WM/DU/93-1 PART B

P.T.C. Workshops Public Transport Corporation	PRODUCTION SERVICES DEPARTMENT	DOCUMENT WI 7301
	WORK INSTRUCTION	

Subject: RECONDITION GOVERNOR FOR "W' CLASS TRAMS

1.0 PURPOSE

The purpose of this Work Instruction is to define the processes, specifications, specialised equipment and reference information required for reconditioning General Electric Governors for "W" Class trams in compliance with the requirements of Specification No. 284, as issued 7/2/92 by Tram and Bus Fleet Support Department, with modifications specified in "System Report, Westinghouse Governor, W Class Tram", (Draft copy, August 1993).

2.0 SCOPE

This Work Instruction applies to General Electric, Governors, Type ML, for use on "W" Class trams as reconditioned at Preston Workshops.

3.0 DEFINITIONS

"W" Class Trams - Suburban electric trams whose numbers fall within the range of No. 681 to No. 1040.

Mechanical Assembly - That part of the governor which comprises the frame, frame head, piston assembly, levers, etc., but not including any electrical components.

Electrical Assembly - That part of the governor which comprises the arc chute assembly, contact finger and electrical lead.

Recondition - To strip, clean and inspect all components and reassemble and test the unit in compliance with the requirements of Specification No. 284.

4.0 RESPONSIBILITIES

Each person involved with any aspect of the reconditioning process of "W" Class tram governors, as detailed in this document, shall be responsible for adherence to its requirements.

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5.0 PROCEDURE

5.1 Strip and Clean Mechanical Assembly - Ref. Drg. R8814B

5.1.1 Collect relevant service history card from supervisor.

5.1.2 Open cover (2) and blow out dust using compressed air.

5.1.3 Remove cover hinge pin (7) and cover (2).

5.1.4 Remove screw (35) fixing cable lug (40) to contact finger (32).

5.1.5 Remove four screws (60) retaining the electrical assembly and detach the complete assembly.

5.1.6 Remove yoke adjusting pin (25).

5.1.7 Detach tension springs (30,31) from yoke (29).

5.1.8 Remove yoke (29).

5.1.9 Detach tension springs (30,31) from tension spring bar (28).

5.1.10 Remove intermediate lever (27) and tension spring bar (28).

5.1.11 Remove screws (26) retaining lever brackets (23,24).

5.1.12 Turn (two) operating spring adjusting screws (19) anti-clockwise, to reduce tension on operating spring (17).

5.1.13 Remove one of the (four) bolts (12A) retaining the mechanism base (10), and replace with a similar bolt, 75mm (3") long. (This "long" bolt is used to retain the mechanism base against operating spring tension whilst the remaining "standard" bolts are being removed).

5.1.14 Remove the remaining bolts (12A), and then remove the "long" bolt.

5.1.15 Remove the mechanism base (10) and clean off all dirt and rust.

5.1.16 Remove the piston assembly (13,14) and operating spring (17).

5.1.17 Remove (four) bolts (12) retaining the frame (1) to the frame head (9).

5.1.18 Remove the diaphragm (16) from the frame head (9).

5.1.19 Thoroughly clean all dirt and rust from the frame (1) and frame head (9).

5.1.20 Store all parts in suitable container until ready for re-assembly.

5.2. Reassemble and Paint Mechanical Assembly - Ref. Drg. R8814B

5.2.1 Inspect all parts that were removed for wear and damage.

5.2.2 Inspect condition of cover assembly (2 etc) for wear and damage.

5.2.3 Test operating spring (17) and tension springs (30) using spring test jigs P0001 and P0002. Springs conforming to specification to be painted green.

5.2.4 Discard any parts which do not comply with drawing specifications. Record details of any discarded parts on the service history card. Place all non-conforming parts in suitable container and tag with "Quarantine" tag.

