C.M.I. 3954-3

CLYDE MAINTENANCE INSTRUCTION

D43 TRACTION MOTOR OVERHAUL

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SECTION 3
STATOR INSPECTION AND RECONDITIONING MECHANICAL

NOTE

This D43 Traction Motor overhaul instruction is presented in seven sections, each under separate cover, and contains detailed instructions to completely disassemble, inspect, overhaul, assemble, and test the traction motor.

Refer to Maintenance Instruction, CMI 3901, for general or"running" maintenance of the traction motor and also for procedures to remove the traction motor from the locomotive bogie.

STATOR INSPECTION AND RECONDITIONING - MECHANICAL

INTRODUCTION

During traction motor overhaul, the stator should be cleaned and inspected to determine mechanical and electrical quality to ensure satisfactory performance during subsequent operation. Visual and electrical inspections are required to determine what type of repair, if any, is needed.

The inspections should be carefully made and all rework performed according to the outlined procedures.

This section is divided into five major parts:-

- Frame Inspection - Coils Intact
- Frame Inspection - Coils Removed
- Minor Frame And Axle Cap Repairs
- Major Frame Repairs - Coils Intact
- Major Frame Repairs - Coils Removed

STATOR CLEANING

Clean the inside and outside of stator assembly by blowing out dirt, dust, and other contaminants using high volume, low pressure, clean, dry, compressed air. Avoid excessive air pressure which could cause insulation damage.

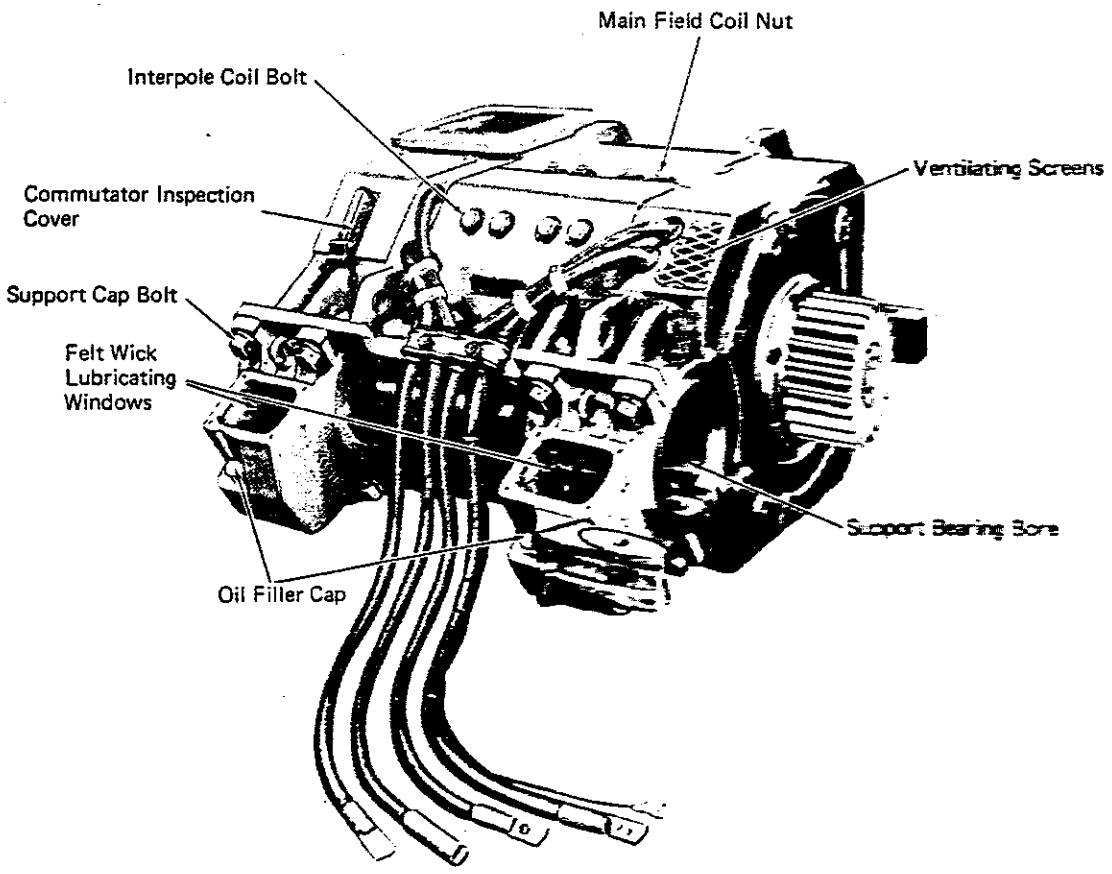


Fig. 1 - Traction Motor

Remove remaining dirt by wiping frame and insulation with a clean cloth dampened with a suitable solvent such as Shellsol 1626.

WARNING:
Provide adequate ventilation when using solvents. The usual precautions should be observed when handling inflammable fluids such as Shellsol 1626 Solvent which has a flash point of 40° C.

In the event that the stator is extremely dirty or oily, the inside and outside may be cleaned using hot water to which a small amount of caustic has been added. The hot water and caustic solution may be applied with a pump and hose using a pressure of 300-350 kPa (45-50 psi). After such washing, the stator should be thoroughly rinsed with clear, clean water to remove all traces of the caustic.

After washing and rinsing, dry the stator by placing it in a 145° C oven. Insulation resistance readings should be checked while the drying process is going on. The drying out should be continued until both the insulation resistance and the temperature have become constant and remain stable for several hours. This procedure usually takes 6 to 8 hours.

FRAME INSPECTION - COILS INTACT

FRAME INSPECTION

Refer to Fig. 1 during inspection of traction motor frame.

1. Check that ventilating screens (if used) are not broken and have no cracked welding. Replace screens or tack weld as required.

2. Check oil filler caps on support bearing caps and replace with new caps if required.

3. Check that internal condition of support bearing caps is satisfactory.

4. Check commutator inspection cover felt seals. Replace with new felt seals if required.

5. Check the tack weld of field pole bolts on support side of frame. Tack weld if cracked.

6. Inspect for cracks in the frame and frame welds. Closely check the following areas:

   a. Between the pinion end bore and the axle bore

   b. Corners of the commutator opening and cover openings

   c. Upper brush holder support web. Repair all cracks by welding. Refer to Welding procedure in this section.

7. Inspect and recondition felt wicks and carriers as follows.

FELT WICK LUBRICATORS

Clean the felt wick lubricator using oil heated to a temperature between 49° C and 60° C and a soft bristled brush. The use of a scraper or wire bristle brush is not recommended. Refer to Maintenance Instruction M.I.1756 for correct type of oil.

After cleaning, the felt wick assemblies should be inspected to determine if the wicks are in satisfactory condition for continued service. Observe the following points.

1. Felt wicks should be discarded if they have hardened, glazed, or burned contact surfaces. Normal service tends to pack the upper portion of the wick, which is permissible unless the wick no longer can absorb oil. Check wick by applying oil and observing

how rapidly the oil is absorbed. If a pool of oil remains on the surface of the wick or is absorbed slowly, replace with a new wick.

2. The wick contact surface should be free of major irregularities. Slight depressions are permissible provided the depressions do not extend the full length of the wick.

   Check contact surface of the wick with a straight edge. If any depression exceeds 3 mm, (1/8") or if a regular "saw tooth" pattern is observed, replace with a new wick.

3. Visually inspect the metal wick carrier assembly for warping, distortion, or cracks. Replace carrier if required. Check carrier pins and pinholes. Replace parts if worn more than 0.30 mm (.012") over a new assembly.

4. Check support bearing lubricator spring pressure by placing a weight on the wick as shown in Fig. 2. Use a 3 kg weight for new assemblies and a 2 kg weight for used assemblies. The support bearing lubricator spring should be able to raise a 0.9 kg weight placed on the contact surface after the wick is depressed, Fig.2. The test should be made with the wick saturated with oil and with all sliding parts clean and lubricated

5. Support bearing wick lubricator springs should be inspected for cracks near rivet point. If any defective or cracked springs are found, the assembly should be replaced .

6. Wicks must be impregnated with oil prior to use. Refer to Maintenance Instruction M.I. 1756. Impregnate wicks as follows:

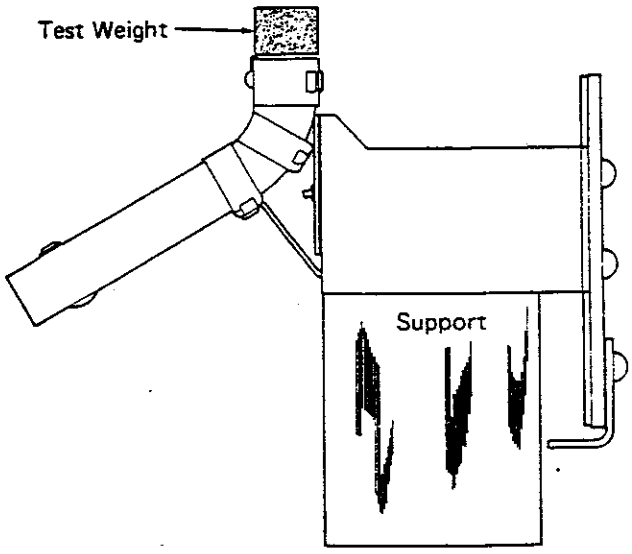


Fig. 2 - Testing Wick Lubricator Springs

   a. Soak wicks for a minimum of 20 minutes in oil at room temperature or 10 minutes in oil heated to 71° C (160 ° F). Wicks should not be allowed to touch bottom of container when soaking in heated tank.

   b. Allow to drain for 10 minutes to facilitate handling and installation. Use care to keep wicks clean while handling.

7 If there is evidence that water has been absorbed into the wick, remove moisture as follows:

   a. Submerge wicks in oil heated to 104°C for 8 hours.

   b. Allow to cool, while still submerged, until oil cools to room temperature.

   c. Remove wick from tank and allow to drain for 24 hours before use.

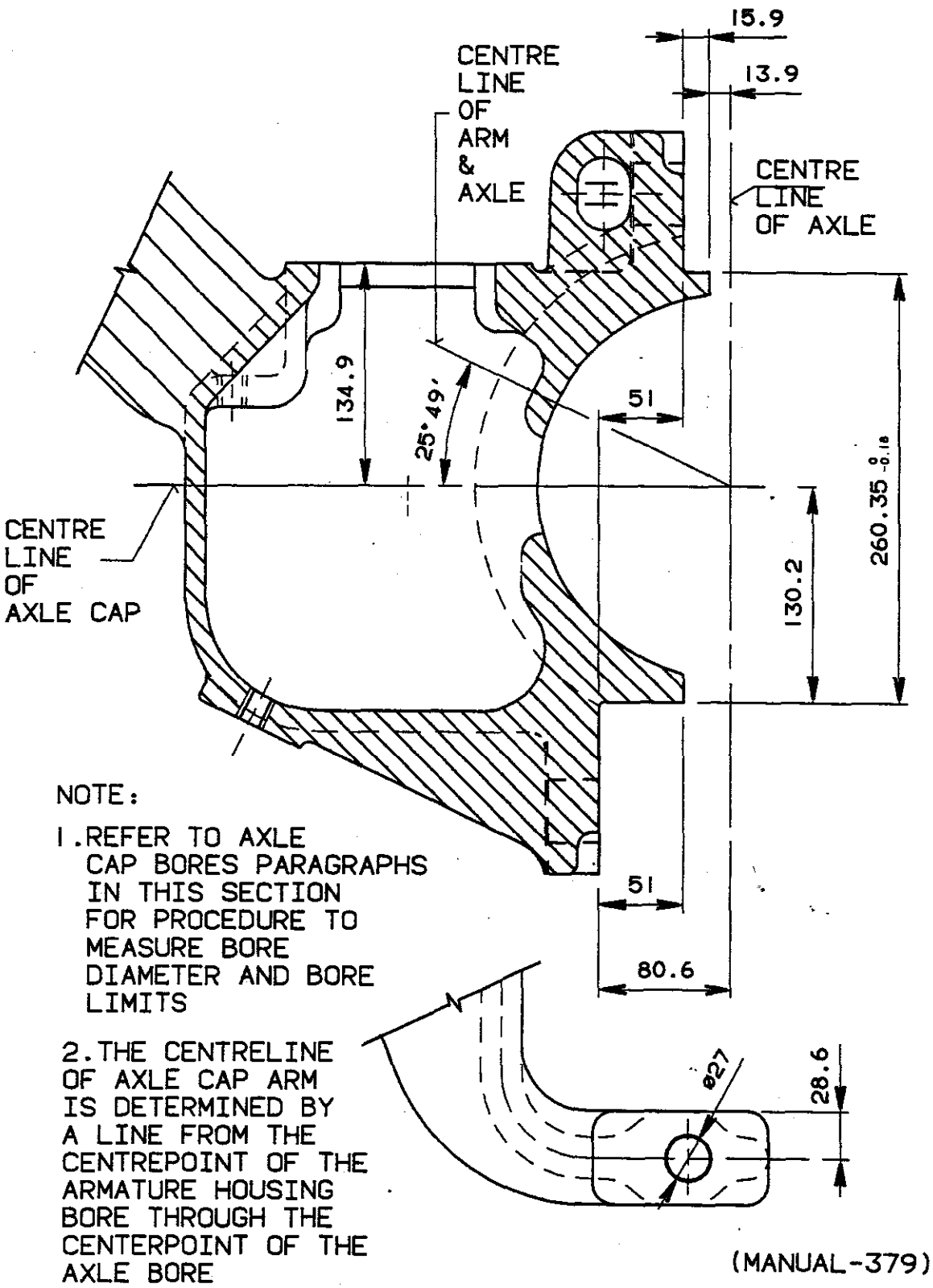


Fig. 3 - Pinion End Axle Cap

AXLE CAP MOUNTING TO FRAME

The two axle caps are machined and line bored when mounted on the traction motor with a 0.46mm (.018") shim inserted between the caps and the motor frame. Line boring of the caps is necessary to achieve the accuracy of bearing fit required.

