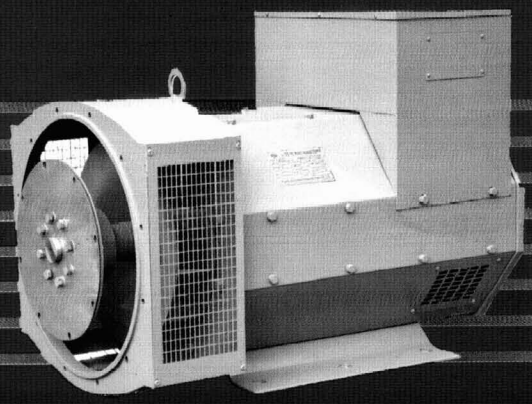
Power generation

A.C.BRUSHLESS SYNCHRONOUS GENERATOR



INSTRUCTIONS FOR

OPERATION AND MAINTENANCE

CE ISO9001

SAFETY CAUTION

Before operating the generating set, please read the operating manual and this generator manual and become familiar with it and the equipment. Please remember safety first. If you are not sure of the instructions or procedures, seek qualified help before continuing.

This service manual emphasizes the safety precautions necessary during the installation, operation, and maintenance of your generator.

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

1.The lifting eyes on the generator are designed to support the generator only, do not lift a complete generator set(engine). Otherwise can cause personal injury or equipment damage.

2.Do not apply any force to the generator fan. Never "BAR OVER" ,the engine-generator set by moving the fan. Failure to comply with these safety procedures may result in severe injury to personnel or damage to the equipment.

3.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.

4.Ensure installation meets all applicable safety and local electrical codes.Have all installations preformed by a qualified electrician.

5.**Electrical shock can cause severe personal injury or death.** Whenever the generator is running, always suppose and disposal that voltage is present. Residua voltagge is present at the generator terminals, and at regulator panel connections, even with the regulator fuse removed. Caution must be exercised, or serious personal injury or death can result.

6.Whenever solvents, cleansers. or flammable liquids are present, adequate ventilation must be available to avoid fire, explosion, or health hazards. Always avoid breathing toxic vapors and put on suitable personal protective equipment to prevent personal injuries(head, eyes, face, feet, hands, respirator. etc).

7.Special caution must be taken out during trouble shooting, because at that time the protective covers and safety devices may be removed or disabled.

I.Description.

This series A.C synchronous brushless generator is a new generation brushless generator, which based on the new age generators vanguard technology.

The generator may be combined with diesel engine(internal-combus-tion engine)to make fixed or movable electrical power.It is suited for commercial buildings, hospitals, factories, farms, fields, ete, as power and lighting.The generating set may be used for the prime power or stand by.

This series generator are of unique design, advanced construction, excellent performances, reliable operation, easy use, small volume and light weight.

Features:

1.This series generator are manufactured in accordance with NEMA ODP type. If consists of main generator,AC brushless exciter, rotating rectifiers,AVR, conduit box, etc.

2.Class H or Class F insulation system.

3.The frame is made by steel plate. The design of stator lamination is unique.If necessary, 4 leadwires or 12 leadwires may be supplied.

4 .Main rotor apply the single piece 4-pole saliant pole lamination, field winding to form a unirotor construction.The field winding is layer wound with thermo setting epoxy for high mechanical and electrical integrity.

Perfomance:

1.This series generator may be operated continuly at rated load under following conditions:

a. Ambient. Air temperature≤40℃, well vantilation. Marin use,≤45℃

b. Elevation≤1000m over sea level.

