ESR 0556

OVERHAUL OF ALCO FUEL INJECTOR PUMP & NOZZLE

Version 1.0
Issued June 2010
Document control

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Summary of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(RSS 0556) 1.0</td>
<td>August 2007</td>
<td>Based on TRS 1326</td>
</tr>
<tr>
<td>(ESR 0556) 1.0</td>
<td>June 2010</td>
<td>Reformatted and renumbered ESR 0556</td>
</tr>
</tbody>
</table>

Summary of changes from previous version

NOTE – If the final document is small enough for the ‘Contents’ and ‘Document control’ to fit on one page remove the page break between the existing pages 2 and 3. HOWEVER if the ‘Document control’ page carries over to a second page separate pages must be used for ‘Contents’ and ‘Document control’

Contents

1. Scope...............................................................................................................................................4
2. General ............................................................................................................................................4
3. Disassembly......................................................................................................................................4
4. Replacement parts ............................................................................................................................7
5. Cleaning ...........................................................................................................................................7
6. Inspection.........................................................................................................................................7
7. Reconditioning Procedures .............................................................................................................9
8. Assembly .........................................................................................................................................10
9. Testing ..........................................................................................................................................10

9.1 Nozzle and holder .......................................................................................................................10
  9.1.1 Nozzle valve lift: ....................................................................................................................10
  9.1.2 Nozzle leak-off rate: ............................................................................................................10
  9.1.3 Holder leak back test: ...........................................................................................................10
  9.1.4 Spray pattern: .......................................................................................................................10
  9.1.5 Opening pressure: ................................................................................................................10
  9.1.6 Tightness of valve seat: .........................................................................................................11
  9.1.7 Nozzle chatter: .......................................................................................................................11
  9.1.8 Nozzle dribble test: ..............................................................................................................11
9.2 Fuel Injector pump ......................................................................................................................11
  9.2.1 Delivery valve seat pressure test: .........................................................................................11
9.2.2 Barrel seating face pressure test: ................................................................. 11
9.2.3 Port closure (spill timing) test: ................................................................. 11

10 Performance ..................................................................................................... 11
  10.1 Expected life .................................................................................................. 11
  10.2 Delivery rate ................................................................................................. 11
  10.3 Test equipment .............................................................................................. 12
  10.4 Recalibration ................................................................................................. 12
  10.5 Calibration fluid quality ................................................................................ 12

11 Identification .................................................................................................... 12

12 Storage ............................................................................................................... 12

13 Reference standards.......................................................................................... 13
  13.1 RailCorp standards ....................................................................................... 13
  13.2 Alco standards ............................................................................................ 13
  13.3 Other standards ........................................................................................... 13
1 Scope

This standard sets out the minimum requirements, procedures and tests for the overhaul of fuel injector pumps, nozzles and holders.

2 General

This standard is to be used in conjunction with Alco Maintenance Instruction MI 11243, Alco Spare Parts Manuals DRP 14428, 14474 and 15695 and Bryce Service Test Specification FCQAB for series pumps and provides clarification, amplification and additional requirements where necessary.

Additional components have been specified for mandatory replacement to provide greater reliability, more cost effective maintenance and to provide the required operating life.

Reconditioned fuel injection pump, nozzle and holder assemblies must satisfy all nominated tests and performance requirements. Injector nozzle and holder assemblies are expected to operate reliably for a minimum period of two and a half years (Mini Maintenance Period) and fuel injection pumps are expected to operate reliably for a period of five years (Component Changeout Period).

The 15mm fuel injector pump Type APF ICQ-150T-4016, (white paint marking) is for use on 48 class locomotives.

The short cap nut nozzle and holder (Type AKK-242T-5700B) and long cap nut nozzle and holder (Type AKK-242T-4342A) may be used with the 15 mm (Alco Series). If the long cap nut nozzle and holder assembly is not suitable for re-use it is to be replaced with the short cap nut nozzle and holder assembly.

Diagram 1 is a cross sectional view of an Alco fuel injection pump and Diagram 2 is a cross sectional view of the short and long cap nut nozzle and holder.

3 Disassembly

The fuel injection pump, nozzle and holder must be disassembled in accordance with Alco MI 11243.

