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SPECIAL MAINTENANCE INSTRUCTION No. RDSO/2017/EL/SMI/ 0309, Rev. ('0')

1.0 Title: Procedure for assembly of Aluminium Gear Case and Crown gear coupling in WAP5 Electric locomotive.

2.0 Brief History:

ELS/BRC has reported failure of WAP-5 aluminium gear case due to rotation of outer racer in gear case housing. Aluminium gear case is a costly component and also effects safety of high speed trains. Comprehensive guidelines need to be issued for assembly of Aluminium gear case and crown gear coupling in WAP5 locomotive.

In view of above; standard procedure is being issued as a general guidance for assembly of Aluminium Gear Case and crown gear coupling in WAP5 locos.

3.0 Assembly Procedure:

3.1 Pre assembly preparation of pinion:

(i) Clean the 17 teeth pinion properly using kerosene oil.

(ii) Record the serial number. Measure the bearing seat dia. on both end of pinion for fixing the cone (bearing along with inner racer) (dimension-127.105+0.00/-0.025 mm)

(iii) Measure the inner dia. of the cone-798 Timken (bearing along with inner racer). Check the theoretical interference (0.06 to 0.075 mm)

(iv) Heat the bearing cone on induction heater to 100°C and mount on shorter shaft side of pinion till it rests up to the bottom of seat. Let it cool down for two minutes.

(v) Keeping the long end of the pinion shaft on upper side, heat the other bearing to 100°C by induction heater and push it on the seat till it touches to the root.

(vi) Let the assembly cool in open air.

3.2 Fixing cup (bearing outer race) in Gear case upper half:

(i) Clean the gear case properly using kerosene oil. Ensure that there is no dust/foreign material present on the outer racer seat.

(ii) DPT of the lugs of the gear case for checking of crackness.

(iii) Checking of thread of filling cap for any damage.

(iv) Fix the oil filling cup with sealing ring at 13 Nm torque.

(v) Measure the inner dia. of gear case seat for fixing the outer racer of pinion bearing (dimension 206.375+0.22/-0.05 mm).

(vi) Measure the OD of outer racer and check the interference(0.07 to 0.082 mm)

(vii) Keep the outer racer in freezer to a temperature of -10°C.

(viii) Heat the seat of gear case to 80°C. Ensure uniform heating of gear case around seat.

(ix) Push the cup in seat till it reaches to the end.

(x) Maintain a pressure to keep the cup in position and let it cool down in open air.

(xi) After cooling down ensure that feeler gauge of 0.05 mm cannot enter in between cup and gear case.

(xii) Fix the plug (03 nos) in the upper half of gear case.

3.3 Preparation of cap piece assembly

(i) Clean the cap piece, remove the 'o' ring. Remove the roll pin.

(ii) Measure the seat dia. on cap piece for outer racer (dimention-206.375+0.22/-0.05 mm).

(iii) Measure OD of cup (outer racer) and check theoretical interference (0.06 to 0.075 mm)

(iv) Press fit the outer racer (cup) on the cap piece by hydraulic press machine in correct position, large face inside.

(v) Fit the breather on the cap piece.

(vi) Place new 'o' ring (dia. 5 mm) in the groove, apply loctite 518 sealant on 'O' ring and fix the roll pin.

Note: 'O' ring should be procured from OEM or RDSO/CLW/DLW approved sources only.

3.4 Fitment of assembled pinion in the gear case upper half

(i) Check the condition of all helical insert in the gear case upper half.

(ii) Insert pre assembled pinion, long shaft end on top vertically via the outer bore of gear case until the rollers remain stopped at the outer ring pressed into the gear case. Turn the pinion in both directions and check if the rollers of the bearing run smoothly and noiseless.

(iii) Put the pre assembled cap piece in the correct position onto gear case. Ensure that the roll pin pressed in to the flange of cap piece lines up with the corresponding bore in the gear case.

(iv) Tighten all the bolts with torque wrench at 170 Nm torque.

(v) Heat the distance ring at 50° C. Press fit the distance ring on pinion shaft till it reaches to its position, maintain the pressure until it cools down.

(vi) Provide new 'O' ring on labyrinth and fit the labyrinth into cap piece till it stops. Tighten all the bolts at 45 Nm torque.

3.5 Checking the backlash in the pinion shaft

(i) Fix the backlash checking tool and Dial indicator on the cap piece and pinion as arrangement shown below in the figure.

