARTS	6
3	1500-HOUR SERVICE	7
4	TECHNICAL DATA	8
5	REFERENCES	12

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 3 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**1 GENERAL CLAUSES**

**1.1 SCOPE**

1.1.1 This Standard covers the technical requirements and qualifications necessary for the 1500-hour service of Cummins KTA-19-R & LT10(R)G Engines used on Xplorer and Endeavour railcars.

1.1.2 The Contractor shall supply management expertise, technology, labour, equipment and plant to ensure Cummins KTA-19-R & LT10(R)G Engines satisfy performance requirements and operate within the manufacturer's specification for a period of not less than 4,500 engine hours following the 1500-hour service.

1.1.3 The scope includes, but is not limited to the provision of 1500-operating hour service.

**1.2 DESCRIPTION OF ENGINES**

**1.2.1 KTA-19-R Engine**

The Cummins KTA-19-R Engine is part of a traction package used on Xplorer/Endeavour Railcars. The traction package, mounted beneath the railcar underframe, consists of one Cummins KTA-19-R engine per car driving a Voith T311r turbo transmission unit by means of a cardan shaft.

Cummins KTA-19-R Engine is a 6 cylinder in-line horizontal (75° tilt), 19 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged and aftercooled, with a continuous rating of 353 kW. The engine is controlled by an electronic control card, with maximum governed speed of 1800 rpm, and idle speed of 625 rpm. Engine protection equipment using various sensors wired to the control card, indicate water temperature, oil pressure, water pressure and engine overspeed.

**1.2.2 LT10(R)G Engine**

The Cummins LT10(R)G Engine is part of an auxiliary engine alternator set used on Xplorer/Endeavour railcars. An engine alternator set, also mounted beneath the Railcar underframe, consists of one Cummins LT10(R)G engine coupled to a 124 kW/155 kVA Stamford UCI274F2 alternator, and provides auxiliary 415 V 3 phase, 50 Hz supply.

Cummins LT10(R)G Engine is a 6 cylinder in-line horizontal, 10 litre, 4 stroke diesel engine. The water cooled diesel engine is turbocharged. The engine speed of 1500 rpm is controlled by a Cummins electronic governor.

The engine, alternator and control equipment are all mounted within the one enclosure. An electric 415 V AC fan within the enclosure provides ventilation.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 4 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**1.3 QUALITY REQUIREMENTS**

- 1.3.1 The Contractor shall operate a quality system conforming to the requirements of AS 3901 or AS 3902.
- 1.3.2 It is preferred that the Contractor be registered under the Standards Australia accreditation scheme of quality systems or with an equivalent recognised authority.

**1.4 SUB-CONTRACTED WORK**

- 1.4.1 The Contractor shall notify the Principal's Representative when the services of a Sub-Contractor will be used.
- 1.4.2 The requirement of Clause 1.5.1 applies to components which are to be tested, manufactured, repaired, reconditioned or supplied by a company or persons other than the Contractor.
- 1.4.3 The Contractor shall ensure that Sub-Contractors comply with the relevant requirements of this Standard.

**1.5 MODIFICATIONS**

- 1.5.1 Future modifications shall only be carried out by the Contractor after receipt of:
- (i) an amendment of the appropriate Section/Clause of this Standard, or
  - (ii) a letter of approval from the Principal's Representative to cover such work.

**1.6 NON-STANDARD REPAIRS**

- 1.6.1 Any repair or reclamation outside the scope of, or not covered by, this Standard is subject to approval of the Principal's Representative prior to commencement of repair/reclamation.

**1.7 TECHNICAL RECORDS**

- 1.7.1 On completion of each 1500-hour service, Engine service records and results are to be made available to the Principal's Representative.
- 1.7.2 The Contractor shall develop appropriate inspection and service report sheets for use with this Standard.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 5 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**1.8 INFORMATION REQUIREMENTS**

1.8.1 Information required from the Contractor shall be compiled and forwarded to the Principal's Representative.

1.8.2 The following information is required from Tenderers or the Contractor.

- (i) One copy of the Contractor's quality plan which will be used for the top overhaul of the Engine.
- (ii) One copy of the quality plan covering the work carried out by the Contractor's Sub-Contractor(s).
- (iii) Supply information as required by the Tender Schedule.
- (iv) Changes to information previously provided under this Clause.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT**

**CONTROLLED COPY No: 031**

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 6 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**2 REPLACEMENT PARTS**

- 2.1 Any replacement new or reconditioned exchange parts used in the 1500-hour service, shall be genuine parts obtained through the accredited agent in Australia or directly from the manufacturer (O.E.M).
- 2.2 Alternate supply of replacement parts may be approved, subject to evidence being produced by the supplier that the replacement parts are equal to, or superior to, the genuine replacement parts.
- 2.3 Optional Parts**
- 2.3.1 Parts that exceed the Manufacturer's tolerances, or cannot be reused shall be replaced.
- 2.3.2 The full Parts List for KTA-19-RR engines is available through Cummins Control Parts List (CPL) No. 1190.
- 2.3.3 The full Parts List for LT10(R)G engines is available through Cummins Control Parts List (CPL) No. 882.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 7 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**3 1500-HOUR SERVICE**

3.1 All checks and adjustments to KTA-19-R and LT10(R)G Engines included in the 1500-hour service shall be performed with Engines in the Xplorer/Endeavour Railcar.

**3.2 KTA-19-R Engine Service**

3.2.1 Valve and Injector adjustment shall be performed in accordance with procedure 07-05 of Cummins K19 Series Engines Troubleshooting and Repair Manual.

3.2.2 Crankshaft end float shall be checked in accordance with procedure 07-22.17 of Cummins K19 Series Engines Troubleshooting and Repair Manual.

3.2.3 Crankcase breather shall be cleaned and checked in accordance with procedure 02-13 of Cummins K19 Series Engines Troubleshooting and Repair Manual.

3.2.4 Coolant Hoses shall be checked in accordance with procedure 01-13 of Cummins K19 Series Engines Troubleshooting and Repair Manual.

3.2.5 Operation of the following Engine protection system equipment shall be checked by bridging or mechanical activation of switches:

- High water temperature alarm
- High water temperature shutdown
- Low lube oil pressure
- low coolant pressure
- Pre-high Temperature Switch

**3.3 LT10(R)G Engine Service**

3.3.1 Valve and Injector adjustment shall be performed in accordance with procedure 07-42 of Cummins L10 Series Engines Troubleshooting and Repair Manual.

3.3.2 Crankshaft end float shall be checked in accordance with procedure 07-17 of Cummins L10 Series Engines Troubleshooting and Repair Manual.

3.3.3 Crankcase breather shall be cleaned and checked in accordance with procedure 02-09 of Cummins L10 Series Engines Troubleshooting and Repair Manual.

3.3.4 Coolant Hoses shall be checked in accordance with procedure 01-14 of Cummins L10 Series Engines Troubleshooting and Repair Manual.

3.3.5 Operation of the following Engine protection system equipment shall be checked by bridging or mechanical activation of switches:

- High water temperature alarm
- High water temperature shutdown
- Low lube oil pressure
- low coolant pressure

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 8 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**4 TECHNICAL DATA**

**4.1 KTA-19-R ENGINE SPECIFICATIONS**

**4.1.1 General Engine Data**

Configuration No.	D193078RX02
General Specification Bulletin No.	3885046
Control Parts List (CPL) No.	1190
Performance Curve	P-4527-A
Installation Diagram	3235371
Power Rating - maximum	380 kW (510 HP) @ 2000 RPM
Continuous Power Rating (Applicable to SRA)	352 kW (472 HP) @ 1800 RPM
Engine Speed	
Overspeed (RPM)	2400
Standard Rating (RPM)	2100
Maximum Governed Speed (RPM)	1800
Idling Speed (RPM)	625
Bore and Stroke	159 mm [6.25 in.] x 159 mm [6.25 in.]
Displacement	18.9 litres [1150 cu. in.]
Compression Ratio	14.5 or 15.5:1
Firing Order	1-5-3-6-2-4
Engine Weight (With Standard Accessories)	
Dry Weight	1720 kg [3800 lb] Maximum
Wet Weight	1800 kg [3965 lb] Maximum

**4.1.2 Air Induction System**

Maximum allowable turbocharged intake restriction 64 cm H<sub>2</sub>O [25 in. H<sub>2</sub>O]

**4.1.3 Oil System**

Oil Grade	15W/40
Oil Pressure	
At idle (minimum allowable)	138 kPa [20 psi] min.
At no load governed speed	345 kPa [50 psi] min.
Oil Filter Capacity	
Bypass Filter	2.8 litres [0.62 gal.]
Full Flow Filter	3.5 litres [0.77 gal.]
Total System Capacity	73 litres (excluding bypass filter)

**4.1.5 Cooling System**

Coolant Capacity (engine only)	30 litres [6.6 gal.]
Standard modulating thermostat range	80-90 °C [175-195 °F]
Maximum coolant cylinder block pressure (pressure cap removed)	275 kPa [40 psi]
Maximum allowable top tank temperature	95 °C [203 °F]
Minimum recommended top tank temperature	70 °C [158 °F]
Minimum recommended pressure cap	50 kPa [7 psi]

# PASSENGER FLEET MAINTENANCE DIESEL SERVICE SUPPORT

Page: 9 of 12

STANDARD / INSTRUCTION

NUMBER: DSS 5141.00

Date: 11/11/97

## 4.1.6 Exhaust System

Maximum allowable back pressure imposed by piping and silencer 75 mm Hg [3 in. Hg]  
 Exhaust pipe size (normally acceptable inside diameter)  
     for KT and KTA 127 mm [5 in.]

## 4.1.7 Fuel System

Engine governing system Cummins PT Fuel Pump  
 Maximum allowable restriction to pump:  
     With clean filter 100 mm Hg [4 in. Hg]  
     With dirty filter 200 mm Hg [8 in. Hg]  
 Maximum allowable fuel return line restriction 63 mm Hg [2.5 in. Hg]  
 Maximum allowable fuel return line restriction  
 with check valves and/or overhead tanks 165 mm Hg [6.5 in. Hg]

## 4.1.8 Electrical System

Battery Size	Ambient Temperature			
	18 °C [0 °F]		0 °C [32 °F]	
	Cold Cranking Amperes	Reserve Capacity* Amperes	Cold Cranking Amperes	Reserve Capacity Amperes
24 Volt**	900	320	640	240

\* The number of plates within a given battery size determine the reserve capacity. Reserve capacity determines the length of time sustained cranking can occur.

\*\* Per battery (two 12-volt batteries in series) CCA ratings are based on -18 °C [0 °F].

Maximum allowable resistance of starting circuit  
 With 12-volt starter - Ohms Not recommended  
 With 24-volt starter - Ohms 0.002

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 10 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**4.2 LT10(R)G ENGINE SPECIFICATIONS**

**4.2.1 General Engine Data**

Configuration No.	D342083UXOZ
Control Parts List (CPL) No.	881
Performance Curve	9257
Engine/Alternator Rating	
ISO Conditions	124 kW/155 kVA at 0.8 pf
Site Conditions	118.5 kW/148 kVA at 0.8 pf
Engine Speed @ Maximum Output	
Governed Speed (RPM)	1500
Bore and Stroke	125 mm [4.921 in.] x 136 mm [5.364 in.]
Displacement	10 litres [611 cu. in.]
Compression Ratio	17.0:1
Firing Order	1-5-3-6-2-4
Engine Weight (With Standard Accessories)	
Dry Weight	876 kg [1930 lb]
Wet Weight	922 kg [2030 lb]
Crankshaft Rotation - (viewed from the front of the engine)	Clockwise

**4.2.2 Air Induction System**

Maximum allowable Intake Restriction with Clean Air Filter Element:	
Heavy Duty Dry Type Cleaner	38 cm H <sub>2</sub> O [15 in. H <sub>2</sub> O]
Maximum allowable Intake Restriction with Dirty Air Filter Element	64 cm H <sub>2</sub> O [25 in. H <sub>2</sub> O]

**4.2.3 Lubricating Oil System**

Oil Grade	SAE 15W40
Oil Pressure - Low idle (Minimum Allowable)	70 kPa [10 psi]
At 1300 RPM or Torque Peak (Minimum Allowable)	207 kPa [30 psi]
Oil Capacity of Standard Engine	
Bypass Filter	2.8 litres [0.62 gal.]
Full Flow Filter	3.5 litres [0.77 gal.]
Oil Pan	
- Automotive (High-Low)	26.5 to 19 litres [6 to 4.2 gal.]
* Total System Capacity including Bypass Filter	34 litres [7.5 gal.]
If an oil pan spacer is used, the total lubricating system capacity is increased by	7.6 litres [1.7 gal.]

**4.2.4 Not Used**

# PASSENGER FLEET MAINTENANCE DIESEL SERVICE SUPPORT

Page: 11 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

## 4.2.5 Cooling System

Coolant Capacity (engine only)	11 litres [2.4 gal.]
Standard Modulating Thermostat Range	82-93 °C [175-195 °F]
Maximum Coolant Cylinder Block Pressure (pressure cap removed)	
Closed Thermostat	275 kPa [40 psi]
Maximum allowable top tank temperature	100 °C [212 °F]
Minimum recommended top tank temperature	70 °C [158 °F]
Minimum recommended pressure cap	50 kPa [7 psi]

## 4.2.6 Exhaust System

Maximum allowable back pressure imposed by piping and silencer	75 mm Hg [3 in. Hg]
Exhaust pipe size (normally acceptable inside diameter)	
for KT and KTA	127 mm [5 in.]

## 4.2.7 Fuel System

Engine Governing System	Cummins PT Fuel Pump with EFC Control
Maximum allowable restriction to pump:	
With clean filter	100 mm Hg [4 in. Hg]
With dirty filter	200 mm Hg [8 in. Hg]
Maximum allowable fuel return line restriction	63 mm Hg [2.5 in. Hg]
Maximum allowable fuel return line restriction with check valves and/or overhead tanks	165 mm Hg [6.5 in. Hg]

## 4.2.8 Electrical System

Battery Size		Ambient Temperature	
18 °C [0 °F]		0 °C [32 °F]	
Cold	Reserve	Cold	Reserve
Cranking	Capacity*	Cranking	Capacity
Amperes	Amperes	Amperes	Amperes
24 Volt**	900	320	240

\* The number of plates within a given battery size determine the reserve capacity. Reserve capacity determines the length of time sustained cranking can occur.

\*\* Per battery (two 12-volt batteries in series) CCA ratings are based on -18 °C [0 °F].

Maximum allowable resistance of starting circuit	
With 12-volt starter - Ohms	Not recommended
With 24-volt starter - Ohms	0.002

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 12 of 12

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5141.00**

**Date: 11/11/97**

**5 REFERENCES**

5.1 The following Manufacturer's Manuals shall be referred to for the 1500-hour service of Cummins KTA-19-R and LT10(R)G Engines:

Cummins K19 Series Engines Shop Manual, Bulletin No. 3810263-00.

Cummins L10 Series Engines Internal Damper Models Shop Manual, Bulletin No. 3379347-07.

Cummins K19 Series Engines Troubleshooting and Repair Manual, Bulletin No. 3810307.

Cummins L10 Series Engines Troubleshooting and Repair Manual, Bulletin No. 3810246.

Cummins-Onan Generator and Controls Service Manual

PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT

CONTROLLED COPY No: 001

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 1 of 10

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5144.00**

**Date: 11/11/97**

**TITLE:** XPLORER/ENDEAVOUR CUMMINS KTA-19-R  
TRACTION ENGINES PROCEDURE FOR ACCEPTANCE  
TESTING SUBSEQUENT TO OVERHAUL

**VOLUME 6**  
**SECTION H**

**SUMMARY / BACKGROUND:**

This Standard/Instruction provides the test requirements for the Acceptance Testing subsequent to Overhaul of KTA-19-R Traction Engines for Xplorer/Endeavour Cars.

**DESCRIPTION:**

This Standard/Instruction sets the procedures for the post Overhaul Acceptance Testing for Cummins KTA-19-R Traction Engines fitted to Xplorer/Endeavour Cars.

It is to be used in conjunction with the Manufacturer's instructions, drawings and technical information listed herein, for these Cummins Engine types.

PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT  
CONTROLLED COPY No: 331

**HAZARD CODE:**

**NOTE:** Standard/Instruction DSS 5144.00 Replaces N/A Which MUST be returned to  
Manager, Diesel Services Support

**Prepared By:**

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11-11-97

CONTENTS

CLAUSE No.	CLAUSE	PAGE No.
TRACTION ENGINES		
1.	RELEVANT DRAWINGS AND INSTRUCTIONS	3
2.	INITIAL INSPECTION	3
3.	INITIAL TEST	4
4.	SHUTDOWN SIGNALS	4
4.1	External Shutdown and Control Signals	4
4.1.1	Fire Signal Shutdown	4
4.1.2	Header Tank Low Signal Shutdown	5
4.1.3	High Transmission Temperature Signal	5
4.2	Engine Shutdown Signals (Local Signals)	5
4.2.1	Low Water Pressure	5
4.2.2	Low Oil Pressure	5
4.2.3	High Coolant Temperature Shutdown	6
4.2.4	OverCrank	6
4.2.5	Emergency Stop	6
4.2.6	OverSpeed	7
5.	LOCAL METERS	7
6.	EXTERNAL TRANSDUCER SIGNALS	7
6.1	Low Oil Pressure Alarm	7
6.2	Turbo Boost Pressure	7
6.3	Water Temperature Signals	7
6.4	Tachometer	7
7.	TRIAL LOAD TEST	8
8.	TEST BOX	8
8.1	Description of Interface Wiring for Remote Interface Test Box	8
9.	ENGINE LOAD CURVES	10

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5144.00**

**Date: 11/11/97**

**ENGINE TESTING**

**TRACTION ENGINES**

**1. RELEVANT DRAWINGS AND INSTRUCTIONS**

1. Onan/Cummins Drawing 10-14-71 Sheet 1 of 2 "Traction Engine Wiring Cummins KT19R".
2. Onan/Cummins Drawing 10-14-71 Sheet 2 of 2 "Traction Engine Wiring Cummins KT19R".
3. Xplorer Work Instruction EWI006 "Traction and Auxiliary Engine A11 Card Link Settings".
4. ABB Drawing 495 027860 "Traction Engine Control".

**2. INITIAL INSPECTION**

Before applying control voltage to the control panel or starting the traction engine, perform the following initial checks:

1. Pressure prime oil system.
2. Check fuel filters are full.
3. Check engine oil level is correct.
4. Check engine coolant level is correct.
5. De-aerate engine coolant lines.
6. Visually inspect and ensure that engine, control cabling, shutdown devices and all traction engine control panel devices are correctly installed and adequately secured.
7. Ensure that the A11 card control links are correctly set as per EWI006.
8. Mechanically check by hand that the electrical connections in the control panel and on the traction engine are securely fastened.

**3. INITIAL TEST**

Connect a purpose built Remote Interface Test Box, supplied by Contractor (refer Section 8).

Before applying control voltage to the Remote Interface Test Box, ensure that the engine "RUN/REMOTE" switch is turned to "STOP".

Apply control voltage to the Remote Interface Test Box. Check that the "ENGINE SWITCHED OFF" indicator on the control panel flashes.

Push the "TEST/RESET" push button. Ensure that all control panel indicators illuminate.

Place "RUN/REMOTE" switch to "RUN"  
Engine should crank and fire, "RUN" light on panel should illuminate

Check engine oil pressure is correct. Inspect engine for oil or fuel leaks. Ensure engine is running smoothly and does not show any signs of distress, such as abnormal noise. De-aerate coolant system at water pump and engine thermostat housing.

Allow engine ten (10) minutes to warm up.

Push high idle push button - engine should run to 1200 RPM.

Push 1/3 throttle button - engine should run to 2100 RPM.

Push 2/3 throttle button - engine should run to 2100 RPM

Push 3/3 throttle button - engine should run to 2100 RPM

Place engine control panel to "STOP"; engines should stop. "SWITCHED OFF" indicator should flash.

Push "RESET" button; all lights should illuminate.

Using the abovementioned Remote Interface Test Box (supplied by Contractor), initiate a remote engine start; traction permissive signal should energise. Push throttle and high idle buttons on engine control panel; engine should remain at idle.

**4. SHUTDOWN SIGNALS**

**4.1 External Shutdown and Control Signals**

**4.1.1 Fire Signal Shutdown**

With engine running in remote no load, initiate an external fire shutdown signal.

Engine should stop, fire indication on panel should illuminate.

Common alarm signal should energise; traction permissive signal should de-energise. Place run switch to "STOP"; reset indicator; restart engine remotely.

**4.1.2 *Header Tank Low Signal Shutdown***

With engine running in remote no load, initiate an external header tank low signal.

Engine should stop; header tank low indication on panel should illuminate.

Common alarm signal should energise; traction permissive signal should de-energise.

Place run switch to "STOP"; reset indicator; restart engine remotely.

**4.1.3 *High Transmission Temperature Signal***

With engine running in remote, 1/3 throttle no load (engine at 2100 RPM), initiate a transmission over temperature signal; engine should continue to run at 2100 RPM; "PRE HIGH TRANSMISSION TEMPERATURE" indicator should illuminate. Traction permissive signal should de-energise whilst transmission over temperature signal is present; common alarm relay should be de-energised.

De-energise transmission temperature signal. Traction permissive signal should re-energise; common alarm relay should remain de-energised.

"PRE-HIGH TRANSMISSION TEMPERATURE" indicator should remain latched on.

Place run switch to "STOP"; reset engine.

**4.2 *Engine Shutdown Signals (Local Signals)***

**4.2.1 *Low Water Pressure***

With engine running in remote no load idle, initiate a low water pressure shutdown by venting water pressure at the water pressure switch hose.

Common alarm signal should energise; traction permissive signal should de-energise.

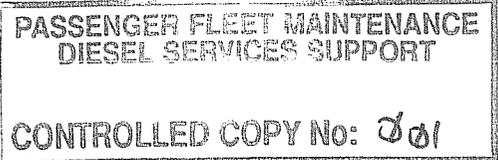
Reset and restart engine.

**4.2.2 *Low Oil Pressure***

With engine running in remote no load idle, initiate a low oil pressure shutdown by venting oil pressure at the oil pressure switch; low oil pressure shutdown should occur with low oil pressure indicator illuminated.

Common alarm signal should energise; traction permissive signal should de-energise.

Reset and restart engine.



STANDARD / INSTRUCTION

NUMBER: DSS 5144.00

Date: 11/11/97

#### 4.2.3 *High Coolant Temperature Shutdown*

With engine running in remote 1/3 throttle no load, remove external cooling system by turning off external cooling fans or similar. Pre-high engine temperature should occur at 94°C. Engine should return to idle and pre-high engine temperature indicator illuminate.

Common alarm signal should energise; traction permissive signal should de-energise.

Continue to run engine; high engine temperature should occur at 98°C. Engine should stop and high engine temperature indicator illuminate.

Allow engine five (5) minutes to cool down.

Reset and restart engine in remote.

If engine has cooled down, traction permissive signal should be energised; common alarm signal should be de-energised; engine "RUN" light illuminated.

With engine running in remote 1/3 throttle no load (revving at 2200 RPM) and external cooling system switched off, run engine to 94°C such that "pre-high engine temperature" fault occurs and engine returns to idle. Turn on cooling system; engine should return to 2100 RPM when temperature drops to 92°C. Pre-high engine temperature indicator should remain illuminated. Traction permissive signal should energise and common alarm relay de-energise.

#### 4.2.4 *OverCrank*

Disconnect wire 2 (refer Onan/Cummins Drawing 10-14-71 Sheets 1 and 2) to start solenoid; reset and restart engine. Monitoring output from A11 control card, determine that:

1. Start signal remains energised for 15 seconds.
2. Start signal remains de-energised for next 15 seconds.
3. Start signal remains energised for next 15 seconds.
4. Start signal remains de-energised for next 15 second.
5. Start signal remains energised for next 15 seconds.
6. Engine should fail with an overcrank indication.

Common alarm signal should energise; traction permissive signal should de-energise.

Reset and restart engine.

#### 4.2.5 *Emergency Stop*

Push emergency stop on control panel; engine should stop with an emergency stop indicator.

Common alarm signal should energise; traction permissive signal should de-energise.

Reset and restart engine.

STANDARD / INSTRUCTION

NUMBER: DSS 5144.00

Date: 11/11/97

#### 4.2.6 *OverSpeed*

With engine running in remote no load, initiate an overspeed signal by bridging wires 63 and 1 at terminals J and H on the Cummins Speed Switch. The engine should shutdown with an "OVERSPEED" indication.

Common alarm signal should energise; traction permissive signal should de-energise.

Reset and restart engine.

### 5. LOCAL METERS

Using external calibrated meters, verify operation of local meters.

Verify that the hour meter is operating when engine is running. With engine stopped, all meters should read zero and hour meter stopped.

To test transmission over temperature meter, place a 62 ohm resistor across terminals 17 and 18; push "LAMP TEST/RESET" button; transmission oil temperature meter should indicate 100°C.

### 6. EXTERNAL TRANSDUCER SIGNALS

Using external calibration meters, check the following output signals:

#### 6.1 Low Oil Pressure Alarm

Energised with engine stopped; de-energised when engine runs.

#### 6.2 Turbo Boost Pressure

With engine stopped, transducer reads 10 ohms.

#### 6.3 Water Temperature Signals

With engine temperature of 85°C, transducer should read approximately 60 ohms.

#### 6.4 Tachometer

With no load on engine (running in local), push 3/3 throttle; engine speed should increase to approximately 2100 RPM.

Using an external calibrated meter, verify local engine tachometer signal to an accuracy of  $\pm 100$  RPM.

Using an external calibrated meter, verify engine speed signal is present on terminal 16.

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5144.00**

**Date: 11/11/97**

**7. TRIAL LOAD TEST**

To satisfy the requirements of the Specification, the engine under test must achieve performance not less than Performance Curves shown on Chart 1 "K19 Engine KW VS RPM".

Using a dynamometer capable of loading the engine to its maximum rating over the full speed range, verify the engine's torque curves for each of the throttle notches.

With engine running connected to dynamometer, run engine for thirty (30) minute period connected to load box with 1/3 throttle. If this is achieved run engine for a thirty (30) minute period with 2/3 throttle; if no faults found run engine for thirty (30) minutes with 3/3 throttle. If no faults, the test is deemed successful.

If a shutdown or fault occurs at any time during the above, the fault is to be rectified and the test is to be restarted at the same throttle notch (i.e. another full thirty (30) minutes). If the fault cannot be positively located, the test time is to be increased to sixty (60) minutes in each throttle notch, including the throttle notch at the stage the fault occurred.

**8. TEST BOX**

**8.1 Description of Interface Wiring for Remote Interface Test Box:**

*Drawing No. 495 027860 (Traction Engine)*

1. Input power supply (nominal 24 VDC).
2. Remote start stop (energised to run).
3. Battery negative connection
4. Transmission high temperature signal (connect to battery negative to indicate high temperature).
5. Fire input signal (connect to battery negative to indicate fire).
6. Header tank low (connect to BN to indicate low coolant level).
7. Link for 24 V supply for OPX1, TE06 and TE08.
8. Traction permissive relay (energised under normal running to allow the transmission to fill).
9. Low oil pressure signal to the on-board logger (energised when the LOP relay in TECB is de-energised).
10. Traction engine fail indication on driver's desk (energised when the engine shuts down or pre-high engine temperature).

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 9 of 10

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5144.00**

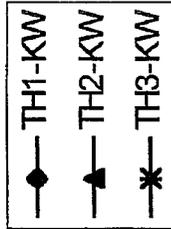
**Date: 11/11/97**

11. Not used.
12. High idle input (energises during hydro dynamic brake to increase coolant flow through system).
13. Throttle 1 input
14. Throttle 2 input
15. Throttle 3 input
16. External tacho signal to cab
- 17/18. Transmission temperature input signal (62 ohms for 100°C)
- 19/20. Water temperature (69 ohms for 80°C, 51 ohms for 90°C). External box is to link 20 to 22.
- 21/22. Turbo boost pressure output (10 ohms for 0 kPa, 98 ohms for 100 kPa).
23. Not used.
24. Signal screen wire
25. Signal screen connection for transducers

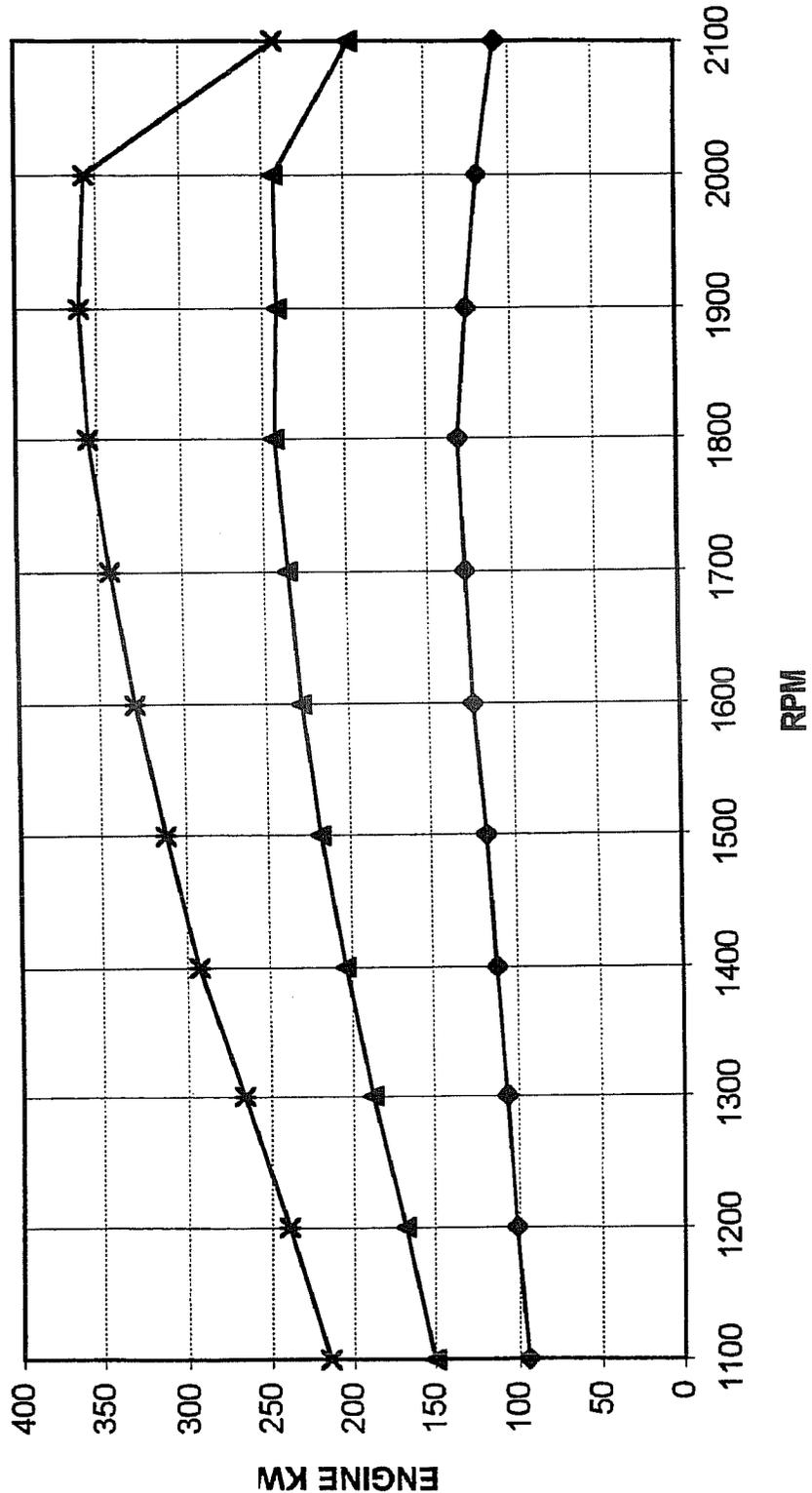
**N.B:** (i) For 1/3 engine throttle energise 1/3 throttle input.  
For 2/3 engine throttle energise both 1/3 and 2/3 throttle inputs.  
For 3/3 engine throttle energise 3/3 throttle input.

(ii) The test box shall be fitted with an "EMERGENCY STOP" button. The button is to be labelled "EMERGENCY STOP" and have a red mushroom head. The button is to latch in the activated position and twist to reset. Activation of the button is to remove all power from the traction engine control panel.

9. ENGINE LOAD CURVES



**CHART 1 - K19 ENGINE KW VS RPM**



PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT  
CONTROLLED COPY No: 031

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 1 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**TITLE:** XPLORER/ENDEAVOUR CUMMINS LT10(R)G  
AUXILIARY ENGINES PROCEDURE FOR ACCEPTANCE  
TESTING SUBSEQUENT TO OVERHAUL

**VOLUME 6**  
**SECTION H**

**SUMMARY / BACKGROUND:**

This Standard/Instruction provides the test requirements for the Acceptance Testing subsequent to Overhaul of LT10(R)G Auxiliary Engines for Xplorer/Endeavour Cars.

