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April 2005

MARKON SAW FUJI

Installation, Service & Maintenance Manual

NAC 160 & 190 RANGE

SAFETY PRECAUTIONS

Before operating the generating set, read the generating set operation manual and this generator manual and become familiar with it and the equipment.

SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE EQUIPMENT IS CORRECTLY OPERATED AND MAINTAINED.

Many accidents occur because of failure to follow fundamental rules and precautions.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

- Ensure installation meets all applicable safety and local electrical codes. Have all installations performed by a qualified electrician.
- Do not operate the generator with protective covers, access covers or terminal
- box covers removed.
- Disable engine starting circuits before carrying out maintenance.
- Disable closing circuits and/or place warning notices on any circuit breakers normally used for connection to the mains or other generators, to avoid accidental closure.

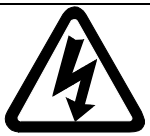
Observe all IMPORTANT, CAUTION, WARNING, and DANGER notices, defined as:

Important ! **Important refers to hazard or unsafe method or practice which can result in product damage or related equipment damage.**

Caution ! **Caution refers to hazard or unsafe method or practice which can result in product damage or personal injury.**

Warning !

Warning refers to a hazard or unsafe method or practice which CAN result in severe personal injury or possible death.



Danger !

Danger refers to immediate hazards which WILL result in severe personal injury or death.

Due to our policy of continuous improvement, details in this manual which were correct at time of printing, may now be due for amendment. Information included must therefore not be regarded as binding.

FOREWORD

The function of this book is to provide the user of the Markon generator with an understanding of the principles of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures.

Each generator has been so designed, constructed, tested and examined as to ensure that it will be safe and without risk to health when properly used. Machine outputs etc. are shown on the nameplate attached to the frame.

Specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with IMPORTANT, CAUTION, WARNING and/or DANGER notes, and it is IMPORTANT that the contents of this book are read and understood before proceeding to fit or use the generator.

Any persons carrying out operating and maintenance procedures should wear any appropriate protective clothing and equipment, use the correct tools and observe any regulations contained in, or made pursuant, to the Health and Safety at Work Act 1974 or any other relevant statute.

The Service, Sales and technical staff of Markon are always ready to assist and reference to the company for advice is welcomed.

REGISTERED FIRM
BM TRADA
CERTIFICATION
ISO 9001:2000
UKAS
QUALITY
MANAGEMENT
012

Markon generators are manufactured to Q.A. procedures conforming to ISO 9001:2000

CONTENTS

SECTION 1

INTRODUCTION

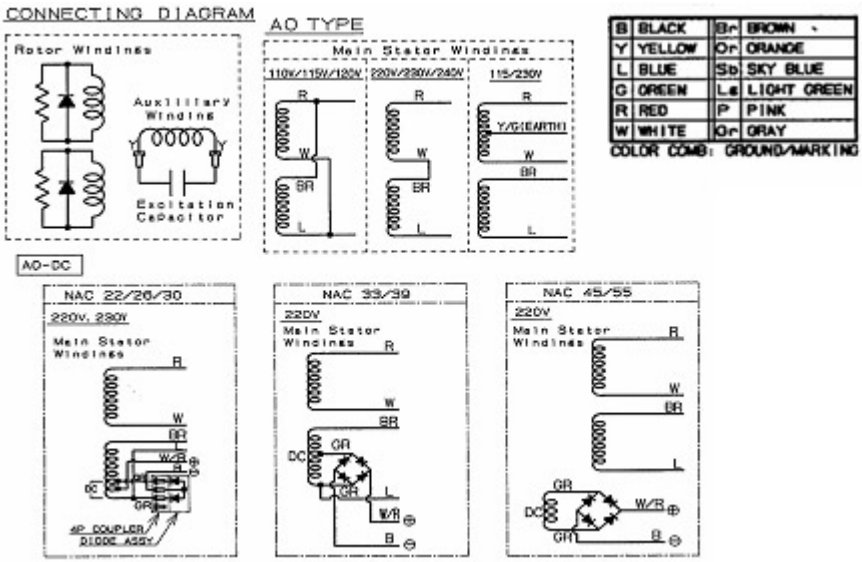
Models covered by this manual are designated as follows:-

