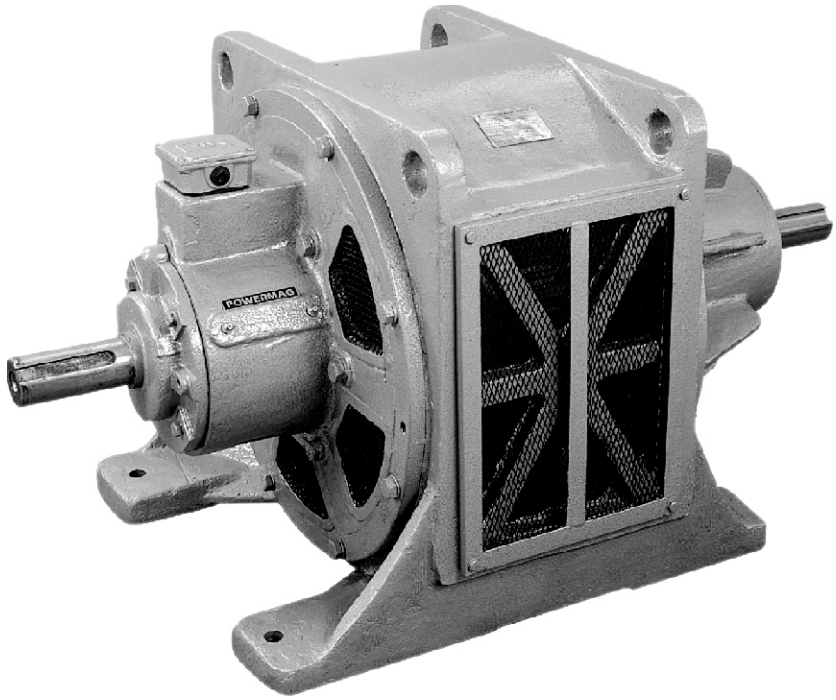
INSTRUCTION MANUAL

POWERMAG

EDDY CURRENT DYNAMOMETER



(0.25 Kg-m - 57.6 Kg-m Torque Rating)

CONTENTS

CAUTION

If the checks or adjustment procedures given in the catalogue do not yield expected results.

a. Stop the eddy current dynamometer and turn off all AC Power.

b. Check that all connections are in strict conformity to the wiring diagram.

c. Consult trouble shooting section of the respective manual.

1.1 - RECEIVING

This manual contains installation procedure, operating, maintenance and trouble shooting instructions for POWERMAG eddy current adjustable dynamometer, in standard foot-mounted aircooled designgs for torque rating 0.25 kg-m to 48 kg-m

POWERMAG eddy current dynamometer and its controls are despatched, after due inspection and routine mechanical and electrical tests. On receipt, ensure that the units have not sustained any outward damage in transit. In case of any noticeable transit damage, promptly notify us, giving name plate ratings and your observations. If such intimation is not received by us before start-up and commissioning, the cause of damage will be determined by our engineers and the decision will be final.

Operation and start-up procedure should be in strict conformity to those given in the respective catalogue.

1.2 - CONSTRUCTION

Standard POWERMAG eddy current adjustable dynamometer consists of a housing frame, inductor, excitation coil, rotor drum, input and output brackets, input and output shafts with bearings. (Kindly refer exploded view on Page No. .....9)

DC power is applied to a ring-shape excitation coil located between frame and bracket. The fan integrated with rotor drum cools the excitation coil.

An integral (48 pole) A.C. Tacho-generator (optional) is mounted on the input rotor shaft, to give voltage and frequency propotional to speed which is used for speed indication (RPM), so that simultaneously torque and speed of the motor / engine can be read under 0% to 100% load test.