When the traction motor is mounted in a truck, the 0.46 mm (.018") shims are removed and 0.25mm (.010") shims are used, giving a 0.20 mm (.008") clamp fit or squeeze to the axle bearing shell.

The caps are not interchangeable with each other on a given motor or with caps of the other motors. To ensure the caps are properly matched, the caps are stamped with a serial number matching the motor frame. During assembly, the numbers on the support bearing caps should be checked to ensure the cap matches the number stamped on the motor frame.

NOTE: The lockwasher used with axle cap bolt has been replaced by hardened flat steel washer 8495681 on current model traction motors. The flat washer provides a larger and smoother seating area which enables the bolt to develop a higher clamp load at a given torque.

Axle caps that have been removed should be checked as follows:

1. Thoroughly clean with a suitable solvent and dry.

2. Paint outside of axle cap with chalk dust mixed with water and allow to dry.

3. Fill axle cap with kerosine and allow to stand for one hour. Check outside for leaks. If leakage occurs at oil drain hole, repair threads and replace drain plug if required.

GEAR CASE MOUNTING

Measure the distance from the centerline of the axle bore to the centerline of the gear case 27.0mm (1-1/16") diameter mounting hole in the axle cap arm, Fig. 5. This dimension shall be within 435.0 mm +/-1.6 (17-1/8" +/-1/16). Wall thickness of axle cap arm from center of 27.0 mm (1-1/16,") diameter gear case mounting hole and inner edge of arm should not be more than 32mm (1-1/4").

AXLE CAP TO FRAME SPLINE CONNECTION

The axle caps should be assembled to the traction motor frame with the 0.46 mm (.018") shims between the caps and motor frames.

CAUTION:
The 0.46 mm shim is placed between the axle cap and the motor frame before machining operation.

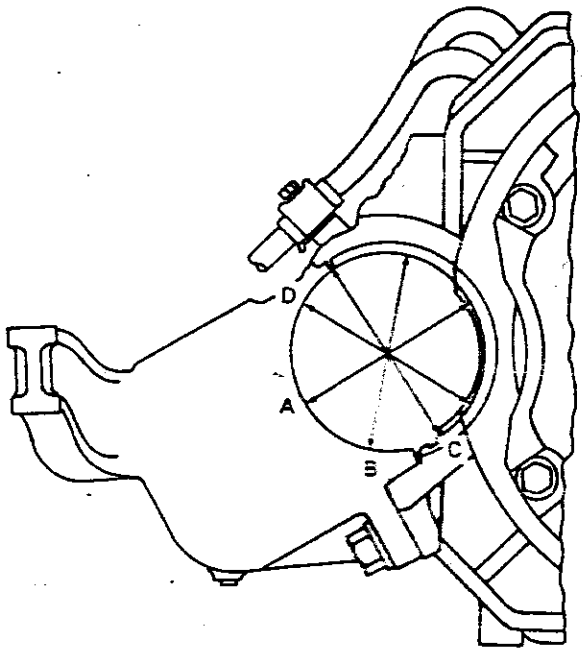
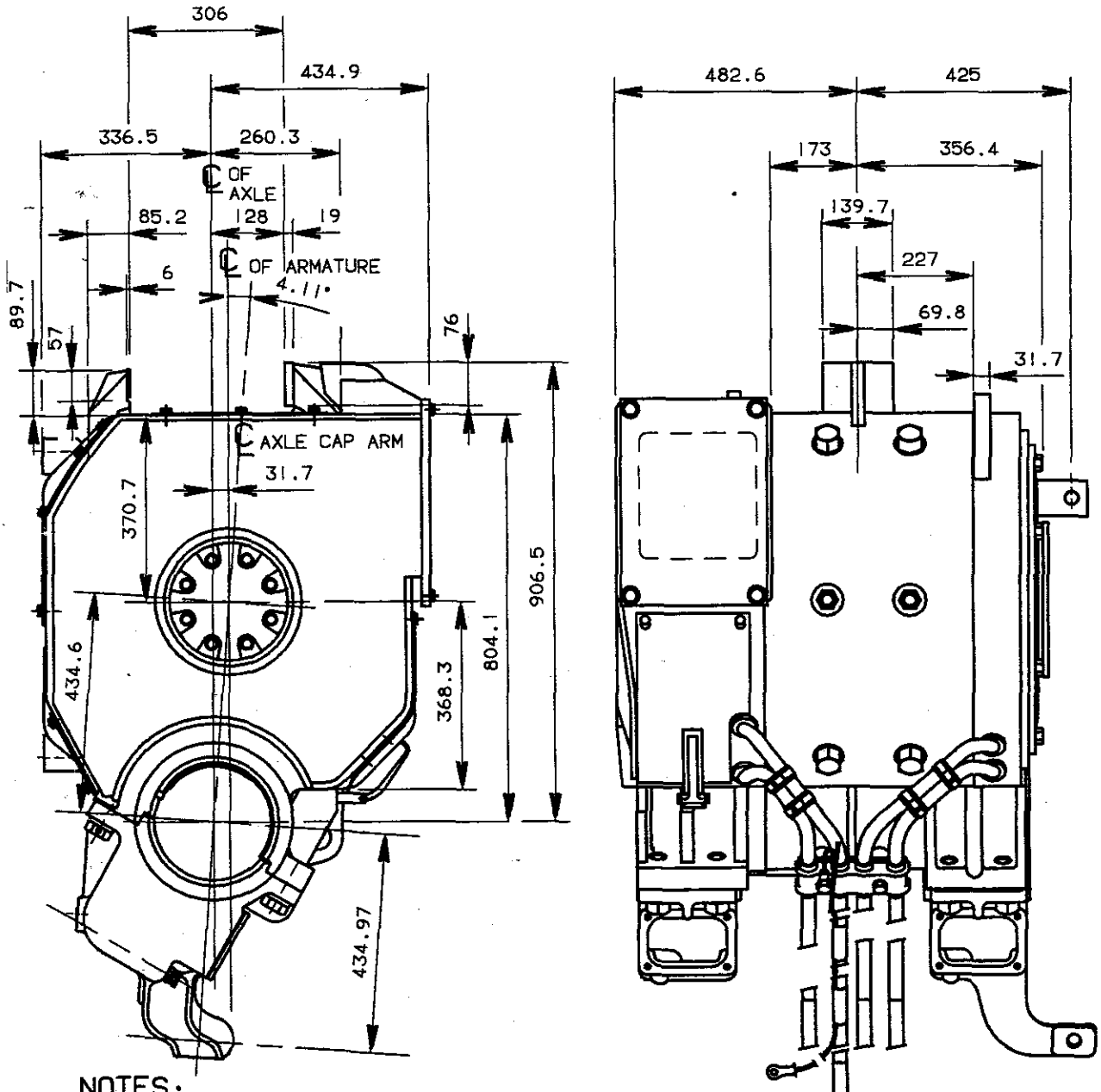


Fig. 4 - Axle Bore Measurement



NOTES:

1) 434.97 BETWEEN AXLE BORE CENTRELINE AND ARMATURE BORE CENTRELINE. REFER TO AXLE BORE SECTION OF TEXT FOR MIN. AND MAX. DIMENSIONS.

2) THE CENTRELINE OF AXLE CAP ARM IS DETERMINED BY A LINE FROM CENTREPOINT OF THE ARMATURE BORE THROUGH THE CENTREPOINT OF THE AXLE BORE.

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Fig. 5 - Traction Motor Outline

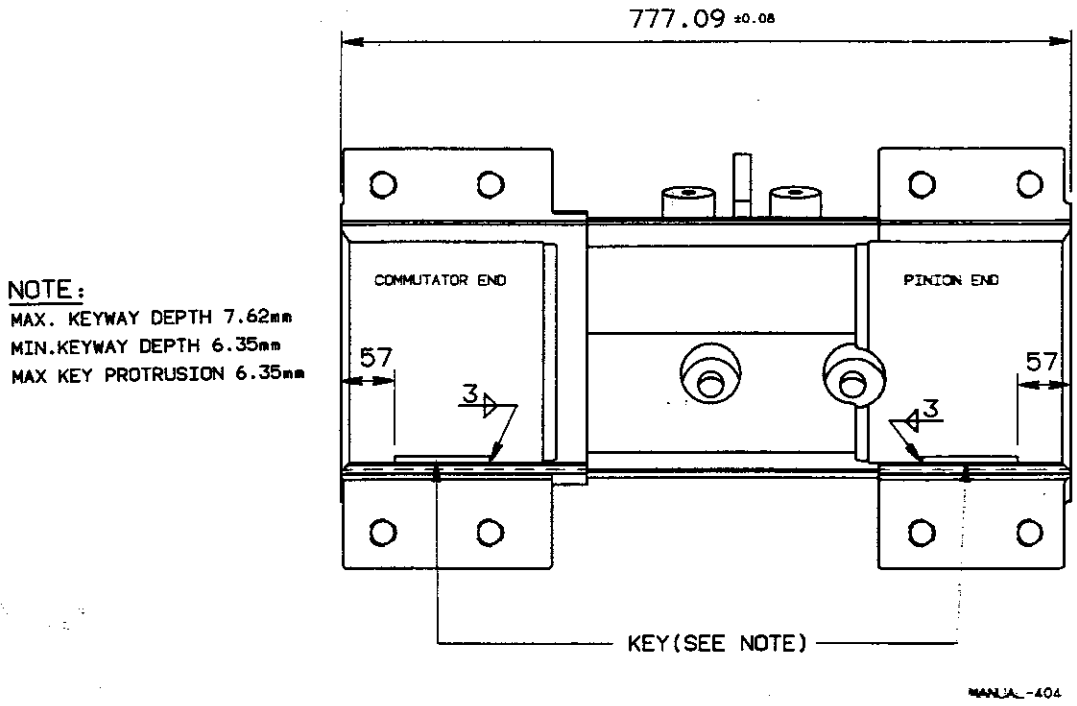


Fig. 6 - Axle Side Motor Frame

Tighten securely in place and check the spline fit on each side with a feeler gauge. This measurement is taken between the support cap and its junction with the traction motor frame. Total the top and bottom readings taken on each side of individual caps. This measured total clearance should not exceed 0.38 mm (.015") or the interference should not exceed 0.18 mm (.007").

The interference fit, if present, can be determined by measuring individual components with micrometers and determining the dimensional difference. The tolerance of the frame spline is 260.17mm to 260.53 mm (10.243" to 10.257"), Fig. 3. The tolerance of the support cap spline is 260.15 mm to 260.35mm (10.242" to 10.250").

AXLE BORES

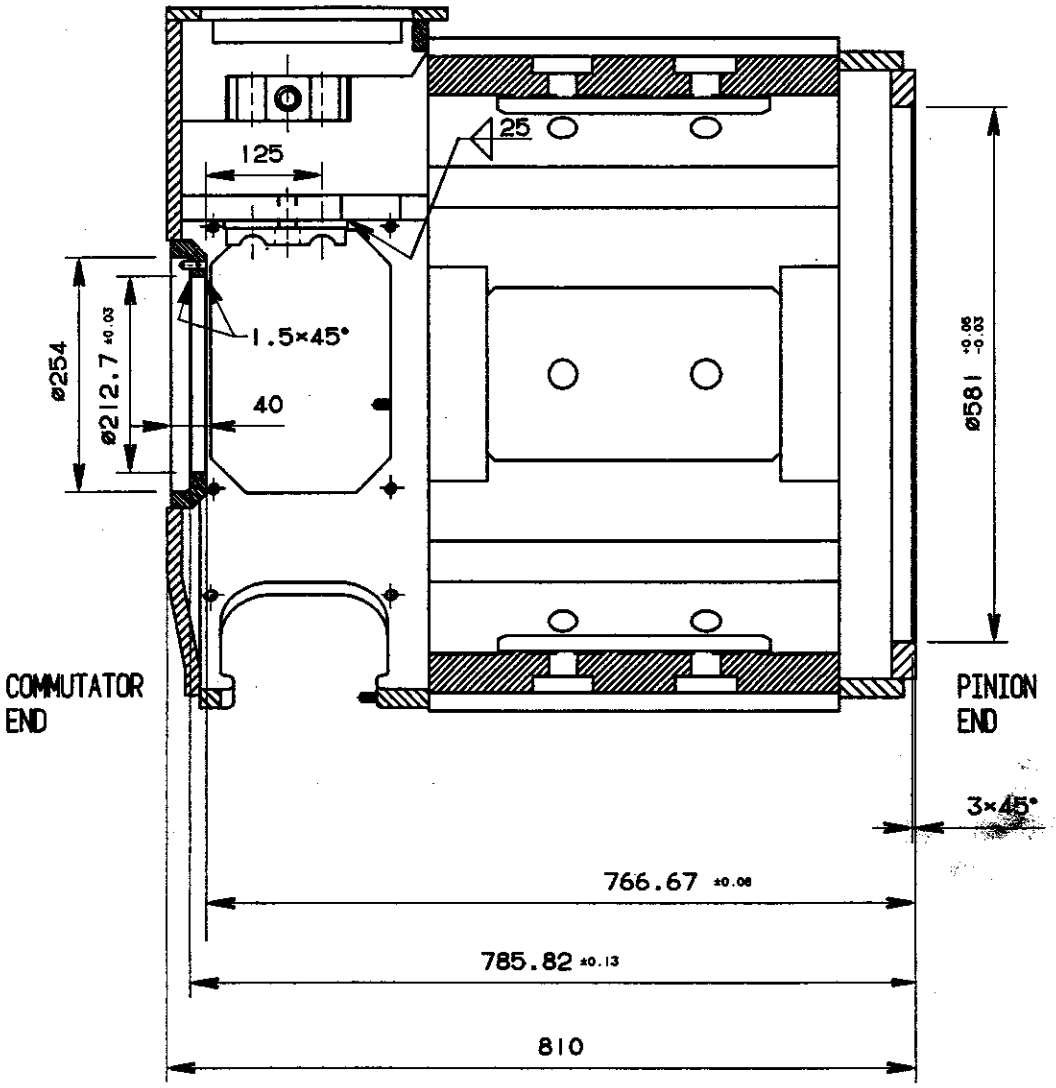
1. With the 0.46 mm (.018") shim in place between the axle cap and the motor frame, and the support bearing caps drawn up tight, measure the axle bore diameter in four places as shown in Fig. 4. Ensure frame is at room temperature.