Reusable parts from the same injector nozzle and pump assembly must be kept together for reassembly.
SHORT CAP NUT NOZZLE AND HOLDER TYPE AKK (242T5700B)

LONG CAP NUT NOZZLE AND HOLDER TYPE AKK (242T4342A)

DIAGRAM 2
4 Replacement parts

All replacement parts must be genuine Alco unless otherwise specified or approved by RailCorp. Replacement parts must be the latest revision.

It is mandatory to replace the following component parts:

**Nozzle and holder – (short and long cap nut)**

- "O" ring, nozzle holder to cylinder head Alco P/N 2231453 1 off
- Nozzle OMT P/N SF145TI829 1 off
  or Bryce P/N PHN145T35K648

**Pump**

- Gasket "O" ring, nut to housing Alco P/N 2321326-1 1 off
- Gasket "O" ring, nut to delivery valve Alco P/N 2321327-1 1 off
- Gasket, nitrile "O" ring to nut Alco P/N 2155085-1 1 off
- Gasket, inspection window cover Alco P/N 2322083 1 off
- Gasket for screw Alco P/N 532209A 2 off

The replacement fuel injection nozzle must be OMT P/N SF145T1829 or Bryce P/N PHN145T35K648.

All other component parts are to be replaced on the basis of condition as specified in Alco MI 11243.

5 Cleaning

Parts are to be washed in distillate fuel oil.

Reusable parts are to be ultrasonically cleaned using a solvent such as Chemisonic, Ardrox 551 or equivalent. Parts awaiting assembly or for storage are to be treated with a suitable rust preventative or injector testing rust proof oil (calibration fluid).

Cleaning containers should have a raised base so that parts are kept above contaminates which settle in the bottom of the tank.

Cleaning fluids are to be chemically monitored for contamination and dilution every month to ensure that cleaning is effective.

6 Inspection

All non mandatory replacement parts are to be inspected and maintained in accordance with Alco MI 11243. These parts are only to be reused if condition is satisfactory.

The following component parts may be reused on the basis of condition.

**Nozzle and holder**

- Short cap nut
  - Nozzle and holder complete Alco P/N 22300128 1 off
• Body, nozzle holder Alco P/N 2231278 1 off
• Seat, lower spring Alco P/N 22312610 1 off
• Spacer, valve stop Alco P/N 2231402 1 off
• Nut, cap Alco P/N 22313310 1 off
• Spacer Alco P/N 2231391 1 off

Long cap nut
• Nozzle and holder complete Alco P/N 22300115-1 1 off
• Body, nozzle holder Alco P/N 2231277-1 1 off
• Seat, upper spring Alco P/N 2231267 1 off
• Seat, lower spring Alco P/N 2231268 1 off
• Spacer Alco P/N 2231391 1 off
• Nut, cap Alco P/N 2231339 1 off
• Spacer Alco P/N 2231391 1 off

Short and long cap nut
• Shim, upper spring seat .002 in. thick Alco P/N 2231411
• Shim, upper spring seat .004 in. thick Alco P/N 2231412
• Shim, upper spring seat .008 in. thick Alco P/N 2231413
• Shim, upper spring seat .020 in. thick Alco P/N 2231414
• Shim, upper spring seat .042 in. thick Alco P/N 2231415
• Spring, pressure adjusting Alco P/N 2231295 1 off

Pump Fuel Injection
• Pump fuel injection complete Alco P/N 2320016 1 off
• Plunger and Barrel Alco P/N 2321267 1 off
• Screw, rack pointer Alco P/N 2321325 2 off
• Screw, inspection window cover Alco P/N 2322104 2 off
• Housing, pump Alco P/N 2321338 1 off
• Pin, locating, plunger and barrel Alco P/N 2321383-1 1 off
• Bushing, control rack Alco P/N 2322164-1 2 off
• Sleeve, control Alco P/N 2321445-1 1 off
• Seat, plunger spring, upper Alco P/N 2321316 1 off
• Seat, plunger spring, lower Alco P/N 2321304 1 off
• Spring, plunger Alco P/N 2322094-1 1 off
• Washer, plunger spring Alco P/N 2322384 1 off
• Cup, guide Alco P/N 2321294-1 1 off
• Ring, snap, guide cup Alco P/N 2321464 1 off
• Delivery valve Alco P/N 23213611 1 off
• Holder, delivery valve Alco P/N 2321349-1 1 off
7 Reconditioning Procedures

The lapping procedure and refinishing of lapping plates are to be in accordance with Alco MI 11243 or an equivalent machine lapping standard. The lapped surfaces must be held to a flatness of 2.5 light bands maximum and 4 RMS finish.

