OPERATION and MAINTENANCE MANUALS

For

BRISBANE CITY COUNCIL

At

BRISBANE WATER

SEWAGE PUMP STATION

SP240 Manet Street

Manuals Prepared by:

S E Power Equipment
47 Proprietary Street
Tingalpa, Qld 4173
Phone No. 07 3890 1744

REVISION B: July 2003

Revision Status

Revision	Date	Initials	Comments
A	26/05/03	JP	Issued for approval
B	30/07/03	JP	

Prepared by: Jim Pringle Date: _____/_____/_____

Reviewed
Project Manager: ___________________________ Date: _____/_____/_____

TABLE OF CONTENTS

SP240

Section 1 - Instructions of Use

INSTRUCTIONS FOR USE

1. Units placed on site using “Hook Truck” (Cleanaway Type) over cable pit.
2. Cable pit to be under switchboard section of unit (rear).
3. Attach hold down / anti-theft chains to location points at rear of unit (beside switchboard).
4. Check engine lube oil level.
5. Check engine coolant level.
6. Check the battery is connected and the electrolyte level is correct.
7. Connect cables to plugs via colour-coded sequence.
8. Connect power inlet socket (240V).
9. Connect communication socket.
10. Connect pump station control socket.
11. Check fuel level (mechanical gauge beside fill point).
12. Refer to section 6, Functional Description for start/run and connection procedure.
13. Remember **SAFETY** is important **ALWAYS** wear your Personal Protection Equipment (PPE)

SP240

Section 2 - Deutz Operation Manual

Engine Serial Number ☐☐☐☐☐☐☐

Please enter the engine serial number here. This number should be quoted when inquiring about Customer Service, Repairs or Spare Parts (see Section 2.1).

Operation Manual

B/F L 1011F
B/FM 1011F

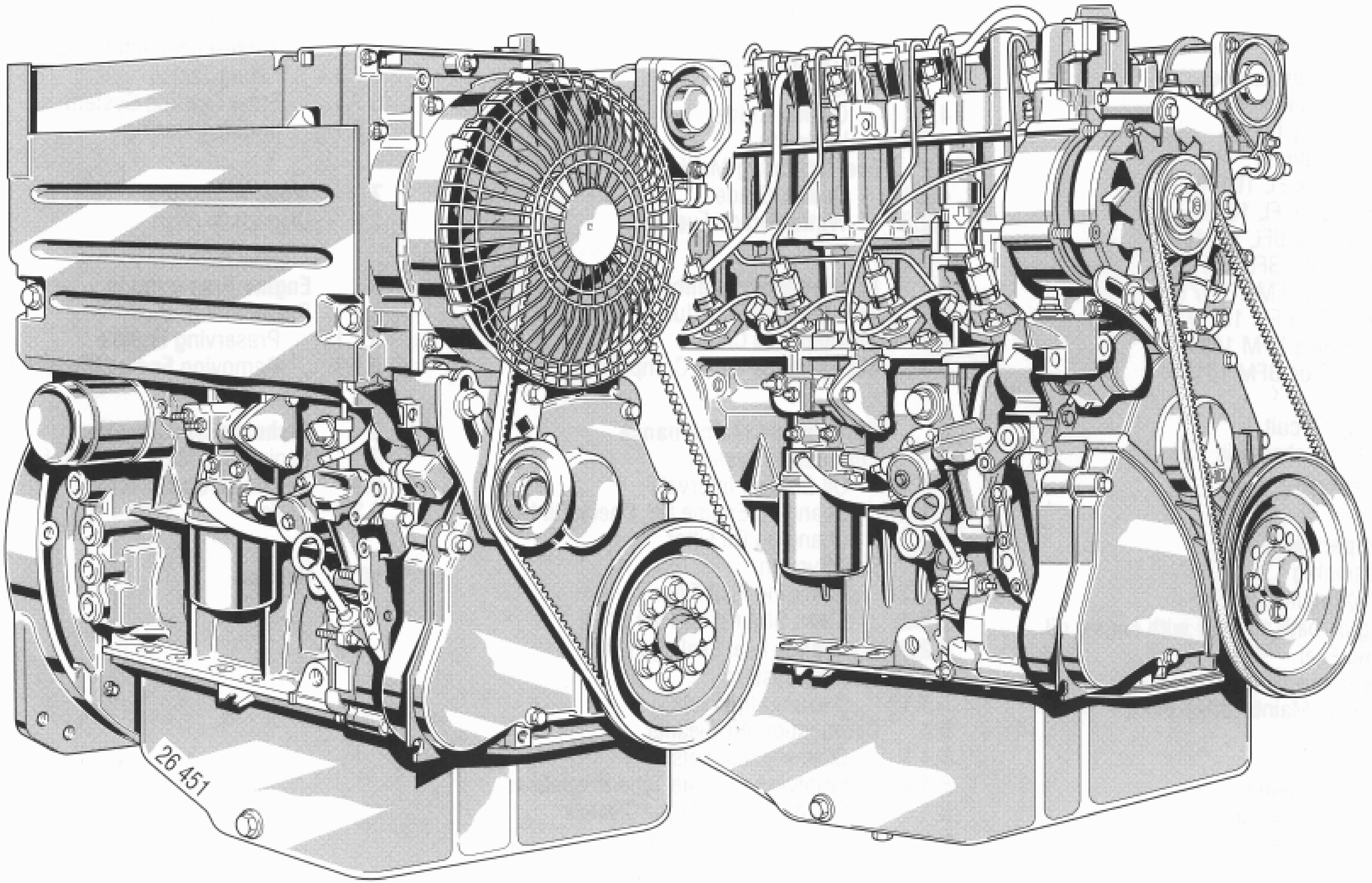
0297 9683 en

DEUTZ®

Dear Customer,

Air / liquid-cooled DEUTZ engines are designed for a large number of applications. Consequently, a wide range of variants are offered to meet the requirements of specific cases.
Your engine is appropriately equipped for the installation concerned, which means that not all of the components described in this Operation Manual are necessarily mounted to your engine.
We have endeavored to highlight any differences so that you will be able to locate the operating and maintenance instructions relevant to your engine quickly and easily.
Please read this Manual before starting your engine, and always observe the operating and maintenance instructions.
We are available to help with any additional inquiries
Sincerely,
DEUTZ SERVICE AG

Index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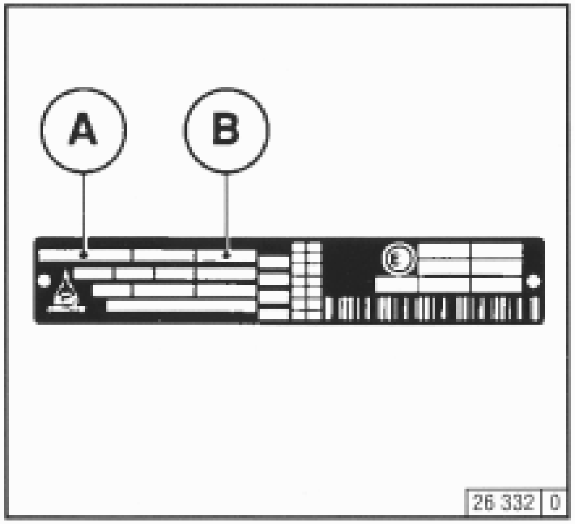
Engine Description

Engine Description

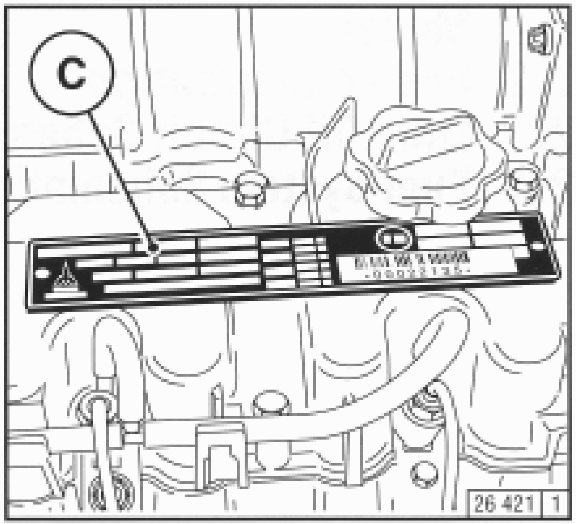
2.1 Model

2.1.1 Rating Plate



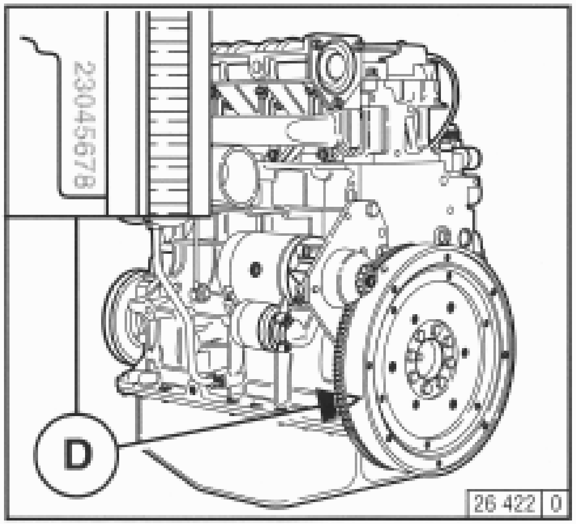
The model **A**, the engine serial number **B** and the performance data are stamped on the rating plate. The model and engine serial number must be given when ordering parts.

2.1.2 Rating Plate Location



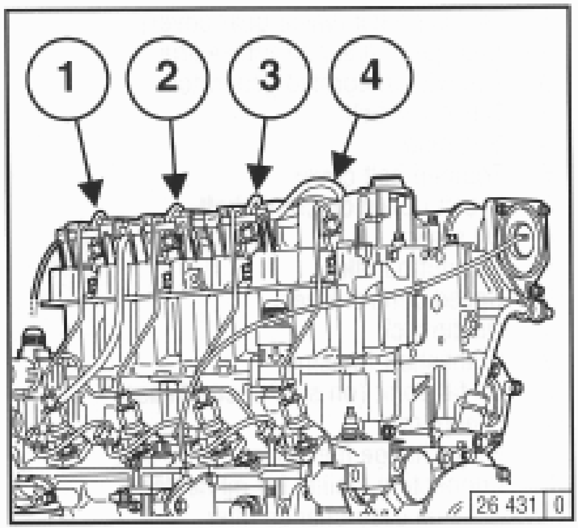
The rating plate **C** is attached to the valve cover.

2.1.3 Engine Serial Number



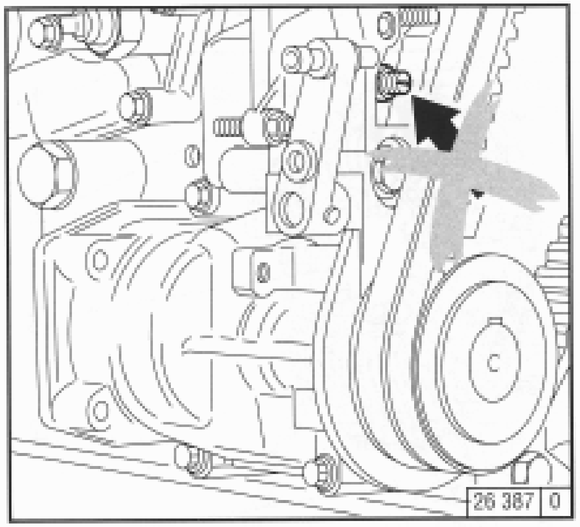
The engine serial number **B** is stamped on the crankcase **D** as well as the rating plate.

2.1.4 Cylinder Numbering



Cylinders are numbered consecutively, beginning at the flywheel end.

2.1.5 Fuel Delivery Lock



The manufacturer shall not be held liable for damages resulting from adjustments made to the regulator by the operator.
The lock screws are protected in order to prevent this:

1. with locking paint on model:
   torque balancer
2. with plastic protective cap on model:
   without torque balancer.

⚠ Adjustments to the regulator are to be carried out only by authorized DEUTZ SERVICE - specialists.

Engine Serial Number

Please enter the engine serial number here. This number should be quoted when inquiring about Customer Service, Repairs or Spare Parts (see Section 2.1).

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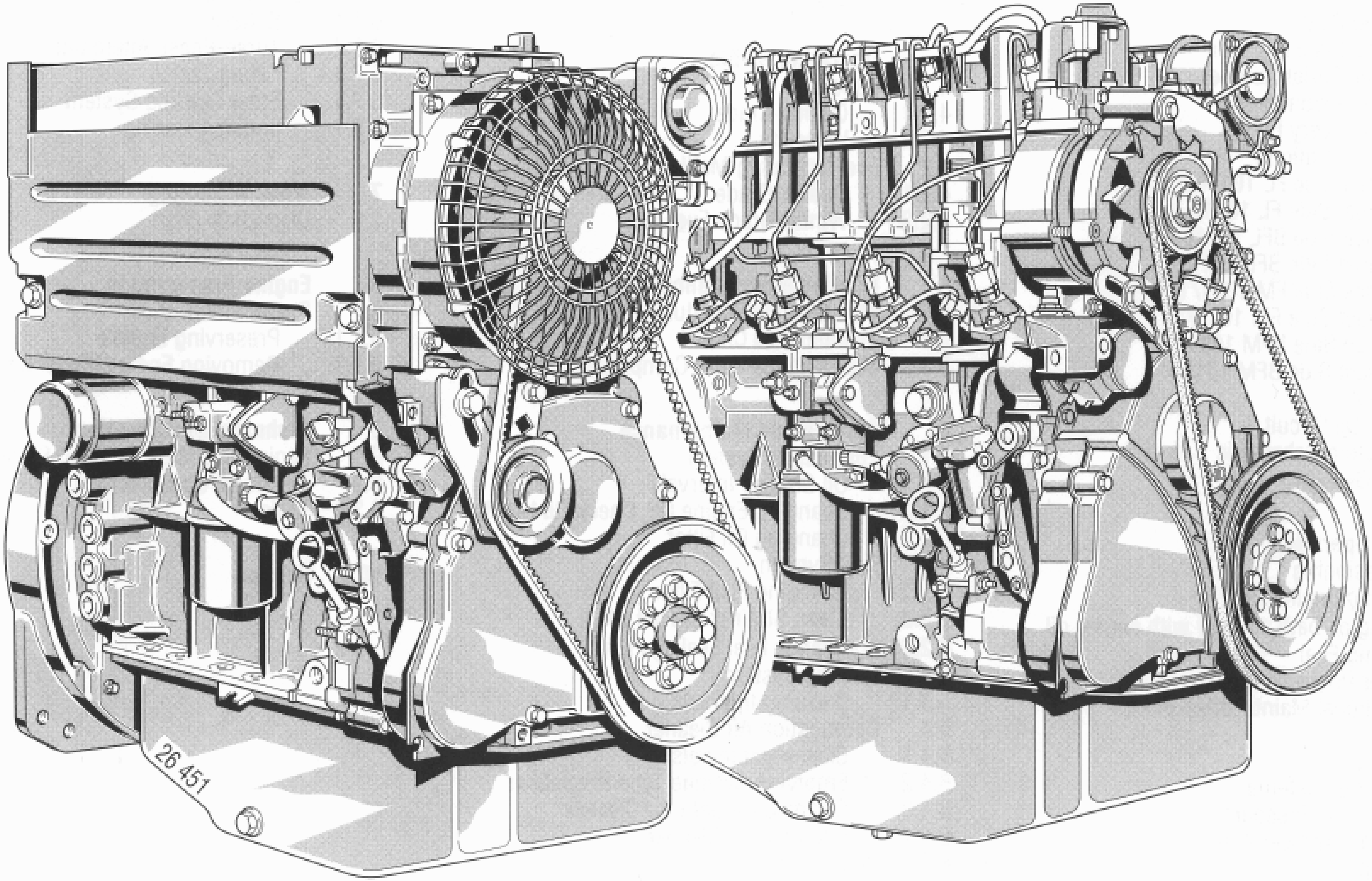
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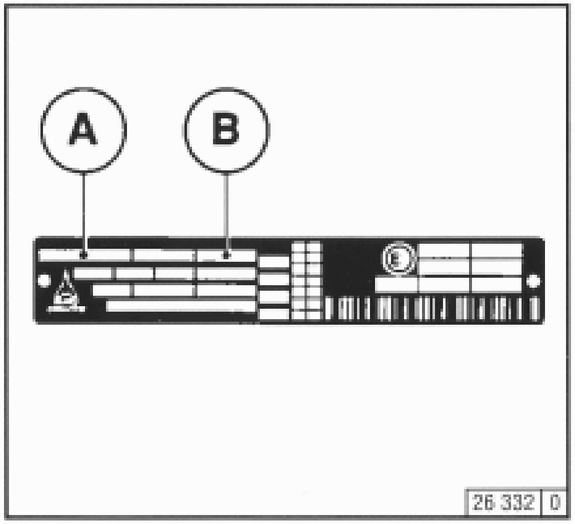
Engine Description

Engine Description

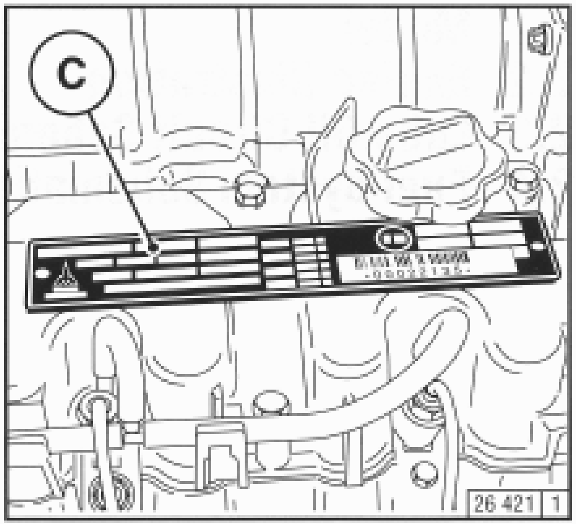
2.1 Model

2.1.1 Rating Plate



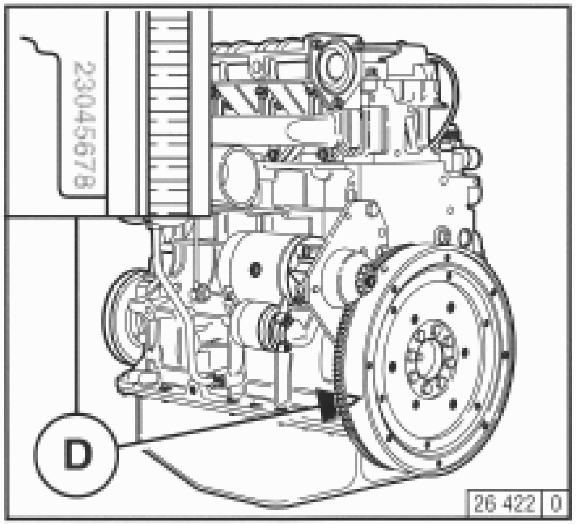
The model **A**, the engine serial number **B** and the performance data are stamped on the rating plate. The model and engine serial number must be given when ordering parts.

2.1.2 Rating Plate Location



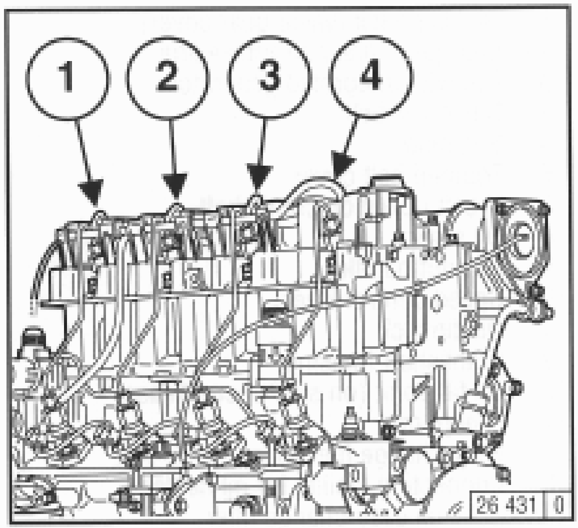
The rating plate **C** is attached to the valve cover.

2.1.3 Engine Serial Number



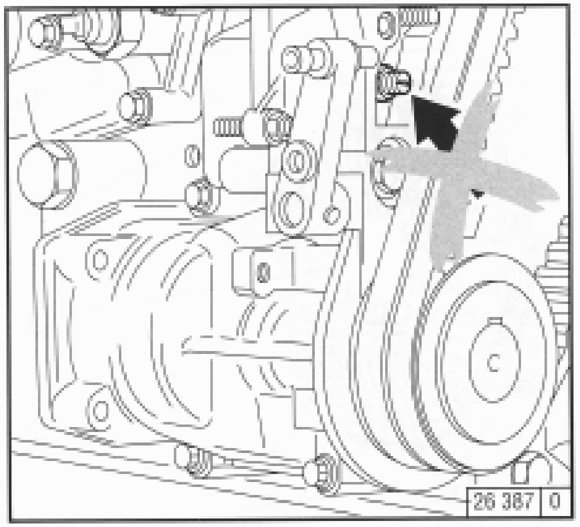
The engine serial number **B** is stamped on the crankcase **D** as well as the rating plate.

2.1.4 Cylinder Numbering



Cylinders are numbered consecutively, beginning at the flywheel end.