   The average of the four readings must be within 234.92 mm and 235.13 mm (9.249" to 9.257"), providing "A" diameter in Fig. 4, is not less than 234.82 mm (9.245").

2. Axle bore must be parallel to armature bore within 0.31 mm (.012").

3. Axle bore centerline on pinion end to be parallel and concentric with axle bore centerline on commutator end within 0.13 mm, (.005").

4. Distance between axle bore centerline and armature bore centerline at the pinion end shall be 434.34 mm (17.100") minimum and 434.75 mm (17.116") maximum, Fig. 5. When pinion end is at minimum of 434.34mm (17.100"), it is permissible for distance between centerlines at the commutator end to be 434.14 mm (17.092").



NOTE:

PINION & COMMUTATOR END BORE TO BE CONCENTRIC TO EACH OTHER WITHIN 0.13mm.BORE FACES MUST BE PERPENDICULAR TO AXIAL CENTERLINE WITHIN 0.05mm TOTAL INDICATOR READING FOR COMMUTATOR END AND 0.13mm FOR PINION END.

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Fig. 7 - Traction Motor Frame Cross-Section

AXLE BORE FACES

The distance between axle bore faces for frames with new axle caps shall be 770.08 mm +/-0.08, (30.594" +/-.003") and 768.55mm (30.534") minimum for all others, Fig. 6.

NOTE: An 0.8 mm (1/32") step is permissible between the pinion end armature bore face and the pinion end axle bore face.

AXLE CAP MOUNTING BOLT SPOTFACE

Check axle cap mounting bolt spotface. The minimum thickness is 25 mm (1").

AXLE BORE KEY AND KEYWAY

Check the axle cap bore key and keyway, Fig. 6. Maximum keyway depth is 7.62 mm (.300"). Minimum keyway depth is 6.35 mm (.250"). Maximum key protrusion is 6.35 mm (.250").

AXLE CAP THREADS

Axle cap frame threads are acceptable if no more than three turns of class 2B no-go thread gauge enter the threads. Axle cap bolt threads must be class 2A.

FRAME THREADS

Threads in the motor frame are acceptable if a class lB no-go thread gage will enter the hole with an easy fit, but not loose. Threads which are recut must be class 2B.

NOSE SUSPENSION LUGS AND WEAR PLATE

The dimension between the nose suspension lower lug and the wear plate, Fig. 5, shall not exceed 307.85 mm (12.120").

COMMUTATOR END ARMATURE HOUSING BORE

1. To check the commutator end housing bore diameter, Fig. 7, measure the diameter at four places 45° apart. The readings must be between 212.65mm and 212.77mm (8.370" and 8.377"), with an average maximum of 212.73mm (8.375").

2. Maximum out-of-round is to be 0.13 mm. Housing bore inside face must be perpendicular to axial centreline within 0.05mm,(.002").

3. Minimum housing bore wall thickness is 39mm, (1.54")

4. Housing bore bolt holes to be within 1.04mm (.041") of nominal location with respect to the bore.

5. Housing bore bolt holes should be 22.2 mm, (7/8") diameter.

ARMATURE HOUSING BORES AND FACES

1. Minimum acceptable dimension between the pinion end housing bore face and commutator end housing bore face, Fig. 7, is 766.59 mm.

2. Pinion end housing bore and commutator end housing bore to be concentric to each other within 0.13 mm (.005") total indicator reading. Refer to Pinion End To Commutator End Armature Bore Concentricity Check Procedure which follows.

PINION END TO COMMUTATOR END ARMATURE BORE FACE CONCENTRICITY CHECK PROCEDURE

The following procedure can be used to check the concentricity between the commutator end and pinion end armature bore faces using a concentricity gauge. Refer to Service Data for gauge file number.

1. Remove axle caps and clean splines on both axle caps and frame. Remove all burrs.

2. Reassemble axle caps to frame with a 0.46mm (.018") shim inserted between the axle cap and frame.

3. Clean pinion end and commutator end armature housing bores, commutator end armature bore inner face, and pinion end armature housing bore outer face with a wire brush. Ensure surfaces are free of rust, residue, and burrs.

4. Apply concentricity gauge commutator end bore insert (Item 1, Fig. 8) into commutator end bore as shown in Fig. 9. Line up insert so the bronze land is located at the bottom. Gently tap insert in place to seat firmly and tighten the two clamps.

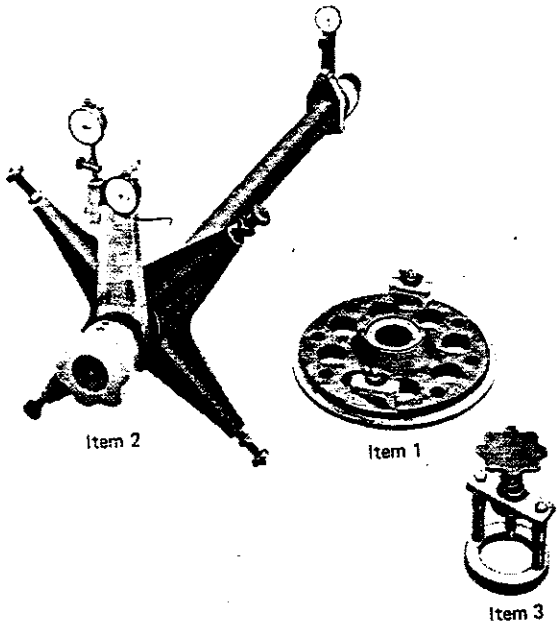


Fig. 8 - Armature Housing Bore Face Concentricity Gauge

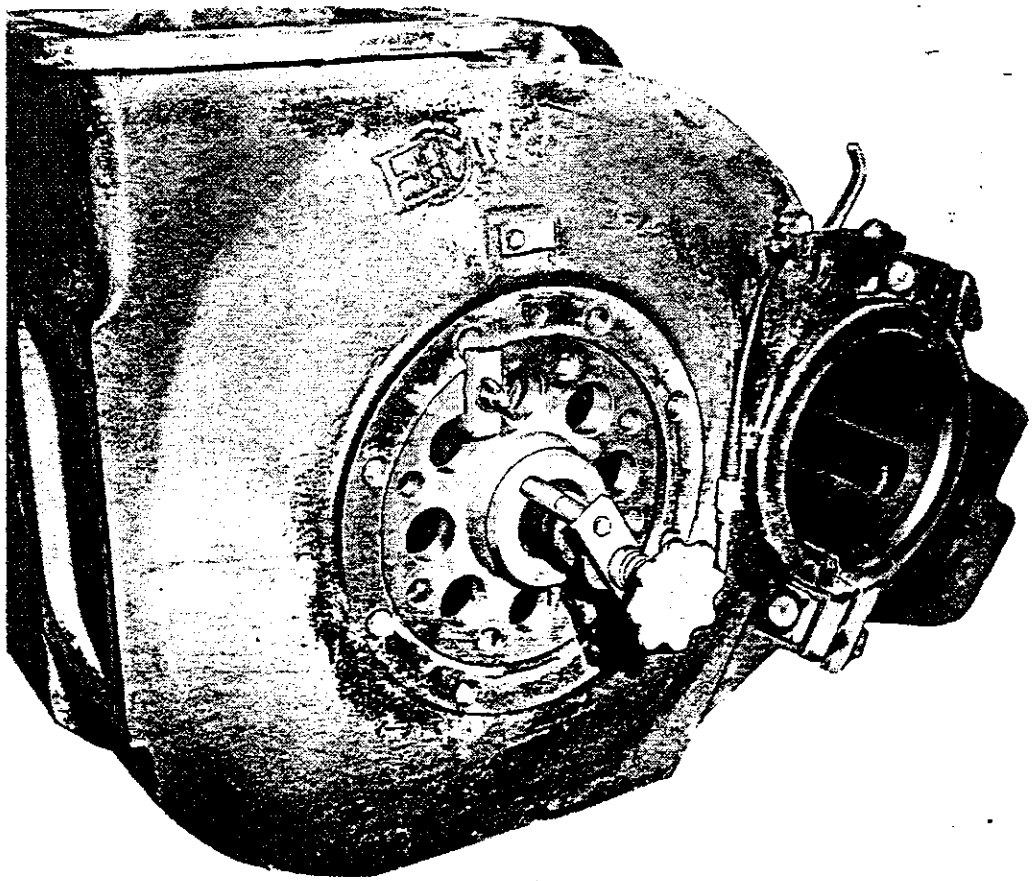


Fig. 9 - Concentricity Gauge Commutator End Insert

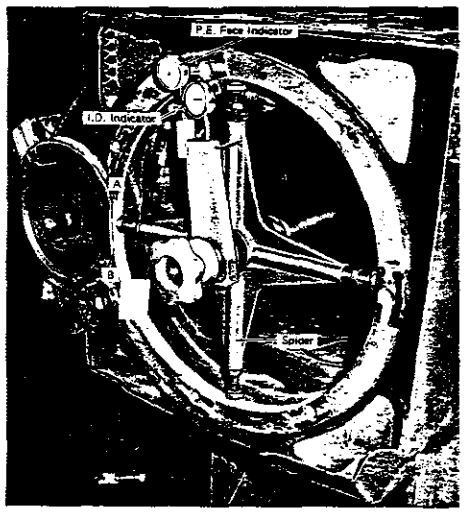


Fig. 10 - Concentricity Gauge Installed Pinion End Frame

NOTE: If the armature bore is oversize, shim insert to compensate for oversize. Ensure insert is centered in the bore to assure true indicator readings.

5. Slide alignment bar (Item 2, Fig. 8) through pinion end bore and into the commutator end bore insert as shown in Fig. 10.

6. Apply stabilizer (Item 3, Fig. 8) to commutator end of alignment bar as shown in Fig. 9.

7. Position pinion end spider on alignment bar so the spokes are horizontal and vertical in the bore, Fig. 10. Snug spider in position.

8. Engage I.D. indicator, Fig. 10, in pinion end bore and align bar to the centerline of the bore. Adjust the spoke adjusting screws to obtain a "Zero" reading around the bore. Disengage the indicator.

9. Engage pinion end face indicator, Fig.10, between the outer edge of the face and outer edge of the pinion end housing mounting holes. Start at point "A" of Fig.10, and sweep the face clockwise. Record indicator readings at 45^{o} intervals up to point"B". Do not run indicator into axle bore area. Total face runout is the sum of the greatest negative reading plus the greatest positive reading.

10. Engage the commutator end face indicator, Fig. 10, on the face between the housing bolt holes and the outer edge of the face. Do not let indicator drop into bolt holes. Record indicator readings at 45^{o} intervals. Total face runout is the sum of the greatest negative reading plus the greatest positive reading.

PINION END ARMATURE HOUSING BORE

There are five nominal sizes of pinion end armature housing bores.

Standard size 581.03 mm + 0.051 - 0.025 (22.875" +.002" -.001")

0.8 mm (1/32") oversize 581.81 mm + 0.051 - 0.025 (22.906" +.002" -.001")

1.59 mm (1/16") oversize 582.70 mm + 0.051 - 0.025 (22.941" +.002" -.001")

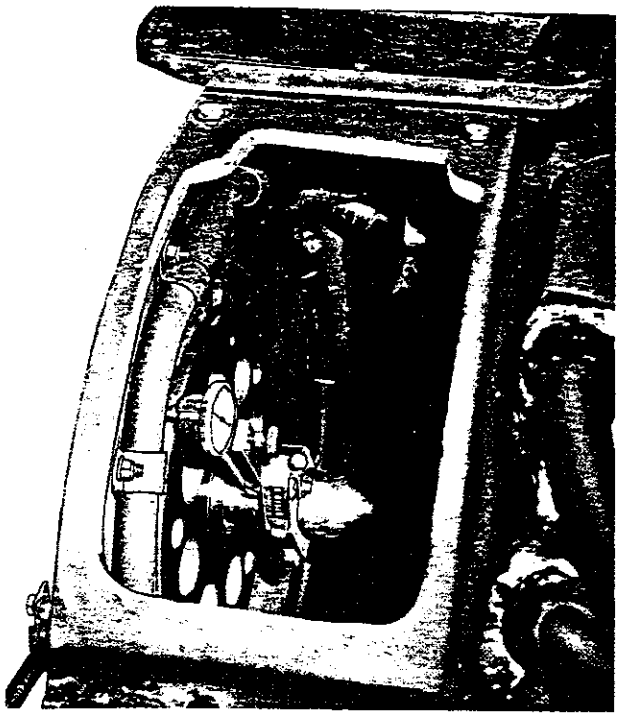


Fig. 11 - Concentricity Gauge Installed Commutator End Frame

2.38 mm (3/32") oversize 583.46 mm + 0.051 - 0.025 (22.971" +.002" -.001")

3.18 mm (1/8") oversize 584.23 mm + 0.051 - 0.025 (23.001" +.002" -.001")

1. To check the pinion end housing bore diameter, Fig. 7, measure the diameter at four places 45° apart. The average reading must be between + 0.13 mm to - 0.03 mm (+.005" to -.001").