5.2.5 Hand paint with black Isonel 300 varnish the frame (1), cover (2), frame head (9) and mechanism base (10).

5.2.6 Install a new diaphragm (16) in the frame head (9).

5.2.7 Fit frame (1) to frame head (9) and install (four) retaining bolts (12).

5.2.8 Tighten nuts (59) uniformly, until the space between the frame (1) and frame head (9) corresponds with the thickness of gauge no. P0003.

5.2.9 Check that piston rod (14) is a free sliding fit through guide in the mechanism base (10).

5.2.10 Install piston assembly (13,14) inside the frame (1) with the slot in piston rod (14) facing away from the air inlet on the frame head (9).

5.2.11 Install (green painted) operating spring (17).

5.2.12 Place spring adjusting ring (18) on top of operating spring (17), with slots facing upwards, and on an axis at right angles to the air inlet on the frame head (9).

5.2.13 Install the mechanism base (10), ensuring that the operating spring adjusting screws (19) locate correctly in the slots of the spring adjusting ring (18).

5.2.14 Recheck the alignment of the slot in the piston rod (14).

5.2.15 Fit the "long" bolt at one corner of the mechanism base (10) and tighten nut to pull it down onto the frame (1).

5.2.16 Install and tighten the (four) bolts (12A) retaining the mechanism base (10) on the frame (1) tighten nuts to a torque of 16 Nm (12 lbf.ft).

5.2.17 Screw in both operating spring adjusting screws (19) until the top of each screw is 19mm (3/4") above the mechanism base (10).

5.2.18 Install lever bracket assembly, ensuring that the brackets (23,24) are held rigidly to the mechanism base (10) ie. with the retaining screws (26) tightened, there must be no movement of the brackets (23,24).

5.2.19 Install intermediate lever (27) and tension spring bar (28).

5.2.20 Fit (green painted) tension springs (30,31) to tension spring bar (28).

5.2.21 Install yoke (29) and fit tension springs (30,31) to yoke.

5.2.22 Fit yoke adjusting pin (25) in "second-highest" hole of lever brackets (23,24).

5.2.23 Check lever (27) and yoke (20) for free movement.

5.3 Test Mechanical Assembly - Ref. Drg. X2251

5.3.1 Connect governor mechanical assembly to test jig P0004, with the assembly installed such that the level mechanism is at the "bottom", as shown in Drg. R8814.

5.3.2 Connect to air supply and gradually increase air pressure until yoke (29) snaps up ie. "opens". Do not allow air pressure to exceed 85 psi.

5.3.3 With the yoke (29) in the "open" condition, slowly reduce air pressure until the yoke "closes". The yoke must close when the air pressure is to 63 psi $\pm$ 3. To increase the "closing" air pressure, screw the operating spring adjusting screws (19) clockwise. Conversely, the "closing" air pressure is reduced if the screws are turned anti-clockwise. It is important that the screws are adjusted uniformly, and both protrude exactly the same height above the mechanism base (10).

5.3.4 Increase air pressure until the yoke (29) "opens". The yoke must open when the air pressure rises to 80 psi +3/-3. If it opens at a lower pressure, transfer the yoke adjusting pin (25) to the next highest hole in the lever brackets (23,24), and retest.

If the yoke is not opened within the specified air pressure range, the yoke and lever parts must be removed and checked against relevant drawings.

5.3.5 Test the governor operation through several cycles, and record the air pressure when the yoke opens and closes.

5.3.6 At the conclusion of this test, the mechanical and electrical assemblies of the governor, along with service history card, are despatched to the Electrical Section for overhaul and testing of electrical assembly. Affix "OK to Proceed" tag.