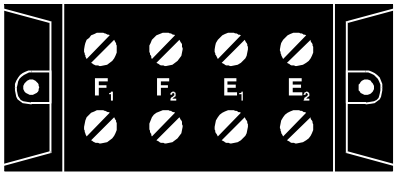
1.3 - DYNAMOMETER SPECIFICATIONS

Torque ratings available	:	0.25, 0.48, 1, 1.4, 2.4, 3.6, 4.8, 7, 9.6, 14.3, 19, 24, 28.7, 36, 48 & 57.6
Speeds	:	120 to 5000 RPM
Ventilation	:	Air-cooled, Self-ventilated, Drip-proof, Totally enclosed-Fin cooled.
Coil Voltage	:	90 V.D.C Max.
Coil Current	:	for torque ratings — Current Amps (DC) 0.25 to 7 kg-m — 3.0 7.0 to 57.6 kg-m — 5.0
T.G. Voltage	:	30V AC / 1500 rpm or 60V AC / 3000 rpm
Ambient temp. range	:	40°C Max.
Operating altitude	:	1000 mts.
Service factor	:	1

1.4 TERMINAL DATA

A Separate Terminal Block is provided on the eddy current coupling. The terminal markings are as shown below.

TERMINAL BLOCK



(On eddy current dynamometer)

Coil input E1+ve

E2-ve

Tacho output F1 & F2

1.5 TACHO GENERATORS

SPECIFICATIONS		
Stator resistance at 28°C. (nominal)	:	11 to 19 ohms
Standard output Voltage/1000 r.p.m	:	20 V r.m.s
Wattage	:	2.5 watts
Frequency/1000 r.p.m.	:	400Hz.
No. of poles	:	48
Linearity	:	0.5%

2.1 INSTALLATION

This section contains general procedure for installing, operating, trouble shooting and ordering renewal parts for the machanical portion of POWERMAG eddy current dynamometers for the torque range of 0.25 kg-m to 57.6 kg-m.

LOCATION:

Unless rated for special duty, these eddy current dynamometer should be located to conform to our following specifications:

1. Ambient temperature to be within -6°C to + 40°C.
2. Alitidue to be under 1000 mts.
3. The atmosphere to be clean and dry and free of inflammable or combustible vapours, excessive moisture or dust.
4. There should be room around the equipment so as to
   - Provide accessibility for inspection and adjustments.
   - Provide non-restricted air flow to the intake and from the exhaust vents on both sides of the eddy current dynamometer.

5. There should be no restriction in the air flow or any possibility of re-circulation of the heated exhaust air, back into the intakes.

MOUNTING :

The eddy current dynamometer can be mounted in any position, if it is protected from axial thrusts from the driven machine. The mounting surfaces should be rigid and vibration-free.

POWERMAG eddy current dynamometer having an input shaft which can be coupled with any motor / engine under test. The motor / engine can be aligned on a common bed plate and coupled to the input shaft of the eddy current dynamometer by means of a suitable coupling.

Mounting flexibilty and variations are possible. For instance, the motor /engine can be conviniently positioned on side or top of the eddy current dynamometer. The input shaft of which can be coupled to the motor / engine shaft, by means of a V-belts.

When "POWERMAG" eddy current dynamometer is to be coupled to a test motor / engine, care should be taken to identify and couple the input shaft of the eddy current dynamometer to motor/engine.

DIRECT COUPLING

In direct coupling, standard - engineering practices should be followed to ensure correct alignment of driving and driven shafts. Misalignments can cause undue stresses on the bearings and significantly lower bearing life. Use a dial indicator and ensure that the angular misalignment is within 0.05 mm (0.002") and that the total run-out of the shaft is within 0.015 mm. Use of a good quality tyre coupling is recommened where alignments cannot be strictly enforced.

2.2 ELECTRICAL CONNECTIONS

All Electrical Connections are clearly indicated in the respective terminal blocks and associated control equipments. For details, refer to the catalogue on the control equipment.

2.3 START-UP PROCEDURE

PRELIMINARY CHECKS

Before operating the equipment, disconnect all incoming power lines and perform the following checks.

1. Check rotating equipments for grounds. If a meggar is used, make sure that all leads are disconnected from the control cabinet. This precaution is to avoid damage to the electronic circuits.
2. Check that the input and output shafts can be rotated freely by hand.
3. Check that all interconnections between the eddy current dynamometer and control equipments are in strict conformity to the wiring diagrams. Refer the relevant catalogue on the specific control unit used with the equipment.