2. If the stator is to have the axle cap renewed, the pinion end armature bore may be measured without the old axle cap assembled on the frame. If the bore is more than 0.53 mm (.021") out-of-round, assembled axle cap (or simulator) and re-measure the bore. If bore is then within 0.38 mm (.015"), bore is acceptable. Refer to Service Data for axle cap simulator file number.

NOTE: Maximum pinion end armature housing bore out-of-round on stator frames without coils is 0.30 mm (.012").

3. The outer bore face must be perpendicular to the axial centerline within 0.15 mm (.006"). Check measurement at the solid portion of the face, or opposite the main pole pads of the frame.

4. Pinion end housing bolt holes must be within 1.04 mm (.041") of nomimal location in respect to the bore.

5. Cracks in the bore side of the housing bolt holes are acceptable.

6. A maximum of 0.8 mm (1/32") is permissible between the pinion end armature bore face and the pinion end axle bore face. When the armature bore face is welded, the axle bore face should be welded. Both faces should then be machined to "new" dimensions.

BRUSH HOLDER BLOCKS AND BOLT HOLES

1. Dimension from commutator end armature housing inner face to the 125 mm block centreline, Fig. 7, is acceptable at +/- 2mm (+- 5/64").

2. Top brush holder blocks must have a 27 mm, (1-1/16") diameter bolt hole. Blocks with the 23.8 mm (15/16") bolt holes should be reworked to 27 mm (1-1/16") diameter.

BRUSH HOLDER CLEANING

HEAVY CLEANING

1. To remove heavy carbon deposits, oil, grease, and severe burn marks, place the brush holders in a tank charged with one part emulsion soak cleaner such as Clifco No.1 BH or equivalent mixed with four parts of water. Soak the brush holders at room temperature without agitation for 3 to 5 hours depending upon the condition of the brush holders.

CAUTION:
Observe safety precautions when handling emulsion soak cleaner and store in a safety-type container. Cleaner as received from supplier has a flash point of 38°C. Mixed with water, it has no flash point. Rubber gloves should be used when using cleaner to prevent drying out the skin or possible irritation. Keep cover on tank when not in use and while brush holders are soaking.

2. Steam clean brush holders using a steam cleaner such as Dober Chemical Corporation Cleaner 6006 or Turco Chemical Company Steamfas. Operate steam cleaning gun nozzle from 25 mm to 150 mm (1" to 6") from surfaces being cleaned.

CAUTION:
Protect skin and clothing while steam cleaning. Operator should wear rubber apron, boots, gloves, and a plastic face shield.

3. Hose off brush holders with clear water.

LIGHT CLEANING

For light cleaning, brush holders should be cleaned by washing in a non-toxic solvent such as Shellsol 1626. A solvent with a fast rate of evaporation is preferred.

CAUTION:
Adequate ventilation and safety precautions are necessary when handling inflammable fluids such as Shellsol 1626.

BRUSH HOLDER INSPECTION AND REPAIR

1. Inspect brush holder terminal lug seat for roughness and rework as required.

2. Check dowel securing the brush holder pins to ensure the casting is peened over at both ends.

3. Remove all arc burns and file off surfaces facing the commutator if metal buildup has occurred.

CARBONWAYS (BRUSH SLOTS)

Check carbonways for wear with gauge. Refer to Service Data for gauge part number. The carbonway should be between 15.90mm (.626") and 16.13 mm (.635") in each brush slot. The length of the short brush slot should be within 50.90mm to 51.13 mm (2.004" to 2.013"). The long brush slot should be within 101.70 mm to 101.93 mm (4.004" to 4.013").

When carbonways are worn or distorted beyond acceptable limits and the wear is not too great, it is possible to rework the slots. Insert gauge into slot and gently peen the

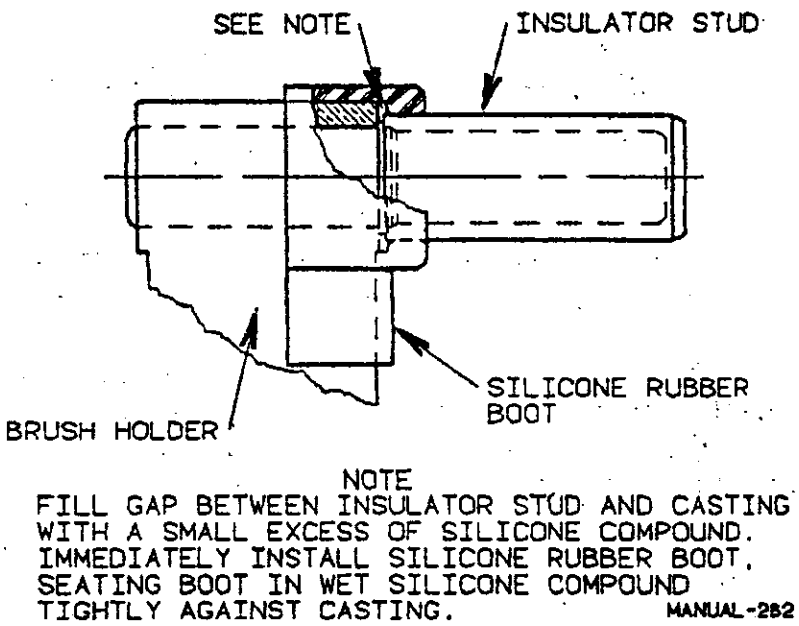


Fig. 12 - Brush Holder Insulator Stud Installation

outer surface of the slot to close it in. By peening and filing, the slot size can be reduced.

BRUSH HOLDER INSULATOR STUDS

Brush holder insulator studs should be kept clean and free of defects. The polyester insulated type insulator studs, Fig. 12, are unusually resistant to flashover damage. If flashover damage should occur, the insulator studs usually can be restored to satisfactory condition by polishing them with fine sandpaper. Polyester glass material should never be subjected to alkaline cleaning solutions.

The brush holders have a silicone rubber boot which fits over the base of the stud and brush holder, Fig. 12.

Replacement polyester glass insulated studs are available in the following sizes:

Standard size - 8159003

To be used in new brush holders or when stud holes are within 25.235 mm +/-0.013mm (.9935" +-.0005").

0.05 mm (.002") Oversize - 8209068

0.20 mm (.008") Oversize - 8219773

For stud holes which have had a standard size pressed out.

The following studs can be used for extensively scored stud holes which have been reamed out.

0.79 mm (.031") Oversize - 8209069
0.84 mm (.033") Oversize - 8222653
1.57 mm (.062") Oversize - 8222652
1.65 mm (.065") Oversize - 8222654

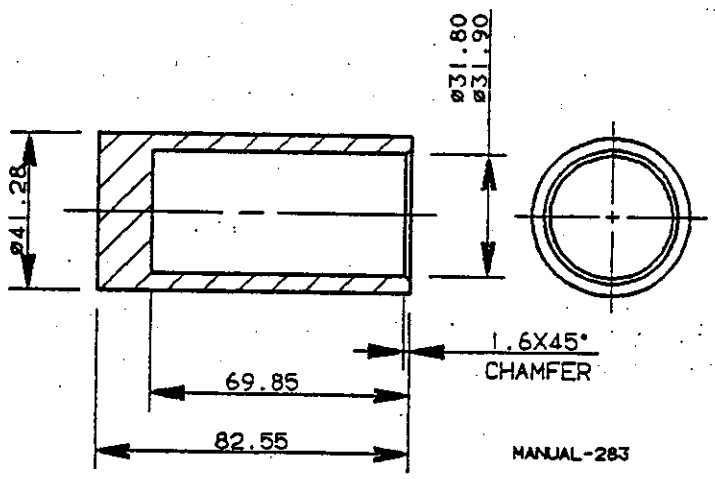


Fig. 13 - Insulator Stud Installation Tool

The oversize studs may be identified by the number 2, 8, 31, 33, 62, or 65 stamped on the bottom of the stud. The number is in reference to the amount oversize in thousandths of an inch. For example, the number 2 identifies the 0.05mm (.002") oversize stud. The number 65 identifies the 1.65 mm (.065") oversize stud.

INSULATOR STUD INSTALLATION

A sleeve-type tool made of half-hard brass, Fig. 13, should be used for pressing the studs into the brush holder.

To replace the brush holder insulator studs, perform the following procedure:

1. Press out brush holder insulator stud, shearing retaining pins.

2. Clean up stud holes of brush holder, if required.

3. Select proper oversize stud. Ensure that 0.05mm +- 0.025 mm (.002" +-.001") press fit is obtained. Press in stud using sleeve-type tool, Fig. 13. Clearance between the stud shoulder and brush holder must be maintained to ensure the insulation does not get damaged against the brush holder.

   Fill the gap between the insulator pin insulation and the casting with a small excess of silicone compound. Immediately install silicone rubber boot, seating boot in wet silicone compound tightly against the casting. Refer to Service Data for silicone compound part number.

COIL SPRING TYPE BRUSH HOLDER

All motors are equipped with constant pressure spring cell brush holders, which will accept a longer brush. This longer brush reduces maintenance by extending the period between brush change-outs.

CONSTANT PRESSURE BRUSH HOLDER

SPRING CELL REMOVAL

When inspection indicates it is necessary to remove the spring cell assemblies from the brush holder, Fig. 14, perform the following.

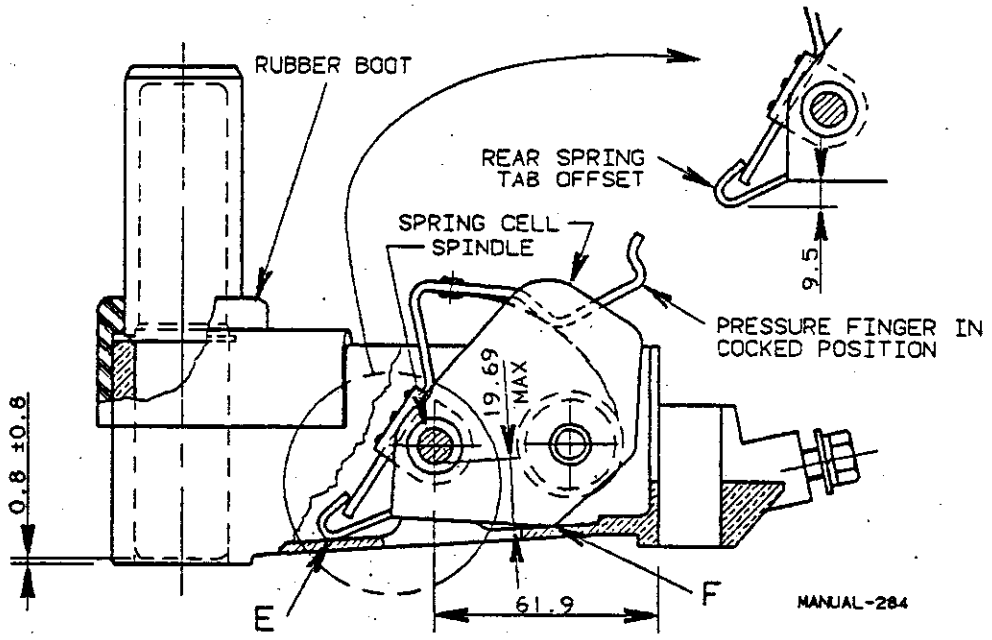


Fig. 14 - Constant Pressure Brush Holder

1. Place brush holder fingers in "cocked" position.

2. Pry lower end of each pin (visible in the holes directly below and at each end of the spindle) slightly upward until pin protrudes from the top of the holder. Pull pin out of hole.

3. Drive spindle out of brush holder to free spring cell assemblies.

SPRING CELL REPLACEMENT

Before replacing spring cell assemblies, inspect brush holder casting and insulator pins. Replace any defective parts with new parts. Repair all defects.

1. Insert the spindle in the spindle hole with the spindle pushed up against the top of the hole. Check the distance from the bottom of the spindle to the inside surface of the bottom web of the brush holder casting, as shown in Fig. 14. If this dimension is greater than 19.69 mm (.775") or if the hole is more than 51 mm (.020") oversize, the hole must be plugged and relocated.

2. Check rear spring tab to ensure that offset of tab is 9.5 mm (3/8"), Fig. 14. Bend rear spring tab as required. Place brush holder fingers in"cocked" position.