5.4 Strip & Clean Electrical Assembly - Ref. Drgs. R8521, R8814B

5.4.1 Remove (four) screws (60) and detach electrical assembly.

5.4.2 Remove screw (54) and field plates (52,53).

5.4.3 Remove arc chute (56).

5.4.4 Remove insulation plate (58).

5.4.5 Remove (two) screws (47A) fastening lower contact tip support (45).

5.4.6 Remove (two) screws (47) fastening blow-out coil terminal (49).

5.4.7 Remove blow-out coil (44).

5.4.8 Inspect connection cable (39) and fittings. Remove only if damaged.

5.4.9 Disassemble contact finger stop (33), insulation block (34), and insulation collar (38) from contact finger (32).

5.4.10 Use wire brush to clean contact finger (32), and lower contact tip support.

5.4.11 Remove and discard contact tips from contact finger (32) and lower contact tip support (45).

5.4.12 Store all parts in suitable container until ready for assembly.

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5.5 Reassemble Electrical Assembly - Ref. Drgs. R8521, R8814B

5.5.1 Inspect all parts that were removed for wear and damage, paying particular attention to evidence of cracks and deterioration in insulation.

5.5.2 Measure resistance of blow-out coil using test unit P008. Discard if not within 0.032 ohm +0.002/-0.002.

5.5.3 Discard any parts which do not comply with drawing specifications.

5.5.4 Record details of any discarded parts on the service history card. Place all non-conforming parts in suitable container and tag with "Quarantine" tag.

5.5.5 Prepare replacement arc chute base (57) if original was discarded. Refer to Drg. R8505B for details. Install new insulation strip (57C) and paint item with black varnish, Isonel 300.

5.5.6 Prepare replacement arc chute (56) if original was discarded. Refer to Drg. R8506A for details and paint item with black varnish, Isonel 300.

5.5.7 Prepare replacement blow-out coil (44) if original was discarded. Fit and solder terminals (48,51) using coil assembly jig P0005.

5.5.8 Fit replacement contact tip (45A) to lower contact tip support (45). Lock screw (46) by punching metal of contact tip (45A) into screw slot. Prepare surface of contact tip using fine file and #400 emery paper.

5.5.9 Fit replacement contact tip (32B) to contact finger (32). Lock screw by punching metal of contact tip into screw slot. Prepare surface of contact tip using fine file and #400 emery paper.

5.5.10 Install blow-out coil assembly (44,48,51), lower contact tip support assembly (45, 45A) and blow-out coil terminal (49). Heads of screws (47) to be sealed with pitch. Heads of screws (47A) to be covered with self adhesive insulating tape.

5.5.11 Install insulation plate (58) between electrical and mechanical assemblies, and fasten with (four) screws (60).

5.5.12 Fit screw (35) into insulation collar (38) and seal with "5-Minute Araldite". Use hacksaw to cut slot in thread-end of screw, perpendicular to flat on insulation collar.

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5.5.13 Reassemble (moving) contact components (32,33,34,35,36,37,38)and connection cable (39,40) onto yoke (29). Adjust alignment of top and bottom contact tips. Ensure that insulation collar (38) moves freely without fouling against end of operating lever (20).

5.5.14 Check fit of arc chute (56) on arc chute base (57). Unless the mating surfaces are both quite flat, it will be necessary to fit 1.2mm thick insulation spacers at each mounting screw position, between arc chute and base, to avoid cracking arc chute when screws are tightened.

5.5.15 Install arc chute (56) and field plates (52,53) using screw (54). Ensure that field plates are fitted hard up against sides of arc chute.

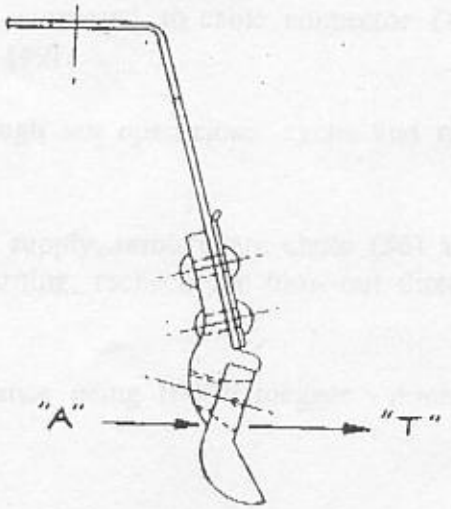
5.5.16 Governor is now ready for electrical testing.