**DESCRIPTION:**

This Standard/Instruction sets the procedures for the post Overhaul Acceptance Testing for Cummins LT10(R)G Auxiliary Engines fitted to Xplorer/Endeavour Cars.

It is to be used in conjunction with the Manufacturer's instructions, drawings and technical information listed herein, for these Cummins Engine types.

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DIESEL SERVICES SUPPORT

CONTROLLED COPY No: 381

**HAZARD CODE:**

**NOTE:** Standard/Instruction DSS 5145.00 Replaces N/A  
Manager, Diesel Services Support

Which MUST be returned to

**Prepared By:**

*B. Wooldridge*  
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Engineer Traction Systems and Bogies

**Authorised By:**

*[Signature]*  
Manager Diesel Services Support  
11-11-97

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 2 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**CONTENTS**

<b>CLAUSE No.</b>	<b>CLAUSE</b>	<b>PAGE No.</b>
<b>AUXILIARY ENGINES</b>		
1.	RELEVANT DRAWINGS AND INSTRUCTIONS	3
2.	INITIAL INSPECTION	3
3.	INITIAL TEST	4
4.	SHUTDOWN SIGNALS	4
4.1	External Engine Shutdown and Control Signals	4
4.1.1	Fire Signal Shutdown	4
4.1.2	Low Water	5
4.2	Local Engine Shutdown Signals	5
4.2.1	Low Oil Pressure	5
4.2.2	High Engine Temperature Shutdown	5
4.2.3	OverCrank	5
4.2.4	Emergency Stop	5
4.2.5	OverSpeed	5
4.2.6	Underspeed	6
4.2.7	Undervoltage	6
4.2.8	Overvoltage	6
4.2.9	Phase Balance	6
4.2.10	Alternator Temperature	6
5.	LOCAL METERS	7
6.	EXTERNAL TRANSDUCER SIGNALS	7
6.1	Low Oil Pressure Alarm	7
6.2	Alternator Voltage	7
6.3	Alternator Current	7
6.4	Water Temperature	7
7.	TRIAL LOAD TEST	8
7.1	Preliminary : Fuel Pump Check	8
7.2	Load Testing	8
8.	REMOTE INTERFACE TEST BOX	9
9.	SHORE SUPPLY AND OUTPUT VOLTAGE SENSING RELAYS	10

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 3 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**ENGINE TESTING**

**AUXILIARY ENGINES**

Connect a purpose built Remote Interface Test Box, supplied by Contractor (refer Section 8).

**1. RELEVANT DRAWINGS AND INSTRUCTIONS**

1. Onan-Dunlite Drawing 2406-P-09 "Engine Wiring Under-Railcar Genset".
2. Onan-Dunlite Drawing 2406-P-08 "Control Cubicle Wiring Circuit Under-Railcar Genset"
3. Xplorer Work Instruction EWI004 "Auxiliary Engine Calibration".
4. Xplorer Work Instruction EWI006 "Traction and Auxiliary Engine A11 Card Link Settings".
5. ABB Drawing 495 027790 "Schematic Diagram - Alternator and Shore Supply".

**2. INITIAL INSPECTION**

Before applying control voltage to the control panel or starting the auxiliary engine, perform the following initial checks:

1. Pressure prime oil system.
2. Ensure fuel filters are full.
3. Check engine oil level is correct.
4. Check engine coolant level is correct.
5. De-aerate the engine coolant lines.
6. Visually inspect and ensure that the engine, control cabling, shutdown devices and all auxiliary engine control panel devices are correctly installed and adequately secured.
7. Ensure that the A11 card control links are correctly set as per EWI006.
8. Mechanically check by hand that the electrical connections in the control panel and on the auxiliary engine and alternator are securely fastened.
9. Adjust the start/stop delay timer as per EWI004 part 2.
10. Adjust the startup fault inhibit timer (SFIT) as per EWI004 Part 3.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 4 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

11. Adjust the governor potentiometer droop and gain settings as per EW1004 part 4.1. If the governor has link terminals marked "A" and "B" ensure that a link is installed between the connections.
12. Inspect voltage regulator links and potentiometers are correct as per EW1004 Parts 8.1 and 8.2.

**3. INITIAL TEST**

Connect the Remote Interface Test Box (to be supplied by the Contractor) to the "Customer Connection" receptacle.

Before applying control voltage to the Remote Interface Test Box, ensure that the engine "RUN/REMOTE" switch is turned to "OFF".

Apply control voltage to the Remote Interface Test Box. Check that the "ENGINE SWITCHED OFF" indicator on the control panel flashes.

Push the "TEST/RESET" push button. Ensure that all control panel indicators illuminate.

With the Remote Interface "RUN/STOP" switch to "STOP", initiate a local engine start by turning the "RUN/REMOTE" switch to "RUN".

Engine should crank and fire, the run light on the panel should illuminate. AECAR output should be de-energised.

Check engine oil pressure is correct. Inspect engine for oil or fuel leaks. Ensure engine is running smoothly and does not show any signs of distress, such as abnormal noise.

Place "RUN/REMOTE" switch to "STOP". Engine should stop. "SWITCHED OFF" indicator should flash. Push "TEST/RESET" button; all lights should illuminate.

**4. SHUTDOWN SIGNALS**

**4.1 External Engine Shutdown and Control Signals**

**4.1.1 Fire Signal Shutdown**

With engine running in local run, initiate a fire signal shutdown. Engine should stop; "FIRE" indicator should illuminate; AECAR output should energise.

Reset engine; AECAR relay should de-energise; "FIRE" indicator should extinguish.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 5 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**4.1.2 *Low Water***

With engine running in local run, initiate a low water signal shutdown. Engine should stop; "LOW WATER" indicator should illuminate. AECAR should energise.

Reset engine; AECAR relay should de-energise; "LOW WATER" indicator should extinguish.

**4.2 *Local Engine Shutdown Signals***

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT**

**4.2.1 *Low Oil Pressure***

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With engine running in local run, initiate a low oil pressure shutdown by venting oil pressure at the oil pressure switch; low oil pressure shutdown should occur with "LOW OIL PRESSURE" indicator illuminated; AECAR output should energise. Reset engine, AECAR output should de-energise; "LOW OIL PRESSURE" indicator should extinguish.

**4.2.2 *High Engine Temperature Shutdown***

With engine running in local run, remove external cooling system by turning off external cooling fans or similar. Engine shutdown should occur at 94°C. AECAR output should energise; "HOT ENGINE" indicator should illuminate. Reset engine; AECAR output should de-energise; "HOT ENGINE" indicator should extinguish. Allow five (5) minutes for the engine to cool down.

**4.2.3 *OverCrank***

Determine that the overcrank shutdown and fault signal works correctly by following the procedure as detailed in EW1004 part 6.

AECAR output should energise; "OVERCRANK" indicator should illuminate. Reset engine; AECAR output should de-energise; "OVERCRANK" indicator should extinguish.

**4.2.4 *Emergency Stop***

With engine running in local run, initiate an emergency stop by activating the emergency stop push button on the control panel. The engine should stop; AECAR output should energise; "EMERGENCY STOP" indicator should illuminate. Reset engine; AECAR output should de-energise; "EMERGENCY STOP" indicator should extinguish.

**4.2.5 *OverSpeed***

With engine running local run, initiate an engine overspeed fault by following the procedure as detailed in EW1004 part 7.2. The engine should stop; AECAR output should energise; "OVERSPEED" indicator should illuminate. Reset engine; AECAR output should de-energise; "OVERSPEED" indicator should extinguish.

Recalibrate engine speed as per EW1004 part 7.3.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 6 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**4.2.6 *UnderSpeed***

With engine running in local run, initiate an engine underspeed fault by following the procedure as detailed in EW1004 part 7.1. The engine should stop; AECAR output should energise; "UNDERSPEED" indicator should illuminate. Reset engine; AECAR output should de-energise; "UNDERSPEED" indicator should extinguish.

Recalibrate engine speed as per EW1004 part 7.3.

**4.2.7 *Undervoltage***

With engine running in local run, initiate an alternator undervoltage by following the procedure as detailed in EW1004 part 8.6.

The engine should stop; AECAR output should energise; "ALT VOLTS" indicator should illuminate. Reset engine; AECAR output should de-energise; "ALT VOLTS" indicator should extinguish.

Recalibrate alternator voltage to 240 VAC.

**4.2.8 *Overvoltage***

With engine running in local run, initiate an alternator undervoltage by following the procedure as detailed in EW1004 part 8.8.

The engine should stop; AECAR output should energise; "ALT VOLTS" indicator should illuminate. Reset engine; AECAR output should de-energise; "ALT VOLTS" indicator should extinguish.

Recalibrate alternator voltage to 240 VAC.

**4.2.9 *Phase Balance***

With engine switched off, disconnect wire 36 from the phase balance relay (PBR), insulate the exposed conductor. Start the engine in local run. After ninety (90) seconds the auxiliary should fail with "PHASE BALANCE" fault indicator illuminated.

The engine should stop; AECAR output should energise. Reset engine; AECAR output should de-energise, "PHASE BALANCE" indicator should extinguish.

Reconnect wire 36 to the phase balance relay.

**4.2.10 *Alternator Temperature***

With engine switched off.

Disconnect wires 19 and 20 from the Thermistor Shutdown Relay (TDS); connect a 10K ohms variable resistor across terminals t1 and t2 of TDW.

# PASSENGER FLEET MAINTENANCE DIESEL SERVICE SUPPORT

Page: 7 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

Disconnect wires 21 and 22 from the Thermistor Shutdown Relay (TDS); connect a 10K ohms variable resistor across terminals t1 and t2 of TDW.

Adjust both potentiometers to approximately 100 ohms.

Start auxiliary in local run; wait two (2) minutes.

Initiate an alternator temperature warning by increasing the potentiometer connected to TDW. The "ALT TEMP" light should remain illuminated but the alternator should not stop.

Initiate an alternator temperature shutdown by increasing the potentiometer connected to TDS. The alternator should shut down. The "ALT TEMP" light should remain illuminated. AECAR output should energise. Reset engine fault; AECAR should energise; "ALT TEMP" indicator should extinguish.

Disconnect the variable potentiometers from TDS and TDW. The resistance on the potentiometer that was connected across TDW should read approximately 50K ohms. The resistance on the potentiometer that was connected across TDS should read approximately 25K ohms.

Measure the resistance across 19 to 20 and 21 to 22 (alternator thermistors). The resistance of the thermistors at room temperature should read approximately 80 ohms.

## 5. LOCAL METERS

Using external calibrated meters, verify operation of local meters.

Verify that the hour meter is operating when engine is running. With engine stopped, all meters should read zero and hour meter stopped.

## 6. EXTERNAL TRANSDUCER SIGNALS

Using external calibration meters, check the following output signals:

### 6.1 Low Oil Pressure Alarm

Energised with engine stopped; de-energised with the engine running.

### 6.2 Alternator Voltage

0-5 mA output, indicating 0-300 V output.

### 6.3 Alternator Current

0-5 mA output, indicating 0-200 A output.

### 6.4 Water temperature

With engine temperature of 85°C, transducer should read approximately 60 ohms.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 8 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**7. TRIAL LOAD TEST**

**7.1 Preliminary : Fuel Pump Check**

Check operation of the fuel pump actuator as follows:

With engine running in local; engine speed 1500 rpm; disconnect wire 3A from terminal 3 on the electronic governor. Engine speed should decrease to idle speed in less than one (1) second and remain at idle speed. Reconnect wire 3A; engine speed should increase to 1500 rpm in less than one (1) second. If the engine speed does not decrease or increase as quickly as specified, it indicates a problem with the fuel actuator, fuel pump or fuel system; investigate and rectify fault.

With the auxiliary turned off, connect a three phase load bank capable of fully loading the auxiliary to the output terminals of the auxiliary.

Ensure that the load bank is switched off.

Ensure that the customer interface control box "RUN/STOP" switch is in "OFF". Switch the auxiliary "RUN/REMOTE" switch to "REMOTE".

Initiate a remote engine start.

After ninety (90) seconds, the auxiliary should go on-line. Ensure that the load bank fan is rotating in the correct direction for the load bank.

Allow the auxiliary ten (10) minutes to warm up.

**7.2 Load Testing**

The auxiliary engines shall be load tested as defined below. The load box shall be capable of absorbing full supply current of 165 amps. The load box shall preferably be an inductive load.

Connections to the load box shall include three phases, neutral and an earth.

With the auxiliary running at 240V, 50Hz increase the load current in 25 amp steps each fifteen (15) minutes. Recordings of time, voltage, current, frequency, oil pressure, coolant temperature and engine blowby shall be recorded at the start of the fifteen (15) minute period and at the end of the fifteen (15) minute period, i.e. two readings at each current level. The maximum current shall not exceed 165 amps.

At the expiration of the load test the full load current of 165 amps is to be removed from the auxiliary at the load box in one step. This is to ensure that the auxiliary is capable of 100% load step changes.

With no load on the auxiliary, apply full load current of 165 amps in one step from the load box. This is to ensure that the auxiliary is capable of 100% load step change.

The step load changes on and off should not cause the auxiliary to exhibit any instability or cause the auxiliary to shutdown.

**8. REMOTE INTERFACE TEST BOX**

The test box is intended to simulate the vehicle control and signals. This ensures that the full functionality of the auxiliary engine and alternator are tested. Continuous monitoring of the fire probe integrity is performed during the acceptance testing procedure by controlling the start and stop signals through these probes. Refer to Figure 1 - "Fire and Run Relay Circuit" for detail on how the "Remote Interface Test Box" is to start and stop the auxiliary engine.

Refer to ABB Drawing 495 027790

**INPUT FUNCTION**

- A. Alternator amp transducer signal
- B. Alternator voltage transducer signal
- C. Return current path for inputs A and B
- D. Not connected
- E. 24 VDC control input
- F. Auxiliary Engine Common Alarm Relay (AECAR) output
- G. Shore Available Indicator (SAL) Output
- H. Alternator Available Lamp (AAL) Output
- I. Not connected
- J. Alternator Shore Relay (ALSR) Output
- K. Not connected
- L. Not connected
- M. Remote START/STOP input signal
- N. Water temperature transducer output
- O. Not connected
- P. Low Oil Pressure Output
- Q. Not connected
- R. Signal Screen for water temperature sender
- S. Fire probe connection output
- T. Fire probe connection output
- U. Fire probe connection output
- V. Fire probe connection output
- X. Low water level input
- Y. Fire input
- Z. Not connected

**N.B:** The test box shall be fitted with an EMERGENCY STOP" button. The button is to be labelled "EMERGENCY STOP" and have a red mushroom head. The button is to latch in the activated position and twist to reset. Activation of the button is to remove all control power from the auxiliary engine.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICE SUPPORT**

Page: 10 of 11

**STANDARD / INSTRUCTION**

**NUMBER: DSS 5145.00**

**Date: 11/11/97**

**9. SHORE SUPPLY AND OUTPUT VOLTAGE SENSING RELAYS**

Using a multimeter check that there is connection between the shore supply receptacle pilot pins 1 and 2.

For safety reasons, and to simulate the Principal's shore supply circuit, the Contractor's shore supply contactor circuit shall check for the integrity of the trip line pins that are installed between shore supply receptacle pilot pins 1 and 2 before allowing closure of the Contractor's shore supply contactor. If a circuit is not detected between the shore supply receptacle pilot pins 1 and 2, power shall not be available at the shore supply plug.

With the engine switched to "REMOTE", but not running, insert a 3 phase shore supply jumper into the auxiliary shore supply point.