3. Place cell assembly in brush holder spring pocket with fingers centered in slot "A" as shown in Fig. 15.

4. Insert aligning tool through spindle hole and spring cell. Add necessary washers at areas "B" and"C" as shown in Fig.15. Check alignment of spring cell with finger slot "A" and, if cell is out of line, remove alignment tool and reassemble.

5. Follow same procedure with centre and left- hand cells. Use as many washers in the lineup as possible. After each cell is assembled, re-check the alignment with finger slot "A".

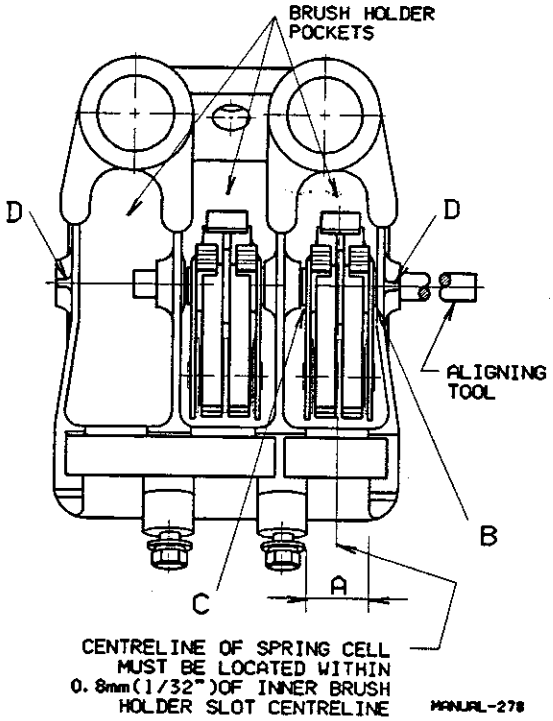


Fig. 15 - Installing Spring Cell In Brush Holder

6. When all cells have been installed, drive the aligning tool out of the assembly with the spindle. Continue to drive the spindle through until the spindle is centred in the brush holder.

7. If old spindle is used, the two 3.2 mm (1/8") diameter holes in the ends,"D" of Fig. 15, should be aligned with the matching holes of the brush holder. If new spindle is used, drill two 3.2 mm (1/8") diameter holes at area "D" of Fig. 15. Insert groove pins in each hole at area "D". Peen casting lightly into each hole to lock pins.

8. Ensure each spring cell is tight in the brush holder. If cells are properly installed, the cells will be held firmly at contact points "E" and "F" of Fig. 14. If required, adjust rear spring tab so that spring cell is anchored tightly in assembly at points "E" and "F". When spindle is driven in place, points "E" and "F" must have definite contact with holder.

9. After assembly, release brush holder fingers from "cocked" position to prevent handling damage and to prepare assembly for installation.

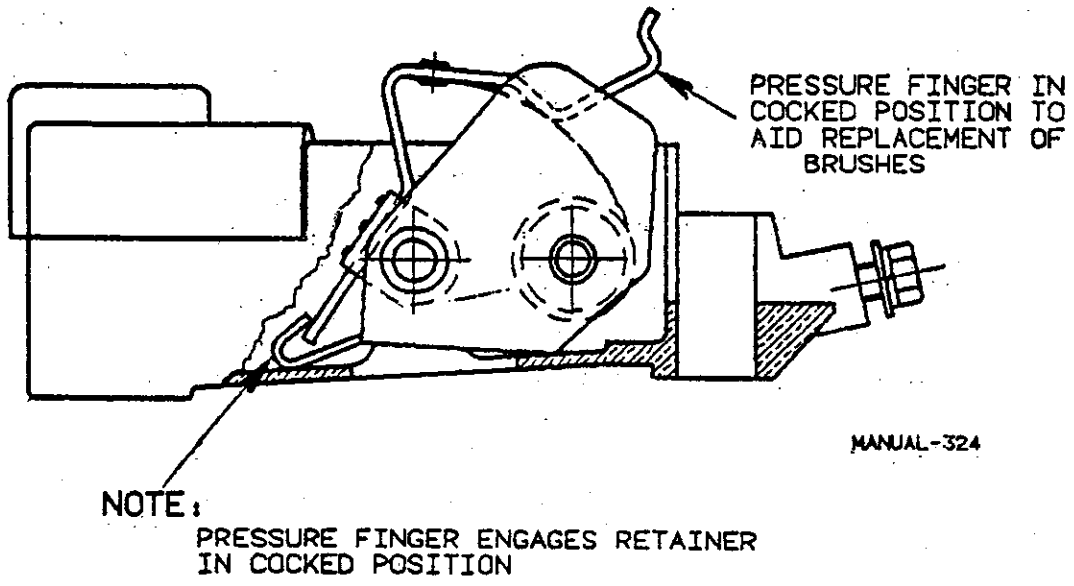


Fig. 16 - Brush Inspection

FRAME INSPECTION COILS REMOVED

All inspections and qualifications are the same as for a stator with coils intact, except for the following inspection of the main field and interpole seat dimensions.

MAIN FIELD POLE SEATS AND COIL PADS

1. Main pole seat diameter, Fig. 17, acceptable to 605.99 mm (23.858").

2. Main pole seat diameter concentricity acceptable to 0.51 mm (.020") total indicator reading. Concentricity total indicator readings between pinion end and commutator end of pole seat need not be compared, but the individual readings must be within 0.51mm (.020").

3. Dimension from centerline of armature to main field coil pads, Fig. 17, acceptable from 306.63 mm to 305.49 mm (12.072" to 12.027"). If dimension is at 305.49 mm (12.027"), main pole shield 8353542 must be used under pole.

INTERPOLE PADS

1. Interpole seat diameter, Fig. 17, acceptable from 761.87 mm to 762.25 mm (29.995" to 30.010").

2. Interpole pad diameter must be concentric within 0.89 mm (.035") total indicator reading between opposite pads.

MINOR FRAME AND AXLE CAP REPAIRS

This portion of the section covers minor frame repair and axle bores which require only a partial weld rebuild of not more than two inches on the bottom and three inches on the top of the axle bore.

If there is evidence of armature bearing failure, armature housing bore or face which requires machining, or if axle bore requires complete remanufacture, refer to Major Frame Repair of this section.

WELDING PROCEDURE - GENERAL

All welding referred to in this section should be done in accordance with the following procedure.

1. For weld build-up, the use of A.W.S. Class E-6012 or E-6013 electrodes of 3 mm to 5mm (1/8" to 3/16") diameter is recommended. For repair of cracks, use A.W.S. Class E-6010 or E-6011 electrodes for all root passes. The diameter of the electrode must be small enough to reach into the root of the groove preparation.

2. Observe the following cautions:

   a. Do not plug weld the eleven bolt holes of the commutator end housing bore face. Welding sets up considerable stresses in the commutator end endplate.

   b. No weld buildup is permitted for the sole purpose of counteracting shrinkage due to welding.

   c. When nickel plated surfaces are encountered, the plating must be removed prior to welding.

   d. Do not peen root passes.

3. All weld deposits should be free of slag inclusions, undercuts, or crater cracks.

4. Proper welding sequence, such as back step sequence or staggering of weld passes is important to minimize distortion associated with weld shrinkage.

5. Peening should be done with an air hammer and blunt nosed tools to partially relieve stress of the welded area. Peening should be done immediately after laying a weld bead and while the metal is still hot. Peening also helps to control shrinkage. For example, during weld buildup of axle bores, shrinking or closing-in of bore at the split line can be controlled by peening. Caution should be taken not to peen excessively.

6. Observe the following to repair cracks.

   a. Magnetic particle inspection should be employed to detect cracks.

   b. Preparation for weld repair requires complete removal of crack. This should be done by chipping, grinding or flame cutting. Flame cutting should be held to a minimum to avoid excessive distortion due to the additional heat input associated with the burning operation.

   c. During the removal of the cracks, scarfing to a single (45^{o}) or double (60^{o}) level should be incorporated during the same operation.

      Scarfing may be done from one or both sides depending upon the thickness of the piece being repaired. The root opening should be 3 mm (1/8") minimum, except on thick sections. Where casting shrink cracks have not progressed through the full thickness, removal of the crack is sufficient providing there is enough parent metal remaining to act as a back-up for welding.

      Magnetic particle inspect the groove preparation to assure complete removal of the crack.

   d Often it is of an advantage to employ back-up plates, especially if a thin section is repaired and scarfed from one side only.

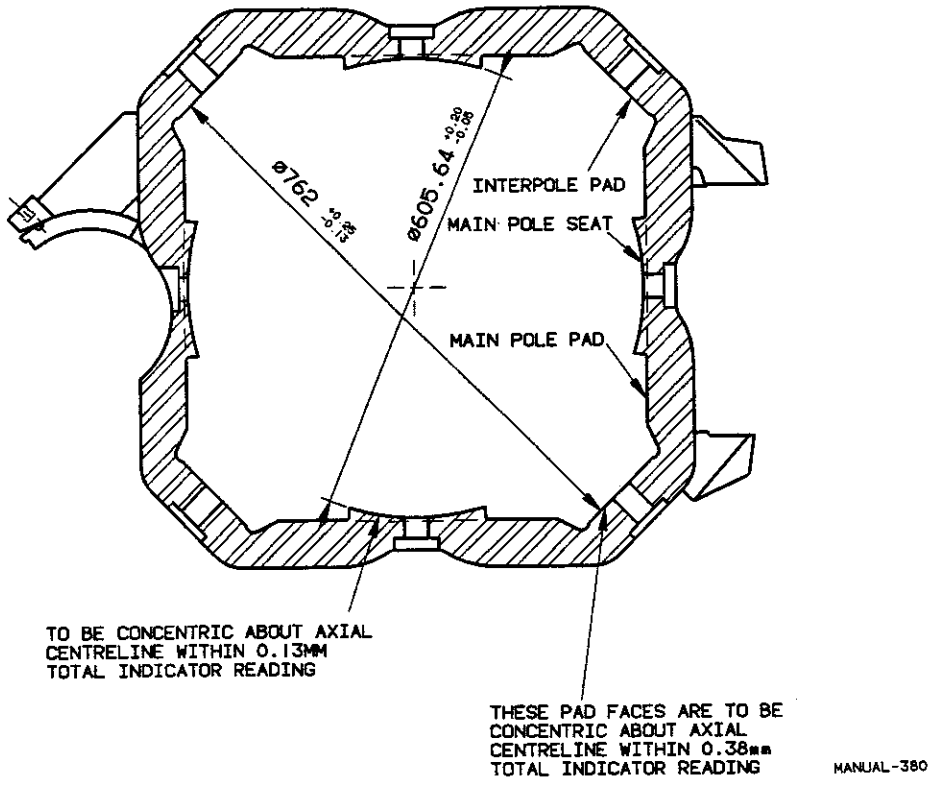


Fig. 17 - Frame Cross Section

Back-up plates must be fabricated of welding quality steel of 3 mm (1/8") minimum thickness, length and width to suit the application.

After the weld repair on one side has been completed, the back-up plate must be removed by flame cutting or chipping. The root pass should then be chipped out to remove entrapped slag or insufficient fusion and a back-up bead (weld pass) applied.

NOTE: It is always good practice to magnetic particle inspect initial root weld passes. Never cover up a root bead crack by applying additional weld beads, without first removing the defective weld. All weld repairs of cracks must pass final magnetic particle inspections.

AXLE CAP SPLINES

If the axle cap bore is acceptable, but the cap spline fits are out-of-tolerance, the spline fits may be restored with the following procedure.

1. Build up the 16 mm (5/8") wide surface on the top of the spline completely with weld. Cover the full area, approximately 292 mm (11-1/2") long.

2. The bottom spline area is approximately 51mm (2") wide. Apply a 22 mm (7/8") wide weld build up to the area next to the cap bore, across the full length of the cap.

3. No peening of any weld metal deposit on the axle caps is required.

4. Machine welded areas of the cap to provide a fit with the frame spline that is between 0.18mm (.007") tight (interference) and 0.33 mm (.013")

loose (clearance). This step should be taken after the frame spline has been properly rebuilt or determined to be dimensionally satisfactory.

NOTE: If old caps are used, serial numbers must correspond with numbers on the frame. New caps must be marked to correspond with frame numbers.

5. Machine a light cut from the axle cap (vertical) mountimg face on frame, if required, in order to allow machine stock in axle bore. Maintain new tolerance of Fig. 3 between upper and lower mounting faces, and on depth of spline surface.

FRAME AXLE BORE AND SPLINE FITS

If the frame axle bore and spline fits are out-of-tolerance, the bore and spline fits may be restored with the following procedure.

1. Depending on the extent of wear or distortion, either completely weld or partial weld the frame portion of the axle bore, Fig. 18. If more than 51 mm (2") of weld is required in the bottom or 76 mm (3") is required on the top of the bore, a complete reweld is required.

CAUTION
If stator frame requires complete axle bore welding, loosen No. 4 main coil assembly and prop away from frame during welding operation to prevent damage to coil insulation.

2. Apply weld build up in increments of two passes over the full 248 mm (9-3/4") length of the bore. Peen each increment immediately after deposition. Peening should cover the full weld area of each increment. Additional peening in the axle bore may be required after weld deposit has cooled to maintain spline or axle cap mounting hole spacing dimensions.

3. Machine light cut from axle cap mounting surface on frame, if required. Remachining spline on the frame should be brought back to new tolerance of 260.35 mm, + 0.15, -0.18 (10.250", +.006" - .007").