2.Electrical performances

a.Steady voltage regulation≤1.0%

b.Transient voltage regulations≤+20%, -15%(60%In, cos ϕ ≤0.4 lag)

c..Adjustable Voltage range 95-105%Un

d.Waveform distortion at no-load, ≤ 5%(line voltage)

e.Starting motor ability, (no-load.Three phase, 4p, cage motor)

Generator	Motor capacity
up to 40kW	0.7Pn
50. 64. 75kW	30kw
90. 120kW	55kw
150. 200. 250kW	75kw
320kW	110kw

Principle of Operation:

This series generators are brushless, self excited. Externally voltage regulated. Synchronous AC generator. The generator is made up of six major components:main stator(armature), main rotor(field),exciter stator(field), exciter rotor(armature), rectifier assembly, and voltage regulator. In understanding the above terminology, note the following: stators are stationary, rotors rotate, a field is an electrical input. And an armature is an electrical output. These system components are electrically interconnected as shown in figure 1and figure2.

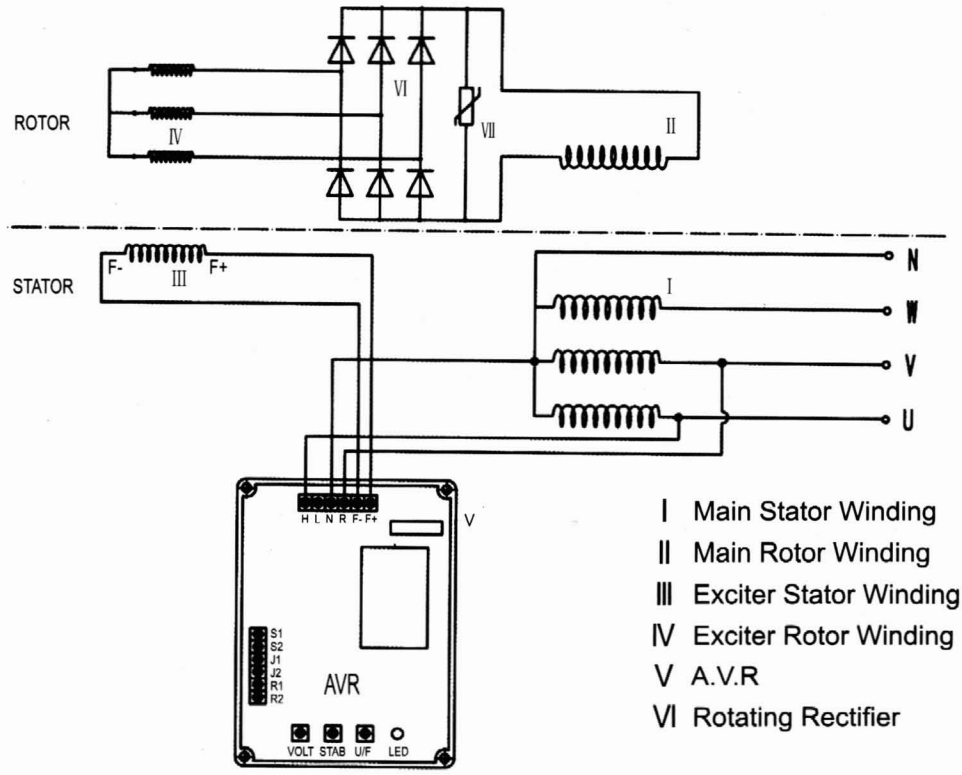


Fig 1. The Three-Phase Generators Diagram

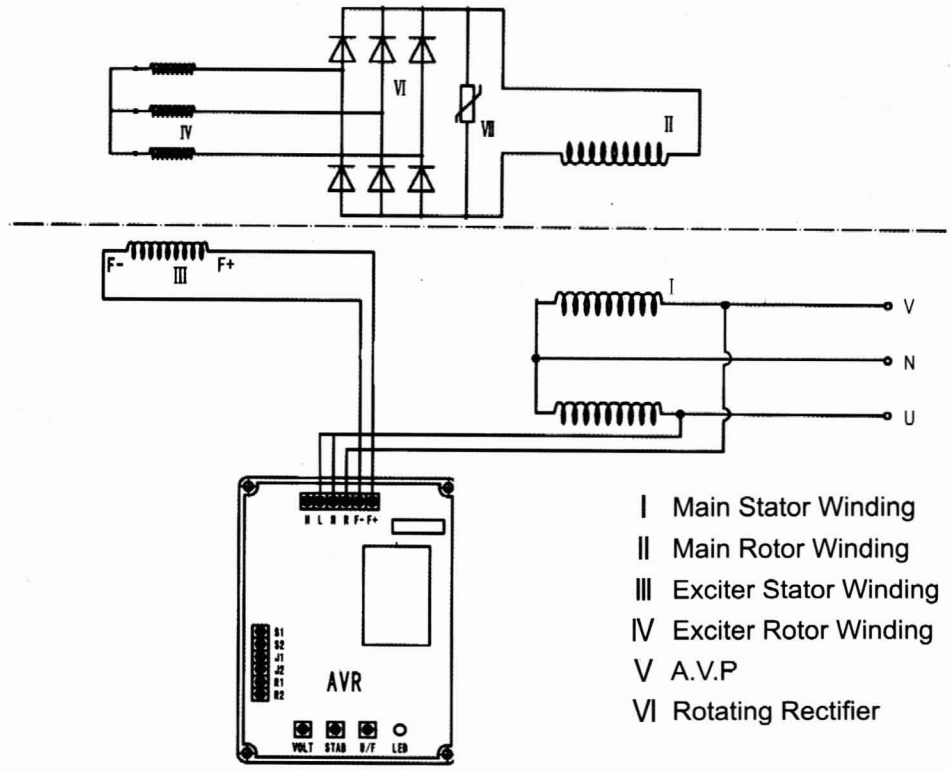


Fig 2. The Single-Phase Generators Diagram

The generator's exciter consists of a stationary field and a rotating armature. The stationary field (exciter stator) designed to be the primary source of the generator's residual magnetism. This residual magnetism allows the exciter rotor (armature) to produce AC voltage even when the exciter stator(field)is not powered. This AC voltage is rectified to DC by the rotating rectifier assembly and fed directly to the main rotor (field). As the generator shaft continues to rotate, the main rotor (field) induces a voltage into the generator's main stator (armature) . At rated speed, the main stator's voltage produced by the residual magnetism of the exciter allows the automatic voltage regulator to function. The regulator provides voltage to the exciter