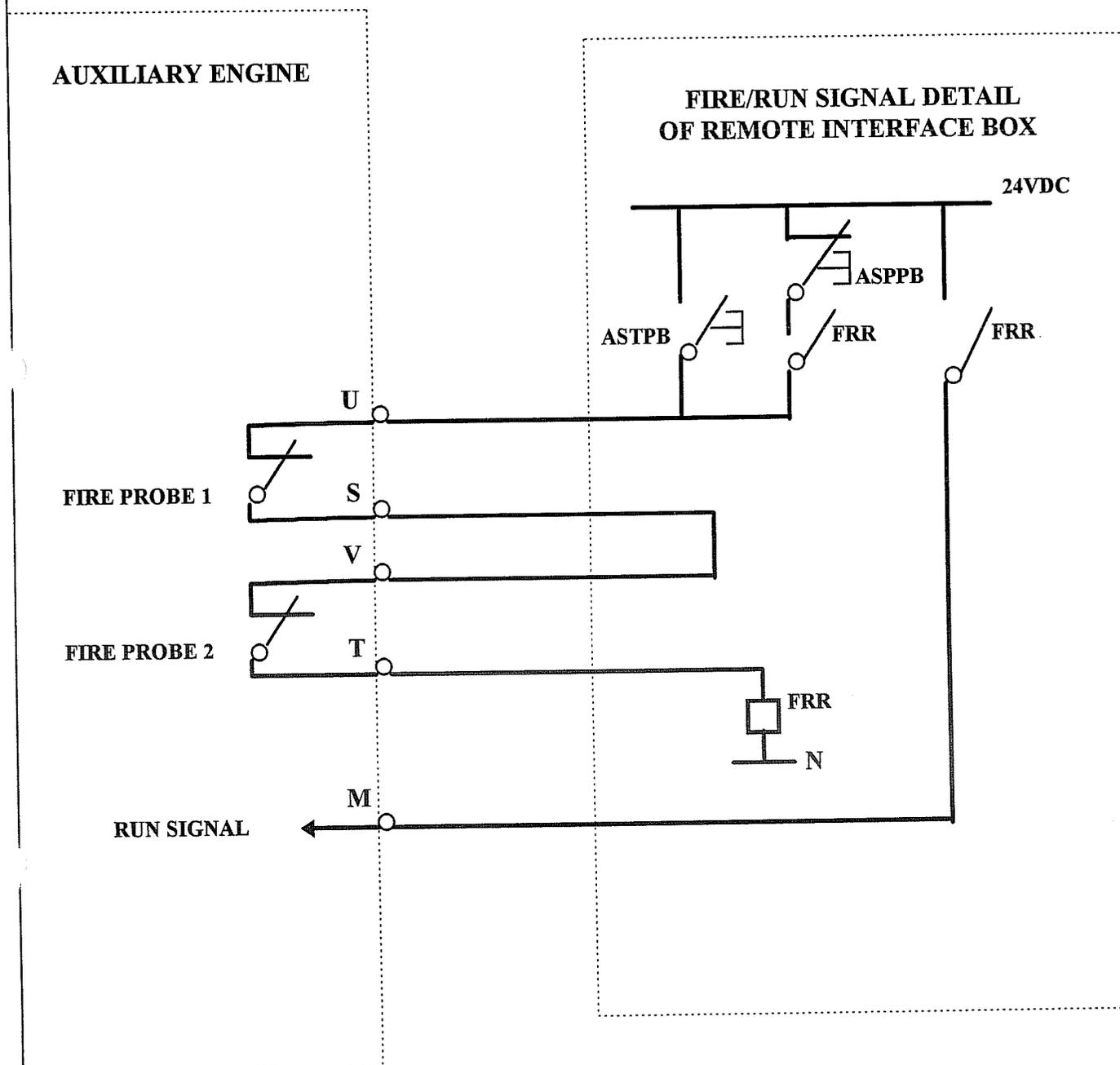
Switch the "SHORE/TRAIN" switch to shore. Check that 3 phase supply is available to the load box. Outputs SAL and ALSR should energise.

Check that with the shore supply powering the load box fan, that the three voltage sensing relays (RSR, BSR, WSR) are energised.

Turn off the shore supply point and disconnect the shore supply jumper.

**PASSENGER FLEET MAINTENANCE  
DIESEL SERVICES SUPPORT**

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FRR = FIRE & RUN RELAY

ASTPB = AUXILIARY START PUSH BUTTON

ASPPB = AUXILIARY STOP PUSH BUTTON

FIGURE 1

FIRE AND RUN RELAY CIRCUIT



# PASSENGER FLEET MAINTENANCE

## XPLORER - ENDEAVOUR SERVICE CENTRE

Date: 1/05/08

### STANDARD OPERATING PROCEDURE

**WORK INSTRUCTION NUMBER: EWI 000**

EWI 000

Revision: 5.01

**SOP TITLE:**

## **REQUIREMENTS FOR WORKING ON TRAINS AT XESC EVELEIGH AND ESC BROADMEADOW**

**1.0 Purpose and Scope:**

The purpose of this instruction is to assist personnel at XESC and ESCB to follow the various requirements and responsibilities in carrying out their duties.  
This instruction is part of site specific safety induction.

This instruction should be read in conjunction with RailCorp's SMS, EMS, policies and procedures and local QMS.  
This Instruction does not cover all requirements.

**2.0 References:**

- SMS – Safety Management System
- SOP's for XPLORER and Endeavour Service Centre
- SWMS for XPLORER and Endeavour Service Centre
- SWI's for XPLORER and Endeavour Service Centre
- RailCorp - Train Operations Manual
- RailCorp - Operator Specific Procedures
- RailCorp – Network procedures
- RailCorp – Working Safely Handbook
- Occupational Health and Safety Act, 2000
- RailCorp Code of Conduct
- Incident Response Procedure for Service Centre SMS-15-TP-0246
- Electrical workers safety regulations

**NOTE: DESTROY ALL PREVIOUS ISSUES OF STANDARD OPERATING PROCEDURE NO. EWI 000 UNCONTROLLED when PRINTED**

**Prepared By:**

XPLORER/Endeavour Service Centre

**Checked By:**

**Authorised By:**

Fleet Manager  
XPLORER/Endeavour Service Centre

WORK INSTRUCTION NUMBER: EWI 000

Date: 01/05/08

Revision: 5.01

### 3.0 Document History / Reviews

Version	Date	Reason for change	Proposed by	Review Dates	Approved by
4	July 04				T Weir
5.01	May 08	SMS inclusions	G Milner		T Weir
		Scheduled Review		May 09	

### 4.0 Definitions

ESCB	Endeavour Service Centre, Broadmeadow
EMD	Engineering Modification, Eveleigh and Broadmeadow
ESA	Engineering Special Action, Eveleigh and Broadmeadow
EWI	Engineering Work Instruction, Eveleigh and Broadmeadow
EMS	Environmental Management System
MSDS	Material Safety Data Sheet
OSP	Operator Specific Procedure
Personnel	All XESC, ESCB staff, RC Officer contractors, or visitors.
PFM	Passenger Fleet Maintenance
PPE	Personal Protective Equipment
QMS	Quality Management System
RSD	Rolling Stock Division
SDG	Service Delivery Group.
SOP	Standard Operating Procedure, Eveleigh and Broadmeadow (includes EWIs, EMDs, and ESAs)
SWI	Safe Working Instruction
SWMS	Safe Working Method Statement
SWU	Safe Working Unit
XESC	XPLORER - Endeavour Service Centre, Eveleigh.

### 5.0 Procedure:

- 5.1 Must have been given a site specific induction including environmental, safety, security and risk management aspects.
- 5.2 In carrying out all duties, the legislation, regulations, policies and guidelines, are to be adhered to at all times. ref:-SMS-03-SR-0213 Legislative & Regulatory Requirements.
- 5.3 Safety of yourself and all who work with you is the responsibility of everyone. Before any work on a car is started all safety precautions must be carried out as detailed in this instruction (including red flags and personal ID tags).

WORK INSTRUCTION NUMBER: EWI 000

Date: 01/05/08

Revision: 5.01

## 5.4 Arrival of trains into XESC or ESCB and movements of trains/cars around the Service Centres

5.4.1 **SHUNTING IN RAILCORP YARDS AND MAINTENANCE CENTRES** – All movements of trains and cars within XESC and ESCB are to comply with OSP16.

5.4.2 **BOOM GATES** – All train movements within XESC are to comply with SOP029.

5.4.3 **RED FLAGS** – Service Manager/Train Technician is to place a red flag the departure drivers end of the car or set once it arrives in the Service Centre. The flag at the south end of the car/set at XESC, must have a ring for personal ID tags. In the absence of the Service Manager from the Depot the delegated Running Service Technician will fulfil the duties of the Service Manager  
Do not move or attach vehicles to a vehicle that has a red flag attached.

Do not start engines of a vehicle/set that has a red flag unless the conditions of 5.6 are met.

5.4.4 **SERVICE CERTIFICATE, LOG BOOK AND REVERSER KEY** – are to be kept with the Service Manager whilst not being used for servicing of the set. Please ensure they are not left unattended on the set. The Service Manager is to personally hand these items to the driver.

## 5.5 Preparation to works on trains at XESC or ESCB

5.5.1 **Pre-Work Brief** – Must have been briefed on the SWMS/SWIs for the Job and instructed implementing the controls recorded on the SWMS/SWIs Ref:- SMS-06-FM-0163.

5.5.2 **ADVISE DEPOT** - Inform other staff, in the order of Service Manager, Technician on call (if applicable) or other staff working in the depot, of your presence or intentions of working on or around cars. Ensure that the staff previously notified are informed once you have finished working on or around cars.

5.5.3 **PPE** - Always use the required PPE that includes but is not limited to safety footwear, safety vests, gloves, goggles, respirators, safety helmets and earmuffs. Ensure that your PPE fits properly and is in a clean and functional condition prior to and after use. ref:-SMS 06 – GD – 0323- Personal Protective Equipment.  
When working on Service and High Level platforms, correct Safety harness ref:-SMS-06-GD-0240 and Fall Arrest system ref:-SMS-06-GD-0241. Safety glasses are required to be worn whilst inside the Service Centre.

5.5.4 **INFORMATION** - Before starting work on a train or component ensure you have appropriate technical information. The XPLORER Endeavour Standard Operating Procedures Manual contains work instructions, SWMS and information on modifications related to XPLORER Endeavour trains and equipment fitted. Where work being carried out is not covered by a work instruction, refer to the train or component manufacturer's manuals. Information may be obtained from the intranet or service manager.

5.5.5 **ACCREDITATION** - Ensure that you are accredited to do the work planned. If re-accreditation is required advice will be given by the Service Manager

## 5.6 Before carrying out any work on a car the following safety measures must be in place:

5.6.1 **RED FLAGS** - The car/set must have a red flag at drivers end. The flag may be placed by the Service Manager or other staff working on the car. The flag at the south end (away

WORK INSTRUCTION NUMBER: EWI 000

Date: 01/05/08

Revision: 5.01

- from Sydney) of the car/set or the end where movement may occur, must have a ring for personal ID tags.
- 5.6.2 **AT XESC**, If the car is in the heavy lifting area (for major component change etc.) the flag is to be placed on the boom gate placed across the "four foot" at the south end of the car, as per SOP029. Your personal ID tag is to be attached to the boom gate whilst you are working on the car in the heavy lifting area.
- 5.6.3 **ID TAG** - Before starting work on a car you must place attach your personal ID tag in to the ring of the red flag. When you have completed work on the car you must remove your personal ID tag. You must not remove any other persons ID tag, the only person who may remove an ID tag is the person who placed it there.
- 5.6.4 **VISITORS/CONTRACTORS/VISITING APPRENTICES** are to be issued a numbered tag by the Service Manager or Administration Officer. The number of the tag and date of issue must be recorded for future reference. The tag must be returned to the issuing officer once work/shift is completed.
- 5.6.5 **BRAKES** - Ensure that brakes are working and spring parking brakes applied. If you are not accredited in XPLORER/Endeavour braking systems, please seek the assistance of the Service Manager or accredited Technician.
- 5.6.6 **CHOCKS** - Wheels must be chocked so can not move in either direction, for any jobs where brakes may be released as part of the testing
- 5.7 **While carrying out any work on a car the following safety measures must be observed**
- 5.7.1 **MSDS** - Adhere to the safety requirements listed on material safety data sheets for the specific product being used. MSDS registers are located in the Service managers office, Logistics managers and Safety Facilitor.
- 5.7.2 **ISOLATED EQUIPMENT with Defect Tag** - DO NOT close Isolation Switches of equipment with a defect tag unless repaired, authorised by the job card or Service Manager. If the isolated equipment has a danger tag or tape, see 5.8.
- 5.7.3 **ENGINES** - If working on auxilliary or traction engines, the respective engine must be isolated. If required to de-isolate and operate for testing purposes ensure that no person is working on, under or near the car.
- 5.7.4 **TRACTION EQUIPMENT** - If testing or operating traction equipment, including traction engine, drive shaft, transmission, ensure that no person is working on, under or near the car.
- 5.7.5 **DOORS** - If testing or opening and closing doors on the train, announcements must be made to warn other staff on or near the train in accordance with EW1029.
- 5.7.6 **CAR MOVEMENTS** - If testing requirements or shunting moves mean that a train being worked on is to move, all persons working on the train must remain seated until movements are completed. Refer to OSP17.
- 5.8 **While carrying out any work on electrical equipment on a car the following safety measures must be observed**
- 5.8.1 **SHORE SUPPLY** - Before connecting the shore supply to a car or train, ensure that no persons are working on or near electrical equipment on the car or train.

WORK INSTRUCTION NUMBER: EWI 000

Date: 01/05/08

Revision: 5.01

- 5.8.2 **ISOLATE** - Ensure all related electrical equipment is isolated prior to work. Use DANGER tags on electrical equipment when equipment is isolated. Remove the tag when work completed. The only person who may remove a tag is the person who placed it there, unless it can be confirmed that the tag has been left in error and all work on the equipment is completed and no persons are working on or near the equipment. Ref:-SMS-06-GD-0268.
- 5.8.3 **LIVE EQUIPMENT** - When working on, near or testing LIVE electrical equipment ensure that precautions are taken, according to the Electrical Workers Safety Regulations, to prevent electric shock, flashes or burns. . Ref:-SMS-06-GD-0268.
- 5.9 **While carrying out any work on the roof of a car or from high level platforms the following safety measures must be observed**
- 5.9.1 **SAFETY HARNESS** – To be used as per SOP030 when working from high level platforms in the Wash Shed at Eveleigh. Ref:-SMS-06-GD-0240.
- 5.9.2 **ISOLATE RADIATION EMITTING EQUIPMENT** – As per EWI025 when working on the roof of cars. Ref:-SMS-06-SW-0648.
- 5.9.3 **WORKING FROM SERVICE AND HIGH LEVEL PLATFORMS in XESC** – Ensure the requirements of EWI027 are met. Ref:-SMS-06-GD-0240.
- 5.10 **Upon completion of work ensure the following requirements are met**
- 5.10.1 **FUNCTIONAL TEST** - When any component from a safety related system has been changed, the system must be functionally tested before the car is returned into service.
- 5.10.2 **WORK AREA** - Whenever it is necessary to leave a job unfinished, the work area should be rendered safe; where this is not possible for any reason, the Service Manager must be informed, or Technician if Service Manager unavailable. Upon completion of each job, all surplus and waste materials, such as screws, nuts, bolts, packaging, grease, oil, rags, and swarf from drilling etc must be removed and the area of work left clean and tidy.
- 5.10.3 **ID TAG** - When you have completed work on a car, remove your ID tag. You must not remove any other persons ID tag, the only person who may remove an ID tag is the person who placed it there.
- 5.10.4 **ADVISE DEPOT** - Ensure that the staff previously notified are informed once you have finished working on or around cars.
- 5.10.5 **RED FLAGS** – The Service Manager will remove the red flag once the set is ready for departure. **A flag is not be removed from a car/set until all ID tags have been removed.** The Service Manager, or Technician on shift in the Service Manager's absence, may remove the red flags after ensuring that no persons are working on or near the car and it can be confirmed that ID tags remaining have been left in error.

**PASSENGER FLEET MAINTENANCE**
**XPLORER - ENDEAVOUR SERVICE CENTRE**

Date: 09/05/03

**STANDARD OPERATING PROCEDURE**

Issue: A

**WORK INSTRUCTION NUMBER: EWI004**

Revision: 1

**EWI TITLE:**

## AUXILIARY ENGINE CALIBRATION

**1.0 Purpose:**

The purpose of this instruction is to explain the procedure to be followed when calibrating the settings of the auxiliary engine operation and shutdown devices.

**2.0 Scope:**

The work in this instruction is to be performed only by staff trained and qualified in this procedure.

**3.0 References:**

ABB Electrical Schematic	495 027790
Onan / Cummins Electrical Schematics	2406-P-08
	2406-P-09
EWI006 ENGINE A11 CARD LINK SETTINGS	

**4.0 Definitions:**

Nil

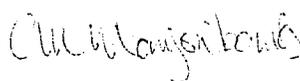
**5.0 Procedure:**
**5.1 A11 Card Link Settings:**

- 5.1.1 Before starting the auxiliary engine ensure all links on the A11 control card are set as per Table 1 below.
- 5.1.2 Refer to figure 1 for link locations.