Torque measurements can be made either by spring balance weighing gear arrangement or by using torque transducer.

TORQUE ANALYSIS WITH SPRING BALANCE WEIGHING GEAR

In this method, 200 mm Dia pulley to be fitted on the output shaft of dynamometer and it should be connected with spring balance - weighing gear by means of steel rope. The spring balance weighing gear is to be hooked on the top of the iron channel fitted on base plate

Torque kg-m can be calculated by the formulat : $T = \frac{4500\ HP}{2\ ?\ N}$

Whereas HP is the rated power and N is the rated speed (rpm) of the motor / engine under test.

(or) Torque kg-m = $\frac{973\ (x)\ kW}{Speed\ (rpm)}$

(or) Torque kg-m = $\frac{5252 \times HP}{Speed\ (rpm)}$ (x) lb. ft

(or) Torque kg-m = $\frac{4500\ HP}{Speed\ (rpm)}$ (x) Nm.

1 Nm = 0.102 kg-m = 0.737 lb. ft.

TORQUE ANALYSIS WITH SPRING BALANCE WEIGHING GEAR

In this method, the inline torque sensor can be coupled between input shaft of eddy current dynamometer and testing equipment motor / engine shaft. Please not in this arrangement the output shaft of the eddy current dynamometer has to be locked with the bracket, so that output shaft of eddy current dynamometer should not rotate.

START-UP AND ADJUSTMENTS

For start-up and adjustment procedure, follow step-by-step instructions, given in the catalogues of control equipment.

2.4 MAINTENANCE

ROUTINE INSPECTION AND MAINTENANCE :

The following periodic inspection and maintenance of the electrical rotating equipments should be performed to prevent interruption in service.

1. Inspect control cabinets and covers for tightness.
2. Check electrical equipments and terminal blocks of eddy current dynamometer for firm electrical connections and cleanliness. If excessive dust or dirt has accumulated,
   - Turn ‘OFF’ all input power.
   - Use a vaccum or low pressure clean air to remove dust and dirt on the components and housings.

3. Check air filters and ventilation covers for cleanliness. If the ventilation covers are found clogging, remove them and clean separately in a boiling solution of water and a suitable grease solvent. Rinse in plain hot water and stand to dry, before refixing them in place. DO NOT use caustic soda.
4. Check for bearing noise and bering temperatures. The permissible temperature rise of the bearings, over the ambient (40°C) is less than 50°C, when measure on the surface of bearing cover. If the said limits are exceeded, the probable causes are

   - Deterioration and caking of grease.
   - Undue stresses on the bearings due to poor belting, improper alignment of coupling etc.

BALL BEARINGS

where regreasable bearings are used lubricate with high lithium grease, using a grease pump, once in every 1200 running hours. Greasing should be done while the eddy current dynamometer is running. Where grease-packed sealed bearings are used, replace bearings once in 2 years.

2.5 TROUBLE SHOOTING

GENERAL

The following are the most common causes of a eddy current dynamometer malfunctioning:

a. Discontinuty in a circuit, caused by a broken wire in the power or control circuit.

b. Loose connection at the termination of any of the interconnecting wires.

c. Circuit grounding, casued by faulty or damaged insulation of wires or a loose component coming in contact with ground.

If a eddy current dynamometer system or component that has been operating properly, suddenly malfunctions, DO NOT make adjustments before FIRST CHECKING all connections

- for tightness
- for breaks
- for faulty or damaged insulation

If the checks do not bring out the fault, proceed as follows:

TEST PROCEDURES

Instruments : A multimeter is generally the only instrument required to make the following tests. A multimeter, having a sensitivity of 1000 ohms per volt on AC and 10,000 ohms per volt on DC, or more, is satisfactory for most tests.

REGULAR CHECKS

If the eddy current dynamometer is found dead, proceed as follows, to locate whether the fault is in the eddy current dynamometer or in the control equipment.