resulting in a build-up of generator terminal voltage. This system of using residual magnetism eliminates the need for a special field flashing circuit in the regulator. After the generator has established the initial residual voltage, the regulator provides a controlled DC field voltage to the exciter stator resulting in a controlled generator terminal voltage.

Ⅱ.Storage.

In the event that the generator is not to be installed on its prime mover immediately, it is recommended that the unit be stored in a cleaned, dry area which is not subject to rapid changes in temperature and humidity.

In the event of long term storage, the generator should be tested cleaned and dried as required, before being put into service. See the maintenance section of this manual for further information.

Ⅲ.Installation and adjustment.

1.Generator must be mounted at the clean, dry and well ventilation place. The prime mover and generator should be installed on a public frame, never put them on the cement floor, and ensure the public frame undeformed.

2.Single bearing generators.

Single bearing units are provided a SAE flywheel housing adapter and flexible drive discs to match the engine. Close tolerances are maintained in the manufacture of the generator to promote ease of alignment.

Special steel drive discs are bolted the shaft. In some case spacer are used to achieve the proper " XG" dimension. Holes are provided in the periphery of the coupling discs which correspond to tapped holes in the engine flywheel. The outside diameter of the drive discs fit in a rabbet in the flywheel so that concentricity is assured.

CAUTION: Grade 12.9 place to the flywheel. Do not use split type lock washers, they will cause stress risers, and may resuly in disc failure.

The SAE flywheel housing adapter and the engine flywheel housing are designed to match each other.with no further alignment necessary.