160 RANGE	
50Hz	60Hz
NAC2200	NAC2600
NAC2600	NAC3000
NAC3000	NAC3400

190 RANGE	
50Hz	60Hz
NAC3300	NAC3800
NAC3900	NAC4400
NAC4500	NAC5200
NAC5500	NAC6000

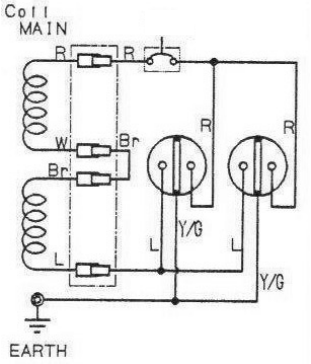
The NAC generator is a self exciting brushless generator, designed to operate with single phase loads at or near a power factor of 1.0.

The principle of operation is schematically represented in the block connecting diagram below.



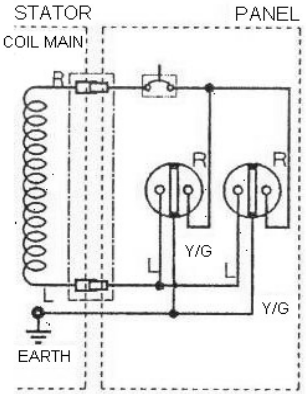
CONTROL BOX CIRCUIT DIAGRAMS

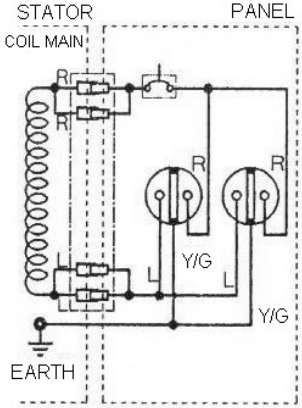
50 Hz	NAC 22 / 26 / 30	R,G	A1/ A2
60 Hz	NAC 26 / 30 / 34	Q	A1/ A2



50 Hz	NAC33/39/45	R,G	A1/ A2
60 Hz	NAC38/44	Q	A1/ A2

50Hz	NAC55	R, G	A1/A2
60Hz	NAC52/60	Q	A1/A2





The generator is designed for minimum maintenance and maximum reliability

SECTION 2

APPLICATION

2.1 STANDARDS

The generator has been designed to comply with the requirements of most International Standards and is suitable for operation in an ambient temperature of 40°C maximum.

2.2 AIRFLOW

The generator should be positioned so that the cooling air may enter and leave the machine without restriction. Inadequate ventilation to the generator will lead to serious overheating and subsequent damage to windings.

2.3 DIRECTION OF ROTATION

A unidirectional fan is used for efficient cooling and the generator is therefore only suitable for clockwise rotation of the shaft when viewed from the drive end.

2.4 DRIVE ARRANGEMENT

All models are designed to suit engines having a drive shaft/crankcase mounting arrangement to:

NAC 160 RANGE; SAE J609a Flange A Extension 5 (3/4" Taper).
NAC 190 RANGE; SAE J609a Flange B Extension 6 (3/4" Taper).

2.5 BEARING

The bearing is preloaded and sealed for life and should require no further attention. Care must be taken to ensure that the anti-creep circlip is correctly located in the groove before mating with the bearing housing, i.e. the bump on the circlip is in the deepest part of the groove. **Note.** The NAC 160 Range bearing does not have a circlip.

2.6 EARTHING

The generator is manufactured and delivered with the stator windings completely isolated from the frame; a suitable earth terminal point is provided in each models foot casting.

2.7 LOADING

The NAC generator is suitable for supplying continuously most types of load with a total load current not exceeding the current quoted on the nameplate. Two points should be noted however:

1. **Engine Power**

The generator set output may be limited by the horsepower rating of the engine. As a guide the engine has to supply approximately two horsepower for each 1000 watts (1kW) of electrical load. Refer to factory for specific generator efficiency.

2. **Electric motor loads**

The current taken by a motor on full load is shown on its nameplate, but it will be several times this value at the instant of starting even when there is no load on the motor. The actual value depends on the type of motor and the starting current should be checked before attempting to decide the size of generator required.

When starting a motor the total current including any other load should not exceed twice the full-load current of the generator.

SECTION 3

INSTALLATION

3.1 SAFETY WARNINGS

The generator is supplied as a component part for installation on a generating set and it is the responsibility of the generating set builder to fit the safety warning label, illustrated right, which is supplied packaged with this manual. The label should be attached to the generator in a position where it is clearly visible on the generating set.