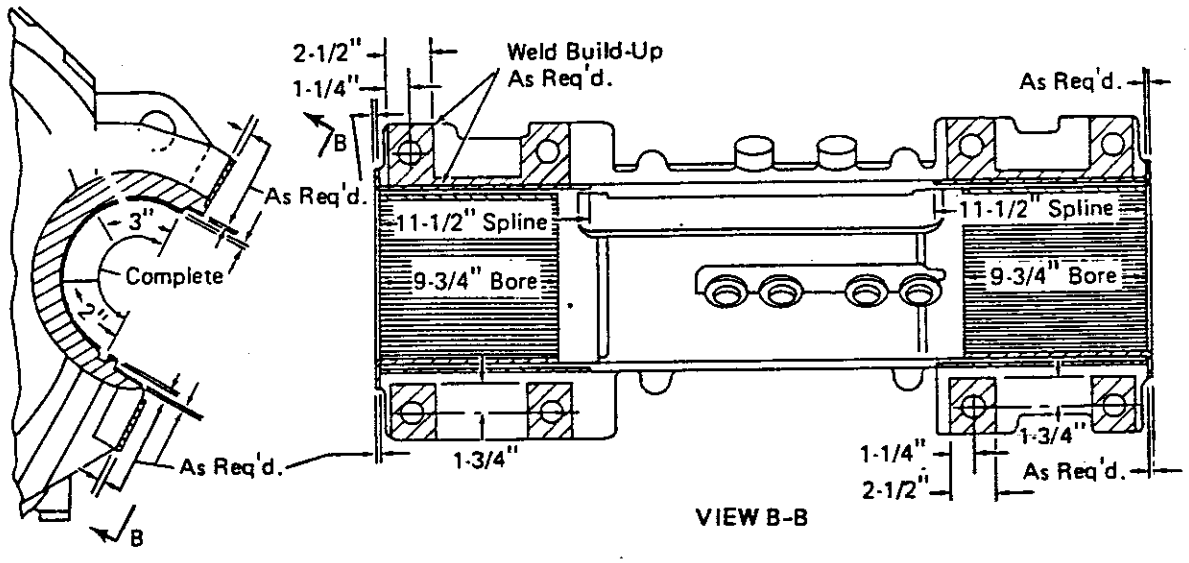


Fig. 18 - Frame Axle Bore Rebuild Welding

CAUTION:
Before removing stock from spline mounting faces on pinion end frame, a check must be made of both cap and frame to hold accumulative in machining on these mating faces to a maximum of 1.6 mm (1/16"). The 434.97 mm (17-1/8") dimension between the gear case mounting bolt and axle bore centreline must be not less than 432.99 mm (17-3/64") after machining mating face for the pinion end cap. The accumulative machining of mating faces for the commutator end cap must not exceed 3 mm (1/8").

4. A minimum of 18.03 mm (.710") must be maintained between the cap mounting surface and the vertical portion of the top spline. A 1.2 mm (3/64") radius or chamfer will be permitted at the frame side of the splines, providing tolerance is maintained on the mounting surfaces of the axle caps.

5. Assemble axle caps to frame with a 0.46 mm (.018") shim. Serial number on axle caps must correspond with serial number on frame. Rebore axle bore to new print dimension. Refer to Axle Bore Reboring Tolerances of this section for bore tolerances.

6. When axle bores have been welded and re-machined, the keyway can change depth, due to a shift in bore location to gain machine stock. A maximum keyway depth of 7.62mm (.300") is permitted. Minimum keyway depth is 6.35 mm (.250"). Maximum key protrusion is 6.35 mm (.250").

FRAME AXLE BORE OUTER FACE

To build-up axle bore outer face, welding should be started on one end of the 180 degree arc, at the largest diameter of the semi-circle.

1. Apply weld metal build-up in increments of two passes over the full length of the semi-circle.

2. Peen each increment immediately after welding. Peening should cover the full welded area.

AXLE BORE REBORE TOLERANCE

1. Centre distance between frame bores and axle bores condemning limit is 434.19 mm (17.094") at the pinion end, however 433.88mm (17.082") will be acceptable at the commutator end when the pinion end is at the low limit of 434.19 mm (17.094").

2. Axle bores must be parallel to armature bores within 0.30 mm (.012"). Commutator end axle bore must be parallel to pinion end axle bore within 0.13 mm (.005").

3. The centreline of the axle bore and centreline of pinion end axle cap gear case support arm bolt hole must be held to a maximum variation of not more than 0.76 mm (.030").

4. Upon completion of axle bores, the spline dimension must be remeasured. If the spline has not been reworked, the spline dimension must correspond to preliminary measurements. If the splines have been reworked, the spline dimension must be within "new" tolerance.

5. A mandrel check shall be made on all frames which have had any work performed on axle bores or splines.

6. Rebored axle bores occasionally do not clean up completely. Rebuilt axle bores not requiring complete weld build up may have an "uncleaned" area of up to 5162 mm^2 (8 sq.in.) any place in the frame half of the bore. However, at the parting line, an additional uncleaned area may extend the full length of the bore.

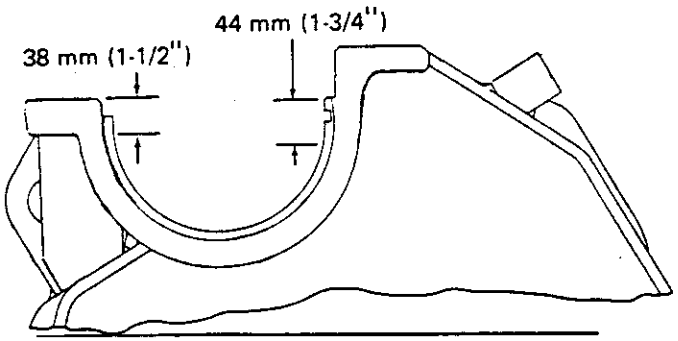


Fig. 19 - Frame Axle Cap "Unclean" Maximum Tolerance

Measure the width of the uncleaned area. Width must be within the limits of Fig. 19.

7. Frames requiring new axle caps should have the 1063.63 mm +- 0.13, (41.875" +-.005") dimension restored. A 0.8 mm (1/32") step is permissible between the pinion end armature bore and the pinion end axle bore.

NOSE SUSPENSION LUG AND WEAR PLATE

If the distance between wear plate and lower suspension lug machined surface is more than 307.2 mm (12-3/32"), refer to Fig. 20 and perform the following procedure.

1. Check the lower suspension lug dimension from horizontal centreline of motor. If dimension is greater than limits of Fig. 20, area should be milled to dimension of Fig. 20 and a 6.35 mm (.250") wear plate welded to suspension lug. Refer to Wear Plate Welding Procedure which follows. It is not necessary to maintain the 45° chamfer on lower suspension lug as shown in Fig. 20, but maintain the 374.6 mm (14-3/4") dimension from vertical centreline of motor as shown in Fig. 20.

2. If the lower suspension lug is within tolerance, the 19.05 mm (.750") upper suspension lug wear plate must be replaced. If upper suspension lug is undersize, build up with weld and re-machine to dimension of Fig. 20. Use only A.W.S.E-7016 stick electrode. Refer to Wear Plate Welding Procedure which follows.

NOTE: Upper suspension lug is not a normal wear area, but if for any reason such as a loose wear plate pounding lug, the suspension lug must be welded and re-machined.

WEAR PLATE WELDING PROCEDURE

The proper preparation of motor frame surface is very important to successful application of the wear plates. The frame surface must be smooth and flat. Remove any weld beads or high spots. If the nose bracket face dimension is not within tolerance of Fig. 20, the surface must be welded and re-machined. Perform the following procedure to install wear plates if required.

1. Position wear plates on frame and hold in place with a hydraulic jack which exerts a force of 4.5 to 7.3 tonnes (5 to 8 tons).

2. Check wear plate fit to frame with a 0.08mm (.003") shim. Shim should not enter more than 13 mm (1/2") at any point between the frame and the pad. Excess gap can cause weld to fatigue.

3. Weld wear plates to frame using E-Fe-Mn-A welding electrode. Ensure good penetration is obtained on both the frame and the wear plate.

4. Allow weld to cool for a few minutes before removing jack. Check the plate fit to frame with a 0.08 mm (.003") shim.

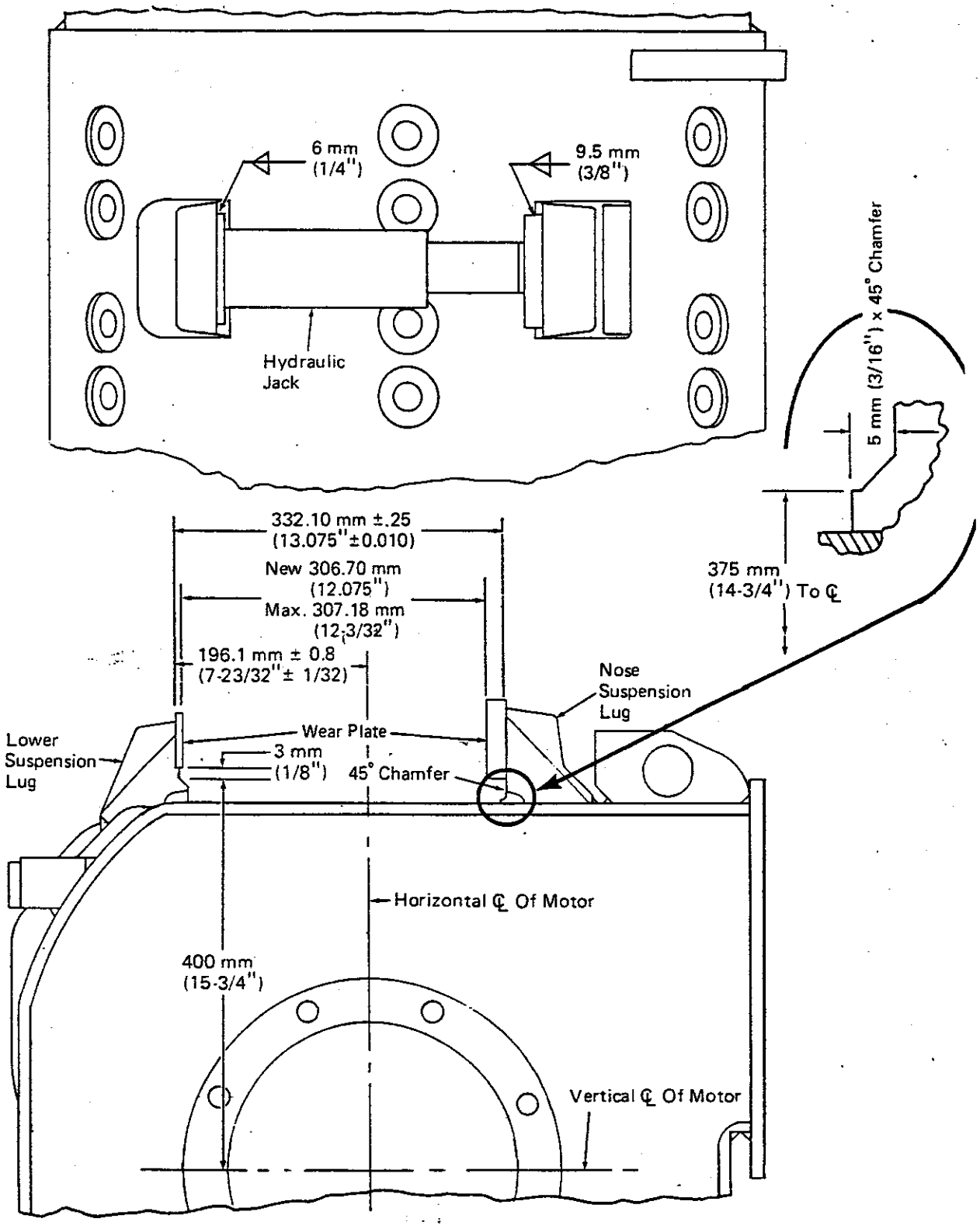
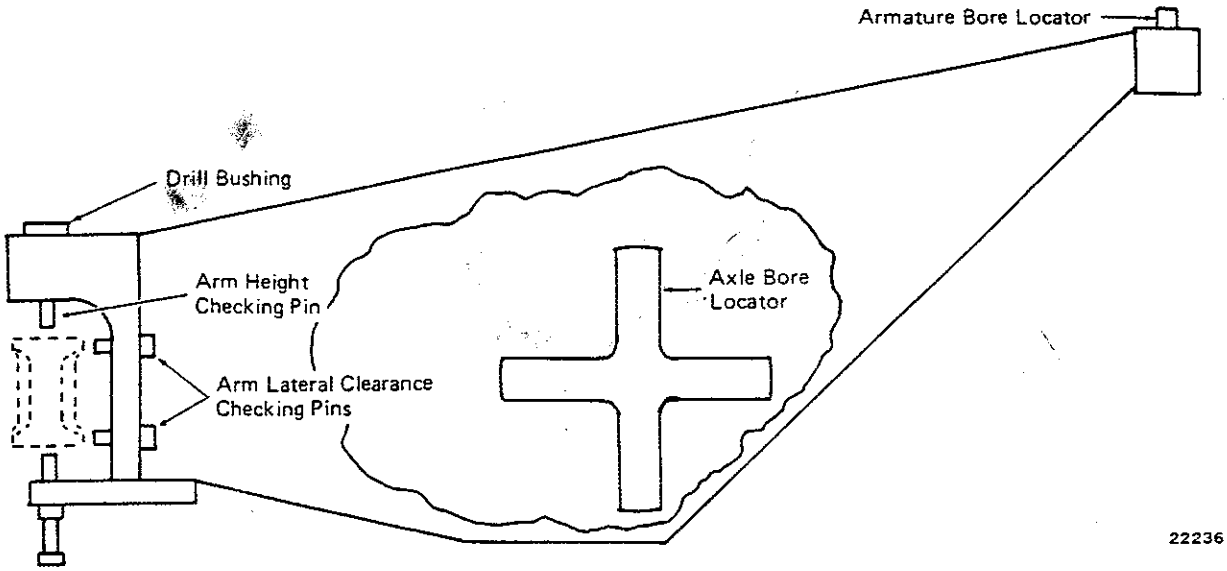