Shims may be necessary under the generator feet to insure a solid mounting. Do not force the feet to an uneven mounting surface, serious problems could result.

ENDPLAY TEST PROCEDURES:

After the generator has been assembled to the engine, check for endplay of the assembled set. Using a suitable lever, force the engin flywheel forward so that the crankshaft is pressed agains its thrust bearing. When force is removed, the engine crankshaft should remain in position. Apply force in the opposite direction forcing the crankshaft towards the generator, and observe if the crankshaft remains in this position after force has been removed. Refter to the engine manul for proper or recommended endplay. If the crankshafe springs away in either directian after force has been removed, it is an indication that the generator shaft is not moving freely, and normal life of the thrust bearing could be impaired. Probable couse of this problem are:

a.Improper "XG" dimension of either the generator or the engine flywheel, or both.Generator bearing may be bottoming out in its bearing bracket.

b.Misalignment:

a)Improper seating of generator drive discs in the engine flywheel.

b)Improper mating of the generator frame to the engine flywheel housing.

c)Set sub-base is not true.Generator and or engine feet requir shims.See mounting instructions.

3.Two bearing generators.

If generator couples with engine by flange rabbget. It is easy to mount.If it coupled by other way, should pay more attention to installation, it may be necessary to shim the generator feet for proper support and alignment .Aligning the generator and engine as accurately as possible will reduce vibration, increase bearing life, and minimize coupling wear.

Ⅳ.Inspection and operation.

1.Inspection.

a.Though the generator, AVR and auxilar devices are solid and well insulated, if the generator was stored for longtime it might be moistened, and should be inspected carefully before operation.

b.Measure the insulating resistance of windings against the ground by ohmmeter, if the value is less than 2 MΩ in cold condition ,the generator should be dried. Caution: At measuring, the electronic elements and capacitor should be shorted, and the AVR. Should be disconnected to avoid damaged.

c.Make sure all connecting joints are tight and contact good.

d.Be sure the frame is properly grounded, and ground wire should be same as the size of Leadwires.

e.Make familiar with the rated data of nameplete before operation.

2.Voltage adjustment

In general, the generator was carefully inspected and tested in operation before it left the factory, and the normal voltage has been corrected, so it is not necessary to adjust. If necessary, the setting potentiometer of Voltage may be adjusted again.

3.Operation

After inspection and adjustment have been made, and no trouble is found ,the generator can run normally and generate the electricity. In order to keep generator run well. Please remember follow in notices:

a. The generator output must be disconnected from the load, then start the prime mover.

b.Check the speed and adjust to the rated RPM. the voltage of generator will get to normal value. Then close the main circuit breaker to the load. The genset speed may be changed under load, and frequency may be lower than the normal frequency. Check and adjust the speed as necessary.

c.Before shut down the genset, remove load and turn off the main circuit breaker. This is especially important, or the loss of residue magnetism can result.

d.If starting up the generator for first time or the generator stored for long time. Generator may be loss of the residue magnetism, and voltage can not built up ,should charge to F+.and F- with DC 12V voltage, the "+" touch to F. and the "-" touch to F-for 15-20 seconds. Caution: the generator must be stud still during charging the magnetism, or AVR may be damaged.

e.Three phase AC generator should be operated at balanced load. Should pay more attention to the load and the balance of current to prevent the generator loaded on the single phase or serious unbalancing condition,or the AVR. and generator can be damaged.

V.Troubleshooting.