3.2 INSPECTION

When the equipment is received all details, especially the Serial Number of the generator, should be checked against the Advice Note. Carefully remove all dust and packing materials. In the event of any part being damaged or missing, this should be reported at once to the manufacturer and the transport company. Always quote the Serial Number on correspondence with the manufacturer.

When nameplates are supplied packaged with the machine, but not fitted, it is the responsibility of the installer to fit the nameplate to the generator.

3.3 COUPLING TO ENGINE

Refer to Assembly/Dismantling Procedure. SECTION 6.

3.4 ELECTRICAL CONNECTIONS

The generator is supplied from the factory with flying leads from the main stator windings. These may be permanently connected or switched in the generator set outlet box to obtain the required output voltage(s). The installer must provide necessary overload protection. The windings are not bonded to the machine frame and it is the responsibility of the installer to provide suitable bonding. Reference should be made to relevant site or safety regulations.

Note that the point of earthing the stator winding is at the discretion of the installer. Normally a 230V 2 wire output will be earthed at one end giving a maximum of 230V to earth (or 115V in parallel mode).

A 110V 2 wire output will normally be earthed at the centre tap (series connection point) giving a maximum of 55V to earth.

3.5 VOLTAGE SELECTION

The main stator windings are in two sections which may be connected in series or parallel to give a choice of output voltage. For example, series connection gives 230V, parallel connection gives 115V.

Each winding section is capable of carrying the same current I. When the windings are connected in series the maximum load current is I, but when the windings are connected in parallel the maximum current is 2 X I.

Example:
A 2kVA generator when connected in series for 230V operation has a capacity of 8.7A, when connected in parallel for 115V it has a capacity of 17.4A.
Please refer to connecting diagram page 1.

SECTION 4

SERVICE & MAINTENANCE

Warning !

The following procedures present hazards which can result in personal injury or death. Only persons qualified to carry out electrical and mechanical servicing should undertake this work.

The generator requires no regular maintenance. It is, however, recommended that:-

1. after storage or long periods of standing idle the condition of windings should be checked. Refer to 'Insulation Resistance Check' in this section,

and

2. during generating set overhaul, the bearing is replaced. Refer to Assembly/ Dismantling Procedure, Section 6.

4.1 INSULATION RESISTANCE CHECK

If the equipment has been stored or allowed to get damp the insulation resistance of the windings should be checked.

Before carrying out this test disconnect the capacitor and any earthed centre taps. The check should be carried out on the stator winding between each winding group and the generator end bell, and between the rotor winding and rotor core using a 500V Megger or similar instrument. The resistance value obtained should be at least 1MW. If the resistance is less than 1MW the windings should be dried out in a warm atmosphere or by passing current from a low voltage source through the windings until this value is obtained.