**NOTE: DESTROY ALL PREVIOUS ISSUES OF WORK INSTRUCTION NO.: EWI004**
**Prepared By:**


09/05/03

Electrical Engineer  
XPLORER/Endeavour Service Centre

**Checked By:**


09/05/03

**Authorised By:**


Maintenance Manager  
XPLORER/Endeavour Service Centre  
Date: 09/05/03

**WORK INSTRUCTION NUMBER: EW1004****Date: 09/05/03****Revision: 1****Table 1**

LINK NUMBER	POSITION
W1	A
W2	B
W3	B (fixed link)
W4	B (fixed link)
W5	A (fixed link)
W6	B
W7	B
W8	B
W9	B

**5.2 Start/Stop Delay Times:**

- 5.2.1 Refer to Figure 4 for start Stop Time Delay (SSTD) location.
- 5.2.2 Check the "DELAY ON START" potentiometer on the SSTD control card is fully anti clockwise, which corresponds to minimum delay on starting. Adjust if necessary.
- 5.2.3 Check the "DELAY ON STOP" potentiometer on the SSTD control card is approximately mid point. This setting corresponds to a 5 minute cool down cycle from when the auxiliary engine goes off line until the auxiliary engine stops.
- 5.2.4 Initiate a remote start, the auxiliary should start immediately. Wait until the auxiliary main contactor closes.
- 5.2.5 After the auxiliary is on-line, stop the auxiliary from the driver's cab. The auxiliary should go off line and shutdown after 5 minutes. If the auxiliary run down time is not 5 minutes adjust the SSTD.

**5.3 Start Up Fault/Fan inhibit Timer:**

- 5.3.1 Check the SFIT time delay is set to 1.5, which corresponds to a 90 second delay period from when auxiliary engine is running until the unit goes on line. Settings below 90 seconds can cause the auxiliary engine to fail "UNDERSPEED" while the engine is still cranking. Adjust if necessary.
- 5.3.2 Refer to Figure 4 for SFIT location.

**5.4 Electronic Governor Settings**

- 5.4.1 Remove the cover from the electronic governor and ensure that the "GAIN" is set to 45, and "DROOP" is 0.
- 5.4.2 Reconnect the actuator control wires to terminals 3 and 4 on the electronic governor.
- 5.4.3 For governor potentiometer layout refer to Figure 2.

**5.5 Magnetic Speed Probe Settings.**

The two magnetic speed probes are to be removed, cleaned and tooth gap reset as follows:

**WORK INSTRUCTION NUMBER: EWI004****Date: 09/05/03****Revision: 1****Table 2**

POTENTIOMETER	SETTING
DIP	Fully anticlockwise
DWELL	Fully anticlockwise
DROOP	Fully anticlockwise
V/TRIM	Fully anticlockwise

5.8.2 Ensure the AVR jumper links are set as follows, (refer to figure 3);

**Table 3**

JUMPER	SETTING
STABILITY SETTING	B - C
FREQUENCY SELECTION	2 - 3

5.8.3 Ensure that terminals 1 and 2 on the regulator are bridged together.

5.8.4 Start the auxiliary engine in "RUN", ensure the auxiliary is running at 50 Hz +/- 0.5 Hz. Measure the alternator voltage from the FCB (fan circuit breaker). Adjust the voltage potentiometer on the regulator if the alternator voltage is not between **242 and 244** Volts.

5.8.5 With the alternator running at 50Hz, 242V, slowly wind the electronic governor "RUN SPEED" anticlockwise until the alternator is running at 47 Hz. With the alternator at 47 Hz, carefully adjust the Under Frequency Roll Off (UFRO) potentiometer until the red LED is flickering.

5.8.6 Increase the auxiliary engine speed back to 50 Hz. Check the UFRO LED has extinguished. Check the alternator voltage is still 242-244 V.

5.8.7 With the alternator running, check the auxiliary engine shuts down with an undervoltage by slowly decreasing the alternator voltage (via the VOLTS potentiometer on the AVR). Check that the auxiliary engine shuts down with a "VOLTS FAIL" at 217 Volts  $\pm$  1 Volts.

5.8.8 Refer to Figure 4 for Under/Over Voltage Relay location

5.8.9 If the auxiliary engine does not shutdown at 217 Volts, adjust the OVER/UNDER VOLTAGE RELAY (OUVR) "UNDER" "SET" potentiometer. Clockwise adjustment on the UNDER SET potentiometer increases the voltage at which the auxiliary engine shuts down. Anticlockwise adjustment on the UNDER SET potentiometer decreases the voltage at which the auxiliary engine shuts down.

5.8.10 With the alternator running, check the auxiliary engine shuts down with an overvoltage by slowly increasing the alternator voltage (via the VOLTS potentiometer on the AVR). Check that the auxiliary engine shuts down with a "VOLTS FAIL" at 263 Volts  $\pm$  1 Volt.

5.8.11 Refer to Figure 4 for Under/Over Voltage Relay location

5.8.12 If the auxiliary engine does not shutdown at 263 volts, adjust the OUVR relay "OVER" "SET" potentiometer. Clockwise adjustment on the OVER SET potentiometer increases the voltage at which the auxiliary engine shuts down. Anticlockwise adjustment on the OVER SET potentiometer decreases the voltage at which the auxiliary engine shuts down.

5.8.13 Adjust the voltage back to 242-244 Volts.

WORK INSTRUCTION NUMBER: EWI004

Date: 09/05/03

Revision: 1

## 5.11 DIAGRAMS

Figure 1: A11 card link settings

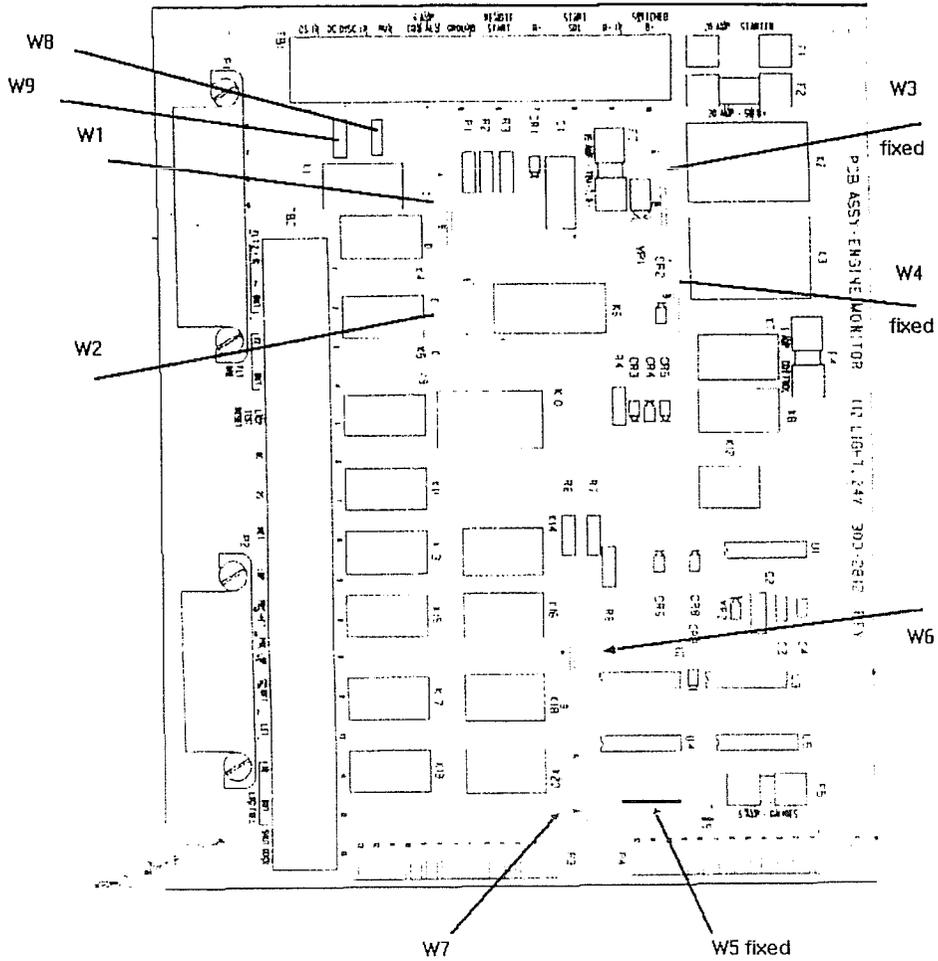
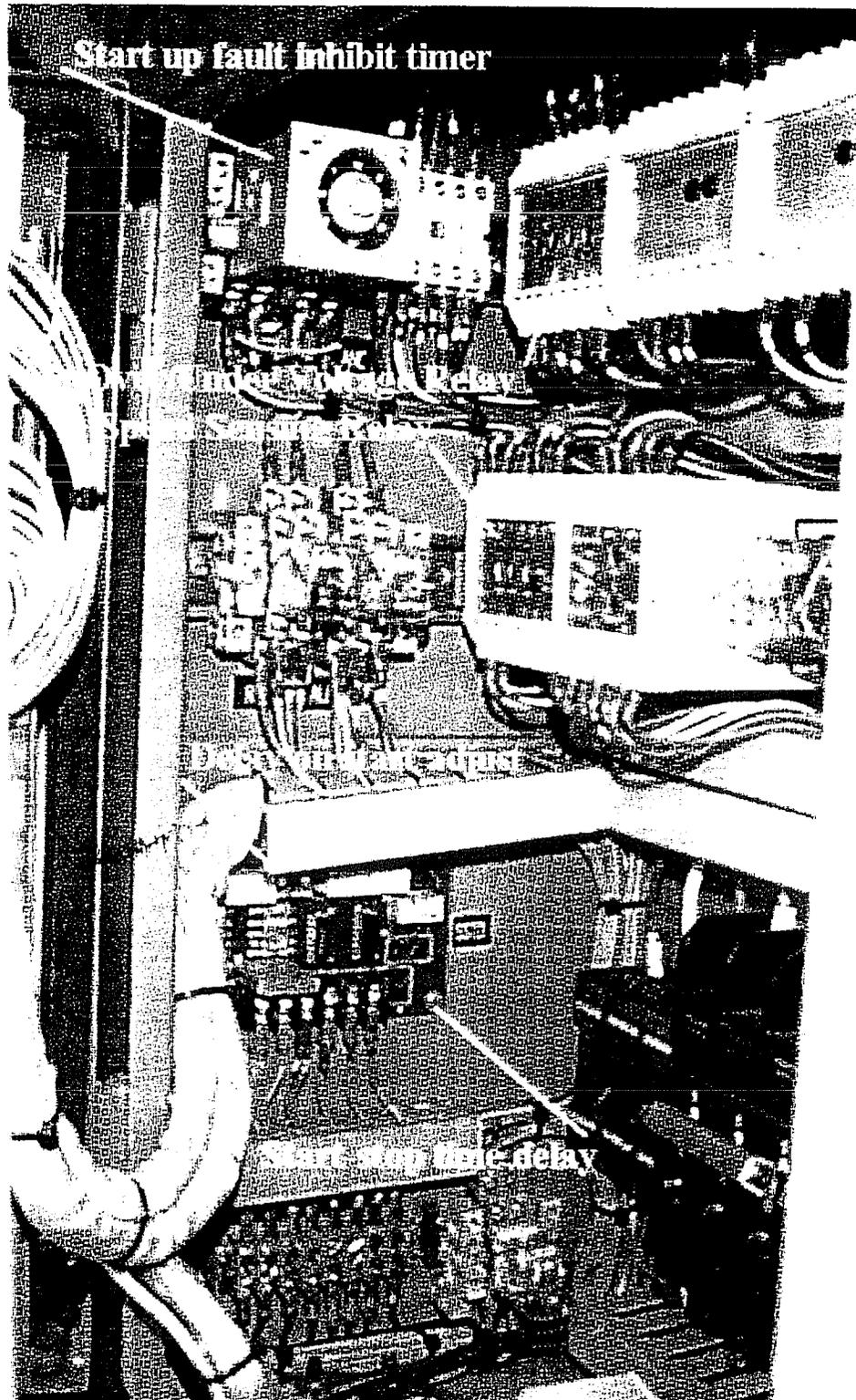


Figure 4: General Layout of Electronic Equipment



6.0 Documentation:

XPLORER AUXILIARY CALIBRATION CONFORMANCE REPORT - attached

**WORK INSTRUCTION NUMBER: EW1004**

**Date: 09/05/03**

**Revision: 1**

## XPLOER / ENDEAVOUR JOB CARD

Page 1 of 1

### AUXILIARY CALIBRATION CONFORMANCE REPORT

**Work Order No.:**

**Date:**        /        /

**CAR NUMBER:**

**XPLOER 25**

**ENDEAVOUR 28**

Auxiliary Engine Serial Number: .....

**Ref: EW1004**

## OBSERVE ALL SAFETY REQUIREMENTS

<u>ITEM No</u>	<u>DESCRIPTION</u>	_____	
1. A11 Card Link Settings	1.1 All card links correctly set	_____	Y/N
2. Start/Stop Delay Times	2.1 Delay on start adjusted to zero	_____	Y/N
	2.2 Delay on stop time	_____	minutes
3. Start-Up Fault Inhibit Timer	3.1 SFIT adjusted to 90 seconds	_____	Y/N
4. Electronic Governor Settings	4.1 Electronic gain value	_____	value
	4.2 Droop adjusted to zero	_____	Y/N
5. Magnetic Speed Probe Settings	5.1 Probes cleaned, inspected and adjusted	_____	Y/N
6. Crank Cycle	6.1 Three crank cycle checked	_____	Y/N
7. Frequency Settings	7.1 Over frequency setting	_____	Hz
	7.2 Under frequency setting	_____	Hz
8. Voltage Settings	8.1 AVR potentiometers correctly adjusted	_____	Y/N
	8.2 AVR links correctly installed	_____	Y/N
	8.3 Under voltage setting	_____	Volts
	8.4 Over voltage setting	_____	Volts
	8.5 AVR Stability adjusted	_____	Y/N
	8.6 Alternator voltage	_____	Volts
9. Voltage Regulator Excitation Check	9.1 Voltage regulator excitation voltage	_____	Volts
10. Fuel Pump Check	10.1 Fuel pump checked (run up speed)	_____	seconds
	10.2 Fuel pump checked (run down speed)	_____	seconds

**Technician Signature:**

**Employee No:**

11. Close work orders in MIMS:

*Ensure all related work orders are closed:* \_\_\_\_\_

12. Prepare Overhaul/Repair Report:

*Include defects and missing parts:* \_\_\_\_\_

13. Forward to MIMS Analyst:

*Level 1, Admin. Building XESC:* \_\_\_\_\_

**Service Manager Signature:**

**Employee No:**

**Comments:**

# XPLORER/ENDEAVOUR SERVICE CENTRE

Page: 1 of 2

**XPLORER/ENDEAVOUR WORK INSTRUCTION NUMBER: EWI 006**

**Date : 22/7/96**

**TITLE:** Traction and Auxiliary Engine A11 Card Link Settings

**EWI: 006**

**Revision: A**

## SUMMARY / BACKGROUND:

To ensure correct logical operation of the traction and auxiliary engine, the adjustable links on the A11 card must be set specifically for the appropriate engine. If engine operation is in doubt, or a new A11 card has being fitted, ensure the links are correctly set.

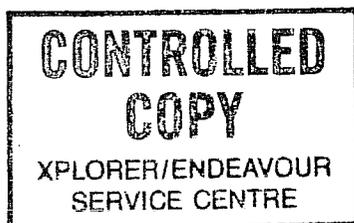
## DESCRIPTION:

### 1. LINK POSITIONS

Refer to Table 1 and Figure 1 below for the correct link positions for the A11 traction and auxiliary engine control card.