SYMPTOM: Generator produces no voltage or abnormal voltage

Regulator fuse blown	Check all wiring, if there is no problem; replace bad fuse, and start the unit again.
Voltmeter damaged	Verify the panel meter with multi-meter or other meter that is known to be accurate.
Defective voltmeter	Check the meter in time.replace bad meter.
Loose the connecting plug of AVR.	Check the connecting plug. Make sure all joints tight and contact good.
Surge suppressor short circuit	Check the surge suppressor and eliminate the short circuit or replace bad one.
Defective diodes	Take down the diodes and test them by multimeter Replace the bad diode.
Lost residue magnetism	Connect a 12V battery to the exciter field. the "+" ofbettery to the F +(red lead), and the "- " to the F- (black lead) for abort 15 to 20 second. Caution:The generator should be stud still during flashing.
Incorrect connect	Check care fully ,and correct the wiring refer to the wiring diagram.
Exciter field break	Clean, twist and weld the broken wire. Wrap this place with insulating material.
Loose joints or poor contact	Clean and tight the joints again.
Atmature winding of generator break	Find the failure place, clean, wend and wrap it.
Armature winding of generator short circuit	Short circuit will couse the serious heating, should replace the winding.
Armature winding of exciter break or short circuit	Locate the failure and replace the winding
Incorrect speed	Verfy speed with tachometer or frequency meter.
AVR protective shutdown circuits are operating	Correct the problem and adjust AVR. Refer to AVR, manual.
AVR inoperative	Adjust or replace the AVR Refet to AVR manual.

SYMPTOM: Voltage is fluctuating

Incorrect speed	Verify speed with tachometer or frequency meter.
Unstable speed	Verify governor stability.
AVR.stabilily	Adjust AVR.stability. Refer to AVR. Manual.
Defective/loose connecting	Inspect all wiring for loose or dirty connections.
Defective diodes, surge suppressor, or generator windings	Test generator with constant excitation(12V battery test)
Remote voltage adjust rheostat(if used)	Check operation of rheostat. Refer to AVR. Manual.
Defectuve AVR.	Replace the AVR. Refer to AVR. Manual.
Defective bearing of worn bearing carrier causing an uneven air gap.	Replace worn bearing. Check bearing carrier for wear Replace as necessary.

SYMPTOM: Generator overheated

Overload	Measure ampers and verify that the load does not exceed the nameplate rating of the generator.
Armature winding of generator short circuit	Replace the damaged winding.
Ventilation obstruction	Clean dust and dirt in the generator.
Armature winding of exciter short circuit	Replace the bad winding.

Ⅵ.Maintenance and overhau1

1.Maintenance.

a.Generator should be installed in the dry, clean, ventilating place, and to prevent the direct contact of wind driven dirt, rain, snow and sunlight.

b.Take note of the ventilation and heating of genertator at times,and the current and voltage don't exceed the rating data.

c.The generator should not be operated at the place that full of water vapor, dust and flammable gas.

d.In general ,maintenance intervals will depend upon operating conditions. Routine overhaul should be made freqently.

2.Major overhaul

a.Measure insulating resistance with 500V Megohm meter, If the reading is less than 2 MΩ ,the generator should be dried.(Must disconnect AVR. With generator during measuring).

b.Replace the grease in bearing housing, and clean the surface of two shield bearing or replace the bearing.

c.Clean the interior of generator by blowing and take care of the all junctions.

d.Inspect all living parts, and make sure joint nut tight and contact well.

3.Overhaul attention.

A.Take care of the disassembeld parts, and avoid to bump each other or mising.

b.Should lightly place main parts such as rotor, stator, bracket, etc.to prevent damage.

c.In order to reassemble easily, should make the mark for the disconnected wiring, and avoid wrong connecting.

d.Disassembled bearing and bearing cap should be covered by clean paper to prevent dirt, and replace the dirty grease.

e.After the generator reassembled, rotate the rotor slowly, ensure there are not abnormal sound and halt.

f.The bracket screws should be driven crosswise, can't drive the screws one by one.

Ⅶ.THYRISTOR OR SCR LOADING.

Solid state electronic control devices which utilize thyristor or SCR firing circuits (such as variable freqency induction motor control precision motor speed controls, no break powered battery charges etc.) may introduce high freqency harmonics which adversely affect, or totally distort the normal wave form of generator. This creates additional heat in the generator windings and may cause the generator to overheat. Problems which can occur are not limited to the generator. Poor wave shape may adversely effect the thyristor devices, the equipment they power, and any other connected load. Please contact the factory for application assistance.