(ii) Adjust the dial indicator to zero.

(iii) Loosen the bottom nut and tighten the upper nut of the central stud so that pinion moves to max up position. Take the raeding of dial indicator.

(iv) Loosen the bottom nut and let pinion come down without any force again take the reading of dial indicator.

(v) Note the difference of the two readings.

(vi) Again set the dial indicator to zero. Now tighten the bottom nut of central stud so that pinion moves to max. Down position. Take the reading of dial indicator.

(vii) Release the pinion by loosening bottom nut so that it comes to its position. Again take the reading of dial indicator.

(viii) Note the difference of the two readings.

(ix) Now add both the differences noted down. It is the backlash of pinion. Backlash should be between 0.025 to 0.25 mm.

3.6 Pre assembly of Intermediate Gear

(i) Clean the 35 teeth intermediate gear using kerosene oil. Record the make, serial number and mfg.

(ii) Clean the two sealing rings and distance ring.

(iii) Measure the seat dia. on the gear for fixing both outer racer simultaneously (223.761+0.029/-0.00 mm).

(iv) Check OD of outer racer and check theoretical interference (0.07 to 0.08 mm)

(v) Heat the intermediate gear to 130°C using induction heater. (It may take 35 to 40 minutes approx. to reach the required temperature.

(vi) Measure OD of distance ring to be (172+0.05/-0.00 mm) & thickness (17.17+0.025/-0.025 mm). Take utmost care to ensure thickness is within limits.

(vii) When temperature of intermediate gear in the induction heater has reached to 130°C, place the intermediate gear on clean wooden surface, keeping the seat for the outer racer upwards.

(viii) Fix one outer racer in housing.

(ix) Place the dummy cone inside and fix sealing ring with 4 bolts to keep racer in the housing while cooling.

(x) Now place intermediate gear upside down keeping other side of seat in up position.

(xi) Fix the distance ring and other outer racer inside the seat and push it to the end. Place the dummy cone in the cup.

(xii) Fix the sealing ring and put across 4 bolts. Let it cool in the open air.

(xiii) After cooling down, remove the sealing rings, dummy bearings.

(xiv) With the help of feeler gauge check the proper fitment of outer racer in the seat.

(xv) Fit the actual bearing cones and sealing rings on both side of intermediate gear.

(xvi) Apply locktite 243 on bolts. Tighten the bolts at 18 Nm torque.

3.7 Assembly of Intermediate gear shaft in the gear:

(i) Clean the shaft properly using kerosene.

(ii) Press the roll pin into the corresponding bore at the flange.

(iii) Install 2 plugs into the corresponding bore at the shaft ends.
(iv) Put the 'O' ring (5 mm) into the corresponding groove in shaft.
(v) Check the seat dia to be (157+0.025/-0.0 mm).
(vi) Press the shaft into the bearing, continue pressing. There is approx 49 to 50 mm gap between inner face of flange and the face of the inner ring.

3.8 Fitment of lower half of Aluminium gear case on the axle

(i) Clean the lower half of Aluminium gear case.
(ii) Fit the oil sight glass with sealing ring and sealing compound.
(iii) Fit the magnetic drain plug and oil filling plug with sealing ring.
(iv) Properly clean the main gear and check free movement of main gear bearing.
(v) Fit the 'O' ring (6 mm) in the groove of main gear bearing cap piece both side.
(vi) Apply anobond 581 sealent around the 'O' ring.
(vii) Compress the upper side of the main gear bearings with the help of stud so that lower side widens to fit the lower half of Aluminium gear case.
(viii) Carefully raise the lower half of gear in position so that roll pin pressed in main gear cap piece lines up with corresponding bore in the gear case lower half. Tighten four bolts to keep it in position.
(ix) Support other side of lower half of aluminium gear case to keep it in position.
(x) Remove the stud.

3.9 Fitment of assembled intermediate gear in the Aluminium gear case

Place the pre-assembled intermediate gear on the aluminium gear case lower half in the correct position, so that the roll pin pressed in the intermediate gear shaft lines up with corresponding bore in the lower half of gear case.

3.10 Fitment of pre-assembled upper half of aluminium gear case:-

(i) Apply anabond to the mating surface of both the halves of gear case.
(ii) Expand the upper side of main gear bearings to fit the pre-assembled upper half of Al. gear case.
(iii) Tighten all the joining bolts at the torque by torque wrench.