2.1.5 Fuel Delivery Lock



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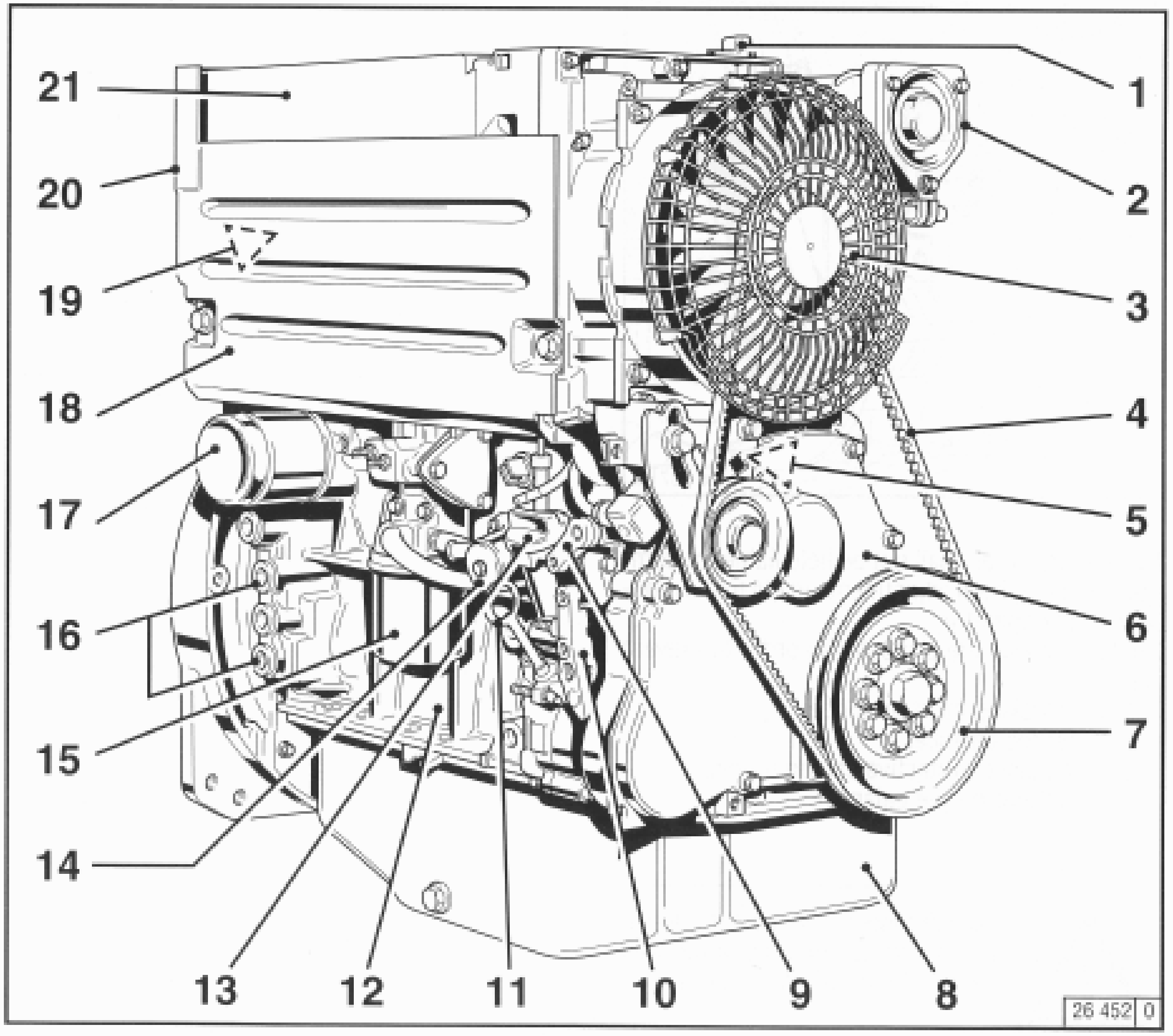
The lock screws are protected in order to prevent this:

1. with locking paint on model:
   torque balancer
2. with plastic protective cap on model:
   without torque balancer.

Adjustments to the regulator are to be carried out only by authorized DEUTZ SERVICE - specialists.

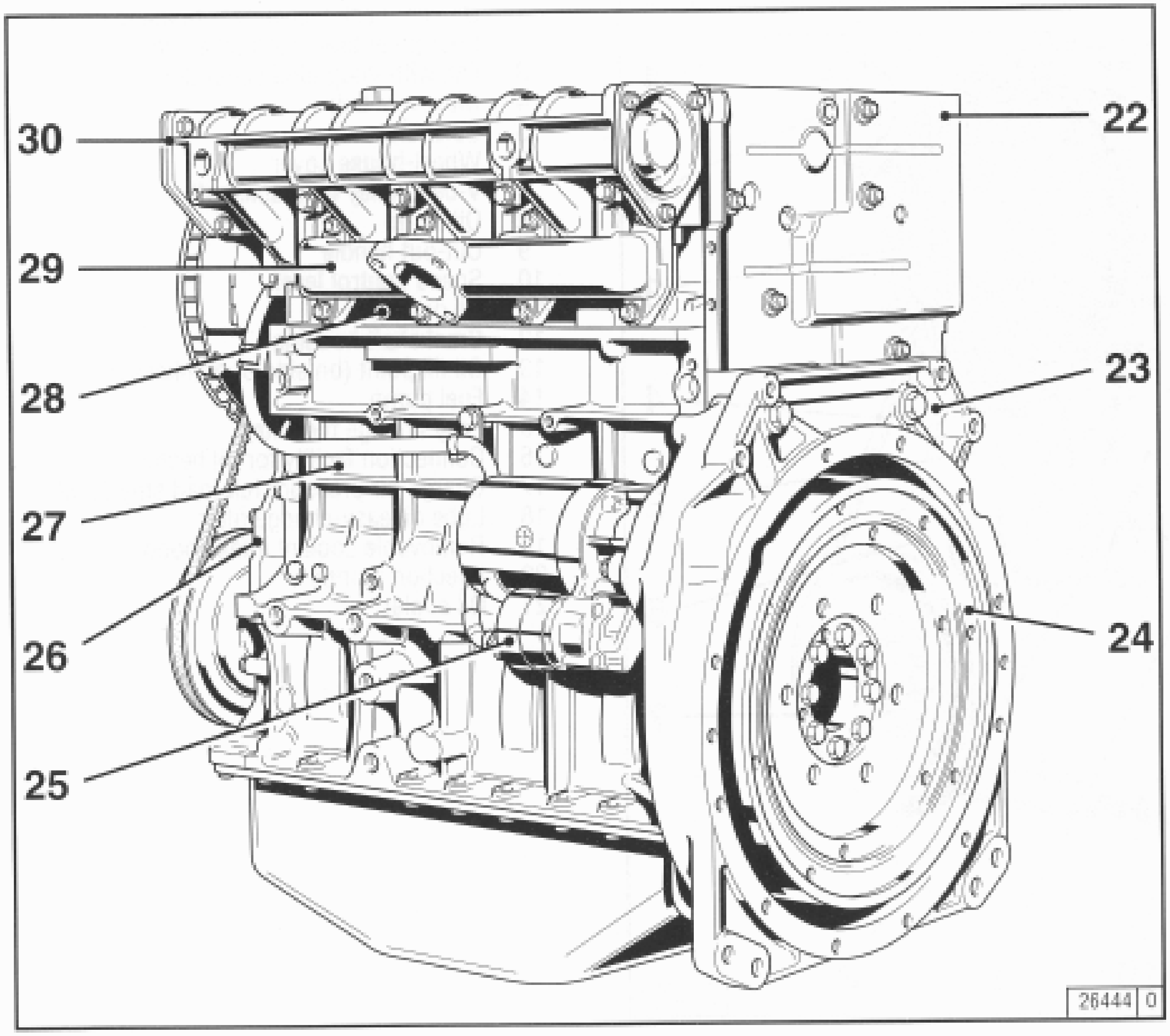
2.2.1 Service Side
FL 1011F



1	Oil filler neck (valve-gear cover)
2	Charge-air line / air-intake line
3	Fan with integrated generator
4	Narrow V-belt
5	Solenoid
6	Toothed belt cover
7	V-belt pulley on crankshaft
8	Oil sump
9	Cut-out handle
10	Speed control lever
11	Oil dipstick
12	Crankshaft housing
13	Oil fill point (on side of crankcase)
14	Fuel pump
15	Easy-change fuel filter
16	Connecting facility for oil heater
17	Lube oil easy-change filter
18	Removable coolant intake hood
19	Injection pumps
20	Date plate
21	Oil cooler

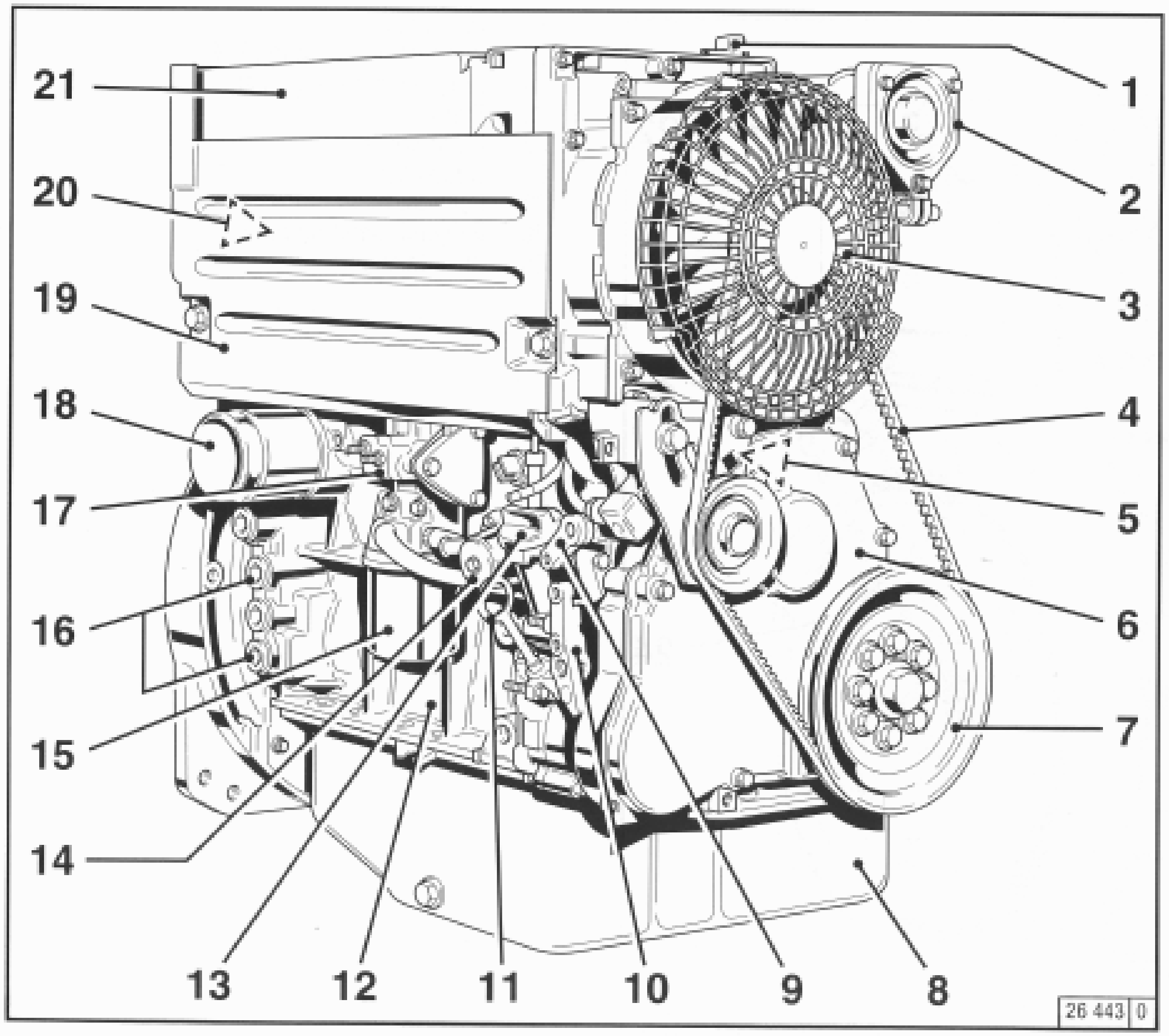
2.2 Engine Illustrations

2.2.2 Exhaust side
FL 1011F



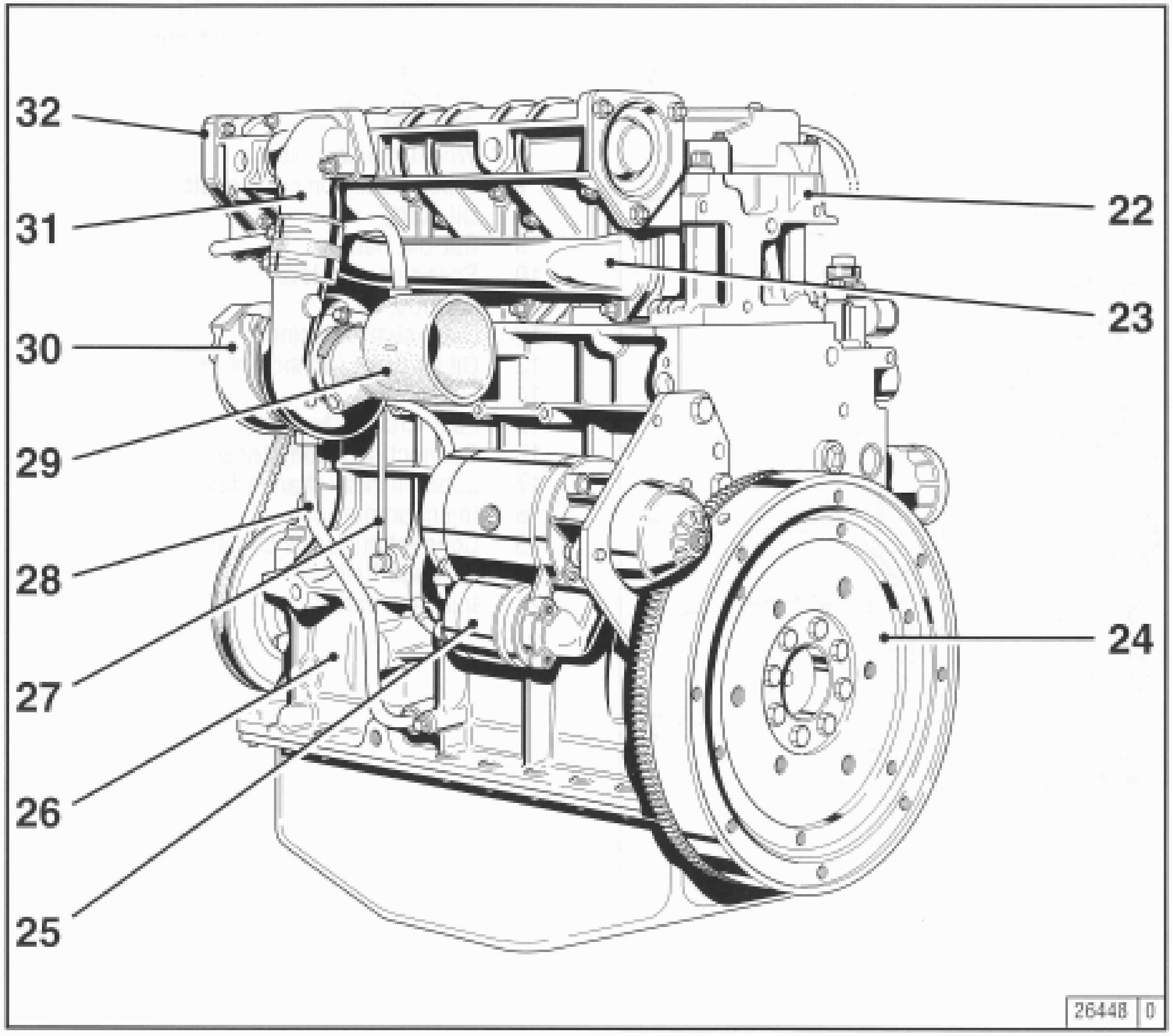
22	Date plate
23	Connection housing (SAE)
24	Flywheel with ring gear
25	Starter
26	Front cover
27	Crankcase
28	Cylinder head
29	Exhaust manifold pipe
30	Air-intake pipe

2.2.3 Service Side
BFL 1011F



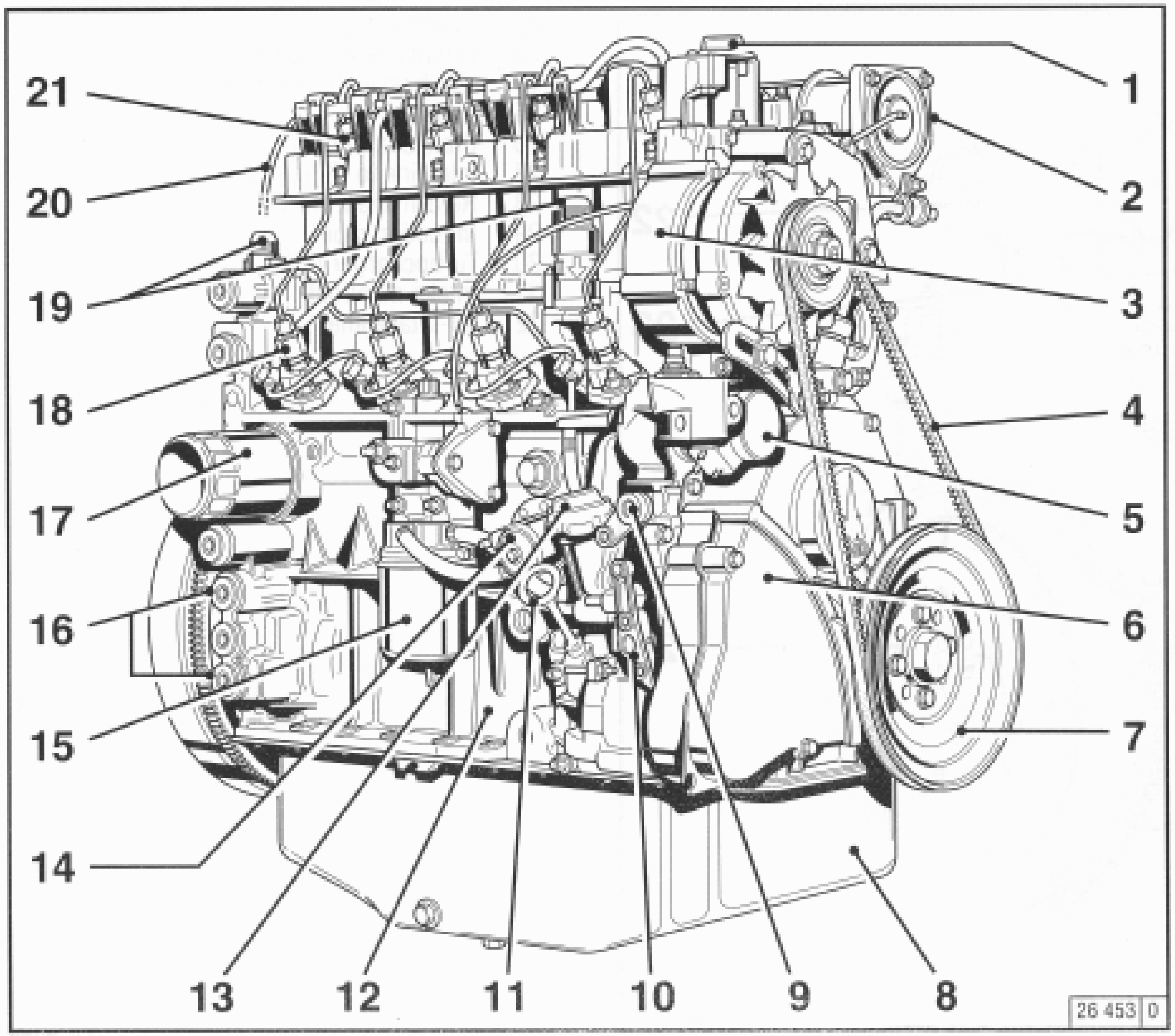
1 Oil filler neck (valve-gear housing cover)
2 Charge-air line / air-intake line
3 Fan with integrated generator
4 Narrow V-belt
5 Solenoid
6 Wheel-house cover
7 V-belt pulley on crankshaft
8 Oil sump
9 Cut-out handle
10 Speed control lever
11 Oil dipstick
12 Crankshaft housing
13 Oil fill point (on side of crankcase)
14 Fuel pump
15 Easy-change fuel filter
16 Connection facility for oil heater
17 Charge-air pressure full-load stop (LDA)
18 Lube oil easy-change filter
19 Removable coolant intake hood
20 Injection pumps
21 Oil cooler

2.2.4 Exhaust side BFL 1011F



22	Cylinder head
23	Exhaust manifold pipe
24	Flywheel with ring gear
25	Starter
26	Crankshaft housing
27	Inlet line to TC (Lube oil)
28	Return line from TC (Lube oil)
29	Induction pipe
30	Turbocharger (TC)
31	Intake manifold
32	Air-intake line

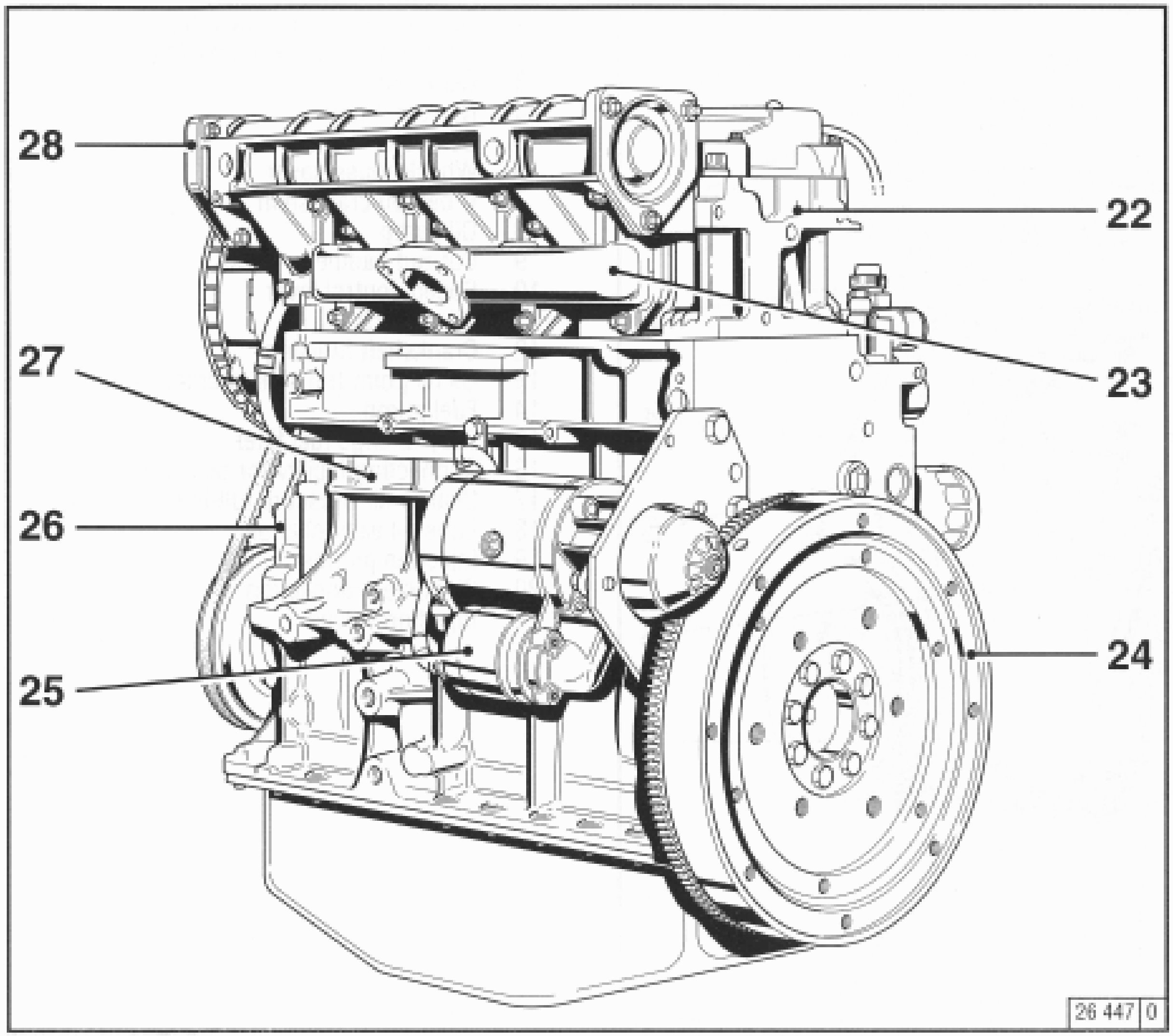
2.2.5 Service Side
FM 1011F



1 Oil filler neck (valve-gear housing)
2 Charge-air line / air-intake line
3 Generator
4 Narrow V-belt
5 Solenoid
6 Wheel-house cover
7 V-belt pulley on crankshaft
8 Oil sump
9 Cut-out handle
10 Speed control lever
11 Oil dipstick
12 Crankshaft housing
13 Oil fill point (on side of crankcase)
14 Fuel pump
15 Easy-change fuel filter
16 Connecting facility for oil heater
17 Lube oil easy-change filter
18 Injection pumps
19 Connection for oil cooler
20 Leakage-fuel line
21 Injection valves