Ⅷ.Notice:

1.AVR wiring can't be connected wrong.

2.Boost exciting must use the "12V" battery, and the generator must be stopped. Using "24V" battery or boosting the excitation in rotating, the AVR would be damaged.

3.The generator runs at "50Hz" or "60Hz", should ensure the wiring right, or maybe affect AVR.working.

4.Before shut down the generating set, first turn off the output switch, then speed down the engine.

5.Take care of the contact of the plug and sockets, ensure them close contacting each other.

6.If the generator can't built up, first of all, look for the couses, such as; fuse; wirings; residue voltatge, etc. Please don't adjust the potentiometer and boosting excitation before known the causes.

7.If the engine runs at idle speed, please don't adjust the potentiometer and boost excitation.

8.Adjusting the voltatge and stability potentiometer, please use small screw-driver and rotate slowly.

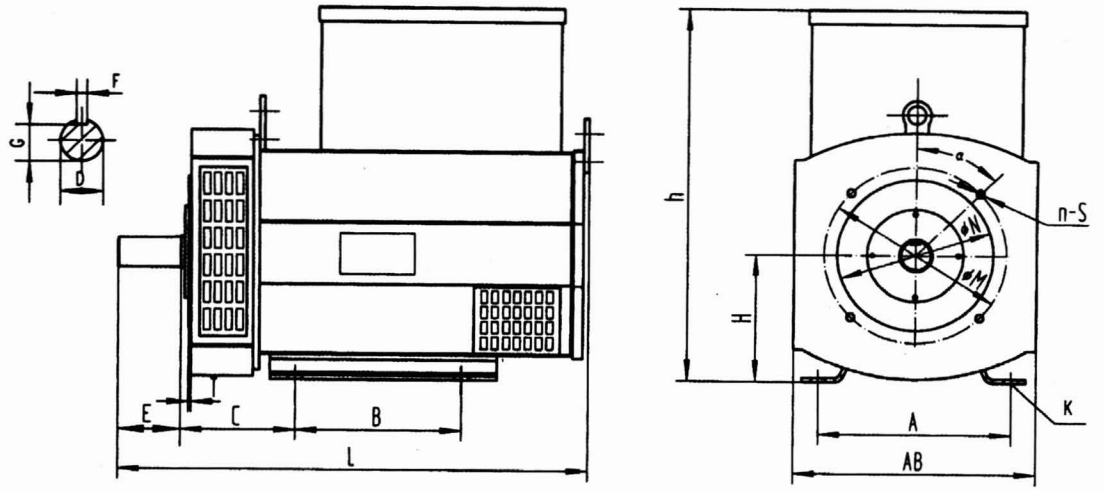


Fig3 TWO BEARING GENERATOR

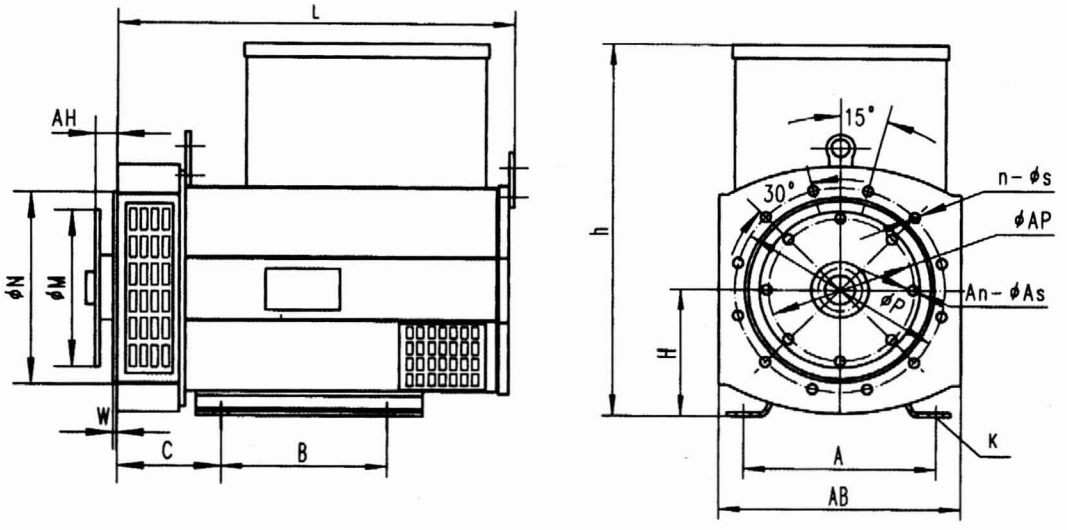


Fig4 SINGLE BEARING GENERATOR

Table 1 TWO BEARING GENERATORS

POWER (KW)	FRAME	H mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	K mm	M mm	N mm	n-s	T mm	A	L mm	AB mm	h mm
5	160S	160	254	210	108	38	80	10	33	14	265	230	4-M12	4	45°	520	290	420
7.5	160M															580		
10.12	180S	180	279	210	161	42	82	12	37							538	410	435
15.16	180M															618		
20.24	225S	225	318	267	205	48	110	14	42.5	19	350	300	4-M16	5		695	410	620
30	225M				186											795		
40	225L															795		