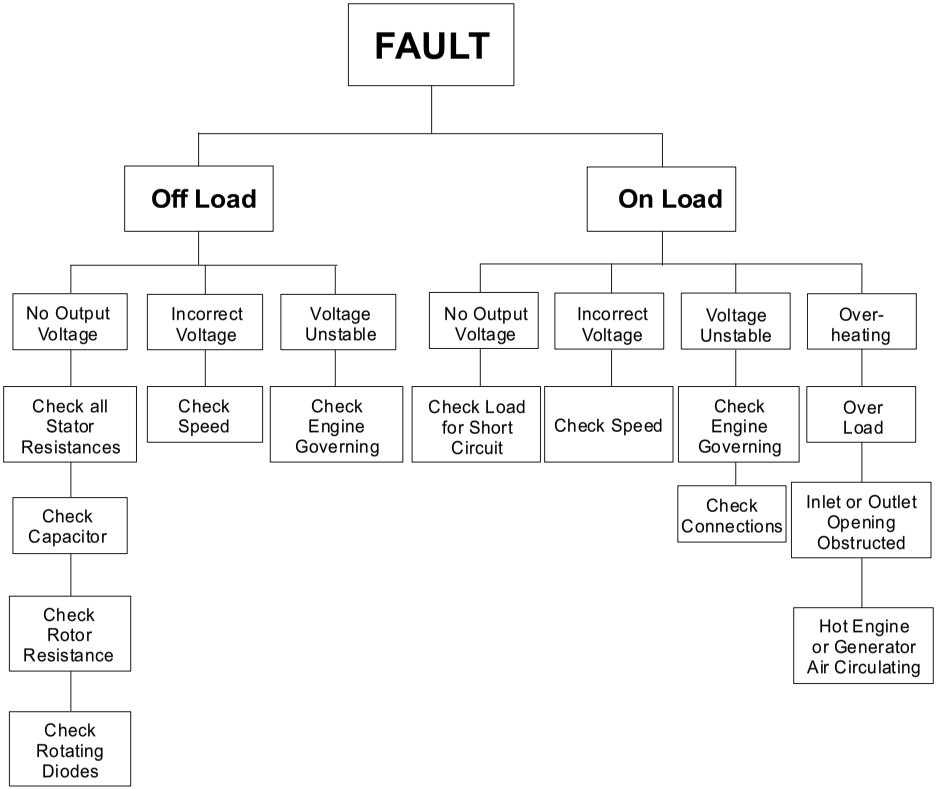
4.2 FAULT FINDING

Should a fault develop during operation it is best identified by carrying out the checks identified in the following fault finding chart (see next page).

Refer to Assembly/Dismantling section when attempting to replace components.

Caution! Replace all guards and protective covers after servicing. Failure to do so may result in operator personal injury.

FAULT FINDING GUIDE



4.3 RESISTANCE CHART

NAC22/26/30/34

M-ODEL (Kv0.10A-max)- -	Type	Rotor (1 Pole) Ω	Auxiliary Winding (Ω)	Mains Winding (Ω)		DC Winding (Ω)
				R-W	Br-L	
-NAC2200 50 Hz	B-DC	15.2	6.50	1.57	1.57	0.51
	B, R, G					-
	U			1.87	1.87	-
NAC2600 60Hz	T-DC		5.45	1.14	1.14	0.39
	T					-
	A			1.40	1.40	-
NAC2600 50Hz	B-DC	17.5	5.80	1.09	1.09	0.29
	B, G, R			1.09	1.09	-
	U			1.30	1.30	-
NAC3000 60Hz	T		5.20	0.77	0.77	-
	T-DC					0.21
	A			0.82	0.82	-
NAC3000 50Hz	B	18.2	6.10	0.95	0.95	-
						-
NAC3400 60Hz	T		5.10	0.53	0.53	-
	A			0.62	0.62	-

NAC33/39/45/55/60

MODEL (kVA-max)	Type	Rotor (1 Pole)	Auxiliary Winding (Ω)	Mains Winding (Ω)			DC Winding (Ω)
				R-W	Br-L	R-L	
NAC3300-A0	B, R	3.8	4.00	0.79	0.79	-	
	U			0.97	0.97	-	-
NAC3800-A0	T		2.60	0.60	0.60	-	-
	T-DC						-
	A			0.67	0.67	-	0.10
NAC3300-A1	G, B, R		4.00	-	-	1.58	-
	U			-	-	1.94	-
NAC3300-A2	R			-	-	0.58	-
	B			0.79	0.79	-	-
	U			-	-	1.94	-
NAC3900-A0	B, R	3.9	2.47	0.66	0.66	-	-
	U			0.78	0.78	-	-
NAC4400-A0	T		2.20	0.47	0.47	-	-
	T-DC						0.08
	A			0.56	0.56	-	-
NAC3900-A1	G, B, R		2.47	-	-	1.32	-
	U			-	-	1.56	-
NAC3900-A2	R			-	-	1.32	-
	B			0.66	0.66	-	-
	U			-	-	1.56	-
NAC4500-A0	B, R	4.3	2.06	0.53	0.53	-	-
	U			0.63	0.63	-	-
NAC5200-A0	T		1.70	0.4	0.4	-	-
	T-DC						0.15
	A		1.65	0.42	0.42	-	-
NAC4500-A1	G, B, R		2.06	-	-	1.06	-
	U			-	-	1.26	-
NAC4500-A2	R			-	-	1.06	-
	B			0.53	0.53	-	-
	U			-	-	1.26	-
NAC5500-A0	B, R	4.7	1.82	0.42	0.42	-	-
	U			0.44	0.44	-	-
NAC6000-A0	T		1.46	0.30	0.30	-	-
	T-DC						0.14
	A			0.34	0.34	-	-
NAC5500-A1	G, B, R		1.82	-	-	0.84	-
	U			-	-	0.88	-
NAC5500-A2	R			-	-	0.84	-
	B			0.42	0.42	-	-
	U			-	-	0.88	-

SECTION 5

SPARES AND AFTER SALES SERVICE

5.1 RECOMMENDED SPARES

Service parts are conveniently packaged for easy identification.