LINK	TRACTION	AUXILIARY
W1	B	A
W2	D	B
W3	B (FIXED)	B (FIXED)
W4	B (FIXED)	B (FIXED)
W5	A (FIXED)	A (FIXED)
W6	A	B
W7	A	B
W8	B	B
W9	B	B

Table 1



**NOTE: DESTROY ALL PREVIOUS ISSUES OF WORK INSTRUCTION NO : EWI 006**

**Prepared By:**

A. Phillip : Senior Engineer

**Checked By:**

Roger Link: Field Service Officer

**Authorised By:**

J. Tolley : Manager  
XPLORER/Endeavour Service Centre

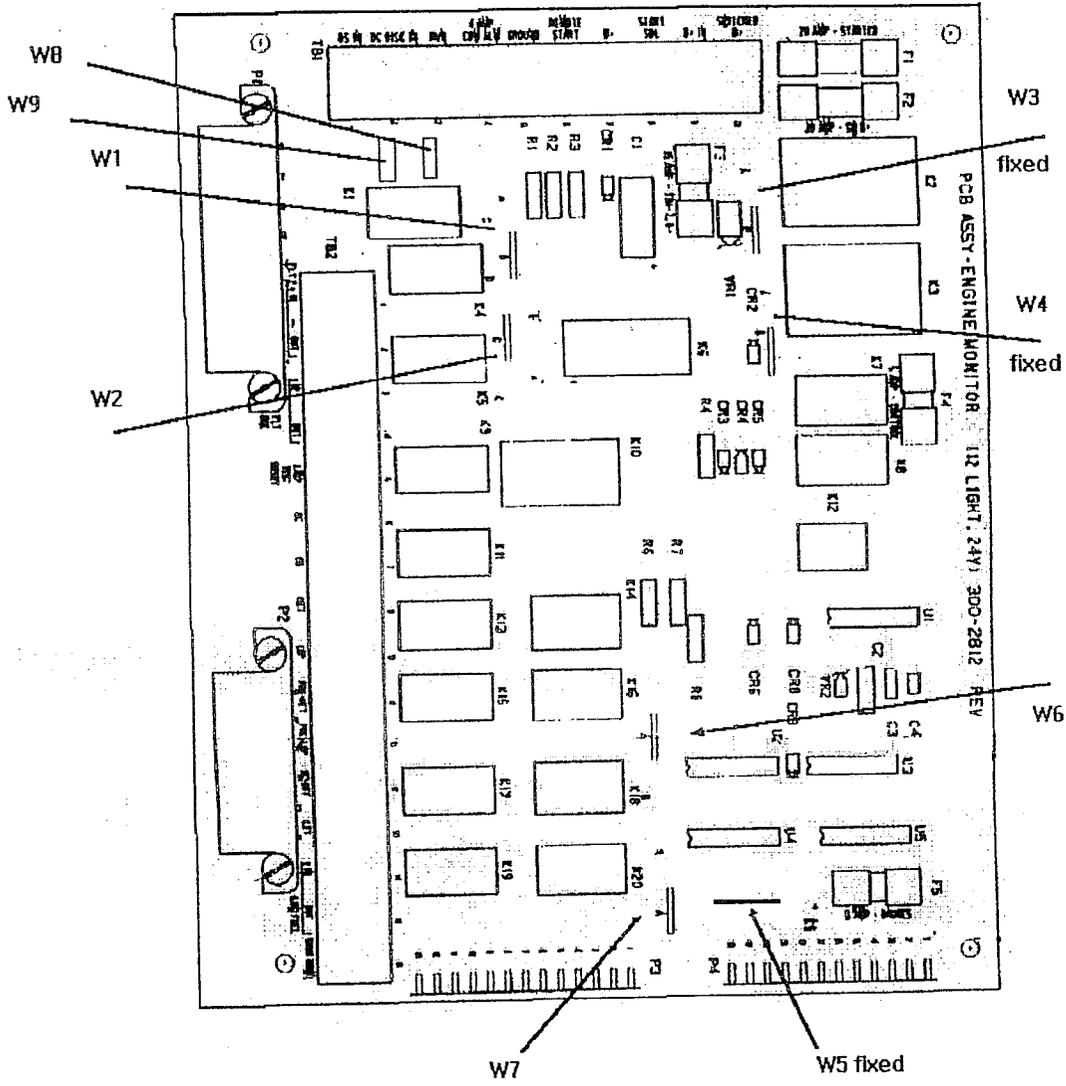


Figure 1 : A11 Card Link Positions

# XPLORER/ENDEAVOUR SERVICE CENTRE

Page: 1 of 4

XPLORER/ENDEAVOUR WORK INSTRUCTION NUMBER: EWI 018

Date: 12/05/97

**TITLE:** TRACTION ENGINE 1500 HOUR SERVICE

**EWI: 018**

**Revision: A**

## SUMMARY / BACKGROUND:

This is the procedure for measuring and setting injector travel, inlet and exhaust valve clearance and crosshead adjustment on KTA 19r engines.(1500hr Service)

Reference is made to procedure 07-05 of the Cummins K19 troubleshooting and repair manual.

## DESCRIPTION:

### SAFETY

- TRAIN MUST BE SECURED AND PROTECTED AT ALL TIMES.
- ISOLATE START CIRCUIT OF THE TRACTION ENGINE TO BE SERVICED.

### PARTS/EQUIPMENT REQUIRED.

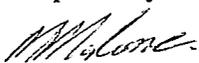
- a. Injector adjustment kit.
- b. Feeler gauges inlet 0.36mm(0.014inch) and exhaust 0.69mm(0.027inch).
- c. Calibrated Tension wrench.
- d. Rocker cover gaskets (6 off).
- e. Cummins Tool ST-669.
- f. Turbo inlet crossover to aftercooler gasket.

### PROCEDURE.

1. General.
  - 1.1 All adjustment procedures should be performed on a cold engine.
  - 1.2 Engine to be cleaned and free from dirt and debris.
  - 1.3 Remove exhaust pipe from turbo to muffler.
  - 1.4 Remove turbo boost air hose and crossover to aftercooler and discard gasket. Take care as to prevent entry of foreign objects into aftercooler.

**NOTE:** DESTROY ALL PREVIOUS ISSUES OF WORK INSTRUCTION NO : EWI 018

**Prepared By:**



M.MALONE

A/Mechanical Engineer

**XESC File Reference:**

97/00231

g:\clerical\eng\ewi018.doc

**Authorised By:**



J.TOLLEY

Manager Xplorer/Endeavour Service Centre

- 1.5 Remove brackets securing oil supply line to rocker covers four(4) and six(6).
- 1.6 Remove all rocker covers (and coolant rail securing strap) and discard used gaskets.
- 1.7 Using engine baring device rotate accessory drive flange to correct mark as outlined on injector and valve adjustment sequence chart.

## 2. Valve Clearance measurement and Crosshead Adjustment.

- 2.1 When the correct position for the valve clearance measurement has been obtained both the inlet and exhaust rockers should be loose and the rocker adjusting screws at the same height. This indicates that inlet and exhaust valves are closed.
- 2.2 Before proceeding to measure and adjust valve clearance, crossheads must be adjusted first (note some engines have non adjustable crossheads fitted and therefore require no adjustment).
- 2.3 To adjust crossheads, loosen the crosshead adjusting screw locknuts on the intake and the exhaust valve crossheads.
- 2.4 On both crossheads turn the adjusting screws out at least one full turn.
- 2.5 Hold the the crosshead down against its mating valve stems.
- 2.6 Turn screw down till it just touches the top of the valve stem but does not raise the crosshead. Hold the adjustment screw in this position and torque to the following:
  - 2.6.1 Using adaptor ST-669            35nm (25ftlb).
  - 2.6.2 Without ST-669                40nm (30ftlb).

## 3. Measure And Adjust Valve Clearance.

- 3.1 Select the correct feeler gauge. Insert the feeler between rocker and crosshead and for a correct setting the feeler gauge must slide back and forward with only a slight drag.
- 3.2 If adjustment is required, loosen the rocker locknut and turn the adjusting screw to obtain the correct setting.
- 3.3 After obtaining the correct setting ensure the rocker locknut is tensioned to the correct torque value.
  - 3.3.1 Using adaptor ST-669            45nm (35ftlb).
  - 3.3.2 Without ST-669                60nm (45ftlb).

**4. Measure And Adjust Injector Travel.**

- 4.1 When the correct mark has been obtained on the accessory drive flange, assemble the parts of the dial indicator kit and install on the cylinder to be adjusted.
- 4.2 Adjust the indicator so that the indicator tip is touching the top of the injector plunger. Ensure that the indicator tip is not touching the rocker lever and has enough travel to obtain a measurement.
- 4.3 Using the rocker lever actuator depress the rocker lever two or three times until the injector "bottoms" out. This is to remove all fuel from the injector cup.
- 4.4 Hold the lever with the injector plunger firmly bottomed in the cup and set the indicator to zero. Raise and lower rocker a few times to confirm zero reading.
- 4.5 Slowly release the rocker lever and observe the reading of the dial gauge at the end of travel. Reading should be:
  - 4.5.1 7.72mm (.304inch)
- 4.6 If reading is not within specification, loosen locknut on injector rocker and turn adjusting screw clockwise or counterclockwise until correct reading is obtained.
- 4.7 Tension injector rocker locknut to the correct torque value:
  - 4.7.1 Using adaptor ST-669 45nm (35ftlb).
  - 4.7.2 Without ST-669 60nm (45ftlb).
- 4.8 Ensure injector travel has not moved out of tolerance after injector rocker has been torqued.

**5. Re-Assembly.**

- 5.1 Clean rocker covers and refit using new gaskets. Ensure coolant rail retaining strap is correctly fitted to rocker cover six(6) and oil supply line brackets are fitted to rocker covers four(4) and six(6). Torque all rocker cover bolts to:
  - 5.1.1 45nm (35ftlb).
- 5.2 Re-fit turbo boost hose (use new hose if old hose has deteriorated) and air crossover with new gasket and torque to:
  - 40 nm (30ftlb).
- 5.3 Refit exhaust pipe to muffler and turbo charger. Ensure band clamps are securely located.

**5.4 At engine start panel, start engine in local and bring to normal operating temperature. Inspect for the following:**

**5.4.1 Oil leaks.**

**5.4.2 Turbo Boost Air and Exhaust Leaks.**

**5.4.3 Coolant Leaks.**

**Rectify if any of the above found.**

**5.5 Stop engine and re-set engine start panel and place engine selector switch in the remote position.**

# XPLORER/ENDEAVOUR SERVICE CENTRE

Page: 1 of 3

**XPLORER/ENDEAVOUR WORK INSTRUCTION NUMBER: EWI 020**

**Date: 29/11/96**

**TITLE: TRACTION ENGINE STALL TEST**

**EWI: 020**

**Revision: A**

## SUMMARY / BACKGROUND:

This is the testing procedure for item 64, Engine Speeds, of CFE 5106.02, XPLORER - Endeavour Inspection Schedules.

Reference is made to the Engine Stall Speed and Time Check, procedure (05-32) of the Cummins K19 Series Troubleshooting and Repair Manual.

## DESCRIPTION:

### 1. SAFETY

- .1 **TRAIN MUST BE SECURE AND PROTECTED AT ALL TIMES**
- .2 **ENSURE THERE ARE NO OTHER PERSONS WORKING ON THE SET**

### 2. PARTS/EQUIPMENT REQUIRED

- .1 Hand held tachometer
- .2 Reflective tape
- .3 Stopwatch
- .4 Job Card for EWI 020
- .5 Communication between operator in cab and technician testing engine

**NOTE: THIS TEST WILL REQUIRE 2 PEOPLE**

### 3. PROCEDURE

**NOTE: TRACTION ENGINE COOLANT TEMPERATURE MUST BE AT LEAST 70°C.  
TRANSMISSION OIL TEMPERATURE MUST BE AT LEAST 80°C.  
TRANSMISSION OIL TEMPERATURE MUST NOT EXCEED 120°C.**

- .1 Set and tag the RUN/STOP/REMOTE switch of all engines on the set to the STOP position.
- .2 Affix a small strip of reflective tape to the vibration damper of the engine to be tested. Hand held tachometer readings will be taken using the tape as a reference.
- .3 Set the RUN/STOP/REMOTE switch of the engine to be tested to the RUN position.

**NOTE: DESTROY ALL PREVIOUS ISSUES OF WORK INSTRUCTION NO : EWI 020**

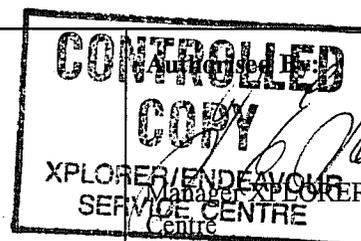
**Prepared By:**

*D Russell*

Mechanical Engineer

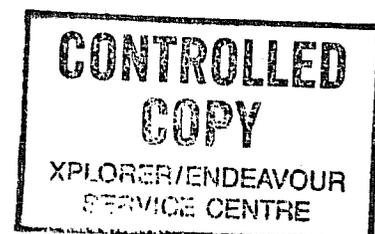
**Checked By:**

*. Barnes*



Manager XPLORER/Endeavour Service Centre

- .4 Once the engine has started, press and hold the 1/3 FUEL, 2/3 FUEL and 3/3 FUEL buttons in turn. Ensure that the engine speed increases to 2050 RPM in each setting.
- .5 Record hand held tachometer readings on the Job Card.
- .6 Press and hold the HIGH IDLE button and ensure that the engine speed increases to 1400 RPM.
- .7 Record hand held tachometer reading on the Job Card.
- .8 Set the RUN/STOP/REMOTE switch of the engine to be tested to the REMOTE position.
- .9 Ensure that the park brake is fully applied, wheels are chocked and the transmission is engaged in Forward or Reverse.
- .10 From inside the crew cab, start the traction engine.
- .11 Record the hand held tachometer reading for the idle position on the Job Card.
- .12 Move the controller gradually through each throttle notch. Using the hand held tachometer, measure and record the engine speed at each throttle notch on the Job Card. Ensure engine speeds are within specifications (Page 3). Adjust/repair if speeds are not within tolerance.
- .13 Bring the controller back to the idle position and ensure transmission oil temperature has not exceeded 120<sup>0</sup>C. If the transmission oil temperature has exceeded 120<sup>0</sup>C, remain in idle until it falls within 80<sup>0</sup>C and 120<sup>0</sup>C.
- .14 Repeat items 3.11 to 3.13 using the engine control panel tachometer.
- .15 Quickly move the controller to the 3/3 (FULL) throttle position. Once the engine speed is stable, using the hand held tachometer, measure and record the engine stall speed on the Job Card. If the engine speed continues to slowly increase, after 15 seconds, the transmission oil temperature may have increased above 120<sup>0</sup>C. Move the controller back to the idle position.
- .16 Repeat item 3.15 once more.
- .17 Quickly move the controller to the 3/3 (FULL) throttle position and start the stopwatch.
- .18 When the engine speed reaches 90% stall speed, stop the stop watch. Return the controller to the idle position.
- .19 Record the time taken to reach 90% stall speed on the Job Card.
- .20 For Traction Engine and Transmission troubleshooting, refer to Section G, Tables G-9 and G-10, of the Adtranz Maintenance Manual.
- .21 Repair any defects located. Record repairs carried out on the Job Card and forward the Job Card to the Service Supervisor.



**SPECIFICATIONS**

<b>IDLE SPEED</b> (ADTRANZ Operation Manual Section 9)	=	650 - 700 RPM
<b>HIGH IDLE</b> (ADTRANZ Operating Manual Section 9)	=	1400 RPM $\pm$ 50 RPM
<b>1/3 THROTTLE</b> (ADTRANZ Operating Manual Section 9)	=	1100 RPM $\pm$ 50 RPM
<b>2/3 THROTTLE</b> (ADTRANZ Operating Manual Section 9)	=	1500 RPM $\pm$ 50 RPM
<b>ENGINE STALL SPEED (3/3 THROTTLE)</b> (ADTRANZ Operating Manual Section 9)	=	1850 - 1950 RPM
<b>90% ENGINE STALL SPEED</b>	=	1665 - 1755 RPM
<b>TIME TO REACH 90% STALL SPEED</b> (Cummins Proc.05-32)	=	8 - 12 secs
<b>MAX. SPEED (NO-LOAD)</b> (ADTRANZ Operating Manual Section 9 and Maintenance Manual Section S)	=	2050 - 2100 RPM

**CONTROLLED  
COPY****XPLORER/ENDEAVOUR  
SERVICE CENTRE**

# XPLOER/ENDEAVOUR JOB CARD

**EWI020 - Traction Engine Stall Test**

**Job No.:**

**Date:**

**Car No.:**

**XPLOER 25**

**ENDEAVOUR 28**

## OBSERVE ALL SAFETY REQUIREMENTS

<b>Item No.</b>	<b>Description</b>	<b>Operator's Initials</b>
-----------------	--------------------	----------------------------

**Stall Test Engine** ..... *Stall test traction engine as per EWI020..* .....

**Tachometer Readings**

**Hand Held Tacho**

**Control Panel Tacho**

**3.5**    1/3                      \_\_\_\_\_ RPM

          2/3                      \_\_\_\_\_ RPM

          3/3                      \_\_\_\_\_ RPM

**3.7**    High Idle                \_\_\_\_\_ RPM

**3.11/12/14** Idle                      \_\_\_\_\_ RPM                      \_\_\_\_\_ RPM

          1/3                      \_\_\_\_\_ RPM                      \_\_\_\_\_ RPM

          2/3                      \_\_\_\_\_ RPM                      \_\_\_\_\_ RPM

          3/3                      \_\_\_\_\_ RPM                      \_\_\_\_\_ RPM

**3.15**    Idle to 3/3                      \_\_\_\_\_ RPM

**3.16**    Idle to 3/3                      \_\_\_\_\_ RPM

Time to reach 90%

**3.19**    stall RPM                      \_\_\_\_\_ secs

DEFECTS LOCATED	ACTION

**The above repairs are certified as having been carried out:**

Employee No.	Subject Code	Activity Code	Job Time	Planned OOC Code	Planned OOC Time	Signature

**Repairs have been encoded and entered into M.I.S.**

**Supervising Officer:**



# PASSENGER FLEET MAINTENANCE

## XPLORER - ENDEAVOUR SERVICE CENTRE

Date: 18/04/08

### STANDARD OPERATING PROCEDURE

### WORK INSTRUCTION NUMBER: EWI 055

EWI 055

Revision: 3.0

**EWI TITLE:**

## TRACTION ENGINE 7500 HOUR SERVICE

**1.0 Purpose:**

The purpose of this instruction is to detail the procedure for carrying out a 7500 hr service on a KTA19-R engine while fitted to a car in place of removing it for a Top Overhaul.