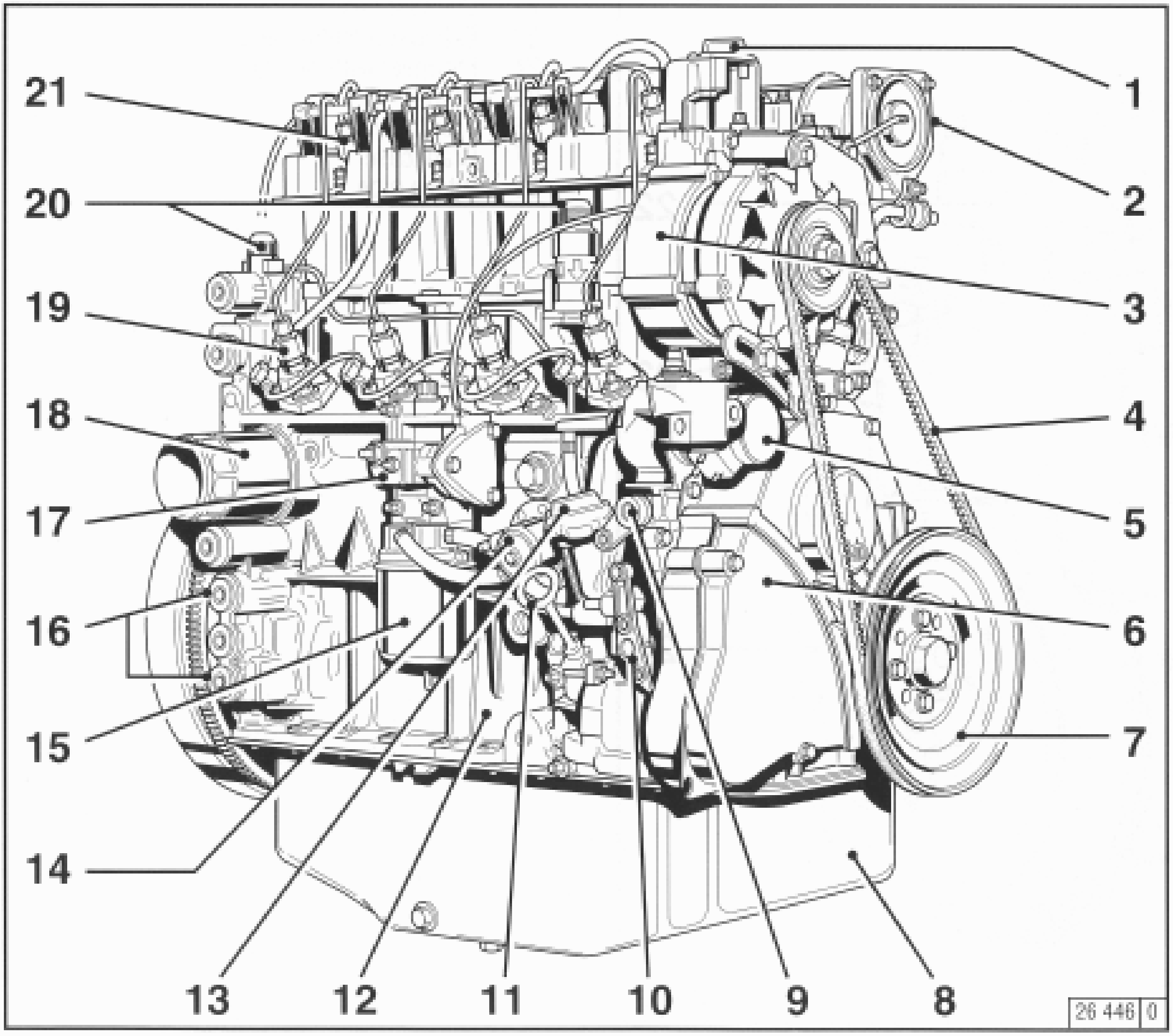
2.2 Engine Illustrations

2.2.6 Exhaust side
FM 1011F



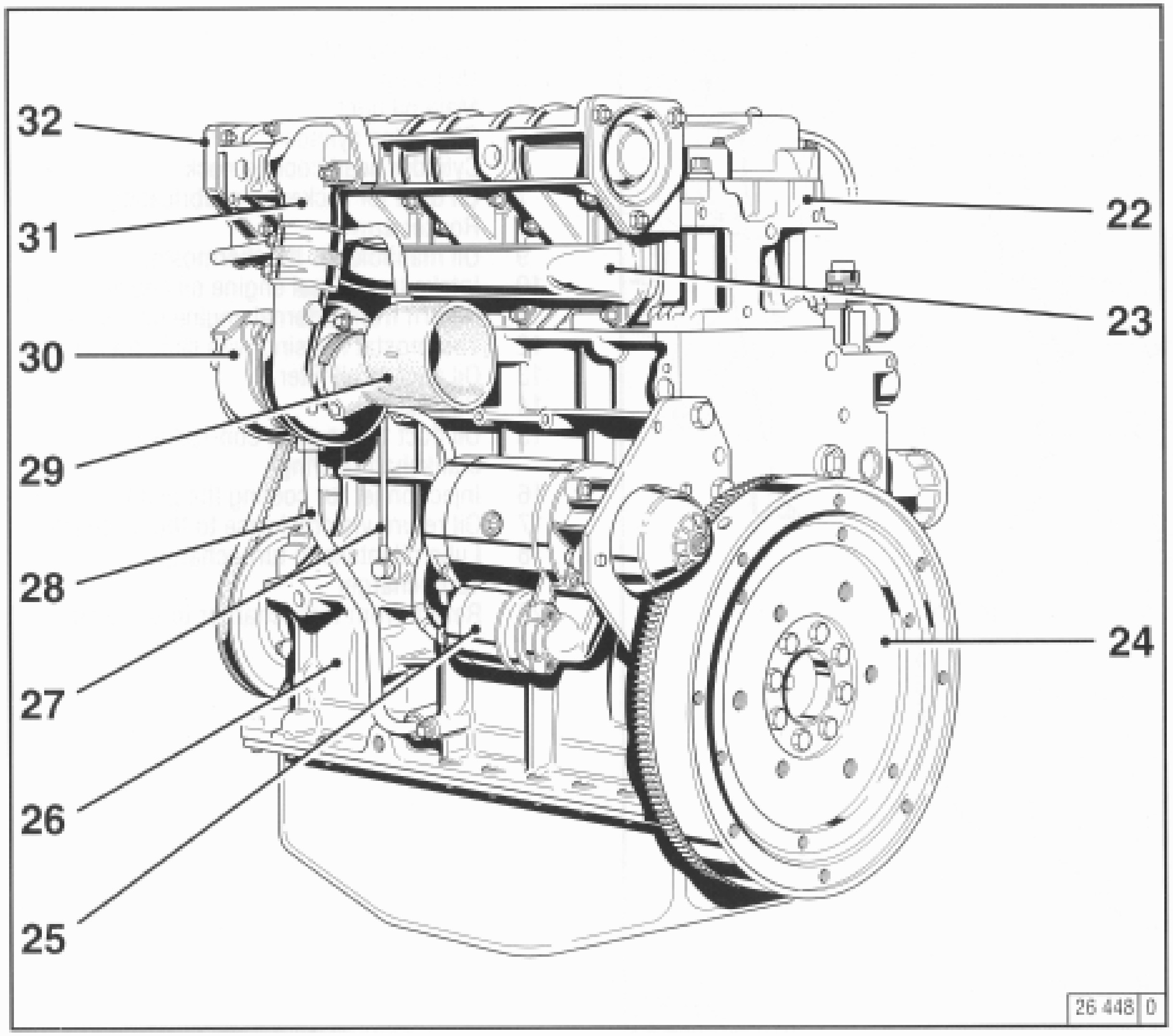
22	Cylinder head
23	Exhaust manifold line
24	Flywheel with ring gear
25	Starter
26	Front cover
27	Crankcase
28	Intake pipe

2.2.7 Service Side BFM 1011F



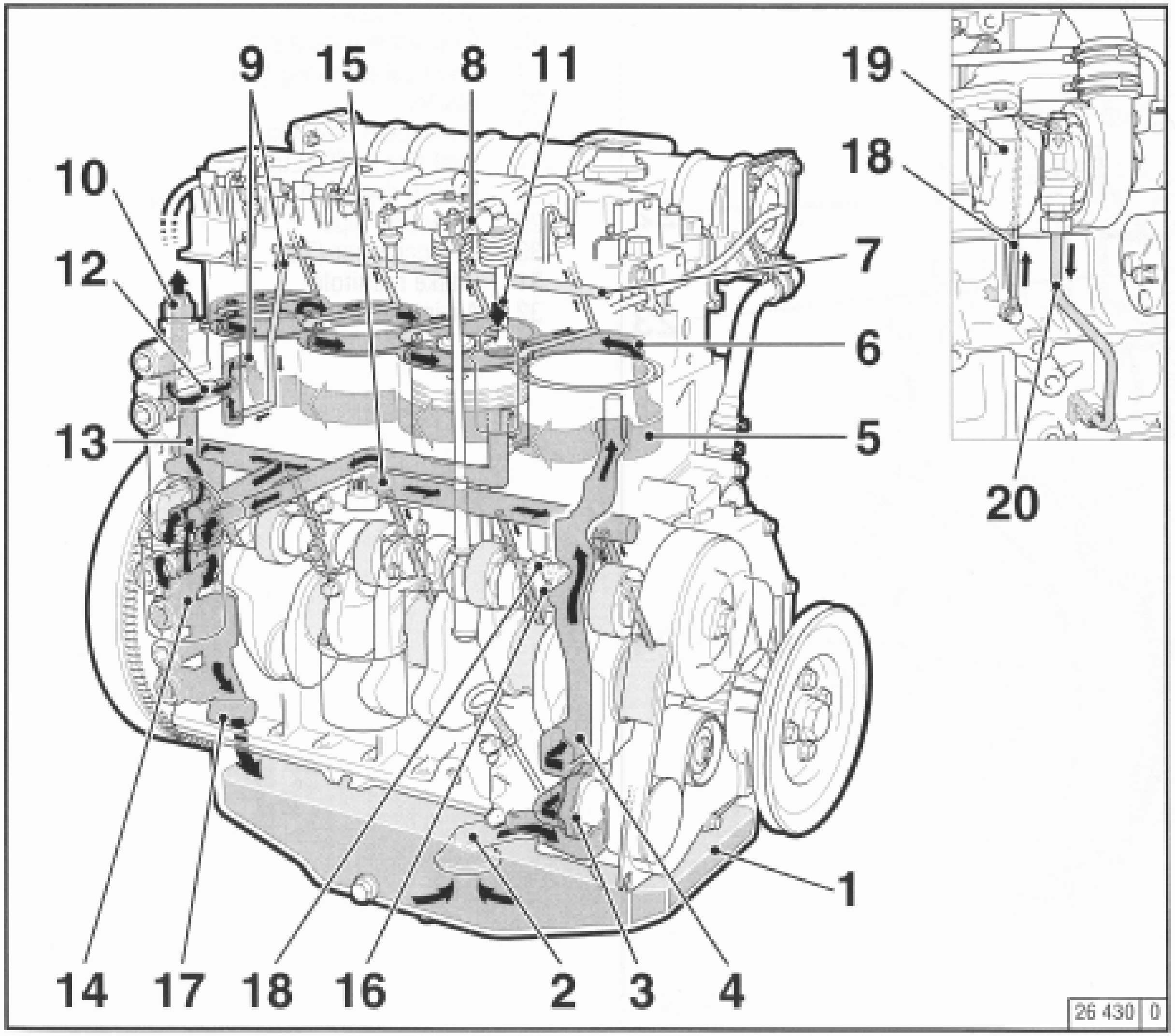
1	Oil filler neck (valve-gear housing cover)
2	Charge-air line / air-intake line
3	Generator
4	Narrow V-belt
5	Solenoid
6	Wheel-house cover
7	V-belt on crankshaft
8	Oil sump
9	Cut-out handle
10	Speed control lever
11	Oil dipstick
12	Crankshaft housing
13	Oil fill point (on side of crankcase)
14	Fuel pump
15	Easy-change fuel filter
16	Connecting facility for oil heater
17	Charge-air pressure full-load stop (TC)
18	Lube oil easy-change
19	Injection pumps
20	Oil cooler connection
21	Injection valves

2.2.8 Exhaust side
BFM 1011F



22	Cylinder head
23	Exhaust manifold pipe
24	Flywheel with ring gear
25	Starter
26	Crankshaft housing
27	Inlet line to TC (Lube oil)
28	Return line from TC (Lube oil)
29	Induction pipe
30	Turbocharger (TC)
31	Intake manifold
32	Air-intake line

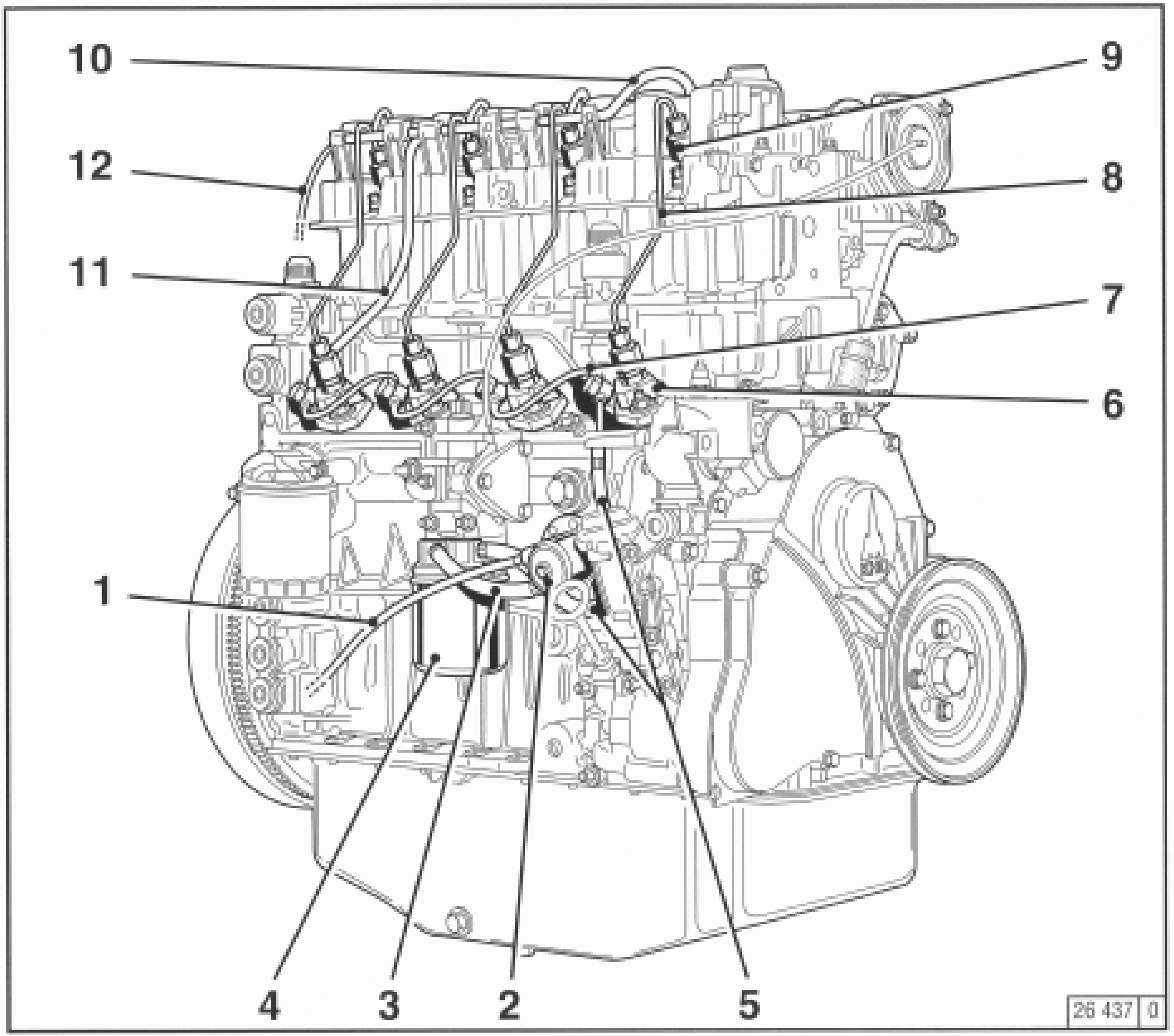
2.3.1 Lube Oil Circuit Schematic



1	Oil sump
2	Intake manifold
3	Oil pump
4	Main oil duct
5	Oil-cooled cylinder
6	Cylinder head cooling neck
7	Oil duct for rocker arm lubrication
8	Rocker arm
9	Oil manifold for the thermostat
10	Intake to external engine oil cooler
11	Return from external engine oil cooler
12	Thermostat housing with slide thermostat
13	Oil duct to oil filter
14	Oil filter
15	Oil duct to the cam, con-rod and crankshaft bearing
16	Injection jet for cooling the pistons
17	Oil return via crankcase to the oil sump
18	Lube oil intake to turbocharger
19	Turbocharger
20	Return from turbocharger to oil sump

2.4 Fuel System

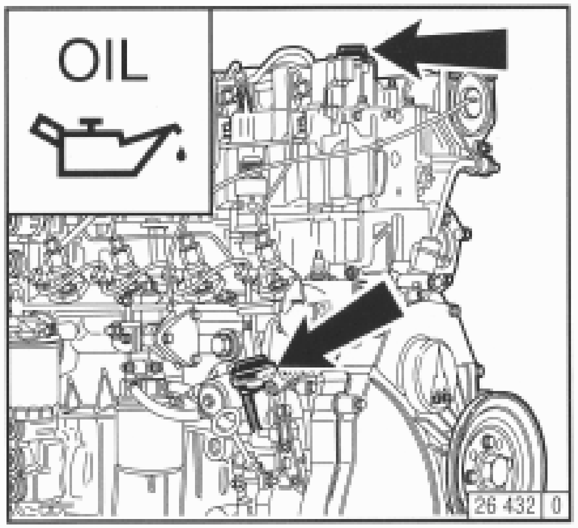
2.4.1 Fuel system schematic



1	Fuel line from tank to fuel pump
2	Fuel pump
3	Fuel line from fuel pump to easy-change fuel filter
4	Easy-change fuel filter
5	Fuel line from filter to injection pump
6	Injection pumps
7	Fuel distributor line
8	Injection lines
9	Injection valves
10	Fuel leakage line
11	Fuel overflow pipe
12	Fuel return line to tank

Engine Operation

3.1.1 Adding Engine Oil



As a rule, engines are delivered empty of oil. Pour lube oil into the oil filler neck (arrow). For oil grade and viscosity, see 4.1.

3.1.1.1 Initial Engine Oil Fill-Up for B/FM1011F Series

- Fill oil into the oil sump up to the "**max.**" mark on the engine dip stick (for oil top-up quantity see 9.1).
- Start the engine and allow to run at a low idling speed for approx. 2 mins.
- Switch off the engine.
- Check the oil level, if necessary, top up oil to the „**max.**" mark.

3.1.1.2 Initial Engine Oil Fill-up for B/FM 1011F Series

- Fill oil into the oil sump up to the "**min.**" mark on the engine dip stick.
- In addition, top up the oil quantity of the supply hoses and of the external oil cooler (according to manufacturer's details).
- Allow the engine to run warm until the thermostat opens (at approx. 95°C).
- Allow the engine to run for approx. 2 mins.
- Switch off the engine.
- Check the oil level, and if necessary, top up oil to the „**max.**" mark.

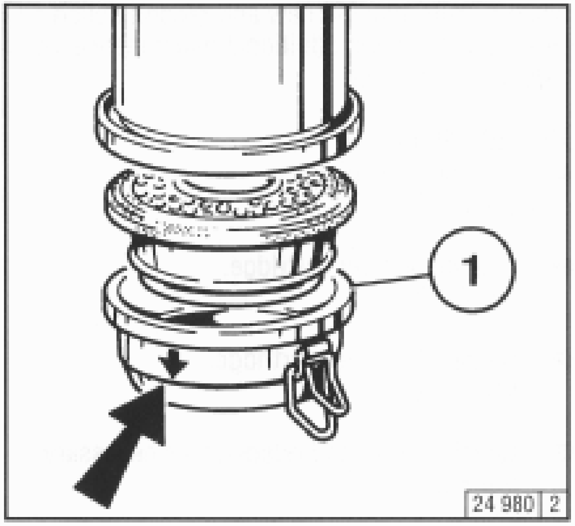
If the person operating the engine does not run up the engine until the thermostat opens, the oil level may lie above the „**max** ". mark on the engine dip stick when delivered. The level can then only be assessed after the engine has been run up.

3.1 Commissioning

3.1.1.3 Initial Engine Oil Fill-Up for B/FM 1011F Genset Engine

- Fill oil into the oil sump up to the "**max.**" mark on the engine dip stick (for oil quantity see 9.1).
- Start up the engine and allow to run at a lower idling speed for approx. 2 mins.
- Switch off the engine.
- Check the oil level and fill up with oil up to the upper „**max.**" mark.