We recommend the following for service and maintenance. In critical applications a set of these service spares should be held with the generator.

Description	**Part No.**
Capacitor (160 Range)	
(NAC2200 & NAC2600)	**6060 206 10XA**
(NAC3000)	**6060 314 00XA**
Capacitor (190 Range)	**6060 312 00XA**
Bearing 6202 (160)	**6206 053 00XA**
Bearing 6204 (190) Circlip	**6206 018 00XA**
PCB Assy (NAC2200/2600)	**1587 334 10XA**
PCB Assy (NAC3000)	**1587 337 00XA**
PCB Assy (NAC3300/3900)	**1587 335 10XA**
PCB Assy (NAC4500/5500)	**1587 335 00XA**

When ordering spare parts the machine serial number and type should be quoted, together with the part description. The serial number is shown on a separate plate on the side of the generator.

Order and enquiries for parts should be addressed to:

Markon Sawafuji
3 Lands End Way
Oakham
Rutland
LE15 6RB
ENGLAND
Telephone: (0) 1572 723811
Fax: (0) 1572 756856
e-mail: info@markonsawafuji.com

Or any of our subsidiary companies listed on the back cover.

5.2 AFTER SALES SERVICE

A full technical advice and on-site service facility is available from our Service Department at Oakham or through our Subsidiary Companies.
A repair facility is also available at our factory in Oakham (*ring for details*).

SECTION 6

ASSEMBLY/DISMANTLING

Component identification numbers refer to those shown in Generator Parts Identification.

6.1 COUPLING GENERATOR TO ENGINE – NAC160

Remove the end cover (2). Remove stator bolts (3) releasing front bracket (14). Fix (14) to engine housing. Slip rotor (12) on to engine taper shaft. Fix by securing with rotor bolt (9). Feed stator assembly (8) and rear bracket (5) over rotor, aligning bearing (10) into bearing housing. Secure stator bolts (3). Refit end cover (3), refer to paragraph 6.8 (torque settings), particularly item c (black bolts).

6.2 COUPLING GENERATOR TO ENGINE – NAC190

Disconnect (14) front plate from generator, secure (14) to engine. Slip rotor (12) on to engine taper shaft. Fix by securing with rotor bolt (9). Refit generator to front plate (14), being careful in aligning bearing (10) – see paragraph 6.6 below.

6.3 REMOVING CAPACITOR

Remove endcover screws (1) and endcover (2). Refit as necessary.

6.4 DISMANTLING STATOR

Remove stator bolts (3). Withdraw stator assembly (8) and bracket rear (5) as one assembly.

6.5 WITHDRAWING ROTOR

Remove rotor bolts (9). Release rotor from engine tapered shaft by supporting rotor in one hand and with a hide mallet strike firmly on a pole face.

6.6 REPLACING BEARING

With the rotor withdrawn, use a standard bearing puller to remove the bearing from the shaft. Place new bearing squarely on the shaft end and drift into place using a suitably sized soft tubular drift on the bearing inner race.

Care must be taken to ensure that the anti-creep circlip (NAC190) is correctly located in the groove before mating with the bearing housing, i.e. the bump on the circlip is in the deepest part of the groove. General: Handle wound assemblies with care to avoid damage to windings.

Important! **Take careful note of connections and position of the PCB assembly board before carrying out the following procedure. Incorrect polarity of the diode will destroy residual magnetism.**

6.7 REPLACING PCB ASSEMBLY

Unsolder the lead connections from the small printed circuit board inserted in the nylon rotor winding carrier. Carefully prise out the defective board. Slide replacement into place and resolder the connection leads.

The above procedure refers to both the NAC160 and NAC190 range.

6.8 ROTOR MOUNTING TO ENGINE

For transit and storage purposes rotor coupling areas (taper part) have been coated with a rust preventive. This ***MUST BE*** removed before assembly to engine.

A practical method for removal of this coating is to clean the mating surface areas with a de-greasing agent based on a petroleum solvent.