20×80	320 Nm
16×80	170 Nm
16×40	170 Nm

(iv) Fill the aluminium Gear case with 7 ltr of oil of prescribed grade oil Optimal Optigear 2201.

(v) Close and tighten the oil filling cap. (Tightening torque 130 Nm)

3.11 Fitment of sleeve on pinion shaft (Gear case side)

(i) Clean the sleeve, travel limitation pin (locking plate) with kerosene.

(ii) Visually check the sleeve for any crack/teeth damage. DPT of sleeve to be done to check for crackness.

(iii) Position the sleeve on the pinion shaft.

(iv) Connect the hydraulic pump along with jig for fixing sleeve on the shaft.

(v) Start pressing the sleeve to move to the root of the shaft.

(vi) Ensure correct position of the sleeve on the shaft so that gap between sleeve face and pinion shaft face is between 0.5 to 1.5 mm..

(vii) Tighten the travel limitation pin to keep the sleeve on its position. Apply locktite 243 on the bolts and tighten them at 68 Nm torque.

(viii) Slowly release the hydraulic pressure.

3.12 Assembly of star (Gear case side)

(i) Ensure all the parts are clean and free from any damage.

(ii) Position the star on the press machine.

(iii) Apply Anabond on the groove.

(iv) Position new membrane on the star so that groove on the membrane matches with the groove on the star.

(v) Position the locking ring and tool for pressing. Ensure distance piece of suitable height to prevent damage to star studs.

(vi) Slowly start pressing till membrane stops rotating on its position. Take utmost care not to over tighten so that membrane gets damage.

(vii) Position the membrane into the cover. The rim of membrane must fit perfectly and concentric in cover all the way round.

(viii) Place the fixing disc on the cover. Tighten the two bolts to clamp membrane between the cover and fixing disc. (Tightening torque 22 Nm)

3.13 Assembly of star in the sleeve (Gear case side)

(i) Place 'O' ring on the groove in the assembled star and apply anabond on the 'O' ring.

(ii) Position the star on the sleeve. Align the zero on the star and sleeve.

(iii) Bolt the cover together with premounted coupling star to the coupling sleeve using 12 hexagonal bolts and lock washer. (Tightening torque 22 Nm)

(iv) Remove plug and fill the cavity of coupling half with 0.5 ltr. oil of grade BP Energear Castrol Hypoy B-85W/140. Tighten the plug again at 16 Nm torque.

3.14 Assembly of sleeve and star (motor side)

(i) Repeat the process mentioned in para (3.11), (3.12) and (3.13) for assembly other coupling half on motor shaft.

3.15 Connecting the stars of gear case end and motor end

(i) Mount two holding plates with two bolts each on both side stars.

(ii) Bring together the coupling halves of gear box and motor concentrically.

(iii) Remove the holding plates. Bring together the coupling halves of the gaer box and motor, so that the gearing is in attack and stud bolts on gear box side fit into the hole pattern of the coupling on the motor side.

(iv) Bolts the coupling halves using 12 hexagonal nuts. Tighten the hexagonal nuts diagonally.

3.16 Run test

Run the motor for 2 hours and take the temperature of all parts in every half hour. Check the Gear case and coupling for oil leakage and excessive noise. Check the bearings and coupling for excessive temperature rise with the help of non-contact type temperature gun. Temperature should not increase beyond the limits as mentioned below:-

Both side bearing of main gear, intermediate gear and pinion	Ambient + 30 ^{0}C
Temperature of both side coupling	Ambient + 30 ^{0}C

3.17 Adjustment of alignment of Hurth coupling after lowering the loco on bogie

(i) Check the vertical alignment of the coupling with the help of steel ruler.

(ii) Add/remove Sims on the gear case mounting for adjusting the level vertically.

(iii) Check the horizontal alignment of coupling with help of steel ruler.

(iv) Loosen the motor mounting bolts and push the motor to required position to correct misalignment.

4.0 **Application to**: WAP-5 Electric locomotive.

5.0 **Agency of Implementation**: Electric Loco sheds, POH workshops, CLW and DLW.

6.0 **Periodicity of Implementation**: During assembly of Aluminium Gear case and Crown gear coupling.

22/9/17

(Pratibha Gupta)
for Director General Electrical

Encl: Nil

Copy to: The Secretary (Elec.), Railway Board, New Delhi-110 001.
(Kind Attn: Sri A. K. Goswami Dir/TRS)- for information please.