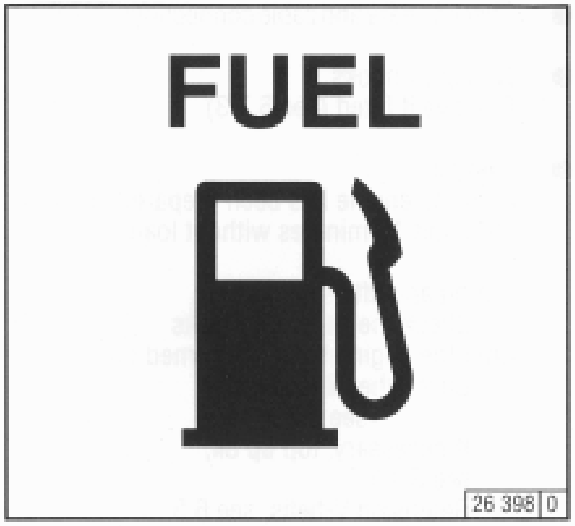
3.1.2 Filling Oil Bath Air Filter with Engine Oil



Fill oil cup 1 of the oil bath air cleaner with oil up to the arrow.
For oil grade and viscosity, see 4.1.

⚠ Do not fill the precleaner dust collector (if fitted) with oil.

3.1.3 Adding Fuel



Use only commercial-grade diesel fuel. For fuel grade, see 4.2. Use summer or winter-grade fuel, depending on the ambient temperature.

⚠ Never fill the tank while the engine is running. Keep the filler cap area clean and do not spill fuel.

3.1.4 Other Preparations

- Check battery and cable connections, see 6.7.1
- Transport hooks
  Remove if fitted (see 6.7.3)
- Trial run
  After the engine has been prepared, let it run for about 10 minutes without load.

  During and after trial run
  - Check the engine for leaks

  After the engine has been turned off
  - Check the oil level,
    see 6.1.2
    If necessary, top up oil,
    see 3.1.1
  - Retension V-belts, see 6.5
- Breaking in
  During the break-in phase – about 200 operating hours – check the oil level twice a day. After the engine is broken in, checking once a day will be sufficient.

3.1.5 Additional Maintenance Work

When commissioning new and reconditioned engines, the following additional maintenance work must be carried out:

After 50-150 OH

- Change lube oil,
  see 6.1.2
- Change oil filter cartridge,
  see 6.1.3
- Change fuel filter cartridge,
  see 6.2.1
- Check V-belts and retension as necessary,
  see 6.5.
- Check the engine for leaks
- Check the engine mount and adjust as necessary, see 9.2

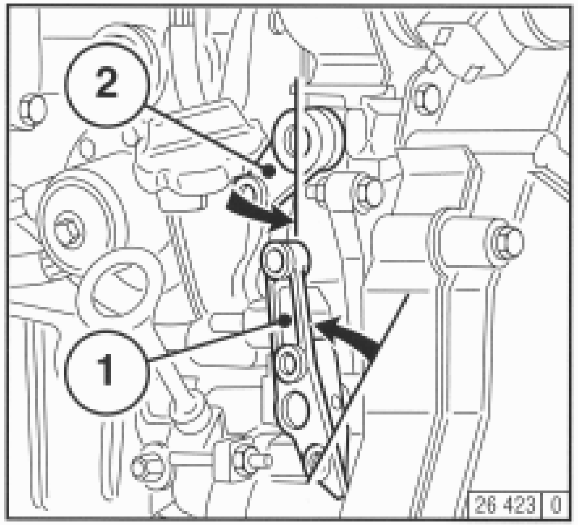
After 500 OH

- Check the valve clearance and adjust as necessary, see 6.6.1.

3

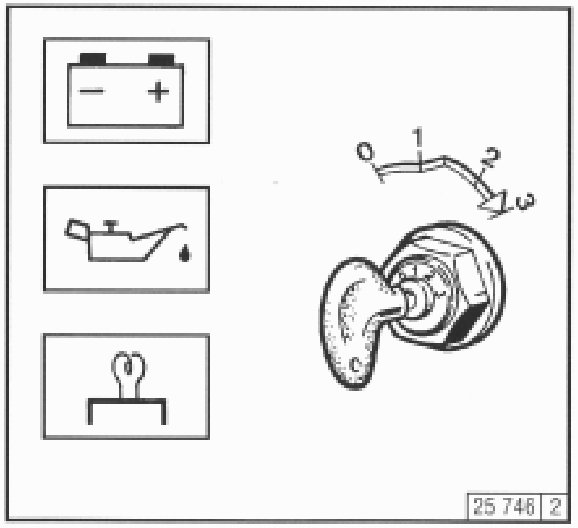
3.2.1 Electric Starting

⚠ Before starting, make sure that nobody is standing in the immediate vicinity of the engine or driven machine.
After repair work:
Check that all guards have been replaced and that all tools have been removed from the engine.
When starting with glow plugs, do not use any other starter substance (e.g. injection with start pilot).
Caution: If the speed regulator has been removed, the engine must not be tested under any circumstances:
Disconnect the battery.



- Where possible, disengage the clutch to separate the engine from any driven parts.
- Move speed control lever 1 into idle position.
- Move cut-out handle 2 into operating position.

Starting without Cold-Start Aid

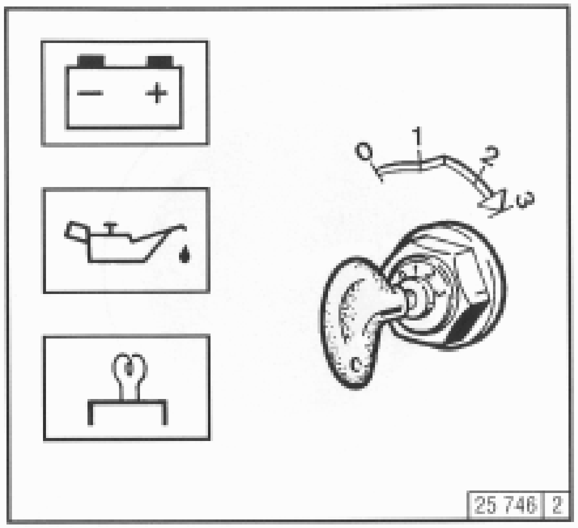


- Insert key.
  - Position 0 = no operating voltage
- Turn key clockwise
  - Position 1 = operating voltage
  - Pilot lights come on
- Push the key in and turn it further clockwise against spring pressure
  - Position 2 = no function
  - Position 3 = start
- Release key as soon as engine fires
  - Pilot lights go out

Do not actuate the starter for more than 20 seconds. If the engine does not catch, wait a minute then try again.
If the engine does not catch after two attempts, refer to the Diagnosis Chart (see 7.1).

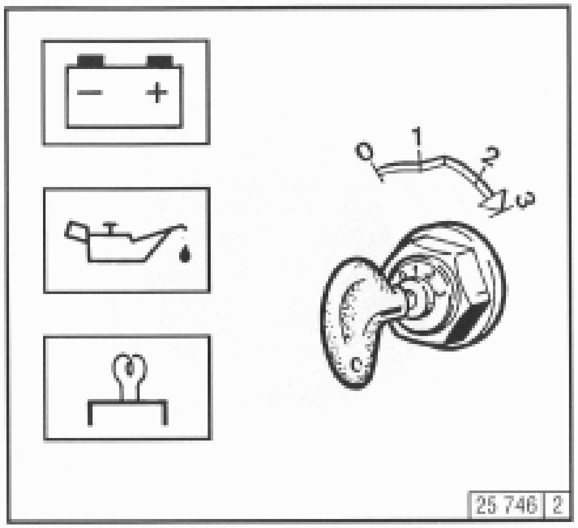
3.2 Starting

with Cold-Start Aid
– Glow Plug



- Insert key.
  - Position 0 = no operating voltage
- Turn key clockwise
  - Position 1 = operating voltage
  - Pilot lights come on
- Push key in and turn further clockwise against spring pressure
  - Position 2 = Preheat, hold for approx. 1 minute.
  - Preheat lamp comes on
  - Position 3 = Start
- Release key as soon as engine fires
  - Pilot lights go out

with Cold-Start Aid
– Ether Starting System



- Insert key
  - Position 0 = no operating voltage
- Turn key clockwise
  - Position 1 = operating voltage
  - Pilot lights come on
- Push key in and turn further clockwise against spring pressure
  - Position 2 = no function
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- Release key as soon as engine fires
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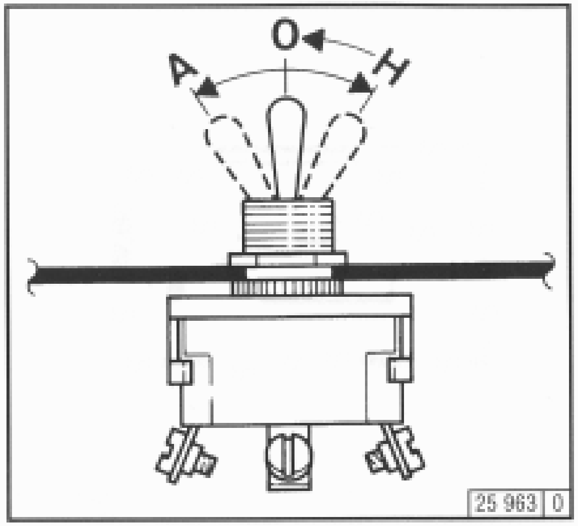
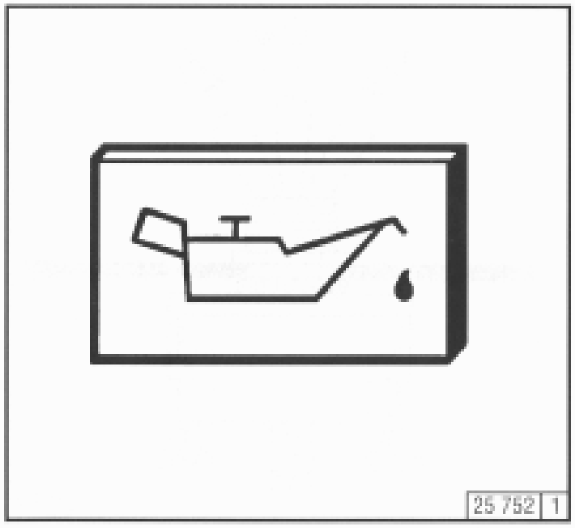


- Starting fluid is injected automatically in switch position **A**, as long as the starter is operated.
- To assist acceleration at lower temperatures and to avoid white fumes, briefly hold the arctic switch in switch position **H**.

⚠ The switch must not be moved to position **H** when the engine is switched off and the ignition is switched on.

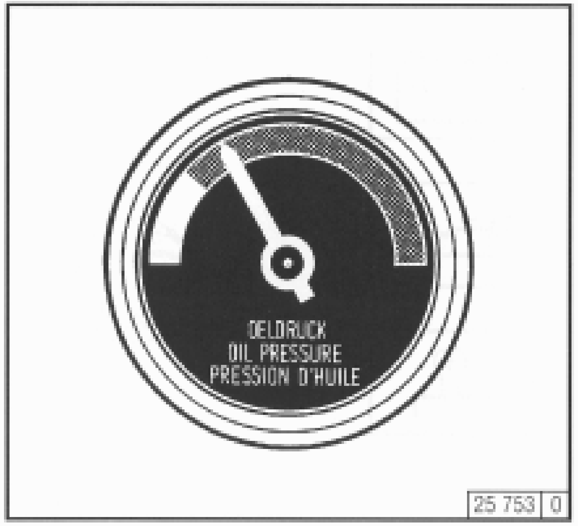
3.3.1 Engine Oil Pressure

Oil Pressure Pilot Light



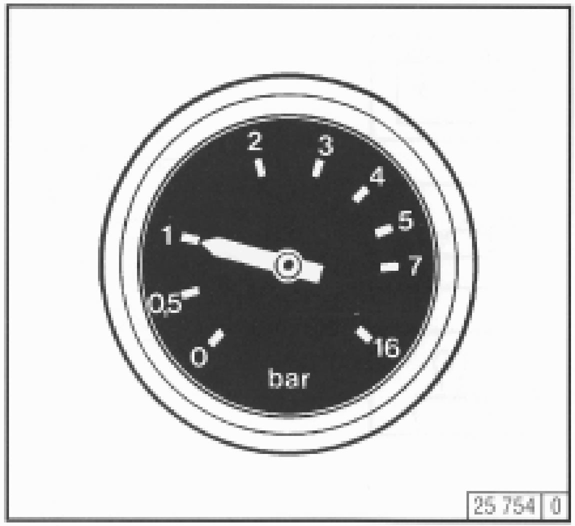
- The oil pressure pilot light comes on with operating voltage on and engine off.
- The oil pressure pilot light should go out when the engine is running.

Oil Pressure Indicator



- The pointer must remain in the green sector over the entire range.

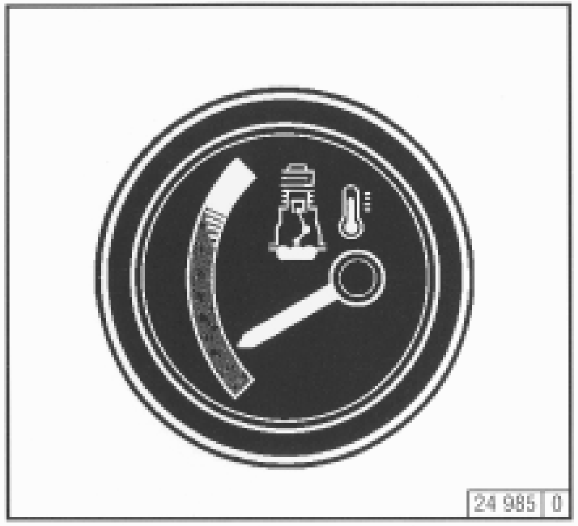
Oil Pressure Gauge



- The pointer must indicate the minimum oil pressure (see 9.1).

3.3.2 Coolant Temperature

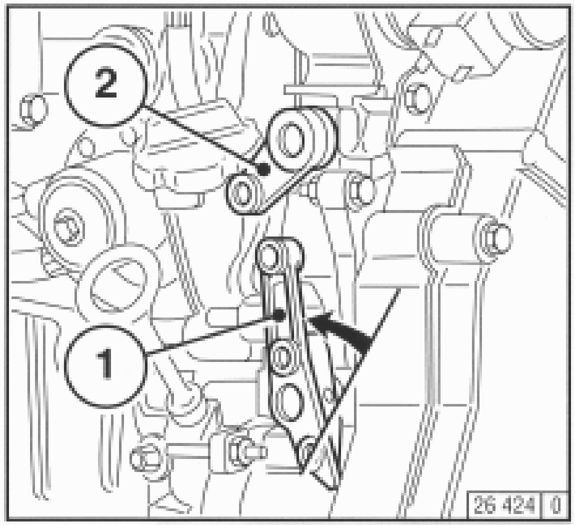
Engine Temperature Gauge



- The engine temperature gauge pointer should remain in the green sector most of the time. It should rarely enter the yellow-green sector. If the pointer enters the orange sector, the engine is overheating. Turn off and establish the cause from the Diagnosis Chart (see 7.1).

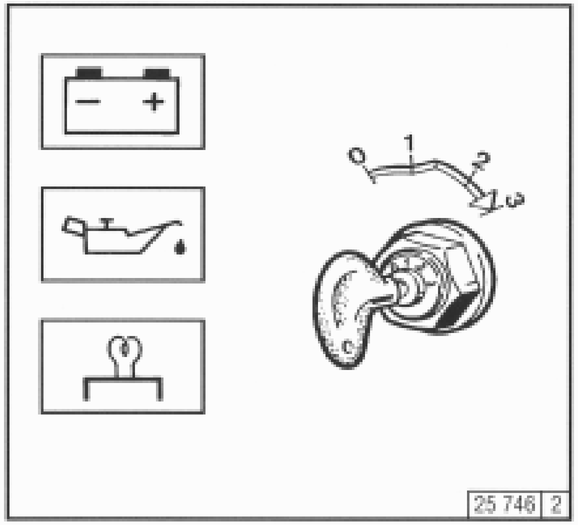
3.4 Stopping

3.4.1 Mechanical Shutdown



- Move speed control lever 1 to low idle.
- Operate shutdown lever 2 until the engine comes to a stop. The charge pilot light and the oil pressure pilot light will come on when the engine stops.
- Turn key counterclockwise (to position 0) and remove. The pilot lights will go out.

3.4.2 Electrical Shutdown (Ignition Key)



- Turn key counterclockwise (to position 0) and remove. The pilot lights will go out.

If possible, do not suddenly switch off the engine when under full load.

3.5 Operating Conditions

3.5.1 Winter Operation

- Lube Oil Viscosity
  - Select the oil viscosity (SAE grade) according to the ambient temperature when the engine is started, see 4.1.2.
  - Increase oil change frequency when operating below -10 °C, see 6.1.1.

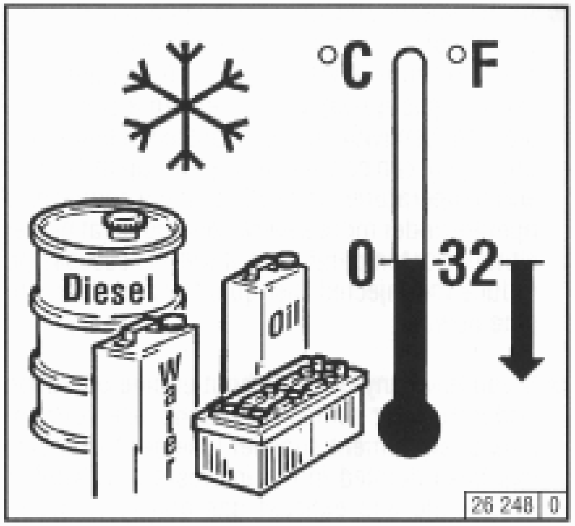
- Diesel Fuel
  - Use winter-grade diesel fuel for operation below 0 °C, see 4.2.2.

- Additional Maintenance Work
  - Drain the sludge from the fuel tank once a week. (Unscrew the sludge drain plug)
  - If necessary, allow the oil in the oil bath air cleaner and the engine oil to settle at the ambient temperature.
  - Below -20 °C, after removing the starter if necessary, smear the ring gear on the fly wheel via the pinion bore from time to time with cold-resistant grease. (e.g. Bosch grease FT 1 V 31).

- Cold-Start Aid
  - At temperatures near or below freezing point, use glow plugs if necessary, see 3.2.1.

    This not only lowers the starting limit temperature, but provides easier starting at temperatures normally not requiring a starting aid.

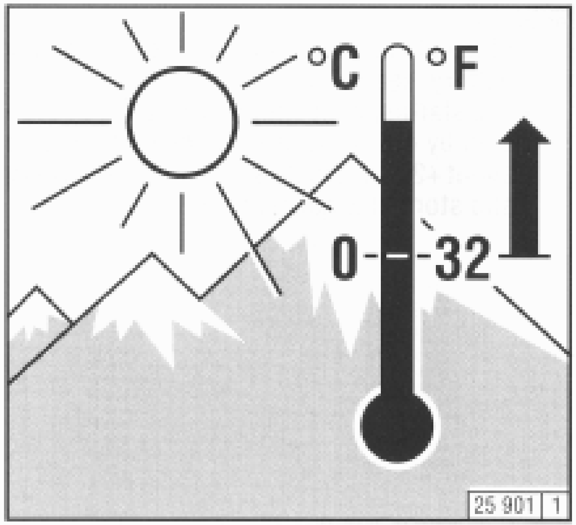
- Battery
  - Efficient cold starting requires a healthy battery, see 6.7.1.
  - The starting limit temperatures can be lowered by 4-5 °C by heating the battery up to about +20 °C. (To do so, remove the battery and store in a warm place).



3.5.2 High Ambient Temperatures, High Altitude

- As the altitude and ambient temperature rise, the density of air tends to decrease, which affects the maximum power output of the engine, the exhaust gas quality and, in extreme cases, the starting behavior. Under transient conditions, the engine can be used at altitudes up to 1000 m and temperatures up to 30 °C. If the engine is to operate under more severe conditions (at higher altitudes or temperatures), it will be necessary to reduce the injected fuel quantity and thus, engine power.

- If you have any doubts about engine operation under these or similar conditions, ask your engine or equipment supplier whether the engine has been derated in the interests of reliability, service life and exhaust gas quality (smoke). Otherwise contact DEUTZ SERVICE.



Operating Media

Operating Media

4.1 Lube Oil

4.1.1 Quality grade

Lube oils are differentiated according to their performance and quality class. In common use are specifications named after the **API** (American Petroleum Institute) and **ACEA** (European Engine Oil Sequences).

Approved API Oils:

At least: CF-4, CG-4, CH-4

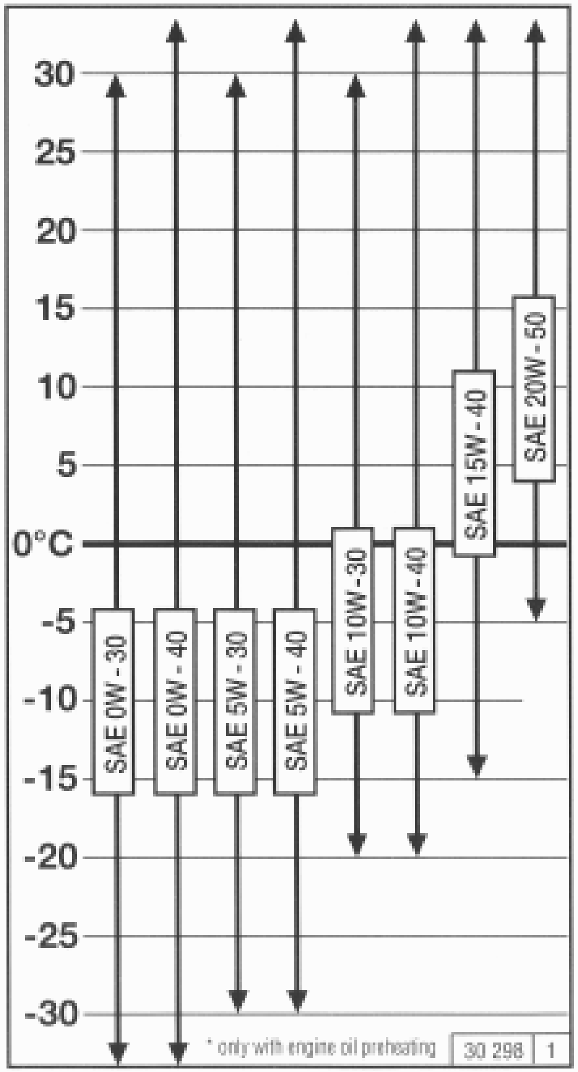
Approved ACEA Oils:

At least: E1-E3-96, E4-98

Oil change intervals, see 6.1.1
Oil capacities, see 9.1

4.1.2 Viscosity

As the viscosity of the lube oil is dependent on temperature, the choice of SAE grade should be governed by the ambient temperature prevailing at the engine operating site. Optimum operating behaviour will be attained if you take the accompanying oil viscosity diagram as a guide.
Should the temperature fall temporarily below the limits of SAE grade selected, cold starting may be affected but the engine will not be damaged.
In order to keep wear to a minimum, do not exceed application limits for extended periods of time.
Oil changes dictated by the seasons can be avoided by using multi-grade lube oils. Multi-grade oils – particularly light-flowing oils – also reduce fuel consumption.