Caution 1 !	**Care should be taken not to allow any cleaning agent to come into prolonged contact with skin.**

6.9 TORQUE SETTINGS:

a. M6 Stator fixing bolts (3) 5.9 - 8.8Nm
b. Rotor fixing bolt (9) 8.8 - 11.7Nm
c. M5 Black bolt x 2 (NAC160) 1.9 – 2.5Nm

Caution 2 !	**After servicing ensure all protective guards and access covers are fitted. Failure to do so can result in operator injury.**

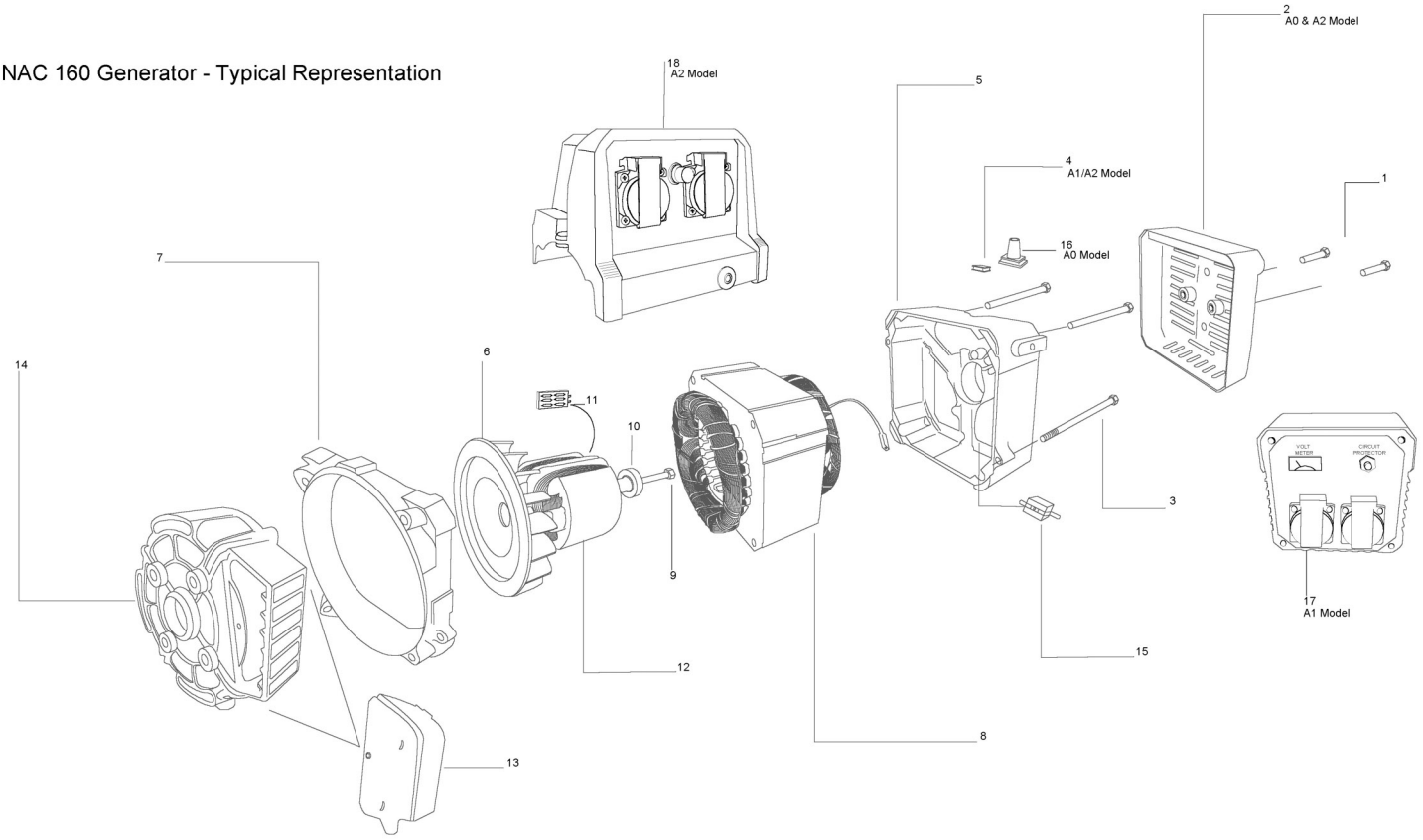
6. 10 Generator Parts Identification - NAC160