1. After making sure that the test motor/engine is functioning properly, proceed to check the eddy current dynamometer. The terminal block on the eddy current dynamometer have four terminals marked E1, E2;

F1, F2 : Refer to "Terminal Data" given in 1.4. E1, E2 are the wires to the excitation coil and F1, F2 are the output from the Tacho-generator.

2. Check the voltage across E1, E2, with the multimeter connected in such a way that E1 is positive with respect to E2. The expected voltage is 0-90 V DC, variable and controlled by the setting of the load-set potentiometer on the control panel.
3. If the coil voltage is available, a damage to the coil can be suspected.
4. To check for the condition of the coil, turn off all power, disconnect the coil wires at E1 & E2 and check the coil resistance. For eddy current dynamometer torque rating between 0.25 kg-m and 7.0 kg-m, the normal coil resistance is expected to be 22 ohms and for torque rating between 9.8 kg-m and 57.6 kg-m, the expected coil resistance is nominally 11 ohms.
5. If voltage across E1 & E2 are not noticed by adjustment of load-set potentiometer, a fault can be suspected outside of the eddy current dynamometereddy current dynamometer.
6. If the eddy current dynamometer is rotating but speed indicating rpm meter is not working, check for T.G. voltage at F1 & F2. The expected voltage is 2V per 100 r.p.m. or 20 V per 1000 r.p.m. depending on whether the test motor / engine of 1500 r.p.m. or 3000 r.p.m., or 5000 r.p.m. respectively. Refer to the T.G. specifications, given in 1.5.
7. If the electrical fault is outside the eddy current dynamometer, proceed to check the control circuit. For this, refer to the "Trouble Shooting" section of the control equipment manual.

2.6 DISASSEMBLY PROCEDURE

It is good practice to disassemble the eddy current dynamometer, once in two years for inspection, cleaning or replacement of defective parts and bearings.

GENERAL:

Read these instruction carefully and study the appropriate cross-section drawing to determine the extent of disassembly required to be carried out. Should it be necessary to extract bearings, they should be removed by force applied to the outer race, when removing from housing or the inner race when removing from a shaft.

Match and identify all parts while removing to avoid confusion while reassemble.

When reassembling the unit, the use of new bearings is recommended. After all parts are cleaned and all machine fits have been checked, proceed with reassemble.

INSTALLATION OF BEARINGS:

Bearings should never be forced onto a shaft or into a housing by blows or impact loading applied to either rece. To do so is to risk serious permanent damage to bearings. Use either an arbor press or a jack and a soft metal tubing faced on both ends, if necessary. Take care to start the bearings true, not cocked; otherwise it is possible to burr the shaft. A light film of thin oil on the shaft will aid in this process. Take extreme care that no particles of metal or other foreign matter enetrs the bearings during installation.

DO NOT UNWRAP BEARINGS UNTIL READY FOR INSTALLATION.

When a bearing is to be pressed over a considerable length of shaft or over shrink fitting seats, it may be

necessary to expand the bearings thermally by pre-heating in oil. The temperature of the oil bath should not exceed 200°F (70°C) and the bearing should not be kept longer than necessary to bring the entire bearing to the required temperature.

CAUTION

It is important to take care of the following points while disassembly:

- Do not open the eddy current dynamometer in a dusty or humid area.
- All parts should be kept on a clean wooden board or lintless cloth.
- Avoid hammer blows during disassembly, particularly while extracting or refitting bearings. Use proper pullers for this purpose or make use of hydraulic press.

To dismatle the eddy current dynamometer, proceed as follows:

a. Disconnect all incoming power, and control wires to the eddy current dynamometer.

b. Disconnect the eddy current dynamometer from the driven machine under test.

c. Remove the cover of terminal box on eddy current dynamometer and remove the wires connected to terminals F1, F2 and E1 & E2.

INPUT ASSEMBLY

a. Tachogenerator
b. Input bracket
c. Input shaft and bearings
d. Drum mountedd on the input shaft.

In this construction, proceed as follows:

- Remove the tachogenerator housing cover, taking care that TG wires are not damaged.
- Remove the circlip and carefully extract the TG rotor assembly.
- Remove the bearing cover.
- Remove the input assembly bracket from the frame.
- Remove circlip.
- Extract drum using a suitable puller.
- Remove shaft with bearings.
- Extract bearing with grease valves using suitable bearing pullers.