**2.0 Scope:**

This procedure is applicable to XPLORER/Endeavour KTA19-R traction engines and should be carried out 7500 hours after engine enters service following a General Overhaul.

**3.0 References:**

- Cummins K19 troubleshooting and repair manual
- EWI 000 Requirements for working on trains
- EWI 018
- EWI 020
- DSS 5131
- EWI 055 Jobcard

**History**

Version	Date	Reason for change	Proposed by	Approved by
2.0	Apr 05			
3.0	Apr 08	Format Change / Reviewed		

**NOTE:** DESTROY ALL PREVIOUS ISSUES OF WORK INSTRUCTION NO. EWI 055  
Uncontrolled when PRINTED

**Prepared By:**

Engineer  
XPLORER/Endeavour Service Centre

**Checked By:**

**Authorised By:**

  
5/5/08  
Fleet Manager  
XPLORER/Endeavour Service Centre

**WORK INSTRUCTION NUMBER: EWI 055**

**Date: 18/04/08**

**Revision: 3.0**

**4.0 PARTS AND TOOLS REQUIRED:**

Item	Stock Code
5.1 Injector adjustment kit.	
5.2 Feeler gauges inlet 0.36mm(0.014inch) and exhaust 0.69mm(0.027inch).	
5.3 Calibrated Tension wrench.	
5.4 Rocker cover gaskets (6 off).	
5.5 Cummins Tool ST-669.	
5.6 Turbo inlet crossover to aftercooler gasket.	
5.7 Turbocharger unit. Non STC engines, Cummins part number 3801689RX. STC engines Cummins part number 3803474RX.	1569490 1810399
5.8 Turbo boost hose.	
5.9 Engine oil.	
5.10 Traction engine oil filters	001329077
5.11 Traction engine fuel filters	001329168
5.12 Traction engine coolant filters	001081470
5.13 Starter motor	001569136
5.14 Starter motor dust seal	001032036
5.15 Injectors (6 off), non STC STC	
5.16 STC valve tool	
5.17 Recon fuel pump	

**5.0 PROCEDURE:**

**6.1 PREPARATION:**

**SAFETY: TRAIN MUST BE SECURED AT ALL TIMES. Refer to EW1000. SOME TESTS ARE CARRIED OUT WHILE ENGINE IS RUNNING, ENSURE PERSONS AND OBJECTS ARE KEPT CLEAR FROM MOVING (ROTATING) EQUIPMENT.**

6.1.1 All adjustment procedures and component changes should be performed on a cold engine.

6.1.2 Engine to be cleaned and free from dirt and debris.

6.1.3 Disassembly, component changeouts, reassembly and tests are to be carried out as per Cummins procedures in K19 troubleshooting and repair manual unless stated otherwise.

**6.2 CHECK ENGINE HISTORY (To be provided by XESC)**

6.2.1 Review engine history on MIMs and record last overhaul type, date performed and hours run since last overhaul. If engine is less than 250 days overdue 7500hr service/overhaul see 6.3.10. If engine is more than 250 days overdue 7500hr service/overhaul defit engine for a General Overhaul in accordance with DSS5140.

6.2.2 Review traction engine control panel overhaul schedule in MIMs.

6.2.3 Review engine history on MIMs and identify any of the following in the last 6 months.

Review	Action
Low oil pressure/loss of oil	Filter particle analysis, Bore inspection
Reports of low power	Review data logger downloads
Reports of overheating	Examine radiator cleanliness, analyse coolant. Test as per 6.3.11
K19 starter motor renewal	If less than 1500 hours in service, re-use
K19 Injector or Fuel Pump renewal	If less than 1500 hours in service, re-use
K19 Turbo renewal	If less than 1500 hours in service, re-use

6.2.4 Review engine oil analysis history on Faults database and identify any anomalies since last overhaul/repair.

**WORK INSTRUCTION NUMBER: EWI 055****Date: 18/04/08****Revision: 3.0****6.3 PRE-INSPECTION TESTS (To be carried out by Cummins and XESC staff)**

- 6.3.1 (XESC) Record engine hours from control panel on job card.
- 6.3.2 (XESC) Inspect engine for any signs of damage. Record any defects located on job card. Assess any damage located and determine whether to continue 7500hr service or defit engine for a Top Overhaul in accordance with DSS5131.
- 6.3.3 (XESC) Inspect wiring harness and starter motor cables for any damage or signs of deterioration. Record any defects located on job card. Assess any damage located and determine whether to continue 7500hr service or defit engine for a Top Overhaul in accordance with DSS5131.
- 6.3.4 (XESC) Inspect fire protection equipment, including "fire wire", hoses, nozzles and dust caps for any damage or signs of deterioration as per item 61 of CFE5106. Record any defects located on job card.
- 6.3.5 (XESC) While engine running, check all coolant lines, fuel lines oil lines and fuel pump for evidence of leaks. Record any defects located on job card. Assess any leaks located and determine whether to continue 7500hr service or defit engine for a Top Overhaul in accordance with DSS5131.
- 6.3.6 (XESC) Ensure correct operation of the following engine protection devices and set points:
- Water temperature - turn off radiators, run engine and note engine temperature at Pre-High Water Temp. alarm and High Water Temp. alarm. Ensure engine returns to idle at 94°C and shuts down at 98°C.
  - Oil pressure in accordance with EWI024. Note: Oil pressures required at item 6.3.12
- 6.3.7 (XESC) Ensure correct operation of Ryton governor by energising HBRT. Investigate cause if non-operational.
- 6.3.8 (XESC) Ensure correct operation of the Auxiliary start solenoid.
- 6.3.9 (XESC) Carry out engine stall test in accordance with EWI020 Traction Engine Stall Test. ***WARNING: Ensure vehicle is attached to at least one other car with brakes applied and all traction engines other than the test engine isolated.*** (Remember, do not hold at full throttle for more than 15 seconds or transmission oil will overheat) If engine fails stall test, investigate for cause of low power, e.g. turbo intake hose. Assess any defects located and determine whether to continue 7500hr service or defit engine for a Top Overhaul in accordance with DSS5131.
- 6.3.10 (Cummins) If engine is overdue 7500hour service or overhaul, carry out a valve clearance measurement to identify any valve seat recession. Record values on job card. Assess valve clearance measurements and determine whether to continue 7500hr service or defit engine for a Top Overhaul in accordance with DSS5131.
- 6.3.11 (Cummins or XESC) Check operation of water pump as follows:
- a) Check that the traction engine water pump is operating correctly by checking the pressure in the coolant system at the quick connect test point on the pressure switch side of the engine. If the test point has not been fitted, see 6.5.2
  - b) Connect the coolant pressure gauge to the test point, running the gauge to the opposite side of the car. Check that the following pressures are achieved. Record values on job card.

Throttle	Coolant Pressure	Tolerance
Idle	To be supplied by Cummins	High idle max 241 kPa
Rated RPM	Minimum 103 kPa	To be supplied by Cummins

**WORK INSTRUCTION NUMBER: EWI 055****Date: 18/04/08****Revision: 3.0**

If pressures achieved are significantly lower than expected, this indicates a defective water pump, traction engine will require a water pump change.

- 6.3.12 **(Cummins)** Measure and record fuel pressures if fuel pressure is low or pump is leaking, change fuel pump.
- 6.3.13 **(Cummins)** Measure and record turbo boost pressures, oil pressures, and crankcase gas pressures (blowby). Record values on job card. If engine fails test, do not continue 7500 hour service, traction engine will require a Top Overhaul in accordance with DSS5131.

Throttle	Turbo Boost Pressure	Oil Pressure	Blowby
Idle	To be supplied by Cummins	138 to 483 kPa	To be supplied by Cummins
High Idle	To be supplied by Cummins	345 to 483 kPa	To be supplied by Cummins
At Rated RPM	To be supplied by Cummins	To be supplied by Cummins	Max 203 mmHg

**ISOLATE START CIRCUIT OF THE TRACTION ENGINE TO BE SERVICED PRIOR TO DISASSEMBLY****6.4 DISASSEMBLY (To be carried out by Cummins with the assistance of XESC staff)**

- 6.4.1 Remove exhaust pipe from turbo to muffler. If required, remove the air intake between turbo inlet and flexible mount.
- 6.4.2 Remove turbo boost air hose and crossover to aftercooler and discard gasket. Take care as to prevent entry of foreign objects into aftercooler.
- 6.4.3 Remove brackets securing oil supply line to rocker covers four(4) and six(6).
- 6.4.4 Remove all rocker covers (and coolant rail securing strap) and discard used gaskets.
- 6.4.5 **(XESC)** Drain oil.

**6.5 INSPECTION**

- 6.5.1 Check condition of coolant hoses. If any coolant hoses have become hard and brittle or show signs of damage renew hoses. Ensure coolant system is drained as required before removing coolant hoses.
- 6.5.2 Check that coolant system test point fitted to engine by coolant pressure test switch. Fit test point if not fitted.

**6.6 COMPONENT CHANGE OUT**

- 6.6.1 Check that crankcase breathers have been replaced with Cummins type PN3281592. Carry out modification to fit new type if not fitted, or change new type breathers for new.
- 6.6.2 Change starter motor and felt seal. If the felt seal is damaged change rear bell housing seal on engine. To change rear seal without engine removed from car, seal must be carefully cut at one of the flexible sections to allow fitment.
- 6.6.3 Change turbo and inspect exhaust riser for cracks internally and externally.
- 6.6.4 Record valve clearances on job card. Adjust valve clearance if necessary as per per Cummins procedure in K19 troubleshooting and repair manual and EWI018.
- 6.6.5 Change injectors and adjust injector travel as per as per Cummins procedure in K19 troubleshooting and repair manual and EWI018. Using engine barring device rotate accessory drive flange to correct mark as outlined on injector and valve adjustment sequence chart.

WORK INSTRUCTION NUMBER: EWI 055

Date: 18/04/08

Revision: 3.0

6.6.6 Change STC valve where fitted.

6.6.7 Change fuel pump.

## 6.7 REASSEMBLY AND TESTING (To be carried out by Cummins with the assistance of XESC staff)

**NOTE: ALL GASKETS AND SEALS REMOVED TO BE RENEWED DURING RE-ASSEMBLY.**

6.7.1 Clean rocker covers and refit using new gaskets. Ensure coolant rail retaining strap is correctly fitted to rocker cover six(6) and oil supply line brackets are fitted to rocker covers four(4) and six(6). Torque all rocker cover bolts to:  
45nm (35ftlb).

6.7.2 Fit new turbo boost hose and fit air crossover with new gasket and torque to:  
40 nm (30ftlb).

6.7.3 Refit exhaust pipe to muffler and turbo charger. Ensure band clamps are securely located.

6.7.4 (XESC) Renew all wet filters and air intake filters.

6.7.5 (XESC) Refill engine with new oil.

6.7.6 (XESC) Refill coolant system if required.

6.7.7 At engine start panel, start engine in "run" position and bring to normal operating temperature. Inspect for the following and rectify any defects located:

- Oil leaks.
- Turbo Boost Air and Exhaust Leaks.
- Coolant Leaks.

6.7.8 Recheck fluid levels. (XESC) Top up if required.

6.7.9 (Cummins) Carry out STC valve test.

6.7.10 (Cummins) Test engine overspeed protection.

6.7.11 (Cummins) Measure and record fuel pump pressures. Record values on job card.

Throttle	Fuel Pressure
Idle	To be supplied by Cummins
High Idle	To be supplied by Cummins
At Rated RPM	945 kPa to 1050 kPa

6.7.12 (XESC) Carry out stall test as per EWI020. **WARNING: Ensure vehicle is attached to at least one other car with brakes applied and all traction engines other than the test engine isolated.** (Remember, do not hold at full throttle for more than 15 seconds or transmission oil will overheat)

6.7.13 (XESC) Stop engine, re-set engine start panel and place engine selector switch in the remote position.

## 7.0 Documentation:

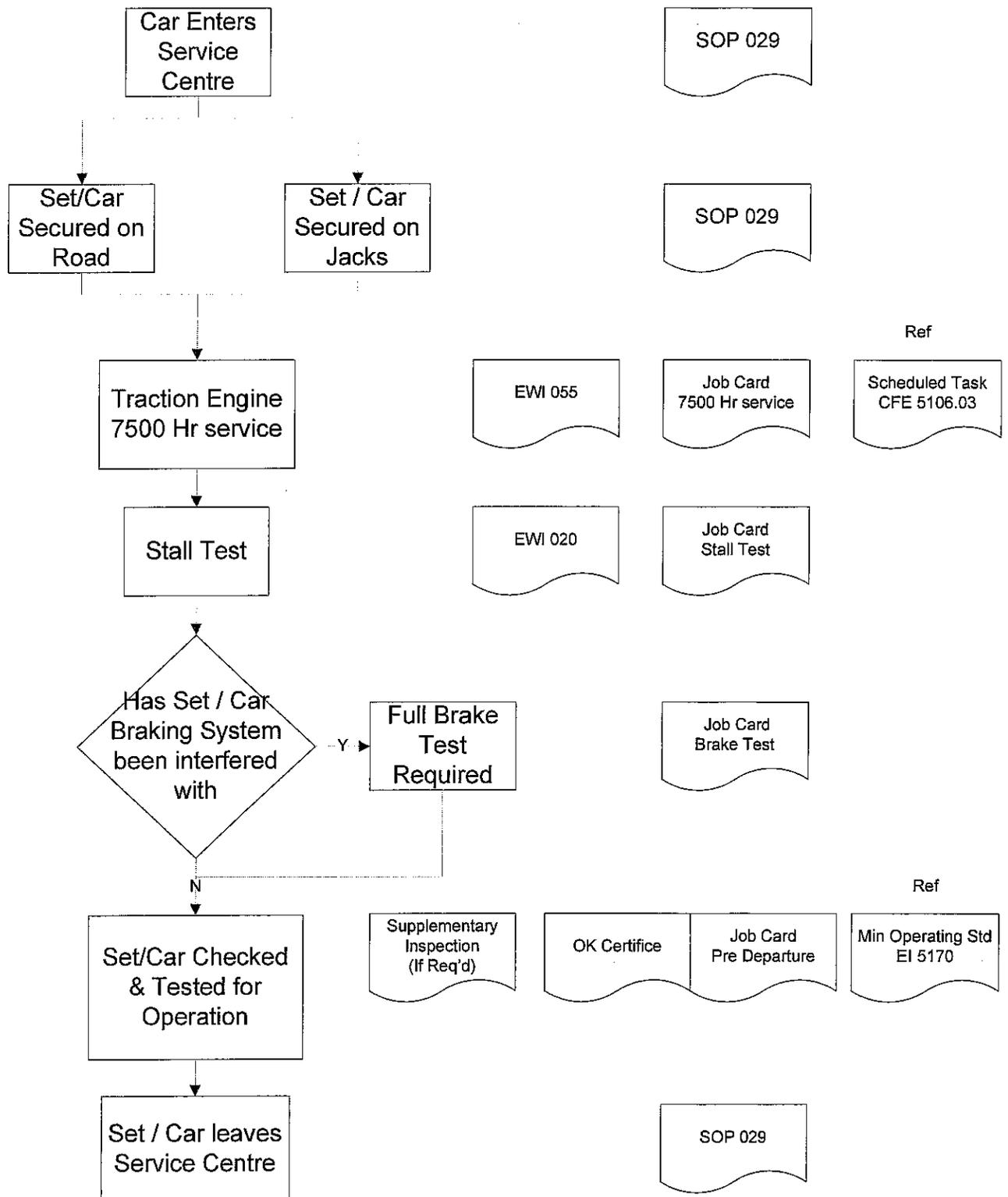
EWI055 Jobcard

**WORK INSTRUCTION NUMBER: EWI 055**

**Date: 18/04/08**

**Revision: 3.0**

## Documentation Required for Servicing Set / Car – EWI 055



**EQUIPMENT TRIAL TR0017**

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14/07/2003  
ISSUE 2

HAZARD CODE:

CONFIGURATION CODE:

**TITLE:** REPLACEMENT OF TRACTION ENGINE TOP OVERHAUL WITH 7500 SERVICE

**CARS or EQUIPMENT AFFECTED:** SEE ATTACHED LIST - Nominated cars and dates

**PURPOSE:**

- Reduce State Rail MPM costs;
- Improve Xplorer and Endeavour fleet availability;
- Make spare traction engines available for OOC changes or poorly performing engines as required during the summer period;
- Maintain a reliable fleet of Xplorer and Endeavour Railcars

It has been established that certain traction engines have "missed" top overhaul and remained in service without failing, from general overhaul to general overhaul. Following discussions with the engine manufacturer and engine overhauler, it is proposed to carry out a trial to review conditions and any issues raised for running to general overhaul with 7500 hour service carried out on traction engines in situ on the cars.