50	250M	250	356	356	192	60	120	18	53							800	480	660
64.75	250L															900		
90.100	280S	280	406	406	215	70	140	20	62.5	24	400	350	8-M16		225°	920	550	730
120	280M															1020		
150	280L															1100		
200	315S	315	508	406	254	80	170	22	71	28	500	450		6		1155	620	852
250	315M			508												1255		
300	315L															1345		

Table 2 SINGLE BEARING GENERATORS

POWER (KW)	FRAME	H(mm)		A mm	B mm	C mm	K mm	Flange	Flex plate	L mm	AB mm	H mm
5	160S	160	0 -0.75	254	210	128	14	SAE5#	SAE7 1/2#	480	300	440
7.5	160M									480		
10.12	180S	180		279	210	148		SAE4# SAE3#	SAE7 1/2# SAE10#	443	410	435
15.16	180M									523		
20.24	225S	225	0 -1	318	267	215	19	SAE4# SAE3#	SAE7 1/2# SAE10# SAE11 1/2#	590	460	620
30	225M					195				690		
40	225L									690		
50	250M	250		356	356	268		SAE3#	SAE11 1/2# SAE14#	725	480	680
64.75	250L					235				825		
90.100	280S	280	0 -2	406	406	277	24	SAE3# SAE2# SAE1#	SAE11 1/2# SAE14#	830	580	730
120	280M									930		
150	280L					317				1010		
200	315S	315		508	406	254	28	SAE1# SAE0#	SAE14# SAE18#	1000	620	850
250	315M				508					1100		
300	315L									1200		

Flange(mm)					
S.A.E.	N	P	n	S	W
SAE5#	314.32	333.37	8	11	5
SAE4#	361.95	381	12	11	5
SAE3#	409.57	428.62	12	11	5
SAE2#	447.68	466.7	12	12	5
SAE1#	511.18	530.2	12	14	6
SAE0#	647.7	679.45	16	14	6

Flex plate(mm)					
S.A.E.	M	AH	AP	An	As
SAE7 1/2#	241.3	30.2	222.25	8	9
SAE8#	263.52	62	244.5	6	11
SAE10#	314.32	53.8	295.27	8	11
SAE11 1/2#	352.42	39.6	333.37	8	11
SAE14#	466.72	25.4	438.2	8	14
SAE18#	571.5	15.7	542.92	8	18