Key Numbers	Description	Quantity
1	END COVER SCREW AND WASHER	2
2	END COVER (A0 Model)	1
3	STATOR BOLT	4
4	BLIND GROMMET	1
5	BRACKET REAR	1
6	FAN (4228 010 00XA)	1
7	SPACER RING	1
8	WOUND STATOR ASSEMBLY	1
9	ROTOR BOLT	1
10	BEARING 6202	1
11	PCB ASSEMBLY	2
12	WOUND ROTOR ASSEMBLY	1
13	COVER IP23	1
14	BRACKET FRONT	1
15	CAPACITOR	1
16	CABLE GROMMET	1
17	END COVER (A1 MODEL)	1
18	TOP BOX (A2 MODEL)	1

For spares quote model & serial no.eg. NAC22B-A0 (Serial No.)

Fig. 6.10

NAC 160 Generator - Typical Representation



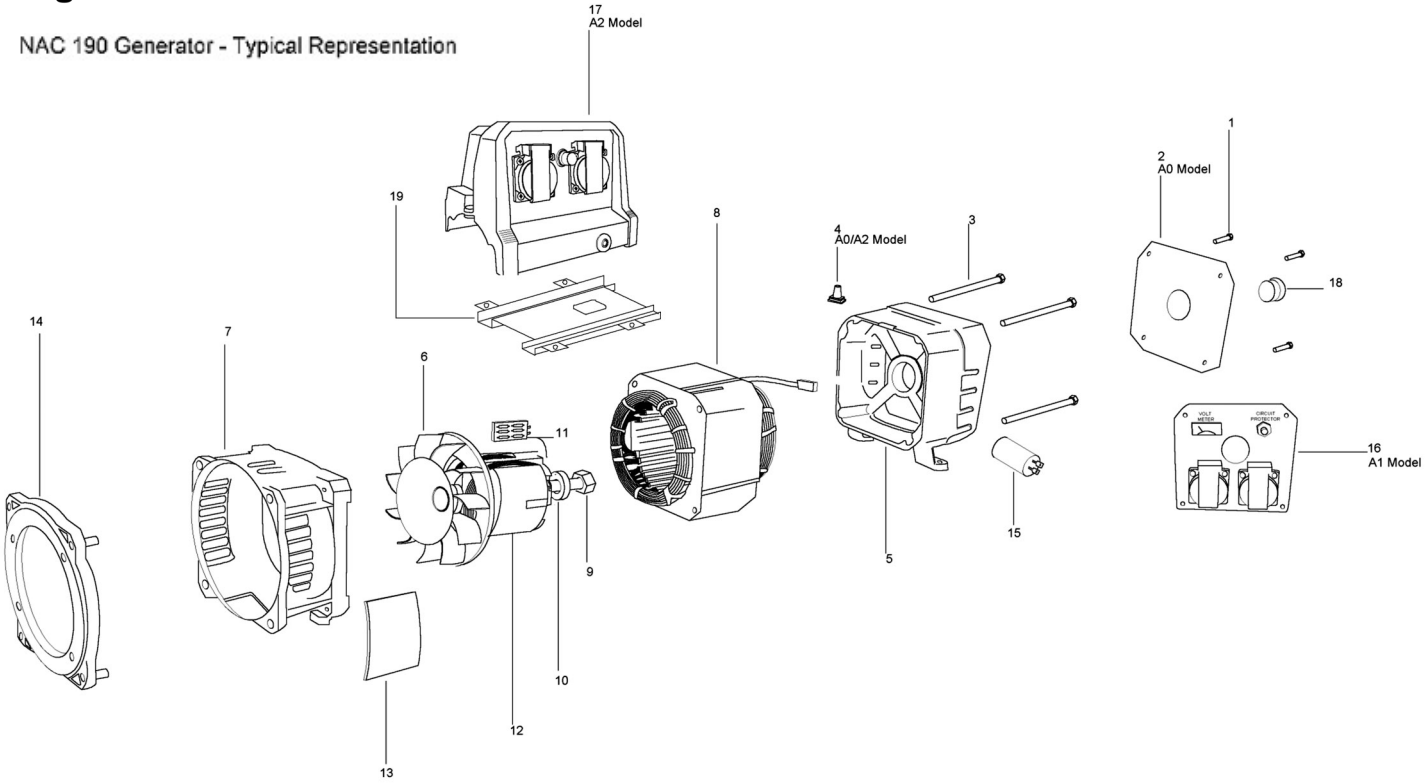
6. 10 Generator Parts Identification - NAC190