5.6 Electrical Test

5.6.1 Remove arc chute (56).

5.6.2 Check that contact gap is 15 - 18mm, and tip wipe is approximately 3mm.

5.6.3 Check contact tip pressure, as follows:
Connect electrical test buzzer across contact tips.
Attach tubular balance hook onto contact finger assembly at point "A",shown below.
With balance held horizontal, and perpendicular to centre of governor, increase the tension "T"until buzzer stops ie. contacts open.
Observe and record reading on tubular balance (contact pressure). This pressure must be at least 1.6 - 1.8 Kg (3.5 - 4.0 lb).



Contact Finger Assembly

5.6.4 Continuity of electrical circuit using test set P008. Total resistance from blow-out coil terminal (49) to cable connector (41) to be no more than 0.30 ohm.

5.6.5 Resistance of blow-out coil using test set P008 - 0.032 ohm +0.002/-0.002.

5.6.6 Insulation resistance, using 1000V megger - minimum resistance 10 Megohm.

5.6.7 High voltage insulation test. Apply 3.2 KV AC for one minute. Maximum leakage 1mA.

5.6.8 Recheck insulation resistance, using 1000V megger - minimum resistance 10 Megohm.

5.6.9 Arc blow-out direction. Connect to low voltage supply from test set P0006, with negative supply connected to cable connector (41). With a compass located on the L.H.S. of the blow-out coil, (viewed from the front of the governor), the south seeking pole of the compass should be repelled.

5.6.10 Replace arc chute (56) and despatch for final test. Affix "Ok to Proceed" tag.

5.7 Final Test

5.7.1 Connect governor to test jig P0004, with the assembly installed such that the lever mechanism is at the "bottom", as shown in Drg. R8814.

5.7.2 Check that contacts open when air pressure is 80 psi +3/-3 and close when pressure is reduced to 63 psi +3/-3.

5.7.3 Connect governor to 600V supply and inductive load (test set No. P007). Ensure that negative supply is connected to cable connector (41) and positive supply to blow-out coil terminal (49).

5.7.4 Operate governor through ten open/close cycles and record air pressures for each cycle.

5.7.5 Disconnect from 600V supply, remove arc chute (56) and inspect contact tips. If there is evidence of burning, recheck arc blow-out direction and contact pressure. Clean tips and retest.

5.7.6 Check insulation resistance using 1000V megger - minimum resistance 10 Megohm.

5.7.7 Replace arc chute (56).

5.7.8 Fit new overhaul ID plate (64) and record overhaul details on service history card.

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5.7.9 Authorised Q.A. Representative to fill in Certificate of Conformance.

5.7.10 Fit "Passed Final Inspection" tag.

5.7.11 Arrange for despatch.

5.8 SPECIAL EQUIPMENT

Spring Test Jig No. P001.
Spring Test Jig No. P002.
Frame Head Tightening Gauge No. P003.
Governor Mechanical Test Jig No. P004.
Blow-out Coil Assembly Jig No. P005.
Low Voltage Supply Test Set No. P006.
High Voltage Supply and Load Test Set No. P007.
Resistance Measuring Test Set No. P008.
1000V Megger.
High Voltage Insulation Test Unit (3.2 KV Ac).
Magnetic Compass.
Electrical Test Buzzer.
Tubular Balance, 0-2kg (0-5lb).

6.0 REFERENCES

PTC Specification No. 284, "Overhaul of G.E. Governors ML Type, "W" Class Trams", issue dated 22/12/92.
System Report, Westinghouse Governor, W Class Trams (Draft Copy, August 1993).
Drawing R8505 Arc Chute Base
Drawing R8506 Arc Chute
Drawing R8814 G.E. Governor General Arrangement
Drawing R8521 Sub-assembly of Arc Chute
Drawing X2251 Testing Arrangement of G.E. Governor

7.0 DOCUMENTATION

JB007 Quality Inspection Document, Workplan No. "ZGOVERNOR".
Service History Card for G.E. Governor, Type ML.
PTC Workshops Certificate of Conformance.
"Ok to Proceed" Tag.
"Passed Final Inspection" Tag.