OUTPUT ASSEMBLY

The output assembly consists of

a. Output bracket
b. Output shaft and bearings
c. Excitation Coil
d. Inductor mounted on the output shaft.

In this construction, proceed as follows:

- Unfasten the bolts and remove output assembly very carefully, taking care that the coil wires are not damaged.
- Remove bearing cover
- Support the assembly vertically on the flange, so that the inner part faces the ceiling.
- Remove the circlip on the shaft.
- Extract the pole assembly very carefully, using a suitable special puller.
- Turn the assembly so that the output shaft faces the ceiling and again support on the flange but taking care that the machined spigot is not damaged.
- Remove the bearing cover
- Remove shaft with bearings.
- Extract bearings using a suitable bearings puller. In case grease valves are provided, these may be extracted along with the bearings.

COIL ASSEMBLY

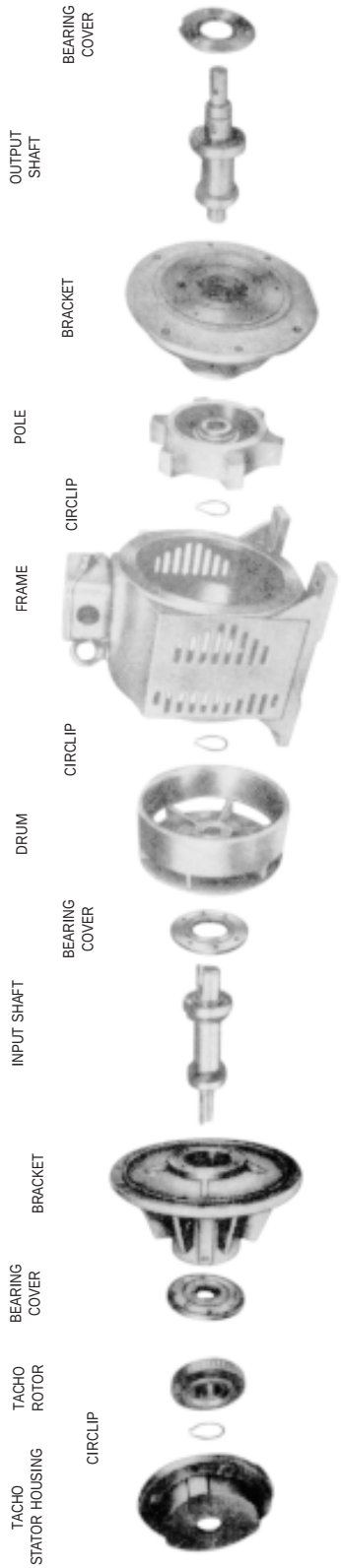
For eddy current dynamometer torque ratings between 0.25 kg-m and 7.0 kg-m, the coil assembly is spot welded to the bracket. To replace the coil, the spot welding has to be chipped off and fresh coil assembly has to be welded in place.

For eddy current dynamometer torque ratings between 9.8 kg-m and 57.6 kg-m, the construction is such that the coil can be removed complete with yoke and the whole assembly can be replaced.