Fig. 20 - Nose Suspension Lug And Wear Plate



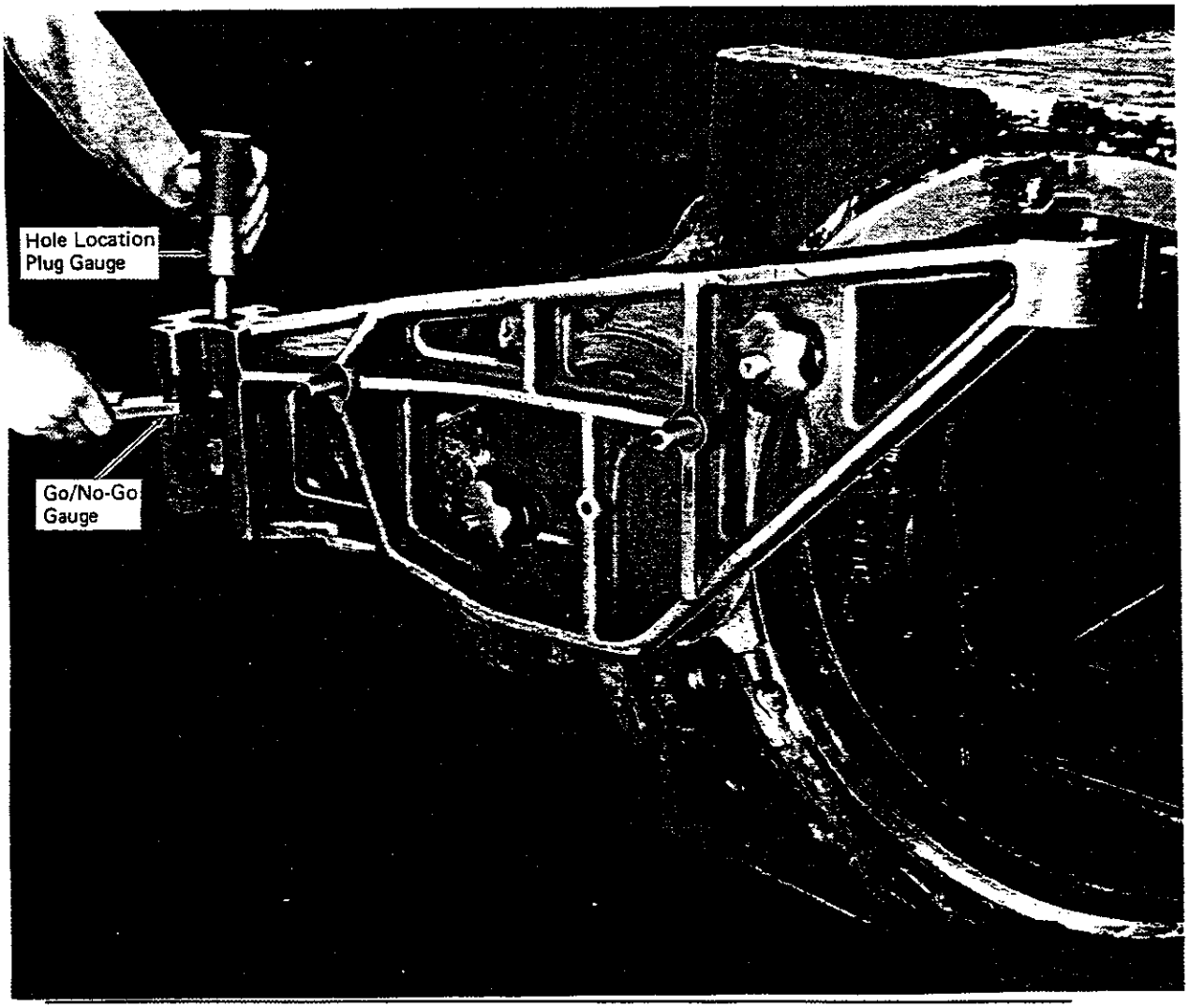


Fig. 21 - Pinion End Axle Cap Arm and Mounting Hole Locator Gague and Drill Jig

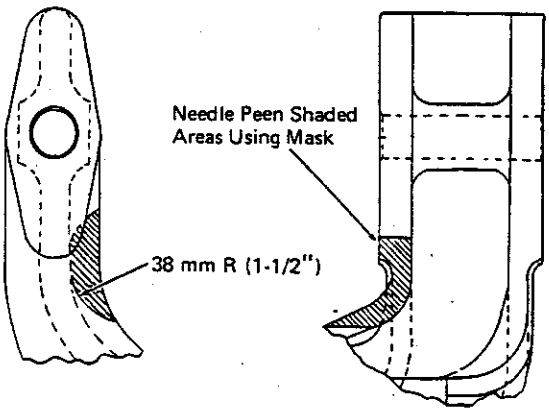


Fig. 22 - Pinion End Axle Cap Gear-case Support Arm Needle Peening

5. Check the distance between the wear plates. The distance should be a nominal 306.70 mm (12.075").

AXLE CAP MOUNTING BOLT SPOTFACE

If the mounting bolt spotface on the axle cap is galled or beyond the 25 mm (1") minimum thickness, the spotface should be welded and machined to the "new" dimensions shown in View A of Fig. 3. The washer spotface and the area around the spotface may be built up to 3mm (1/8") to add support to the mounting flange. The weld at the lower end of the weld area is to blend into the cap and not have a weld undercut or abrupt stop.

PINION END AXLE CAP GEAR CASE MOUNTING

1. Check location of the 27 mm (1-1/16") diameter mounting hole in the pinion end axle cap arm using combination gauge and drill jig as shown in Fig. 21. Refer to Service Data for combination gauge and drill jig file number.

2. If the 27 mm (1-1/16") diameter mounting hole is off location, apply heat from a torch to the elbow section of the axle cap arm. After sufficient heating, apply pressure to the arm and straighten arm to obtain proper hole location.

3. If the mounting hole dimensions are out-of-tolerance, or were thrown out-of-line when straightening arm, perform the following procedure.

   a. Plug weld the 27 mm (1-1/16") gear case mounting hole in the axle cap.

   b. Remove excess weld from top and bottom gear case mounting surfaces.

   c. Reassemble combination gauge and drill jig and redrill 27 mm (1-1/16") diameter hole. Hole location is 434.98 mm +/- 0.8mm (17-1/8" +/- 1/32") from axle bore centreline to the 27 mm (1-1/16") diameter hole centreline.

4. Needle peen gear case support arm as shown in Fig. 22, using axle cap needle peening fixture. Needle peen with twelve 3 mm, round end peening wire needles at 517 to 655kPa (75 to 95 psi) for 30 to 35 seconds to obtain 100% coverage. Refer to Service Data for needle peening fixture file number.

   The area shown to be needle peened in Fig. 22 must have a 3 mm (1/8") corner radius. A radius smaller than 3 mm (1/8") or irregular notched surface will require grinding with a high speed pencil type grinder to produce a smooth, blended surface. Any grinding or welding in this area necessitates re-needle peening of the entire area using peening fixture.

BRUSH HOLDER BLOCKS

Re-assemble brush holder blocks to frame. If the block requires more space than the 40 mm (1.574") bolt hole will provide to be within the limits of Fig. 7, the tapped hole in the frame must be relocated to bring the blocks within tolerance.

MAJOR FRAME REPAIR COILS INTACT

NOTE: If welding is required, refer to General Welding Procedure in the Minor Frame and Axle Cap Repairs part of this instruction.

PINION END ARMATURE HOUSING BORE

NOTE: If pinion end armature housing bore requires reboring, commutator end armature housing bore must be welded and machined to limits of Fig. 7.

When it is necessary to rebore one or both armature housing bores and/or re-face one or both armature housing bore faces, it will be necessary to line bore both bores and machine both bore faces in the same set up.

Pinion end armature housing bore may be welded to the standard size of 581.03 mm, + 0.051, -0.025 (22.875", +.002", -.001"), Fig. 7 and Fig. 23, or may be machined to any of the following approved oversizes, without welding.

0.8 mm (1/32) oversize 581.81 mm + 0.051, -0.025 (22.906" +.002" - 001")

1.59 mm (1/16") oversize 582.70 mm + 0.051, -0.025 (22.941" +.002", -.001")

2.38 mm (3/32") oversize 583.46 mm + 0.051, -0.025 (22.971" +.002", -.001")

3.18 mm (1/8") oversize 584.23 mm + 0.051, -0.025 (23.001" +.002" -.001")

If the pinion end armature housing bore requires rewelding, perform the following procedure:

1. Pinion end armature housing bore may be built up with weld as shown in Fig. 23. Plug housing bolt holes with ceramic plugs to prevent weld splatter on bolt threads. Weld one-half (180°) of the bore and then peen the weld deposit. Repeat this procedure for the other half. Refer to Service Data for ceramic plug file number.

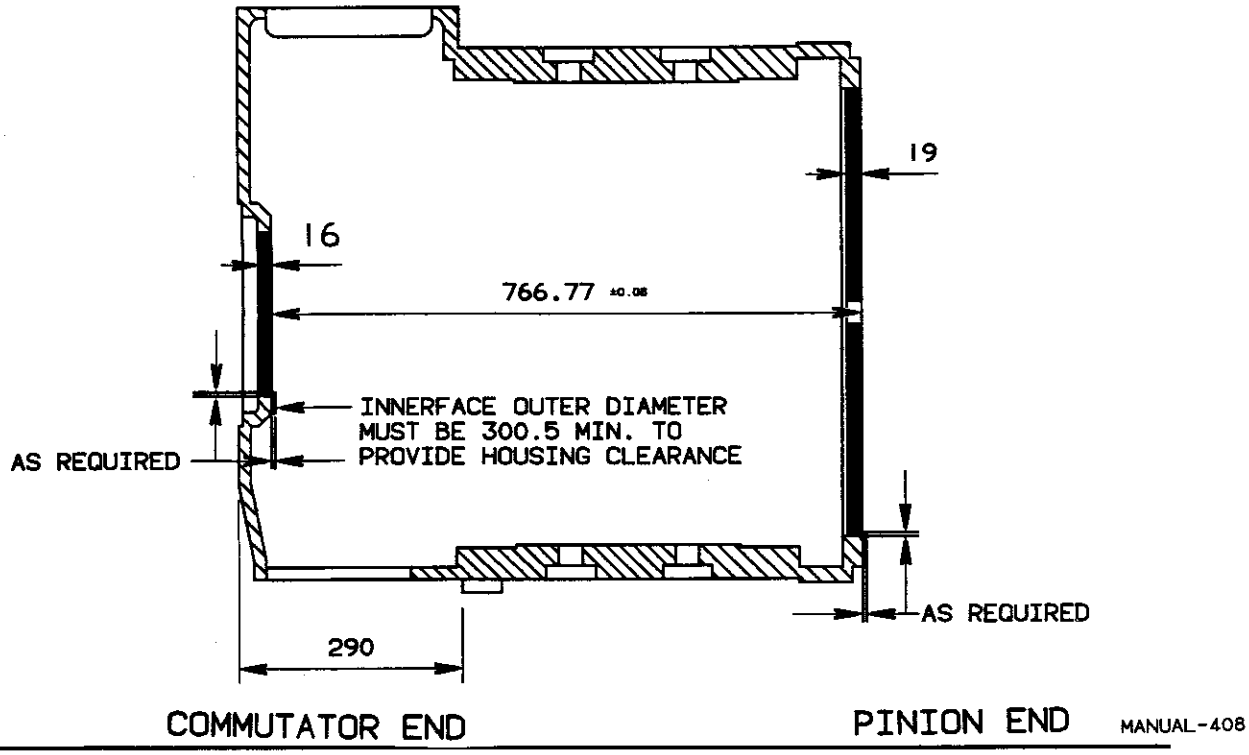


Fig. 23 - Pinion End & Commutator End Armature Housing Bor

MAJOR FRAME REPAIR COILS INTACT

NOTE: If welding is required, refer to General Welding Procedure in the Minor Frame and Axle Cap Repairs part of this instruction.

PINION END ARMATURE HOUSING BORE

NOTE: If pinion end armature housing bore requires reboring, commutator end armature housing bore must be welded and machined to limits of Fig. 7.

When it is necessary to rebore one or both armature housing bores and/or re-face one or both armature housing bore faces, it will be necessary to line bore both bores and machine both bore faces in the same set up.

Pinion end armature housing bore may be welded to the standard size of 581.03 mm, + 0.051, -0.025 (22.875", +.002", -.001"), Fig. 7 and Fig. 23, or may be machined to any of the following approved oversizes, without welding.