4.2 Fuel

4.2.1 Quality Grade

Use commercially available diesel fuel with less than 0.5 % sulfur content. If the sulfur content is higher than 0.5 % oil change intervals should be reduced, see 6.1.1.

The following fuel specifications / standards are approved:

- DIN 51 601 (Febr. 1986)
- BS 2869: A1 and A2
  (with A2, take note of the sulfur content)
- ASTM D 975-88; 1-D and 2-D
- CEN EN 590 or DIN EN 590
- NATO Code F-54 and F-75

Exhaust emission values determined during type inspections always refer to the reference fuel prescribed by the authorities for the type inspection

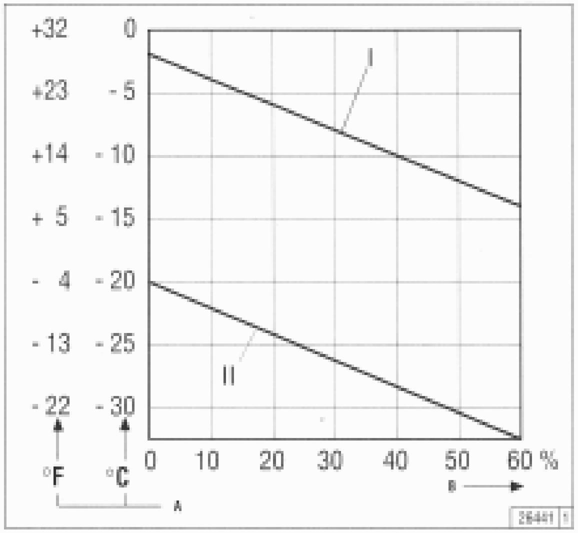
4.2.2 Winter-Grade Fuel

Waxing may occur at low temperatures, clogging the fuel system and reducing engine efficiency. If the ambient temperature is less than 0 °C, winter-grade fuel (suitable down to -20 °C) should be used. This fuel is available from the filling stations well in advance of the cold months.

- At temperatures below -20 °C, kerosene should be added to the diesel fuel. The relevant percentages are given in the adjacent diagram.
- Special diesel fuels can be used for climatic zones down to - 44 °C.

If summer-grade diesel fuel must be used at temperatures below 0 °C, up to 60% kerosene can be added (see diagram).

In most cases, adequate resistance to cold can be obtained by adding a flow improver (additive). Please inquire at your DEUTZ partner.



I = Summer diesel fuel
II = Winter diesel fuel
III = Super diesel fuel

A = Ambient temperature

B = Proportion of Kerosene to be added
Mix in tank only. Fill with the appropriate amount of kerosene first, then add the diesel fuel.

Routine Maintenance

5.1 Maintenance Schedule

Operating Hours (OP) every 1)									check	clean	change	Operation	see Section
once after 2) 50-150	every 10 OH or daily	125	250	500	750	1000	2000	3000					
	●								●			Oil level in engine / separate container 9)	6.1.2/3.1.4
●									●			Engine leaks	
	●								●			Oil bath- and dry type air cleaners 3) 4) 5)	6.4
		●							●			Battery and cable connectors	6.7.1
		●	●	●		●	●		●			Cooling system (depending on engine use 3)	6.3.1
●				●7)		●6)					●	Engine oil (depending on engine use) 4) 6)	6.1.1
●				●7)		●6)					●	Oil filter cartridge (depending on oil change interval) 4) 6)	6.1.3
●						●					●	Fuel filter cartridge	6.2.1
				●2)		●			●			Valve clearance (adjust if necessary)	6.6.1
●									●			Engine mounts (retighten if necessary)	9.2
●				●					●			V-belts (retension if necessary)	6.5
											●	Toothed belts 8) 10)	
								●	●			Injection valves	
						●				●		Fuel pump / strainer 5)	6.2.2
						●			●			Fuel leakage line (change defective lines) 11)	6.2.3

The specified engine maintenance times are maximum values. Depending on the operating environment, shorter maintenance intervals may be required. Please observe the operating instructions of the equipment manufacturer.

1) recommended maximum
2) once when commissioning new and reconditioned engines
3) clean if needed
4) Oil quality API-CF-4, CG-4, CH-4 or ACEA-E1-3/96 and EA-98
5) change if required
6) for oil change intervals, naturally aspirated engines, see Section 6.1.1
7) for oil change intervals, turbocharged engines, see Section 6.1.1
8) without toothed belt ventilation renew after 3000 running hours, after 5 years at the latest if running hours are not reached: in both cases together with idler pulley with toothed belt ventilation renew after 4500 running hours, after 5 years at the latest if running hours are not reached: in both cases together with idler pulley
9) during run-in period, check 2 x daily
10) retensioning of toothed belts is not permitted
11) Change at the latest after 2 years .

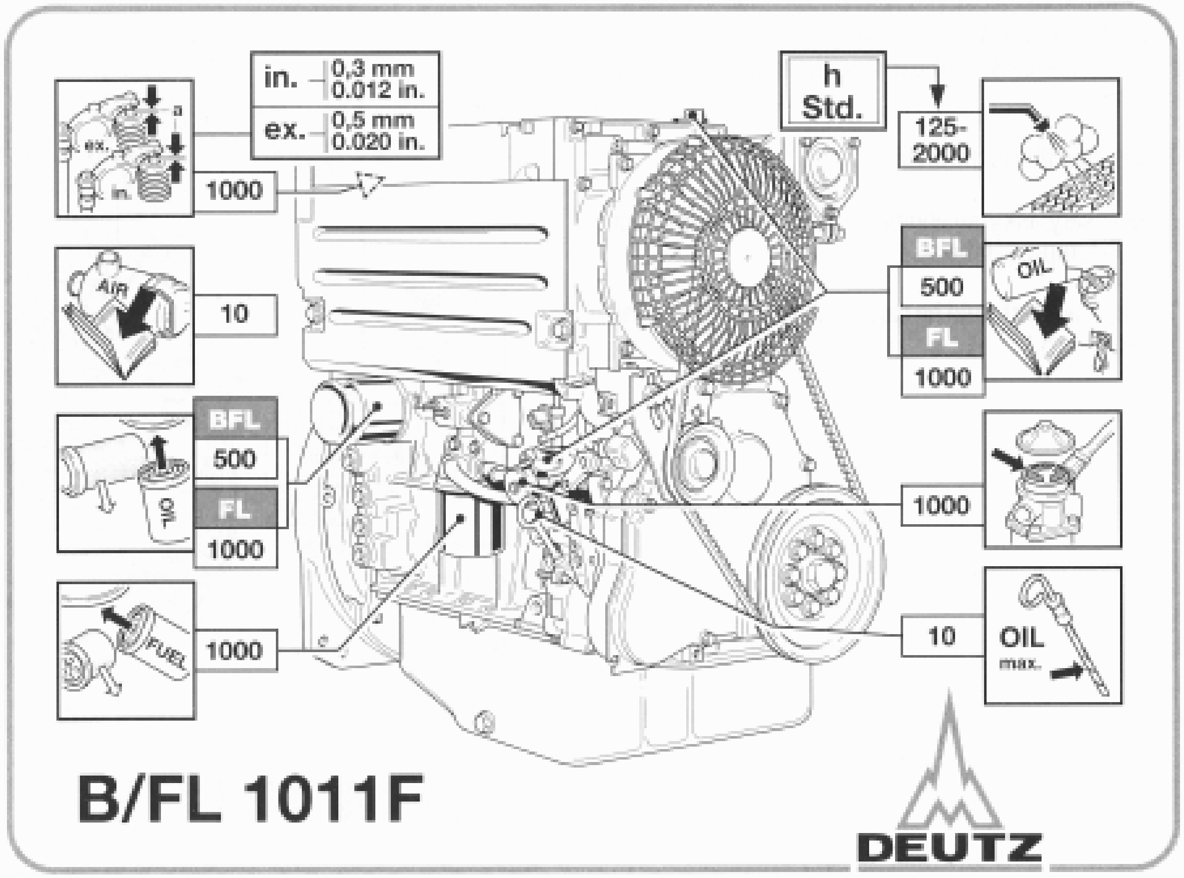
5.2 Maintenance Chart

The maintenance chart shown here is supplied as a self-adhesive label with each engine. It should be affixed where it can be seen clearly on the engine or driven equipment.

Check that this is the case.

If necessary, ask your engine or equipment supplier for a fresh supply of labels.

Routine work should be carried out according to the schedule in 5.1.



0297 7790 0

Stop the engine before carrying out any maintenance work.

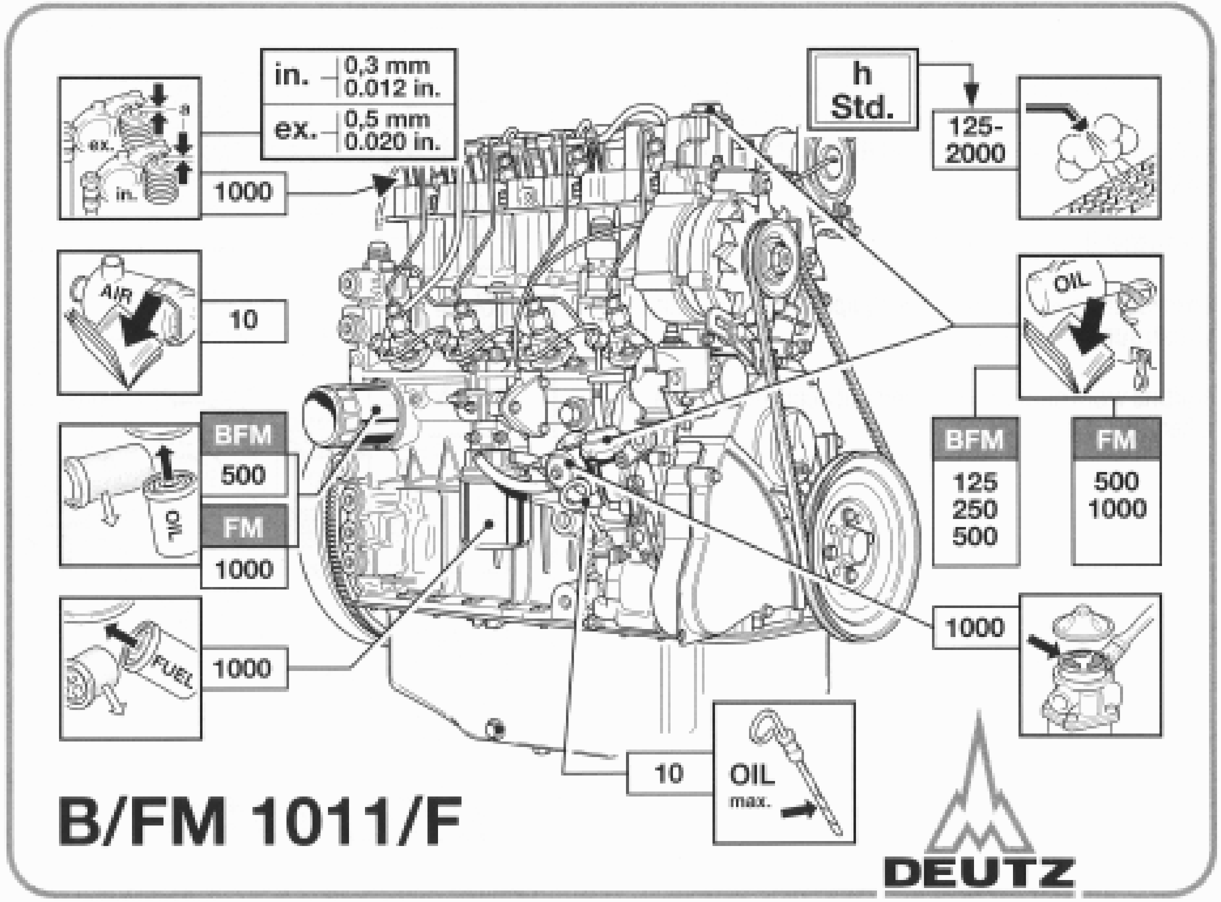
5.2 Maintenance Chart

The maintenance chart shown here is supplied as a self-adhesive label with each engine. It should be affixed where it can be seen clearly on the engine or driven equipment.

Check that this is the case.

If necessary, ask your engine or equipment supplier for a fresh supply of labels.

Routine work should be carried out according to the schedule in 5.1.



0297 7781 0

Stop the engine before carrying out any maintenance work.

5.3 Maintenance Work Completed

OH	Date	Signature / Stamp	OH	Date	Signature / Stamp
* 50			—		
125			250		
375			500		
625			750		
875			1000		
1125			1250		
1375			1500		
1625			1750		
1875			2000		
2125			2250		
2375			2500		
2625			2750		

Duly completed maintenance jobs can be recorded and signed off in the above chart.
* After commissioning of new and reconditioned engines.

5.3 Maintenance Work Completed

OH	Date	Signature / Stamp	OH	Date	Signature / Stamp
2875			3000		
3125			3250		
3375			3500		
3652			3750		
3875			4000		
4125			4250		
4375			4500		
4625			4750		
4875			5000		
5125			5250		
5375			5500		
5625			5750		

Duly completed maintenance jobs can be recorded and signed off in the above chart.

5.3 Maintenance Work Completed

OH	Date	Signature / Stamp	OH	Date	Signature / Stamp
5875			6000		
6125			6250		
6375			6500		
6625			6750		
6875			7000		
7125			7250		
7375			7500		
7625			7750		
7875			8000		
8125			8250		
8375			8500		
8625			8750		

Duly completed maintenance jobs can be recorded and signed off in the above chart.

Service and Maintenance

6.1.1 Oil Change Intervals

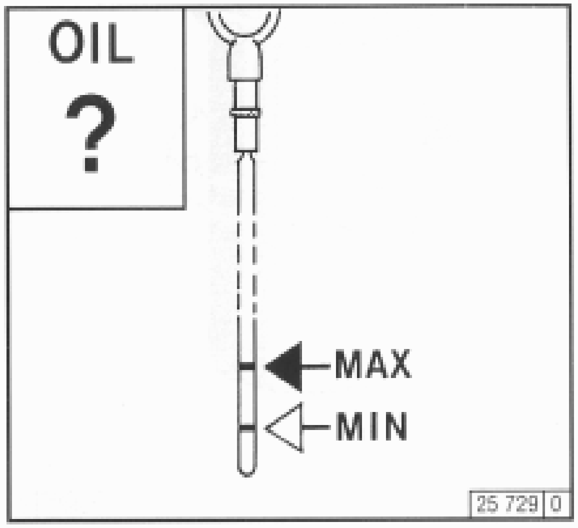
- The oil change intervals are dependent on the engine application and the quality of the lube oil.
- If the engine runs fewer hours during the year than stated in the table, the oil should be changed at least once a year.
- The table refers to the following conditions:
  - For diesel fuel: sulfur content max. 0.5% by weight.
  - Continuous ambient temperatures down to -10 °C (+14 °F).
- If the sulfur content is > 0.5 to 1% or the continuous ambient temperature below -10 °C (+14 °F), the intervals between oil changes should be halved.

Installed engines			**Lube oil intervals in OH**		
			Naturally aspirated engines	**Turbocharged engines**	
Lube oil quality	**API classification**		CF-4 + CG-4 + CH-4	CF-4	CG-4 + CH-4
	ACEA classification		E1-E3/96 + E4-98	E1-E2/96	E3 + E4-98
Normal oil usage, e.g.:			1000	250	500
Road vehicles, cranes, construction machinery, ships, electrical units, pumps, rail-run vehicles					
Heavy-duty oil usage, e.g.:			500	125	250
Combine harvesters, emergency pumps, underground equipment, sweeping machines, winter operation equipment, emergency power generating units					
Vehicle engines			**Lube oil intervals in km**		
			Naturally aspirated engines	**Turbocharged engines**	
Lube oil quality	**API classification**		CF-4 + CG-4 + CH-4	CF-4	CG-4 + CH-4
	ACEA classification		E1-E3/96 + E4-98	E1-E2/96	E3 + E4-98
Service group	**Annual kilometrage km**	**average speed approx. km/h**			
I	to 30 000	20	20 000	5 000	10 000
II	more than 30 000 - to 100 000	40	40 000	10 000	20 000
III	more than 100 000	60	60 000	15 000	30 000

- In the case of fuels containing more than 1% sulfur, contact your service representative.

6.1.2 Checking Oil Level/Changing Engine Oil

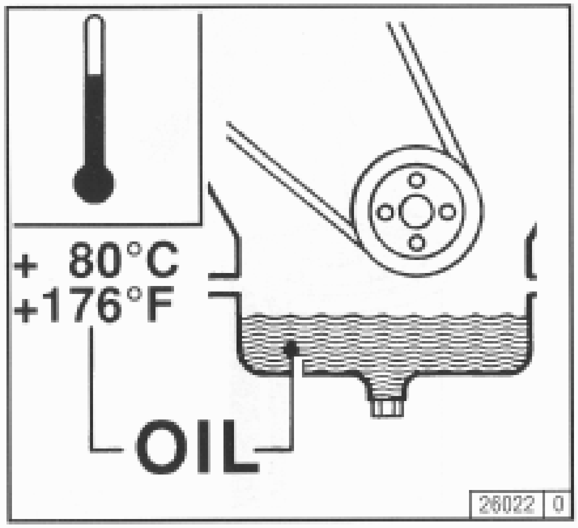
6.1.2.1 Checking Oil Level



- Ensure that the engine or vehicle is in a level position.
- Remove the oil dipstick.
- Wipe the dipstick with a non-fibrous, clean cloth.
- Insert it to the stop and remove again.
- Check the oil level, and if necessary, top up to the "**MAX**" mark.
  - If the oil level is only just aove the "**MIN**" mark, more oil must be added.

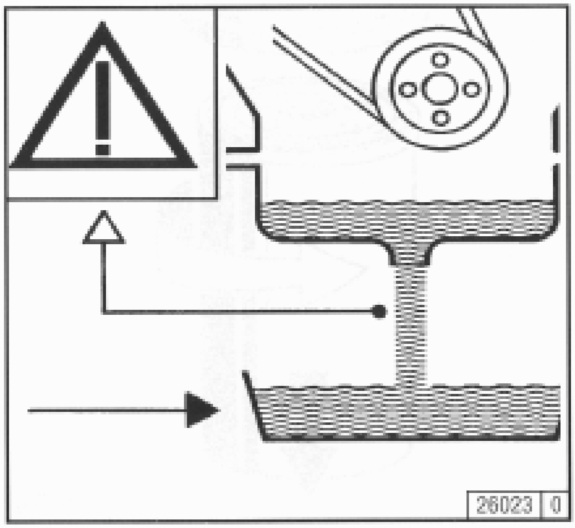
The oil level must not drop below the "**MIN**" mark.

6.1.2.2 Changing Engine Oil



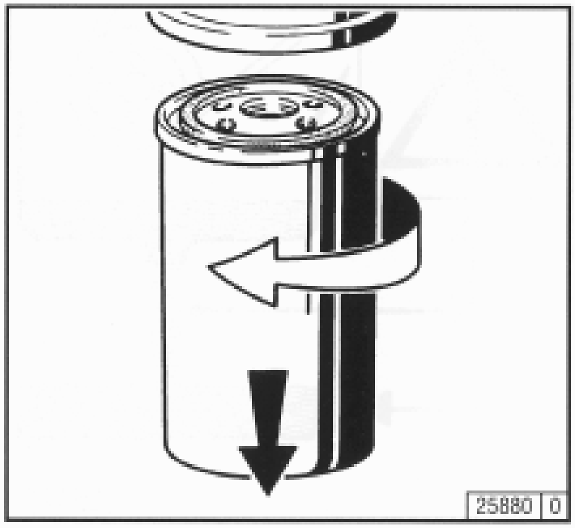
- Allow the engine to warm up.
- Ensure that the engine or vehicle is in a level position.
  - Lube oil temperature approx. 80 °C.
- Turn the engine off

⚠ Be careful when draining hot oil – danger of scalds!
Do not let used oil run into the soil but catch it in a container ready for proper disposal!

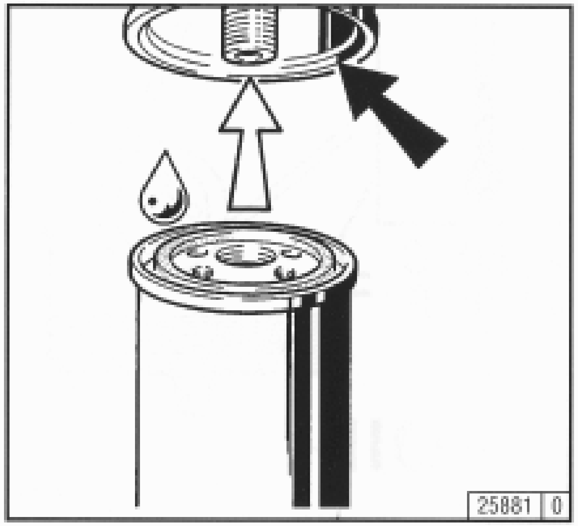


- Place oil tray under the engine.
- Unscrew drain plug.
- Drain oil.
- Fit oil drain plug, with the new gasket and tighten firmly (for torque, see 9.2)
- Pure in lube oil
  - For grade / viscosity, see 4.1
  - For quantity, see 9.1
- Check oil level, see 6.1.2.1.

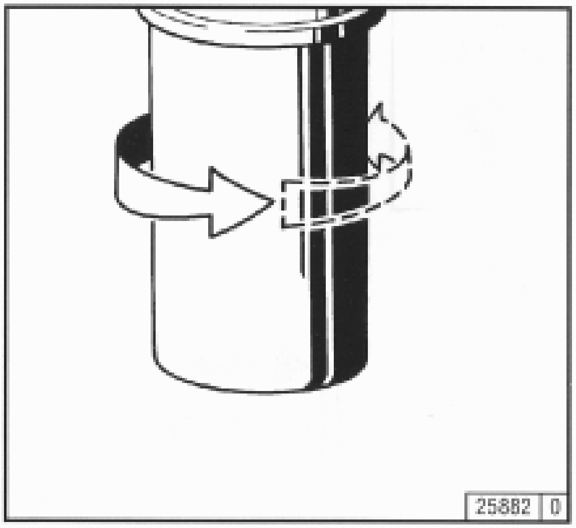
6.1.3 Changing Oil Filter



- Undo the filter cartridge using a commercial tool and spin off.
- Catch any dripping oil.