It will not be necessary to refinish the nozzle valve (seat and shank), nozzle body seat and plunger barrel end seat as these are mandatory replacement parts. Any new replacement parts will not require refinishing.

The following re-used parts will require lapping to ensure a good seal against fuel pressure; delivery valve body seats, delivery valve holder seat, nozzle holder seat and stop valve spacer. The nominated parts are to be lapped using a medium grade lapping compound such as Gen CAV nozzle lapping paste, medium grade, P/N 7044-981A or equivalent.
If lapping plates are used they must be rotated daily, refinished or qualified on the job weekly and qualified by optical calibration flatness test every six months. Records are to be maintained for the qualification of lapping plates by optical test.

The lapping plate set shall consist of three lapping plates 200x200x25mm in a covered wooden box. The lapping surface of each plate is grooved into 3mm squares separated by 4mm grooves.

8 Assembly

The fuel injection nozzle, holder and pump are to be assembled in accordance with Alco MI 11243. The injector nozzle cap nut must be tightened to 350 to 400 Nm (250 to 260 ft.lb) (short cap nut) and 270 Nm (200 ft.lb) (long cap nut) using a calibrated tension wrench.

9 Testing

The fuel injector pump, nozzle and holder are to be tested in accordance with Alco MI 11243.

The nozzle, holder and fuel injection pump are to be tested with calibration fluid.

The fuel injection pump, nozzle and holder must satisfy the following tests:

9.1 Nozzle and holder

9.1.1 Nozzle valve lift:

The nozzle valve lift must be checked in accordance with the procedure in Alco MI 11243. The nozzle lift condemning limits are to be in accordance with the OEM's specification.

9.1.2 Nozzle leak-off rate:

The nozzle is to be tested on the nozzle leak off fixture. It must not take more than 19 seconds for the pressure to drop from 24 130kPa (3500psi) to 6900kPa (1000psi). It is essential that 2.72mm (0.107 inch) x 304.8mm (12 inch) tubing is used for this test.

9.1.3 Holder leak back test:

Assemble injector with dummy nozzle and then apply a pressure of 26 900 to 27 900 kPa (3900 to 4050 psi) and hold this pressure for a period of 30 seconds. Ensure that there is no pressure drop. If a pressure drop occurs this will indicate that there is an internal leak in the body. The injector must then be disassembled for inspection to determine the cause of the leak.

9.1.4 Spray pattern:

Calibration fluid must discharge from all nozzle holes and the spray pattern should be uniform.

9.1.5 Opening pressure:

The opening pressure must be greater than 26 900kPa (3900psi) and less than 27 900kPa (4050psi).
9.1.6 **Tightness of valve seat:**
Test that the valve seat is not leaking. Hold a pressure of 690kPa (100psi) below opening pressure on the nozzle and holder for a period of 10 seconds and check that no drops form at the tip of the nozzle.

9.1.7 **Nozzle chatter:**
Ensure the needle valve is free. The nozzle is to be tested on the nozzle leak off fixture.

9.1.8 **Nozzle dribble test:**
Wipe the bottom of the nozzle clean of all moisture. After two quick sharp pumps, check the bottom of the nozzle for any wetness. If wetness is detected the nozzle must not be used.

9.2 **Fuel Injector pump**

9.2.1 **Delivery valve seat pressure test:**
The injector fuel pump is to be pressure tested for correct sealing of the delivery valve seat in accordance with Bryce Service Test Specification FCQAB for series pumps. A low pressure air supply of 3.4 to 4.5 bar (50 to 80 psi) is required for testing.

9.2.2 **Barrel seating face pressure test:**
The injector fuel pump is to be tested for correct sealing of the barrel seating face in accordance with Bryce Service Test Specification FCQAB for series pumps. A low pressure air supply of 3.4 to 4.5 bar (50 to 80 psi) is required for this test.

9.2.3 **Port closure (spill timing) test:**
The injector fuel pump port closure is to be tested in accordance with Bryce Service Test Specification FCQAB for series pumps. Testing can be carried out with either valve and spring in position or removed in accordance with Bryce Specification FCQAB. Ensure that this test is carried out with the control rod in mid rack position. The dimension "X" from the base of the tappet to the underside of the pump flange must be between 3.4 and 3.65 mm.