Key Numbers	Description	Quantity
1	END COVER SCREW AND WASHER	4
2	END COVER PLATE (A0 Model)	1
3	STATOR BOLT	4
4	CABLE GROMMET	1
5	BRACKET REAR	1
6	FAN (4228 011 00XA)	1
7	BRACKET FRONT	1
8	WOUND STATOR ASSEMBLY	1
9	ROTOR BOLT	1
10	BEARING 6204 (Circlip)	1
11	PCB ASSEMBLY	2
12	WOUND ROTOR ASSEMBLY	1
13	COVER IP23	2
14	FRONT PLATE (Adaptor with Studs)	1
15	CAPACITOR	1
16	END COVER PLATE (A1 Model)	1
17	TOP BOX (A2 Model)	1
18	CAP (4229 020 00XA)	1
19	CONTROL BOX MOUNTING PLATE (A2)	1

For spares quote model & serial no.eg. NAC39B-A0 (Serial No.)

Fig. 6.10

NAC 190 Generator - Typical Representation



Notes:

A.C. GENERATOR WARRANTY

DEFECTS AFTER DELIVERY

We will make good by repair or, at our option, by the supply of a replacement, any fault which under proper use appears in the goods within the period specified on Clause 12, and is found on examination by us to be solely due to defective material and workmanship; provided that the defective part is promptly returned, carriage paid, with all identification numbers and marks intact, to our works or, if appropriate, to the Dealer who supplied the goods.

Any part repaired or replaced, under warranty, will be returned by M.S. free of charge (via sea freight if outside the UK).

We shall not be liable for any expenses which may be incurred in removing or replacing any part sent to us for inspection or in fitting any replacement supplied by us. We shall be under no liability for defects in any goods which have not been properly installed in accordance with M.S. recommended installation practices as detailed in the publications M.S. Installation, Service and Maintenance Manual' and 'M.S. Application Guidelines', or which have been improperly stored or which have been repaired, adjusted or altered by any person except ourselves or our authorised agents, or in any second-hand goods, proprietary articles or goods not of our own manufacture although supplied by us, such articles and goods being covered by the warranty (if any) given by the separate manufacturers.

Any claim under this clause must contain full particulars of the alleged defect, the description of the goods, the date or purchase, and the name and address of the Vendor, the Serial Number (as shown on the manufacturers identification plate) or for Spares the order reference under which the goods were supplied.

Our judgement in all cases of claims shall be final and conclusive and the claimant shall accept our decision on all questions as to defects and the exchange of a part or parts.

Our liability shall be fully discharged by either repair or replacement as above, and in any event shall not exceed the current list price of the defective goods.

Our liability under this clause shall be in lieu of any warranty or condition implied by law as to the quality or fitness for any particular purpose of the goods, and save as expressly provided in this clause we shall not be under any liability, whether in contract, tort or otherwise, in respect of defects in goods delivered or for any injury, damages or loss resulting from such defects or from any work undone in connection therewith.

WARRANTY PERIOD

A.C. Generators In respect of a.c. generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch by M.S. or twelve months from the date of first commissioning (whichever is the shorter period)

Spares. In respect of Spares the Warranty Period is three months from the date of despatch by us or on fitment whichever is the earlier. These periods are subject to the exclusions and conditions specified in Clause 11.

MACHINE SERIAL NUMBER

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PO BOX 17
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STAMFORD
LINCOLNSHIRE
PE9 2NB
ENGLAND
Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 484100
e-mail www.newage-avkseg.com

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9	**SINGAPORE**	NEWAGE ASIA PACIFIC PTE LTD 10 Toh Guan Road #05-03 TT International Tradepark Singapore 608838 Tel: (65) 794 3730 Fax: (65) 898 9065
10	**SPAIN**	STAMFORD IBERICA SA Poligono Industrial "Los Linares" Avda.de Fuenlabrada, 38 E-28970 HUMANES DE MADRID Tel: (34) 91 498 2000 Fax : (34) 91 498 2004