- Clean any dirt from the filter carrier rim.
- Lightly oil the rubber gasket of the new oil filter cartridge.
- Screw in the new cartridge finger tight against the gasket.

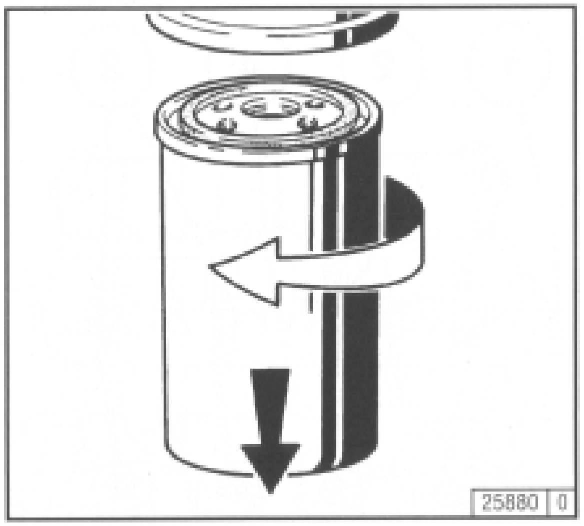


- Tighten the oil filter cartridge with another half-turn.
- Check oil level, see 6.1.2.
- Check oil pressure, see 3.3.1.
- Check cartridge seal for leaks.

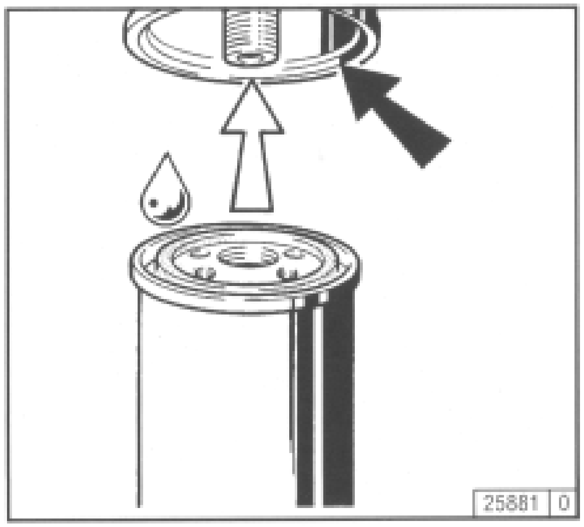
⚠ Beware of burns from hot oil.

6.2 Fuel System

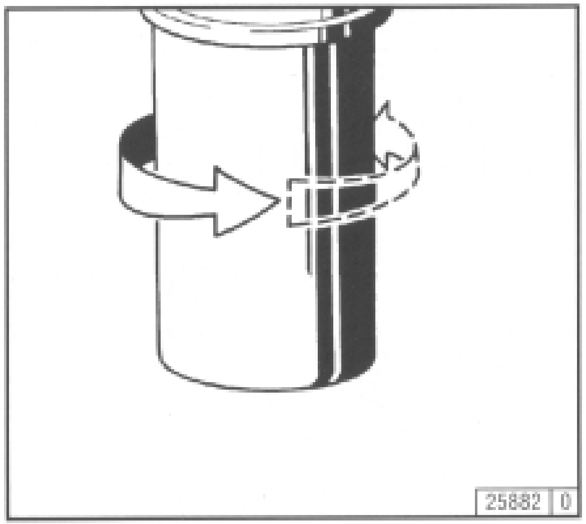
6.2.1 Changing Fuel Filter



- Close fuel stopcock.
- Undo fuel filter cartridge with commercial tool and spin off.
- Catch any fuel.



- Clean any dirt from the filter cartridge with a final half-turn.
- Apply light film of oil or diesel fuel to the rubber gasket of the new fuel filter cartridge.
- Screw in the new cartridge finger tight against the gasket.

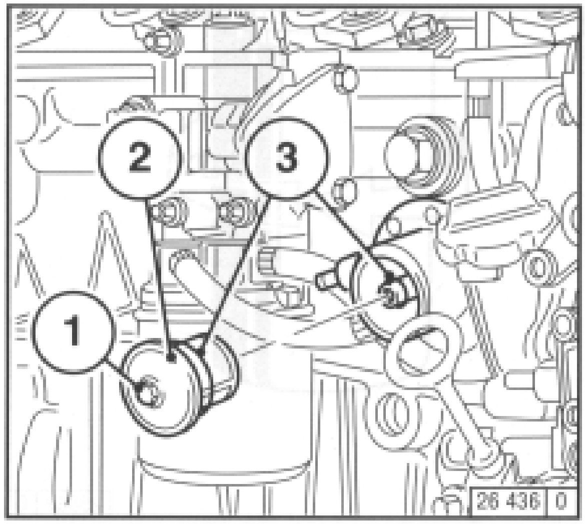


- Tighten the fuel filter cartridge with a final half-turn.
- Open fuel stopcock.
- Check for leaks.

Keep naked flames away when working on the fuel system. Do not smoke.

The fuel system does not need to be bled.

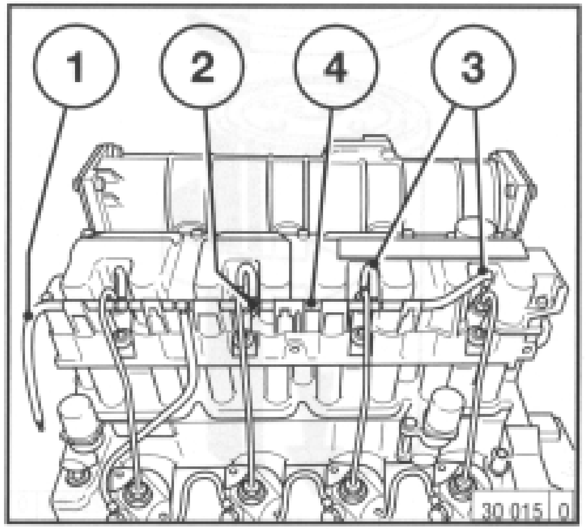
6.2.2 Fuel Pump Cleaning the Strainer



- Close the fuel shut-off valve.
- Loosen and unscrew the hexagonal nut 1.
- Remove the fuel strainer cover 2 (cover and strainer, one unit)
- Clean the fuel strainer with diesel fuel. Replace if necessary.
- Place seals 3 in position.
- Mount the fuel strainer cover 2.
- Tighten the hexagonal screw 1.
- Check for leaks.

⚠ Keep naked flames away when working on the fuel system.
Do not smoke!

6.2.3 Change Fuel Leakage Line



- Close the fuel shutoff valve.
- Disconnect rubber hoses 3 from the injection valves.
- Disconnect rubber hose 1 from fuel tank.
- Disconnect rubber hoses 4, 3 and 1 from unions 2 and dispose of in an environmentally friendly manner.
- Connect new rubber hoses 4, 3 and 1 to unions 2.
- Connect rubber hoses 3 to injection valves.
- Connect rubber hose 1 to fuel tank.
- Open fuel shutoff valve.
- Check for leaks after start-up.

6.3 Cooling System

6.3.1 Cleaning Intervals

- The amount of contamination in the cooling system depends on the engine application.
- Spilled oil or fuel on the engine increases the risk of contamination. Be especially careful if the engine is used in dusty environments.
- Serious contamination can occur, for example:
  - on construction sites where there is a high level of air-borne dust.
  - in harvesting application where there are high concentrations of chaff and chopped straw in the vicinity of the machine.
- Because applications vary, cleaning intervals have to be determined from case to case. The cleaning intervals given in the table on the right can be used as a guide.

Inspection and cleaning intervals Recommended OH	Engine application
2000	Ships, Electrical units in enclosed areas, pumps
1000	Vehicles on reinforced highways
500	Tractors, fork-lift trucks, mobile electrical units
250	Vehicles on construction sites and on roads with loose surfaces, construction machinery, compressors, mining equipment
125	Agricultural machinery, tractors used for harvesting purposes

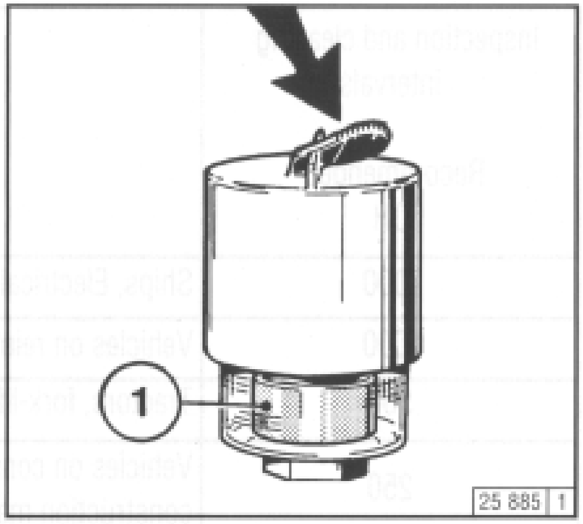
6.4.1 Cleaning Intervals

- The amount of dirt in the air cleaner depends on the amount of dust in the air and the size of the air cleaner used. If a high level of dust is anticipated, a cyclone-type precleaner can be fitted to the air cleaner.

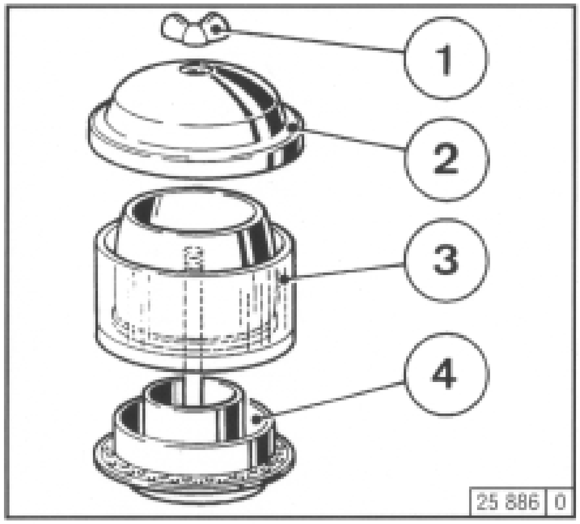
- Cleaning intervals will have to be determined from case to case.

- Air cleaner servicing is needed when:
  - **Service indicator** the red signal 1 is fully visible when the engine is off.
  - **Service switch** the yellow pilot light comes on when the engine is running.

- After carrying out service work, reset the signal by pressing the button on the service indicator.



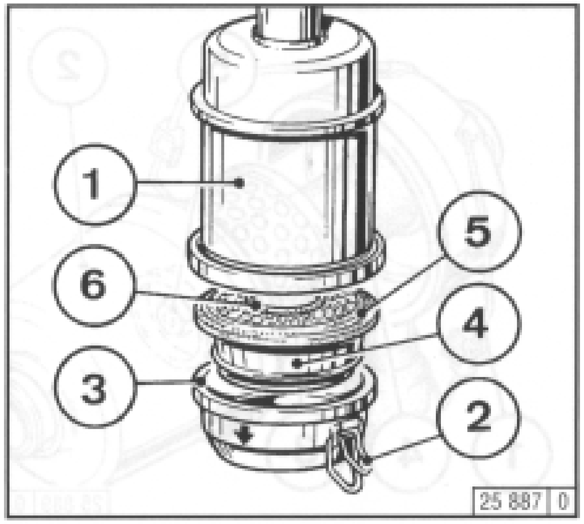
6.4.2 Emptying Cyclone Type Precleaner



- Undo wing nut 1 and remove cover 2.
- Remove collector bowl 3 from lower section 4 and empty. Clean leaves, straw and other foreign matter from lower section of precleaner.
- Reposition collector bowl 3 onto lower section 4, fasten cover 2 in place by tightening wing nut 1.

Never fill collector bowl with oil. Replace collector bowl if damaged.

6.4.3 Cleaning Oil Bath Air Cleaner

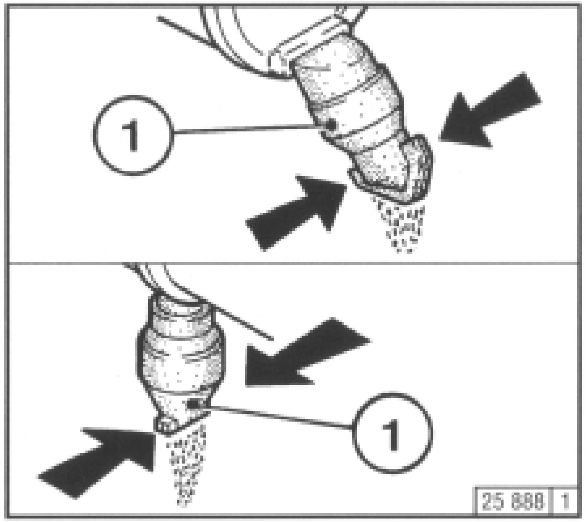


- Turn engine off and wait about 10 minutes for the oil to drain from filter housing 1.
- Release snap clips 2 and remove oil cup 3 together with filter element 4. If necessary prise element out with a screwdriver, taking care not to damage the rubber gasket 5.
- Remove dirty oil and sludge. Clean oil cup.
- Clean filter element 4 in diesel fuel and allow to drip-dry.
- Clean filter housing 1 if very dirty.
- Inspect and replace rubber gasket 5 and 6 if necessary.
- Fill oil cup with engine oil up to the mark (arrow) (for viscosity, see 4.1.2).
- Refit oil cup and element to filter housing and secure with snap clips.

⚠ Never clean air cleaner with gasoline. Dispose of cold oil in accordance with environmental regulations!

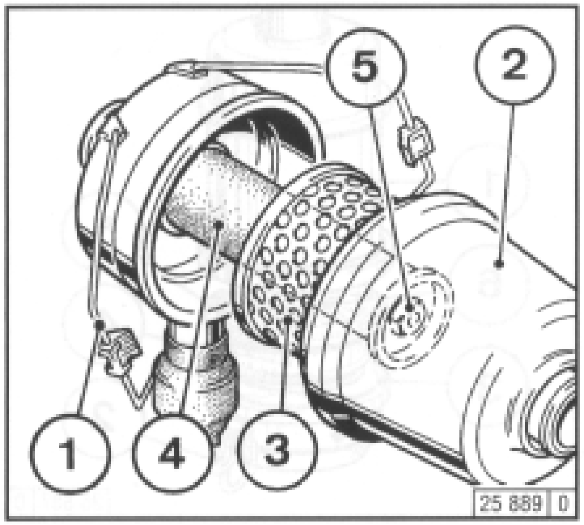
6.4.4 Dry Type Air Cleaner

Dust Discharge Valve



- Empty dust discharge valve 1 by pressing apart lips of discharge slot as indicated by arrows.
- Clean discharge slot from time to time.
- Remove any caked dirt by pressing together the upper section of the valve.

Filter Cartridge

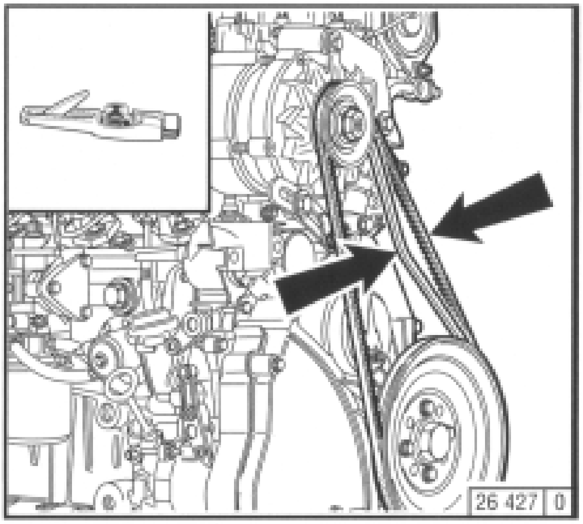


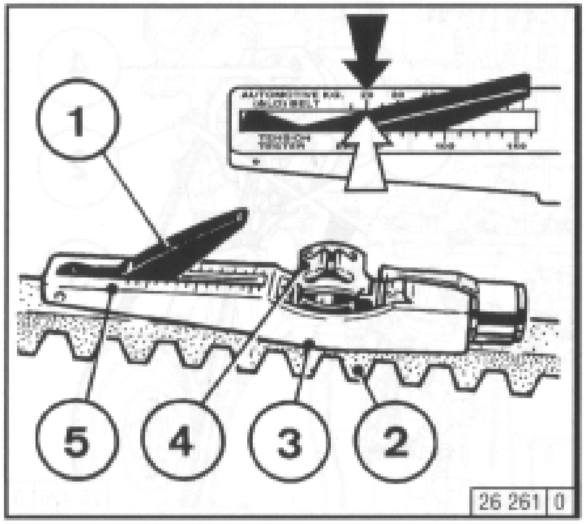
- Undo clip fasteners 1.
- Take off hood 2 and remove cartridge 3.
- Clean cartridge (replace at least once a year)
- Clean cartridge 3.
  Blow out from inside out with dry compressed air (max. 5 bar), (or in difficult cases, tap out, taking care not to damage the cartridge, or wash according to manufacturer's instructions).
- Through regular removal and replacement, the gaskets on the filter cartridge can become damaged. Check paper filter (light showing through) and gaskets for damage. Replace if necessary.
- After five cleaner services or after two years at the latest, replace safety cartridge 4 (never clean).
  To do so:
  - Undo hex. nut 5 and remove cartridge 4.
  - Install new cartridge, insert and tighten hex nut.
- Install cartridge 3, replace hood 2 and do up clip fasteners 1.

⚠ Never clean filter cartridge with gasoline or hot fluids.

6.5 Belt Drives

6.5.1 Checking V-Belts



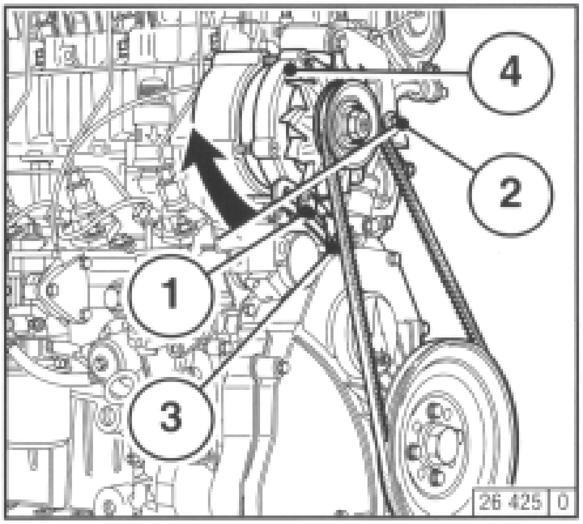


- Inspect entire V-belt for damage.
- Replace damaged V-belts.
- After installing new belts, run engine for 15 minutes, then check belt tension.
- To check the tension of the V-belt, use a tension gauge (see 9.3).
  - Place indicator arm 1 into gauge.
  - Position gauge on V-belt 2, midway between the pulleys, with flange 3 on bottom of gauge against the edge of belt.
  - Push slowly on the black pad 4 at right angles to belt 2 until the spring is heard or felt to trigger.
  - Carefully remove the gauge without altering the position of the indicator arm 1.
  - Read off the value where the black indicator arm 1 intersects scale 5 (arrow). For settings, see 9.1.
  - If necessary, retension belt and measure again.

Check tension and change belts only with the engine off. Refit belt guard, if provided.

When new V-belts are fitted, check the belt tension after ca. 15 minutes running time.

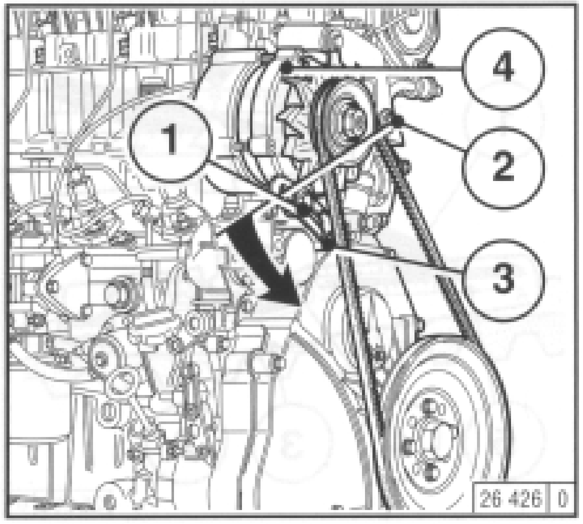
6.5.2 Tensioning Alternator Belts



- Slacken off bolts 1, 2 and 3.
- Adjust alternator 4 in direction of arrow by turning bolt 3 until correct belt tension is achieved.
- Retighten bolts 1, 2 and 3.

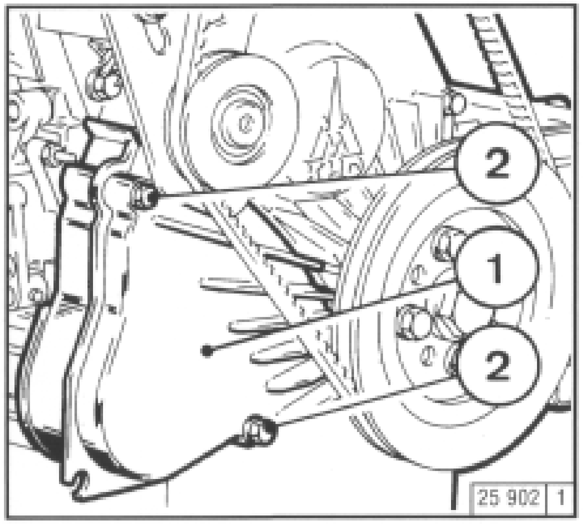
Check, tension and change belts only with the engine off. Refit belt guard, if provided.

6.5.3 Changing Alternator Belts

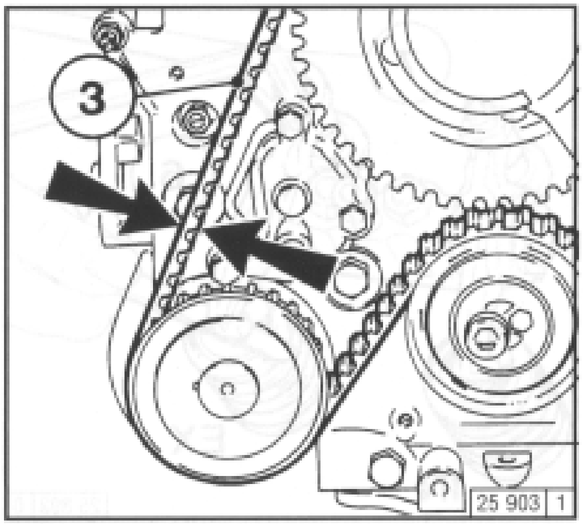


- Slacken off bolts 1, 2 and 3.
- Adjust alternator 4 in direction of arrow by turning bolt 3.
- Remove and replace belt.
- Adjust alternator 4 against the direction of the arrow by turning bolt 3, until correct belt tension is achieved.
- Retighten bolts 1, 2 and 3.