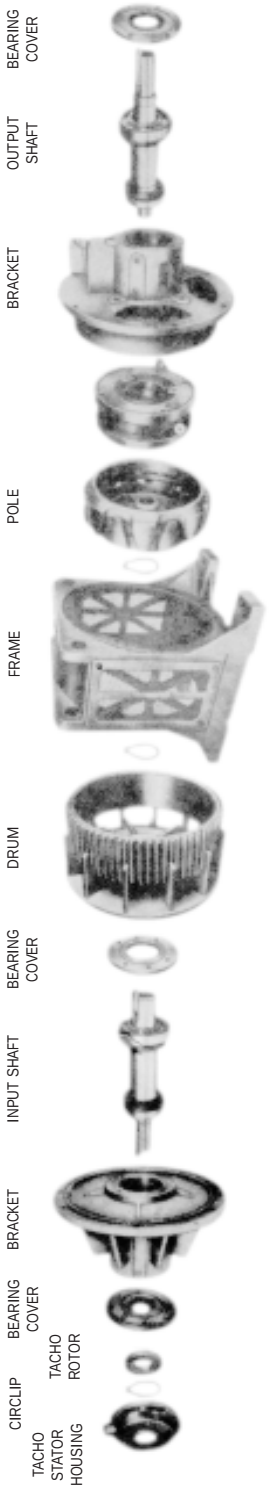
2.7 REASSEMBLY PROCEDURE

To reassemble the parts, follow the foregoing step-by-step procedure in the reverse sequence, taking care of the following:

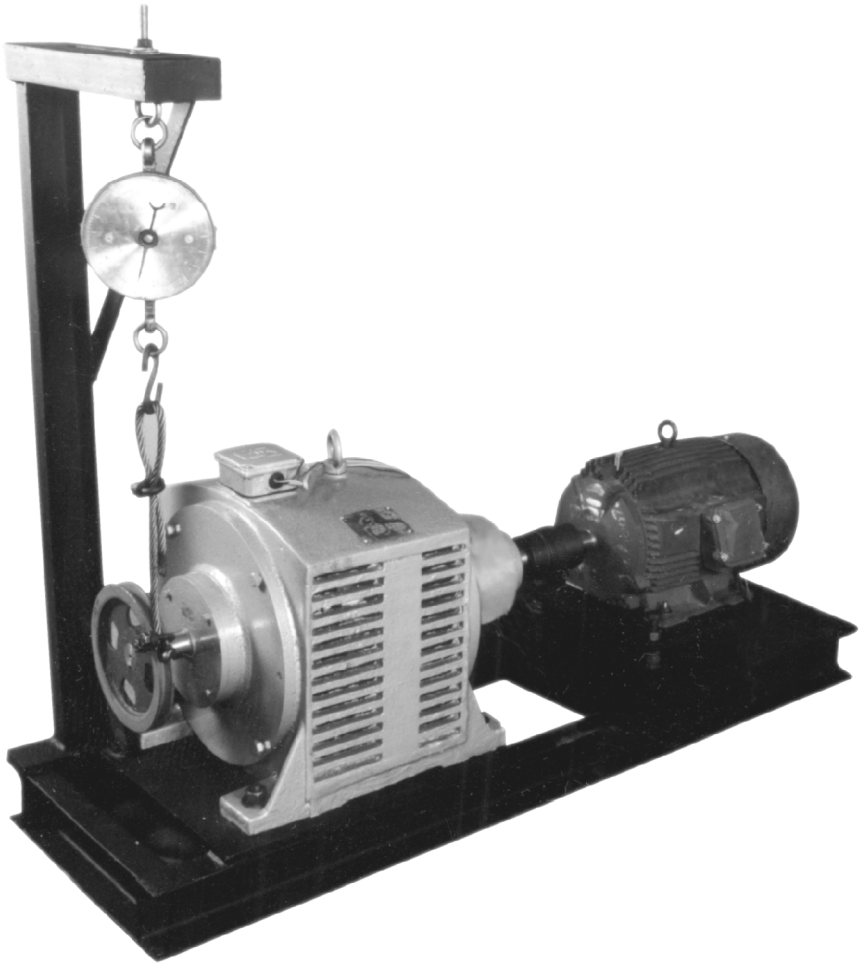
- To fix the drum on the motor shaft, remove the fan cover, support the shaft and preferably lock it to prevent rotation during assembly. The bore of the drum can be pre-heated to about 150°C by means of a blow lamp before shrink fitting it on the shaft.
- For fixing the pole to the output shaft, follow the same precautions as above. Heat the pole and shrink fit on shaft, after supporting and locking the shaft.
- Standard Engineering practices should be followed during assembly. Care should be taken to tighten bolts evenly and firmly.



DYNAMOMETER
0.25 KGM - 7 KGM TORQUE



DYNAMOMETER
9 KGM - 57.6 KGM TORQUE



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