10 **Performance**

10.1 **Expected life**
All reconditioned Alco injector nozzles, holders and fuel injection pumps are expected to provide reliable operation for a minimum period of;

- Nozzle and holder: 2 1/2 yrs or mini maintenance changeout period (300,000km).
- Fuel injection pump: 5 years or component changeout period (600,000km).

10.2 **Delivery rate**
The fuel injection pump delivery rates are to be tested in accordance with the pump calibration data in Alco MI 11243. Tests are to be performed at idle and full fuel
conditions on the calibrating test stand to ensure that they are within the manufacturer’s
tolerance.

Master pump and calibrating nozzle are to be used to set the delivery rates and tolerance
on the calibration stand. The pumps are to be tested in accordance with Alco MI 11243. Alternatively test equipment capable of producing test delivery rates without the use of
masters may be used with the approval of RailCorp.

The master fuel injection pump (Alco P/N 2320016-3) must have delivery rates of
between 341 and 350 cc per 300 strokes with a full fuel rack setting of 30 mm at 500 rpm
and of between 29 and 35 cc per 300 strokes with an idle rack setting of 9 mm at 175
rpm. There must be no fuel output from the fuel pump when the control rod latch is
engaged at a test speed of 500 rpm. The calibrating oil pressure must be between 140
and 205 kPa (20 and 30 psi) at a temperature between 45 and 50øC (115 and 120øF)
using fast cam flank on test cam.

10.3 Test equipment

- Pump calibrating test stand Alco P/N 2470331-5
- Nozzle leak off fixture Alco P/N 2470861
- Master calibrating nozzle Alco P/N 24786013-1
- Master calibrating tube assembly Alco P/N 2478859-1
- Master calibrating fuel pump Alco P/N 24705824
- Master pump nozzle and tube assembly Alco P/N 247084-1

10.4 Recalibration

The master nozzles, pumps and tube assemblies are to be recalibrated every year. Pressure gauges used on the pump calibration test stand are also to be recalibrated yearly. Pressure gauges used on the nozzle test stand are to be recalibrated after testing
every 100 nozzles. Pressure gauges must be tested by a NATA accredited facility. Records are to be maintained for the qualification of master nozzles, pumps, tube assemblies and gauges.

10.5 Calibration fluid quality

The calibration fluid used in the calibration test stand must be Shell Calibration Fluid B or
equivalent. It must be checked for correct viscosity every 100 operating hours. If
equipment is not available for checking viscosity the calibrating fluid must be changed
every 100 hours of operation. The calibrating fluid and filter must be changed every year
at a minimum. When the calibrating fluid is changed the test equipment system must be
thoroughly flushed to remove any dirt or foreign materials.

11 Identification

Fuel injector pumps are to be colour coded for ease of identification.

15mm fuel pumps are to be marked with "Alco" in white paint on the pump housing.

12 Storage

The nozzle, holder and fuel injection pump must be completely filled with calibration fluid
prior to storage. A suitable cap is to be applied to the nut to prevent foreign material from
entering the pump.
The nozzle, holder and pump are to be stored in an upright position in wooden holding racks. The racks must hold complete engine sets of fuel injection equipment and are to be stored in suitable metal box with a sealed lid.

Silica gel bags are to be placed in the storage box to absorb any moisture that may be present. The boxes are not to be stored in areas where there is the possibility of a high moisture exposure eg: close to doorways, areas of high draft from outside areas or in the vicinity of air conditioning systems, steam or hot water piping.

Separate storage boxes are to be provided for the nozzle and holder and fuel injection pump. The nozzle and holder and fuel injection pump are to remain inside their storage boxes until they are ready for installation into an engine. Used nozzles and holders and fuel injection pumps are not to be stored in the same box as reconditioned components at the same time.

13 Reference standards

13.1 RailCorp standards
ESR 0550  Overhaul of 48 class locomotive engine assembly

13.2 Alco standards
Alco Maintenance Instruction MI 11243,
Alco Spare Parts Manuals DRP 14428, 14474 and 15695

13.3 Other standards
Bryce Service Test Specification FCQAB for series pumps