0.8 mm (1/32) oversize 581.81 mm + 0.051, -0.025 (22.906" +.002" - 001")

1.59 mm (1/16") oversize 582.70 mm + 0.051, -0.025 (22.941" +.002", -.001")

2.38 mm (3/32") oversize 583.46 mm + 0.051, -0.025 (22.971" +.002", -.001")

3.18 mm (1/8") oversize 584.23 mm + 0.051, -0.025 (23.001" +.002" -.001")

If the pinion end armature housing bore requires rewelding, perform the following procedure:

1. Pinion end armature housing bore may be built up with weld as shown in Fig. 23. Plug housing bolt holes with ceramic plugs to prevent weld splatter on bolt threads. Weld one-half (180°) of the bore and then peen the weld deposit. Repeat this procedure for the other half. Refer to Service Data for ceramic plug file number.

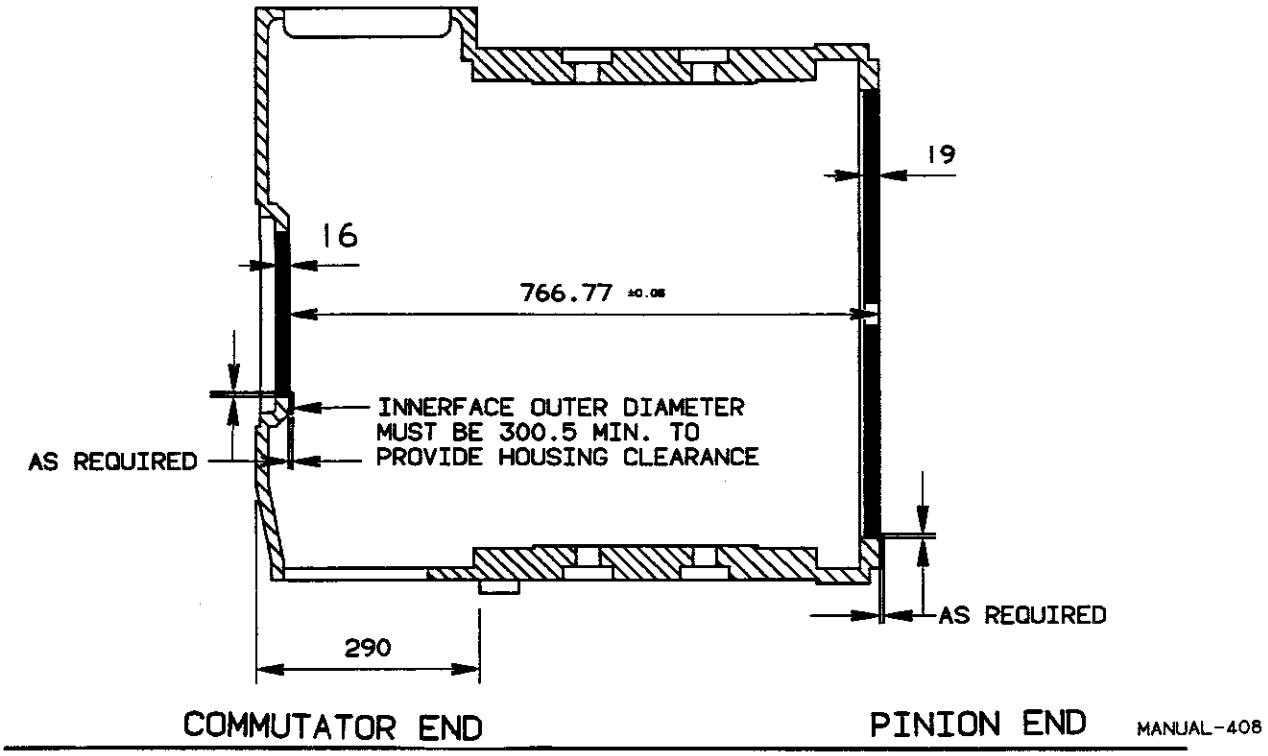


Fig. 23 - Pinion End & Commutator End Armature Housing Bor

2. To machine the armature housing bore, refer to Pinion End Armature Housing Bore paragraphs of Inspection and Qualification part of this instruction for size and concentricity tolerance.

COMMUTATOR END ARMATURE HOUSING BORE

NOTE: If commutator end armature housing bore requires reboring, pinion end armature housing bore must be welded and machined to limits of Fig.7.

When it is necessary to rebore one or both armature housing bores and/or re-surface one or both armature housing bore faces, it will be necessary to line bore both bores and machine both bore faces in the same set up.

If the commutator end armature housing bore requires rewelding, perform the following.

1. Commutator end armature housing bore may be built up with weld as shown in Fig-23.

2. To machine the armature housing bore, refer to Commutator End Armature Housing Bore paragraphs of Inspection and Qualification part of this instruction for size and concentricity tolerance.

PINION END ARMATURE BORE OUTER FACE

NOTE: When it is necessary to rebore one or both armature housing bores and/or reface one or both armature housing bore faces, it will be necessary to line bore both bores and machine both bore faces in the same set up.

When pinion end armature bore outer face requires a complete weld build-up, either of two methods can be used.

1. Weld the complete outer face and then peen the entire welded area.

2. Weld the area around the pinion end mounting bolt holes as shown in Fig. 24. Peen the entire welded area. Protect the threaded bolt holes during welding and ensure the unwelded area is free of weld splatter.

COMMUTATOR END ARMATURE BORE INNER FACE

NOTE: When it is necessary to rebore one or both armature housing bores and/or re face one or both armature housing bore faces, it will be necessary to line bore both bores and machine both bore faces in the same set up.

The complete surface of the commutator end inner armature bore face may be built up with weld if necessary, but check the following to ensure weld build up is required.

1. Recheck bore face. When the commutator end armature bore has been welded, the commutator end armature bore face usually pulls inward approximately 0.13 mm to 0.25 mm (.005" to .010") which usually provides sufficient machining stock.

2. Check commutator end plate to determine if plate is thick enough to permit relocation of the 1 044.58 mm (41.125") dimension of Fig. 23.

No peening of weld is required. Peening increases stresses of the commutator end plate already induced by the heat input of the weld build-up.

COMMUTATOR END ARMATURE BORE OUTER FACE

NOTE: When it is necessary to rebore one or both armature housing bores and/or reface one or both armature housing bore faces, it will be necessary to line bore both bores and machine both faces in the same set up.

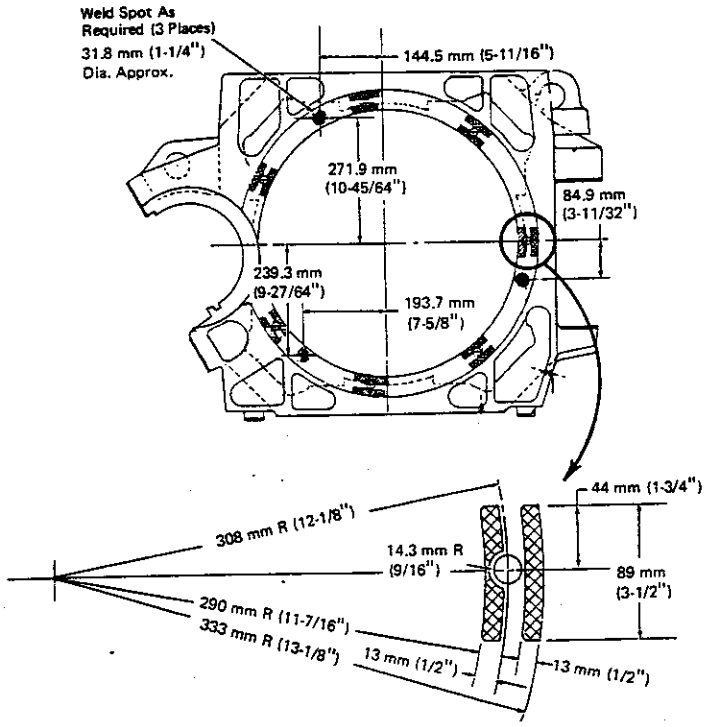


Fig. 24 - Pinion End Armature Housing Bore Face Welding

Enlarge commutator end 20.6 mm (13/16") armature housing bolt holes to 22.2 mm (7/8"), Fig. 25. Holes must be within 1.0 mm (0.041") of nominal location with respect to armature bore.

MAJOR FRAME REPAIR COILS REMOVED

MAIN FIELD POLE SEATS AND COIL PADS

1. The frame main pole seat diameter, 605.64mm (23.844"), Fig. 17, is to be processed during frame line boring operation to remove random high spots that may exist. However, the 605.64 mm (23.844") diameter is not to exceed 605.99 mm (23.858"). Maximum difference between opposite main pole seats is not to exceed 0.38 mm (.015") total indicator reading when checked from the housing bore centreline.

2. Main pole seat diameter is acceptable to 605.99 mm (23.858"), Fig.17. If main pole seat diameter is greater than 605.99 mm (23.858"), machine oversize to 608.58 mm (23.960") and add 1.5 mm (.058") shims 8329728 to each pole seat to obtain 605.64mm (23.844"). Shims not to exceed 1.6 mm (1/16"). Weld shims to each pole seat.

3. Main coil pad diameter is acceptable, without machining, from 306.63 mm to 305.49 mm (12.072" to 12.027"), when checked from the frame housing centre-line, Fig. 17. The main pole coil pads on each side of the pole seat must be equalized within 0.51 mm (.020") using shims where necessary.

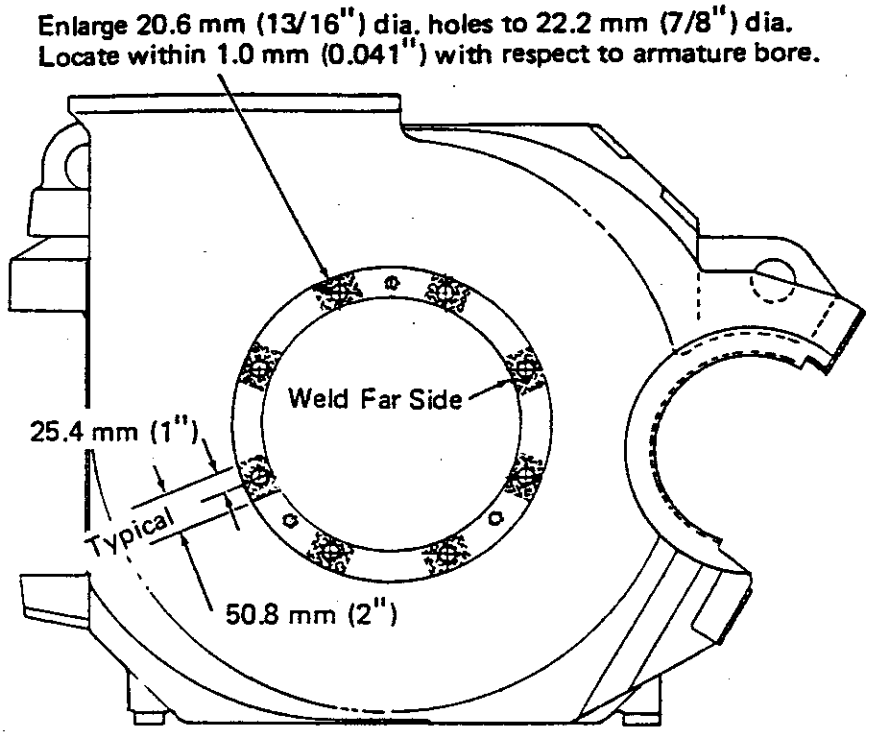


Fig. 25 - Commutator End Armature Housing Bore Face Weldin

4. Coil pads on each side of pole seats must be parallel to centerline by no more than 0.51mm (.020").

5. Coil pads requiring use of adhesive backed shims must have pad areas thoroughly cleaned and all rust, paint, and varnish removed to provide good contact for shims.

6. If a main coil pad diameter dimension from housing bore centreline is at the minimum 305.49 mm (12.027") main pole shield 8353542 must be used in the coil and pole assembly to obtain proper air gap.

INTERPOLE PADS

1. The interpole pad dimension is acceptable at 762.00 mm, + 0.25, - 0.13 (30.000" +.010" -.005"). If the dimension exceeds the 762.00mm, but by not more than 3.2 mm (1/8"), add shims as necessary.

2. Interpole pad diameter must be concentric within 0.89 mm (.035") total indicator reading between opposite pads.

NOTE: Frames with main and interpole coil pads that cannot be corrected by shimming or straightening should be returned to the Electro-Motive Division for machining due to special tooling and facilities required to make corrections.

SERVICE DATA

EQUIPMENT

Brush Holder Spring Cell Aligning Tool..... 8305181

Brush Holder Spindle Hole Plug 8166383

Brush Holder Spring Tension Scale 8415805

Brush Slot Gauge 8259133

Concentricity Gauge, Armature Housing Bore Faces .....*File No. 884

Combination Gauge And Drill Jig,

Pinion End Axle Cap Arm And Mounting Hole..... *File No. 885

Needle Peening Fixture, Axle Cap Arm ..... *File No. 886

Axle Cap Simulator ..... *File No. 888

Ceramic Plug-Armature Bore Face Welding (2B-31798) .....*File No. 889

Silicone Compound, 5 oz tube 8453256

MATERIAL

Solder, Flux 8116442

Solder, 63-37 8004403

Solder, Sil-Fos 8004440

Solder, Tin Base 8225761

* File numbers represent facility drawings that are available from Clyde Service Department. These drawings include construction details of tooling that can be manufactured.