**SCOPE:** For the nominated cars, the next traction engine Top Overhaul will not be carried out, instead a 7500 hour service will be carried out on the car. Trial will affect traction engine maintenance only.

**MANAGEMENT TO BE ADVISED:** PFM General Manager, Group Operations Manager (Diesel Fleet), Maintenance Managers (XESC and ESC) to be advised.

**REFERENCE DOCUMENTS:** List of nominated cars and dates; EW1055 Traction Engine 7500 Hour Service; Strip down reports for Traction Engines 33900042 and 33900099

**TRIAL PLAN:**

1. 23/4/03 Review content of Top Overhaul with QTS and OEM (Cummins).
2. 29/4-20/5/03 Carry out strip down of Traction engines that have inadvertently missed top overhaul.
3. From 11/7/03 For the nominated cars at the dates shown, carry out a 7500 hour service in accordance with EW1055, record all relevant measurements and check condition of components, etc.
4. To 2004/2005 Monitor performance of trial engines (as per weekly and intermediate inspections, driver reports, oil sampling process) until general overhaul due date.
5. 2004/2005 Carry out general overhaul on engines, when engines fall due for overhaul. At overhaul, investigate condition of engine components.

**SAFETY IMPLICATIONS:**

Risk	Cause	Consequence	Severity/Likelihood	Comment/Mitigation
Engine failure	Excessive wear on components	Seized engine. Damage to other car components. In-service delays.	Medium/Low	Adjustable items will be checked, key components renewed. Evidence from engines inspected suggests wear likely to be acceptable. Engines will continue to receive scheduled maintenance including oil analysis, weekly inspections, intermediate inspections (oil and filter changes).
Injury during in situ work	Difficult working conditions	Lost time injury	Medium/Low	1500 hours services currently carried out in situ without problems. SWMs to be developed if required. Risk of injury may be less than removing and refitting engine.

**Person Responsible for Trial:** Trevor Weir

**Completion and Review Date:** Approximately end 2004, when first of the nominated traction engines become due for General Overhaul.

Prepared by: Kate Marjoribanks

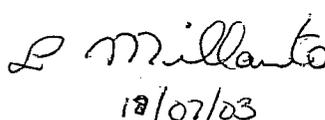
**QUALITY and TECHNICAL SUPPORT**

Authorised by: B. MAIR

Approved by: L. MILLANTA



18/7/03



18/07/03

Manager Quality and Technical Support

General Manager Passenger Fleet Maintenance

**EQUIPMENT TRIAL TR0017**

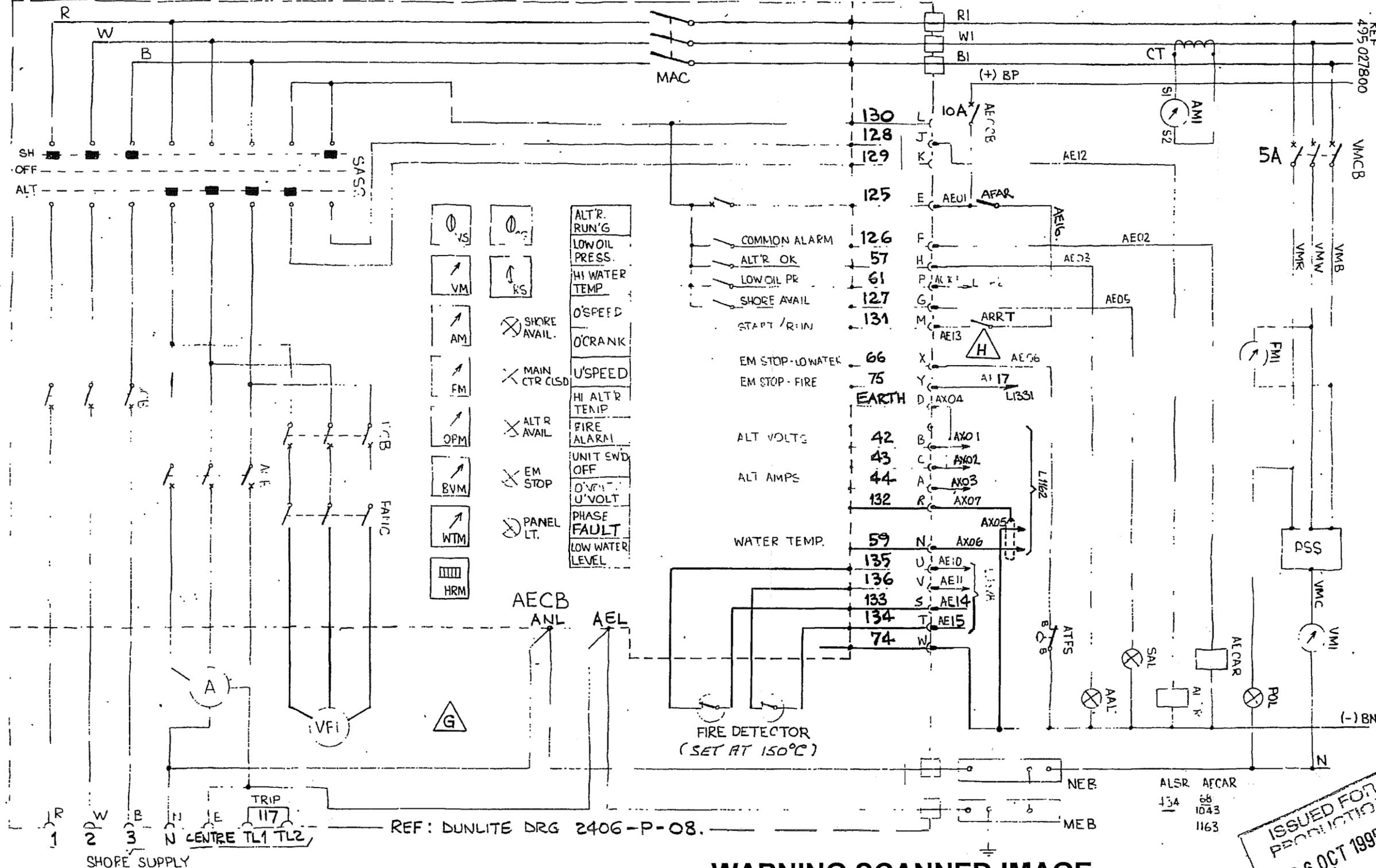
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14/07/2003

ISSUE 2

**List of nominated cars and dates:**

Car	Engine	Date due top overhaul	Work Order	STC engine	Date planned 7500 hour service	Date due general overhaul
2804	33900088	31/12/2002	163297		28/07/2003	15/05/2004
2856	33900086	3/06/2003	166378		4/08/2003	23/09/2004
2809	33900024	23/06/2003	166882		11/08/2003	9/10/2004
2521	33900027	25/06/2003		STC engine	18/08/2003	24/11/2005
2517	33900076	13/09/2003			13/09/2003	28/07/2005
2802	33900068	7/10/2003			7/10/2003	19/01/2005
2512	33900026	14/11/2003			14/11/2003	27/09/2005
2528	33900069	14/12/2003		STC engine	14/12/2003	28/10/2005
2511	33900087	26/01/2004		STC engine	26/01/2004	10/12/2005
2860	33900053	8/01/2004			8/01/2004	22/04/2005
2812	33900101	31/01/2004			31/01/2004	15/05/2005
2863	33900050	4/02/2004			4/02/2004	19/05/2005

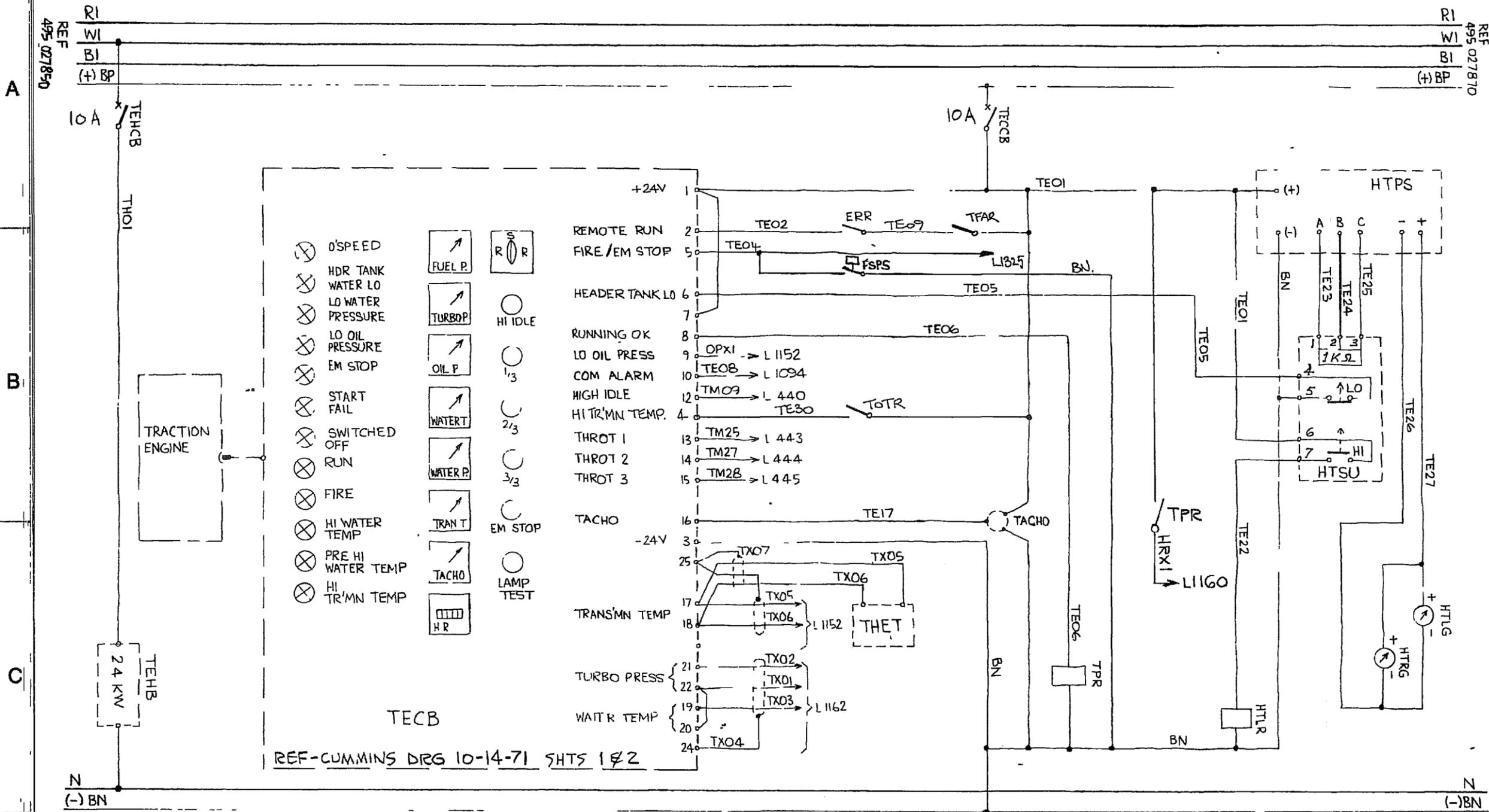


0	H   882-26063
9	25/10/95 H.S.
8	LINE 26 ARRT WAS ARR.
7	G   882-26032
6	11/08/95 H.S.
5	ZONE C2
4	VF2 DELETED
3	F   D67B7
2	DATE: 27th Jan 1994 K.C.
1	Zone B4 & C4
0	Wire N° 75 was 66
9	Wire N° 66 was 75
8	Wire N° 132 was 133
7	Wire N° 133 was 132
6	Pin "Q" Deleted.
5	Wire AX05 Revised
4	Fire Detector wiring revised.
3	FIRE DETECTOR SETTING ADDED
2	E   JSB 28-7-93
1	AFAR MOVED.
0	AE17 WAS AE07.
9	LINEN° 1531 1AE16 ADDED
8	D   1.3.93 AP
7	WIRE NUMBERS
6	AE14 ← AE12
5	AE15 ← AE13
4	CCT. BRKR.
3	AMPS ADDED
2	DUNLITE DRG. REF
1	& CABLE * ADD.
0	PHASE FAULT WAS
9	PHASE BALANCE
8	C   4-2-93 FR
7	FIRE DET'RS. MOD.
6	L24 TERM LETTERS
5	MOD. AE12, AE13
4	B   FR
3	GENERAL REVE
2	A ORIGINAL
1	

ISSUED FOR PRODUCTION  
26 OCT 1995

WARNING SCANNED IMAGE

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						DATE	2.10.92	CHIEF D'MAN							
						CHK'D		Electrical	Mechanical					Structural	Project
						Engineer	RB								
THIRD ANGLE PROJECTION		QTY	ASSEMBLY NUMBER	CONTRACT FIRST USED ON	DO NOT SCALE DRAWINGS, WHEN IN DOUBT ASK			BATCH 93 <b>EDMS FL0339702</b> CUSTOMER NAME AND DWG. TITLE IF REQD.		SCALE		3 or 4 SIZE DWG			



- ⊗ O'SPEED
- ⊗ HDR TANK WATER LO
- ⊗ LO WATER PRESSURE
- ⊗ LO OIL PRESSURE
- ⊗ EM STOP
- ⊗ START FAIL
- ⊗ SWITCHED OFF
- ⊗ RUN
- ⊗ FIRE
- ⊗ HI WATER TEMP
- ⊗ PRE HI WATER TEMP
- ⊗ HI TR'MN TEMP
- ↑ FUEL P.
- ↑ TURBOP
- ↑ OIL P.
- ↑ WATER T
- ↑ WATER P.
- ↑ TRAN T
- ↑ TACHO
- HR
- R S R
- HI IDLE
- 1/3
- 2/3
- 3/3
- EM STOP
- LAMP TEST

REF-CUMMINS DRG 10-14-71 SHTS 1 & 2

**WARNING SCANNED IMAGE**

BATCH 49  
EDMS FL0339706

TPR	HTLR
434	392
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	1064

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4	ABB @ SRA use to Cont. 90136
3	E/ JSB 28-7-93
2	TERMINAL A MOVED TE30 & TOTR ADDED. HTSU TERMS REVD
1	TE09, TFAR, BU & LINE NO 1325 ADDED. TE03 DELETED.
0	D 15393 AF
9	CCT BRK AMPS
8	TPR CONTACT & CUMMINS DRG REF ADD
7	C 42-93 FR
6	5 ILS & 1 P/B ADDED TX05, 6 WERE TO L1162
5	FBPS ADDED
4	B 9-11 92 FR
3	GENERAL REV'S
2	
1	A ORIGINAL

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				DATE	2-10-92	CHIEF D'MAN							
				CHK'D		Electrical	Mechanical	Structural					Project
				Engineer	dB								
THIRD ANGLE PROJECTION	QTY	ASSEMBLY NUMBER	CONTRACT FIRST USED ON	DO NOT SCALE DRAWINGS, WHEN IN DOUBT ASK				5	3 or 4 SIZE DWG	6	P3		