6.5.4 Checking Toothed Belt Timing belts

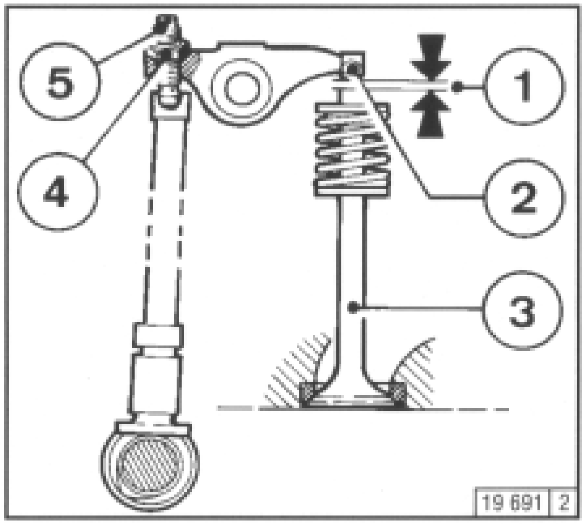


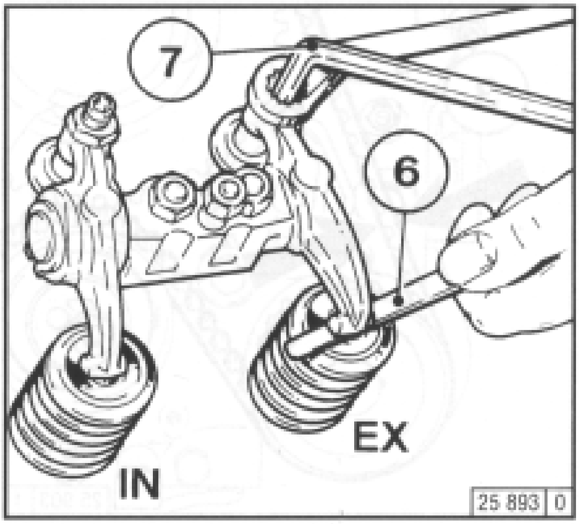
- Unscrew hex. bolts 2. Remove the cover 1.



- Check the face and back of the teeth along the complete length of the toothed belt (see arrows).
- To facilitate this, rotate the engine through two turns.
- If damaged, replace the toothed belt / sprocket (see workshop manual).
- Replace the cover 1 with hex. bolts 2.

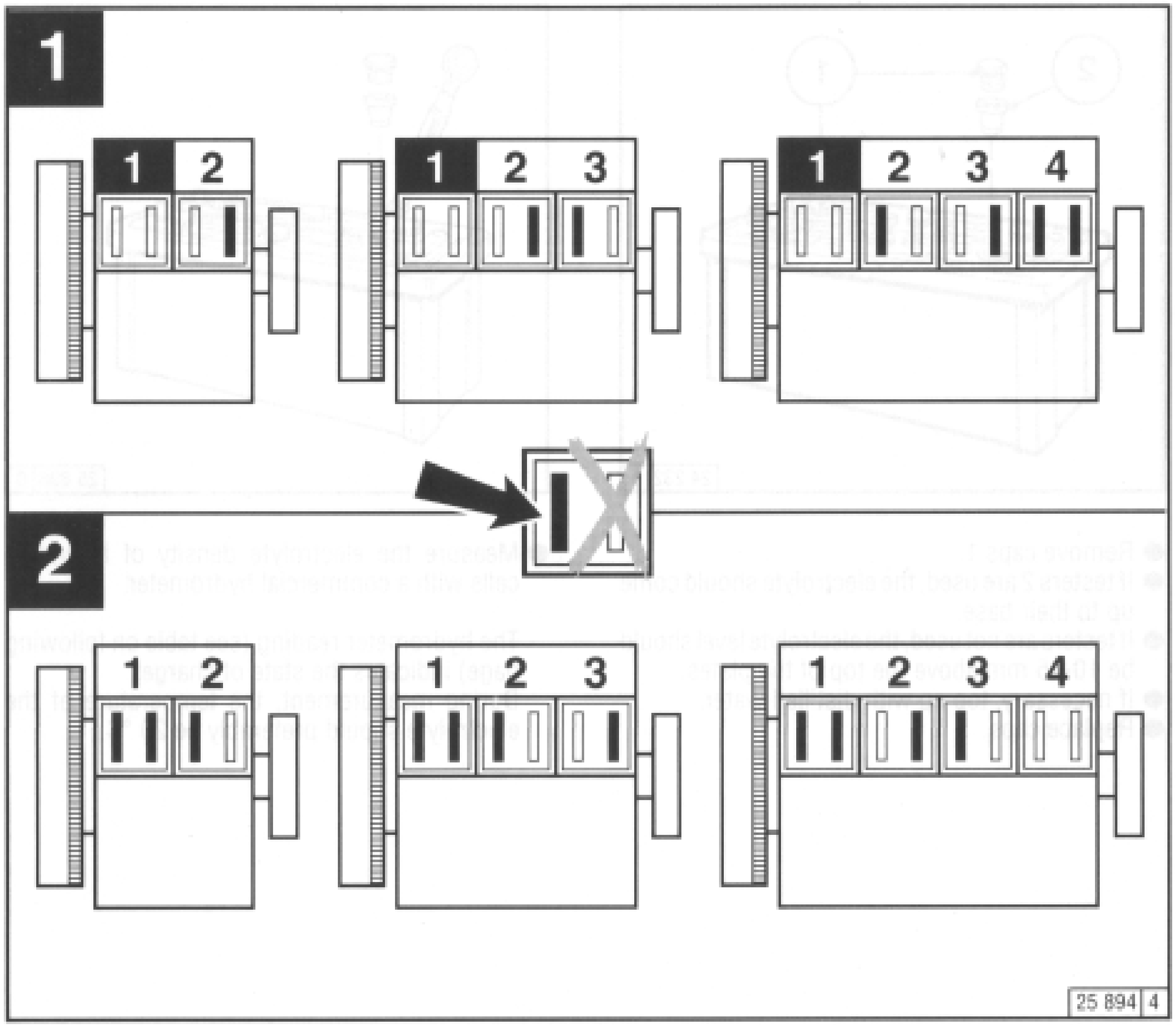
6.6.1 Checking / Adjusting Valve Clearances





- Remove the cylinder head cover.
- Position crankshaft as per schematic 6.6.1.1.
- Before adjusting valve clearance, allow engine to cool down for at least 30 minutes. The oil temperature should be below 80 °C.
- Check valve clearance 1 between rocker arm / tappet contact face 2 and valve stem 3 with feeler gauge 6 (there should be only slight resistance when feeler blade is inserted).
  For permissible valve clearance, see 9.1.
- Adjust valve clearance if necessary:
  - Release locknut 4.
  - Use allen key 7 to turn setscrew 5 so that the correct clearance is attained after locknut 4 has been tightened.
- Check and adjust valve clearance on all remaining cylinders.
- Replace cylinder head cover (use new gasket if needed).

6.6.1.1 Valve Clearance Adjustments Schematic

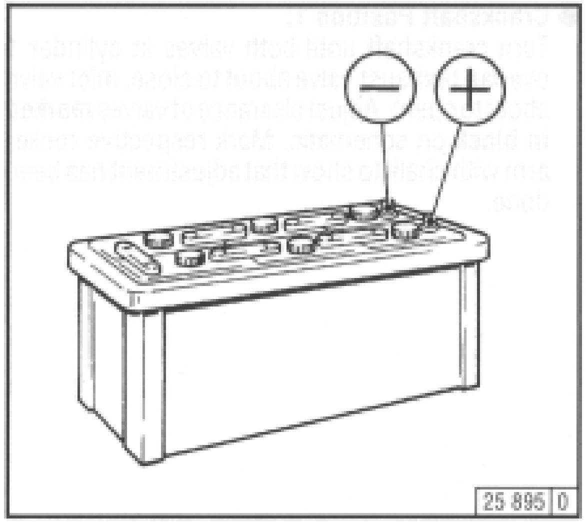


- **Crankshaft Position 1:**
  Turn crankshaft until both valves in cylinder 1 overlap (exhaust valve about to close, inlet valve about to open). Adjust clearance of valves **marked in black** on schematic. Mark respective rocker arm with chalk to show that adjustment has been done.

- **Crankshaft Position 2:**
  Turn crankshaft one full revolution (360°). Adjust clearance of valves **marked in black** on schematic.

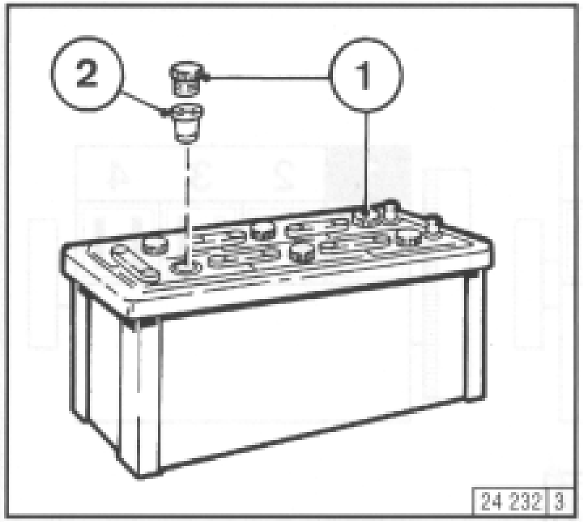
6.7.1 Battery

6.7.1.1 Checking Battery and Cable Connectors



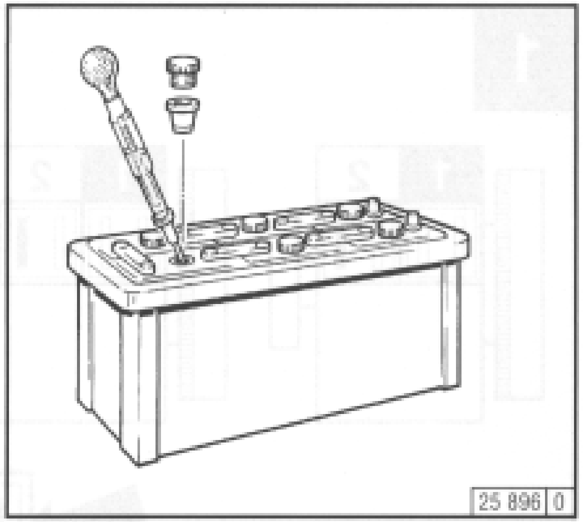
- Keep battery clean and dry.
- Undo dirty clamps.
- Clean terminal posts (+ and -) and clamps of the battery, and grease with acid-free and acid-resistant grease.
- When reassembling, ensure that clamps make good contact. Do up clamp bolts finger tight.

6.7.1.2 Checking Electrolyte Level



- Remove caps 1.
- If testers 2 are used, the electrolyte should come up to their base.
- If testers are not used, the electrolyte level should be 10-15 mm above the top of the plates.
- If necessary, top up with distilled water.
- Replace caps.

6.7.1.3 Checking Electrolyte Density



- Measure the electrolyte density of individual cells with a commercial hydrometer.

The hydrometer reading (see table on following page) indicates the state of charge.
During measurement, the temperature of the electrolyte should preferably be 20 °C.

Electrolyte density				
in kg/l		in ° Bé (Baumégrad)*		State of Charge
Normal	Tropics	Normal	Tropics	
1.28	1.23	32	27	Fully charged
1.20	1.12	24	16	Half charged, recharge
1.12	1.08	16	11	Discharged, recharge immediately

* Measurement of electrolyte density in ° Bé (Baumégrad) is out of date and rarely used today.

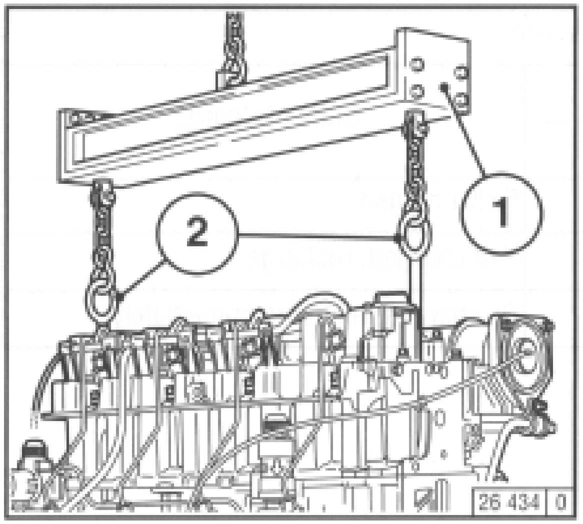
The gases emitted by the battery are explosive! Keep sparks and naked flames away from the battery. Do not allow battery acid to come into contact with skin or clothing. Wear protective goggles. Do not rest tools on the battery.

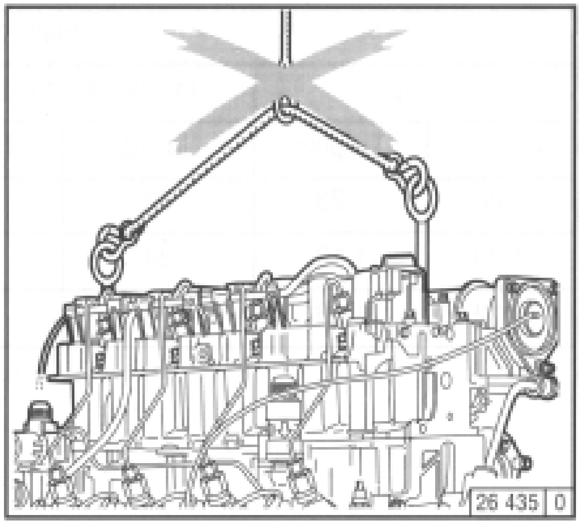
6.7.2 Three-Phase Alternator

Notes on the three-phase system:

- Never disconnect the cables between battery, alternator and regulator while the engine is running.
- If, however, it is necessary to start and operate the engine without the battery, disconnect the regulator from the alternator before starting.
- Be sure not to confuse the battery terminals.
- Replace defective bulb of the charge pilot lamp immediately.
- When washing the engine, cover up the alternator and regulator.
- The habit of touching a lead against the frame to check whether it is live must under no circumstances be used with three-phase electrical systems.
- In case of electric welding, connect the ground terminal on the welder directly to the piece being welded.

6.7.3 Lifting Tackle



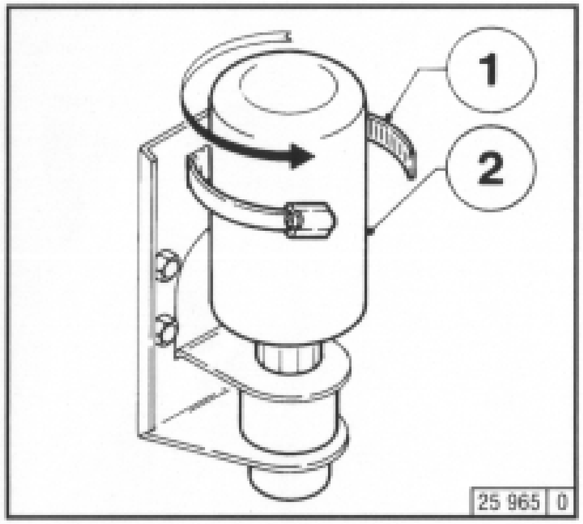


- Always use proper lifting tackle 1 when transporting the engine.
- After transportation and before commissioning of the engine:
  Remove attachment eyes 2.

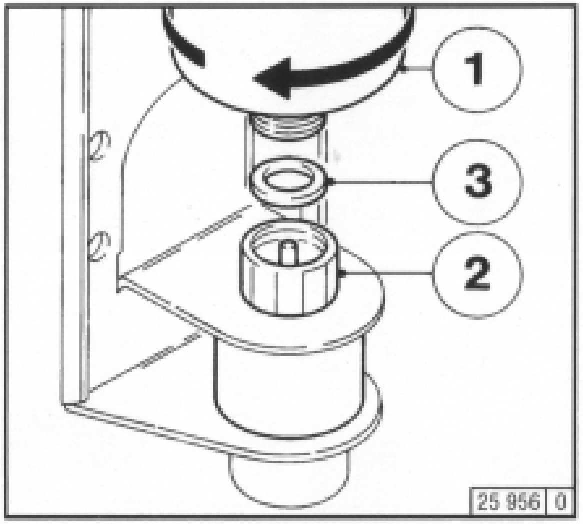
⚠ Use only the correct lifting tackle.

6.7.4 Ether Starting System

6.7.4.1 Changing the Fluid Container



- Before removing the container, clean the container support and the top of the solenoid valve.
- Loosen the bracket 1.
- Unscrew the fluid container 2.
- Empty or replace the depressurized fluid container.



- Place the container 1 on the solenoid valve 2 and tighten by hand.
- When mounting, ensure that gasket 3 is seated correctly.
- Pull in the brackets.
- Check for leaks.

⚠ Before commissioning, leave the fluid container of the ether starting system in position for 15 minutes. Check for leaks. The starting fluid is inflammable. Ensure that the container is not damaged. Prevent foreign substances from entering the container. The fluid container must not be stored at temperatures above 50 °C.

Faults, Causes and Remedies

7.1 Diagnosis Chart

7.1 Diagnosis Chart

- Faults are often caused by maloperation of the engine or failure to service the engine.
- In the event of a fault, always check whether the operating and servicing regulations have been adhered to.
- A corresponding fault table can be found on the adjacent page.
- If you cannot ascertain the cause of a fault or cannot rectify the fault, please contact DEUTZ SERVICE.

7.1 Diagnosis Chart

Faults, Causes and Remedies

Remedy	
Check	P
Adjust	E
Replace	W
Clean	R
Top up	A
Lower level	S

Fault: Engine fails or is difficult to start	Engine starts but runs unevenly or stalls	Engine overheats. Temperature monitor gives warning	Engine gives poor performance	Engine not firing on all cylinders	Engine has little or no oil pressure	Engine oil consumption excessive	Engine smokes – blue	– white	– black	Cause	Section	Remedy
●										Not declutched (where possible)	Operation	P
●								●		Below starting limit temperature		P
		●			●					Oil level too low		A
		●	●			●	●			Oil level too high		P
					●	●	●			Excessive inclination of engine		S
●					●					Incorrect lube oil SAE class or quality	Operating media	W
●	●		●					●		Fuel quality not as per operating manual		W
		●	●						●	Air cleaner clogged / turbocharger defective	Combustion air	P / W
		●	●						●	Air cleaner service switch / indicator defective		P / W
									●	LDA* defective		P
			●						●	Charge air line leaking		P
		●								Oil cooler panels clogged	Cooling system	P / R
		●								Cooling fan defective, split or loose V-belt		P / W
		●								Cooling air temperature rise / heating short circuit		P
		●								Resistance in cooling system too great / through-flow quantity too small		P
●										Battery defective or discharged	Electrics	P / A

* LDA = Aneroid device

Faults, Causes and Remedies

7.1 Diagnosis Chart

Remedy

Check	P
Adjust	E
Replace	W
Clean	R
Top up	A
Lower level	S

Engine fails or is difficult to start	Engine starts but runs unevenly or stalls	Engine overheats. Temperature monitor gives warning	Engine gives poor performance	Engine not firing on all cylinders	Engine has little or no oil pressure	Engine oil consumption excessive	Engine smokes – blue	– white	– black	Cause	Section	Remedy
●										Electric cable connections to starter electrical system loose or oxidized	Electrics	P
●										Starter defect or pinion does not engage		P
●										Solenoid defective (release switch)		P
●	●		●					●	●	Incorrect valve clearance	Engine	E
	●		●	●						Leaking injection line		P
●	●	●	●	●				●	●	Injection valve defective		P / W

Engine Preservation

8.1 Preservation

Engine Preservation

8.1 Preservation

If the engine is to remain idle for an extended period of time, it is necessary to take protective measures to prevent rust formation. The preservative measures described here will protect the engine for up to 6 month. The procedure will have to be reversed before the engine is recommissioned.

- Anti-corrosion oils to specification:
  MIL-L-21260B
  TL 9150-037/2
  Nato Code C 640 / 642
- Anti-corrosion media for exterior protection only to specification:
  Nato Code C 632
- Recommended cleansing agent to remove preservatives when recommissioning engine:
  Petroleum benzine
  (hazardous materials class A3)

8.1.1 Preserving Engine

- Clean engine (with cold cleansing agent if preferred) using high pressure equipment.
- Run engine until warm, then turn off.
- Drain engine oil, see 6.1.2, and fill with anti-corrosion oil.
- If necessary, clean oil bath cleaner, see 6.4.3, and fill with anti-corrosion oil.
- Drain fuel tank.
- Make up a mixture of 90 % diesel fuel and 10 % anti-corrosion oil, and refill fuel tank.
- Run engine for about 10 minutes.
- Turn engine off.
- Turn engine over manually several times to preserve the cylinders and combustion chamber.
- Remove V-belts and store in wrapped condition.
- Spray grooves on V-belt pulleys with anti-corrosion spray.
- Close off intake ports and exhaust ports.

8.1.2 Removing Engine Preservatives

- Remove anti-corrosion agent from grooves in V-belt pulleys.
- Install V-belts. Retension after brief operation if necessary, see 6.5.
- Remove covers from intake port and exhaust port.
- Set the engine in operation, see also section 5.1, annotation 2.

Technical Specifications

Technical Specifications

9.1 Engine Specifications and Settings

Model		F2L 1011F	F3L 1011F	F4L 1011F	F4L 1011FL*
Numbers of cylinders		2	3	4	4
Cylinder arrangement		vertical in line			
Bore	[mm]	91			
Stroke	[mm]	105	105	105	112
Total displacement	[cm³]	1366	2049	2732	2912
Compression ratio	[ε]	18,5			
Working cycle		4-stroke diesel engine			
Combustion system		naturally aspirated engine with direct injection			
Direction of rotation		counter clockwise			
Weight incl. integrated cooling system as per DIN 70020-A (without starter, with alternator)	ca.[kg]	167	208	249	250
Engine power	[kW (PS)]	1)			
Speed	[1/min]	1)			
Lubrication		pressure lubrication			
SAE oil		20 W 20			
Max. oil temperature in oil sump	[°C]	130			
Min. oil pressure in warm condition, oil temperature 110 °C at: 900/min (low idling speed)	[bar]	1,4 3)			
1800 /min	[bar]	2,2 3)			
max. 3300 /min, ***max. 3000 /min**	[bar]	3 3)			
Oil change quantity (oil sump) ca.	[ltr.]	6 2)	5,5 2)	10 2)	10 2)
Oil change quantity with filter (Standard 0.5 ltr.) ca.	[ltr.]	6,5 2)	6 2)	10,5 2)	10,5 2)
Valve clearance with cold engine	[mm]	inlet 0.3			
(Engine cooling time at least 30 Min.: Oil temperature below 80°C)	[mm]	exhaust 0.5			
Start of delivery	[°crank angle b TDC]	1)			
Injector opening pressure: vehicle/genset engine	[bar]	$210 / 250^{+8}$			
Firing order of the engine		1 - 2	1 - 2 - 3	1 - 3 - 4 - 2	1 - 3 - 4 - 2
V-Belt tension: Pretension / Retension (after the engine has been running under load for 15 mins):	[N]	450 / 350 ±20			

---

1) Engine power, speed, start of delivery are stamped on engine rating plate, see also 2.1.

2) Ca. value can vary depending on model. **The upper oil dipstick marking should always be taken as authoritative**.

3) Values for engines without engine oil heating.

9.1 Engine Specifications and Settings

Model		BF3L 1011F/L	BF4L 1011F/FT
Number of cylinders		3	4
Cylinder arrangement		vertical in line	
Bore	[mm]	91	
Stroke	[mm]	105/112	105
Total displacement	[cm³]	2184	2732
Compression ratio	[ε]	17	
Working cycle / Combustion system		4-stroke diesel with turbocharging and direct injection	
Direction of rotation		counter clockwise	
Weight without cooling system	[kg]	Refer to head-office	
Weight without starter, with alternator as per DIN 70020-A ca.	[kg]	233	256
Engine power	[kW (PS)]	1)	
Speed	[1/min]	1)	
Lubrication		pressure lubrication	
SAE oil		20 W 20	
Max. oil temperature in the oil sump	[°C]	130	
at: 900/min (low idling speed)	[bar]	1,4 3)	
1800 /min	[bar]	2,2 3)	
max. 3000 /min	[bar]	3 3)	
Oil change quantity (oil sump without cooling system) ca.	[ltr.]	7,5	10 2)
Oil change quantity with filter (Standard 0.5 ltr.) ca.	[ltr.]	8	10,5 2)
Valve clearance with cold engine (Engine cooling time at least 30 mins.: oil temperature below 80°C)	[mm]	inlet $0,3^{+0,1}$ / exhaust $0,5^{+0,1}$	
Injector opening pressure: vehicle/genset engine	[bar]	$210 / 250^{+8}$	
Start of delivery	[°crank angle b TDC]	1)	
Firing order of the engine		1 - 2 - 3	1-3-4-2
V-Belt tension: Pretension / Retension (after the engine has been running under load for 15 mins):	[N]	450 / 350 ±20	

---

1) Engine power, speed, start of delivery are stamped on engine rating plate, see also 2.1.
2) Ca. value can vary depending on oil sump and or coolor design (external cooling system). **The upper oil dipstick marking should always be taken as authoritative.**
3) Values for engines without engine oil heating.

Technical Specifications

9.1 Engine Specifications and Settings

<table>
<tr><th>Model</th><th></th><th>F3M 1011F</th><th>F4M 1011F</th></tr>
<tr><td>Number of cylinders</td><td></td><td>3</td><td>4</td></tr>
<tr><td>Cylinder arrangement</td><td></td><td colspan="2">vertical in line</td></tr>
<tr><td>Bore</td><td>[mm]</td><td colspan="2">91</td></tr>
<tr><td>Stroke</td><td>[mm]</td><td>112</td><td>112</td></tr>
<tr><td>Total displacement</td><td>[cm³]</td><td>2184</td><td>2912</td></tr>
<tr><td>Compression ratio</td><td>[ε]</td><td colspan="2">18,5</td></tr>
<tr><td>Working cycle</td><td></td><td colspan="2">4-stroke diesel engine</td></tr>
<tr><td>Combustion system</td><td></td><td colspan="2">naturally aspirated engine with direct injection</td></tr>
<tr><td>Direction of rotation</td><td></td><td colspan="2">counter clockwise</td></tr>
<tr><td>Weight without cooling system</td><td></td><td colspan="2">Rückfrage Stammhaus</td></tr>
<tr><td>(without starter, with generator) ca.</td><td>[kg]</td><td>200</td><td>242</td></tr>
<tr><td>Engine power</td><td>[kW (PS)]</td><td colspan="2">1)</td></tr>
<tr><td>Speed</td><td>[1/min]</td><td colspan="2">1)</td></tr>
<tr><td>Lubrication</td><td></td><td colspan="2">Druckumlaufschmierung</td></tr>
<tr><td>SAE oil</td><td></td><td colspan="2">20 W 20</td></tr>
<tr><td>Maximum oil temperature in the oil sump</td><td>[°C]</td><td colspan="2">130</td></tr>
<tr><td>Minimum oil pressure in warm condition, oil temperature 110 °C, at: 900/min (low idling speed)</td><td>[bar]</td><td colspan="2">1,4 3)</td></tr>
<tr><td>1800 /min</td><td>[bar]</td><td colspan="2">2,2 3)</td></tr>
<tr><td>max. 3000 /min</td><td>[bar]</td><td colspan="2">3 3)</td></tr>
<tr><td>Engine with Thermostat</td><td></td><td></td><td></td></tr>
<tr><td>Oil change quantity without external cooler (see 3.1.1.2)/ without filter approx.</td><td>[ltr.]</td><td>5,5 2)</td><td>10 2)</td></tr>
<tr><td>Oil change quantity without external cooler (see 3.1.1.2) + filter replacement (Standard 0.5 litre) approx.</td><td>[ltr.]</td><td>6 2)</td><td>10,5 2)</td></tr>
<tr><td>Genset engine without Thermostat:</td><td></td><td></td><td></td></tr>
<tr><td>Oil change quantity including cooler (see 3.1.1.3)/ without filter approx.</td><td>[ltr.]</td><td>8,5 2)</td><td>13 2)</td></tr>
<tr><td>Oil change quantity including cooler (see 3.1.1.3) + filter replacement (Standard 0.5 litre) approx.</td><td>[ltr.]</td><td>9 2)</td><td>13,5 2)</td></tr>
<tr><td>Valve clearance at cold engine (Engine cooling time at least 30 mins.: oil temperature below 80°C)</td><td>[mm]</td><td colspan="2">inlet 0,3 $^{+0,1}$ / exhaust 0,5 $^{+0,1}$</td></tr>
<tr><td>Start delivery</td><td>[°crank angle b TDC]</td><td colspan="2">1)</td></tr>
<tr><td>Injector opening pressure: vehicle/genset engine</td><td>[bar]</td><td colspan="2">210 / 250^{+8}</td></tr>
<tr><td>Firing order of the engine</td><td></td><td>1 - 2 - 3</td><td>1 - 3 - 4 - 2</td></tr>
<tr><td>V-Belt tension: Pretension / Retension (after the engine has been running under load for 15 mins):</td><td>[N]</td><td colspan="2">450 / 350 ±20</td></tr>
</table>

1) Engine power, speed, start of delivery are stamped on engine rating plate, see also 2.1.

2) Ca. value can vary depending on oil sump and or coolor design (external cooling system). **The upper oil dipstick marking should always be taken as authoritative.**

3) Values for engines without engine oil heating.

9.1 Engine Specifications and Settings

Technical Specifications

Model		**BF3M 1011 F**	**BF4M 1011 F**
Number of cylinders		3	4
Cylinder arrangement		vertical, in line	
Bore	[mm]	91	
Stroke	[mm]	112	
Total displacement	[cm³]	2184	2912
Compression ratio	[ε]	17	
Working cycle		4-stroke diesel	
Combustion system		turbocharging and direct injection	
Direction of rotation		counter clockwise Refer to head-office	
Weight without cooling system (without starter, with generator) ca.	[kg]	226	249
Engine power	[kW (PS)]	1)	
Speed	[1/min]	1)	
Lubrication		pressure lubrication	
SAE oil		20 W 20	
Maximum oil temperature in the oil sump	[°C]	130	
Minimum oil pressure in warm condition, oil temperature 110 °C, at: 900/min (low idling speed)	[bar]	1,4 [3]	
1800 /min	[bar]	2,2 [3]	
max. 2800 /min	[bar]	3 [3]	
Engine with Thermostat			
Oil change quantity without external cooler (see 3.1.1.2)/ without filter approx.	[ltr.]	7,5	10 [2]
Oil change quantity without external cooler (see 3.1.1.2) + filter replacement (Standard 0.5 litre) approx.	[ltr.]	8	10,5 [2]
Genset engine without Thermostat:			
Oil change quantity including cooler (see 3.1.1.3)/ without filter approx.	[ltr.]	11	13,5 [2]
Oil change quantity including cooler (see 3.1.1.3) + filter replacement (Standard 0.5 litre) approx.	[ltr.]	11,5	14 [2]
Valve clearance at cold engine (Engine cooling time at least 30 mins.: oil temperature below 80°C)	[mm]	inlet 0,3 $^{+0,1}$ / exhaust 0,5 $^{+0,1}$	
Start delivery	[°crank angle b TDC]	1)	
Injector opening pressure: vehicle/genset engine	[bar]	210 / 250 $^{+8}$	
Firing order of the engine		1-2-3	1-3-4-2
V-Belt tension: Pretension / Retension (after the engine has been running under load for 15 mins):	[N]	400 / 300 ±20	

[1] Engine power, speed, start of delivery are stamped on engine rating plate, see also 2.1.

[2] Ca. value can vary depending on oil sump and or coolor design (external cooling system). **The upper oil dipstick marking should always be taken as authoritative.**

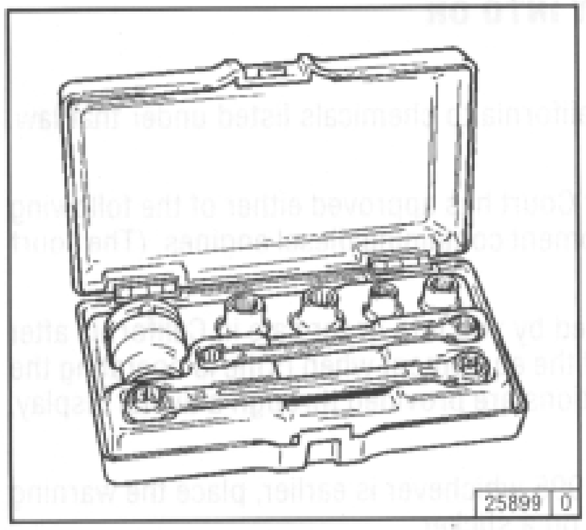
[3] Values for engines without engine oil heating.

9.2 Torque Wrench Settings

Location	Preload [Nm]			Torquing Load [Nm]				Total [Nm]	Remarks
	1st Stage	2nd Stage	3rd Stage	1st Stage	2nd Stage	3rd Stage	4th Stage		
Rocker cover								8,5	
Rocker arm set screw								21	
Air intake manifold								21	
Exhaust manifold								40	
Oil drain plug								55	
Injector mounting								21	TORX
Injector line mounting								22	
Oil pan (cast iron)								31	
Oil pan (sheet metal)								21	

9.3 Tools

TORX

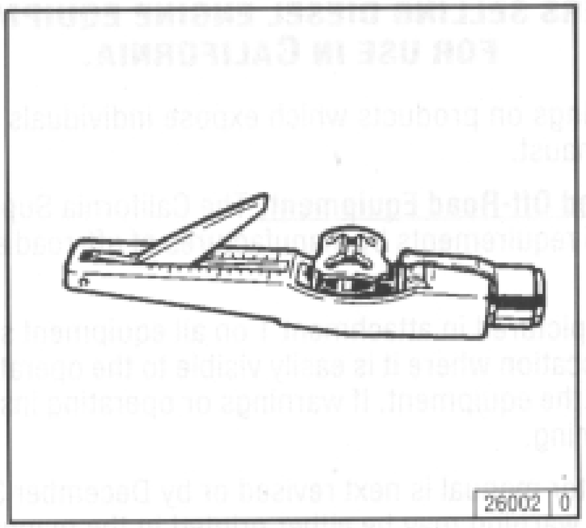


A TORX wrench set (order number 8189) is used with engines in the 1011 series.
This system was chosen because of the many advantages it offers:

- Outstanding accessibility to bolts.
- High load transfer when loosening and tightening.
- Almost impossible for socket to slide off or break.

TORX tools can be ordered from:
COMPANY WILBÄR
Postfach 14 05 80
D-42826 Remscheid

V-belt Tension Gauge



The V-belt tension gauge can be obtained under order number 81 15 + 81 20 from:

COMPANY WILBÄR
Postfach 14 05 80
D-42826 Remscheid

SP240

Section 3 - Deutz Spare Parts Manual

Spare Parts Catalogue

B/FL 1011 F/FT/FL

0297 7793

Engine Serial No.:

Please enter here the serial No. of your engine. This will facilitate dealing with your questions concerning after-sales service, repair and spare parts.

DEUTZ

Preface

DEUTZ Diesel Engines

are products based on long-standing research and development. The deep funds of acquired know-how in conjunction with high quality requirements guarantee that engines leaving our works achieve a long life, high reliability and excellent fuel economy. Naturally, they also attain best ratings as regards environmental protection.

Genuine DEUTZ Parts

are subject to equally stringent quality requirements as the engines themselves. Improvements in engine design certainly also pass into the genuine DEUTZ parts. To ensure that your engine will retain its functions and high reliability, you should use genuine DEUTZ parts only.

DEUTZ Exchange Components

are a cheap alternative. Of course, they are subject to the same high quality requirements as new parts. And as regards functions and reliability, DEUTZ exchange components equal genuine DEUTZ parts.

SERVICE

In case of operational trouble with your equipment or queries about spare parts please turn to your nearest service dealership. Our skilled staff of service experts will trace and remedy any defect quickly, using genuine DEUTZ parts.

Beware of the Running Engine

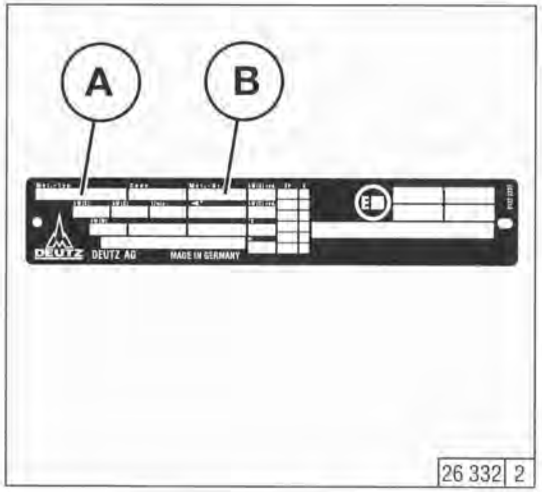
Be sure to shut down the engine before performing maintenance or repair work. After repair, put back in place any removed panels and guards. When doing work on the running engine, working clothes should fit tightly so that loose ends cannot get caught. Do not run the engine in enclosed rooms – poison hazard.

Asbestos

Gaskets used for this engine do not contain asbestos. Please use suitable spare parts when carrying out maintenance and repair work.

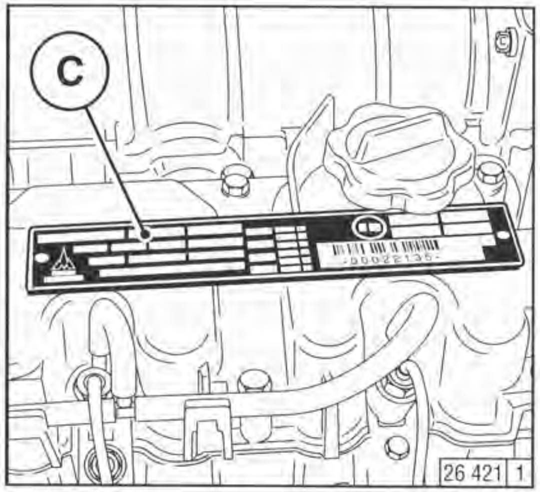
Description of Engine

1. Maker's Nameplate



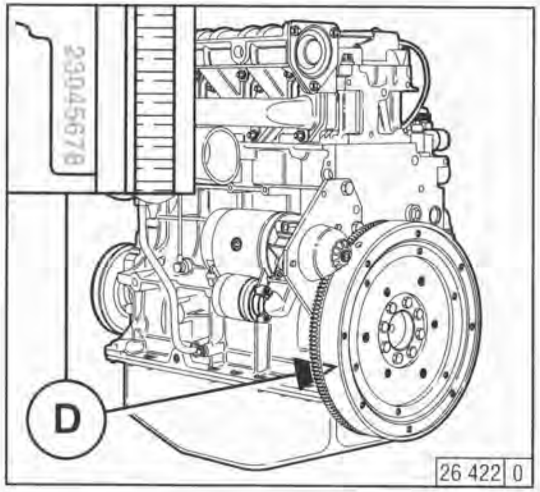
Engine model designation **A**, Engine Ser. No. **B** and the power rating are given on the maker's nameplate. Be sure to state engine model and engine serial number when writing out a parts order.

2. Position of Nameplate



The rating plate **C** is attached to the valve cover.

3. Engine Serial No.



The engine serial No. **D** is stamped on the crankcase and also on the nameplate.

Ordering spare parts

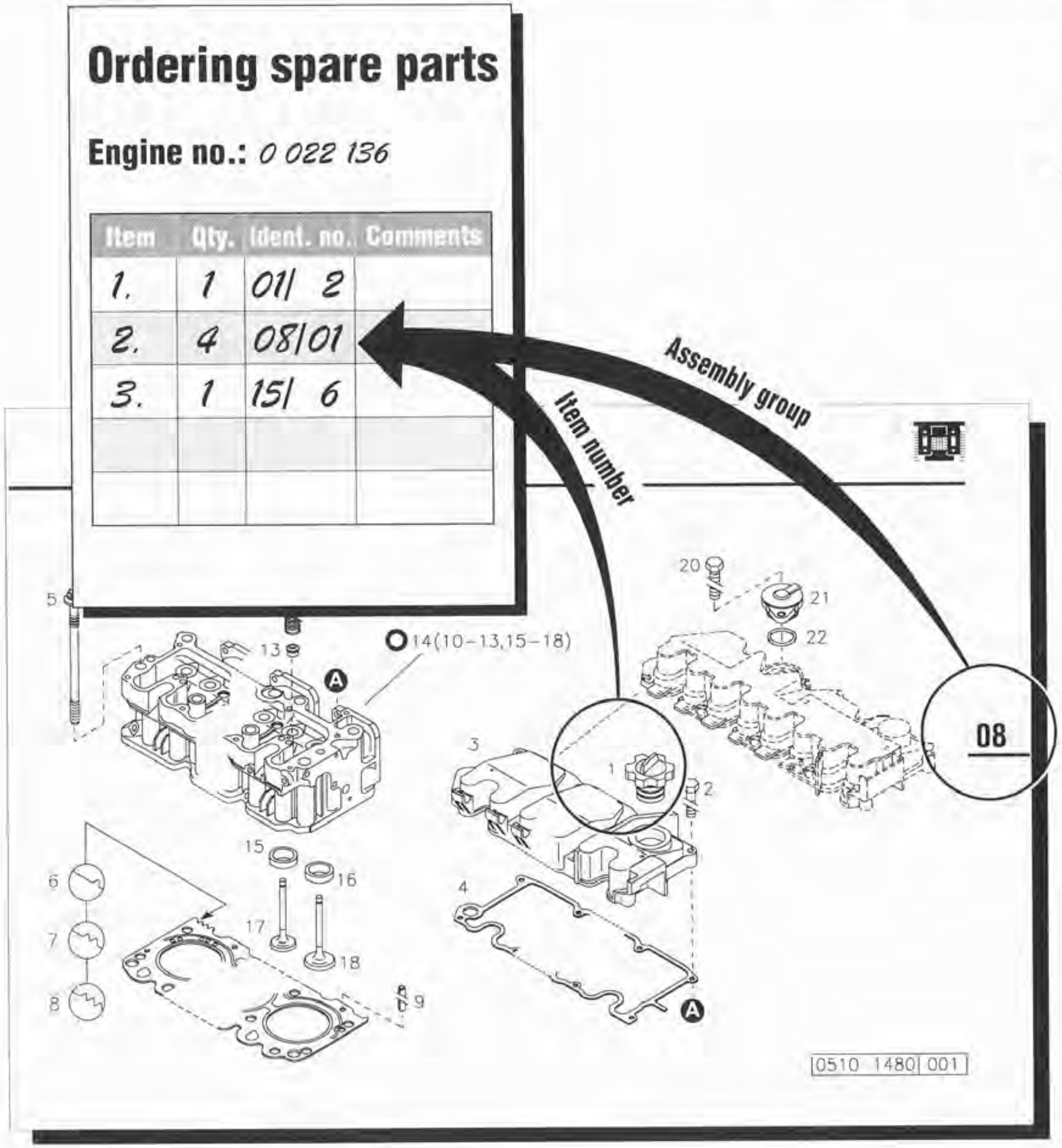
Order information

Please specify the following information when ordering original DEUTZ parts:

- Engine no.
- Ident. no.
- Quantity

Document structure

- The picture diagrams in this spare parts list are sorted according to engine assembly groups.
- Each section is preceded by an overview of the assembly groups.
- The ident. no. **08/01** is made up of the assembly group (e.g. **08**) and item number (e.g. **01**).



Ordering spare parts

Engine no.: 0 022 136

Item	Qty.	Ident. no.	Comments
1.	1	01/ 2	
2.	4	08/01	
3.	1	15/ 6	

Service

Knowing it's DEUTZ

DEUTZ has always stood for excellence in motor construction, pioneering many developments in the industry. As an independent motor manufacturer, we offer — worldwide — a comprehensive range of diesel and gas motors spanning from 4kW to 7,400kW. Our products are perfectly tailored to meet our customers' individual requirements.

Over 1.4 million DEUTZ motors do their job reliably all over the world. We are determined to preserve the high standard of performance and dependability of our motors, thus keeping our customers satisfied at all times. Therefore we are represented worldwide through a network of highly competent service partners who will meet the needs of our customers, wherever they are.

This is why DEUTZ is not only the name for motors which pack a lot of inventive genius. DEUTZ also means reliable service and comprehensive support to enhance your motor's performance.

This index Sales & Service offers you an overview of the DEUTZ partners in your vicinity, including the products for which they are responsible and the range of services provided. But even when no direct product responsibility is mentioned, your DEUTZ partner will be happy to help you with expert advice.

The Index is constantly updated. Please ask your DEUTZ service partner for the latest edition.

DEUTZ AG — at your service.

Register Sales & Service
Register Vertrieb & Service
Réseau Distribution & Service
Registro Red de Distribucion & Servicio
Registro Vendita & Service

Order-No.: 0297 7444

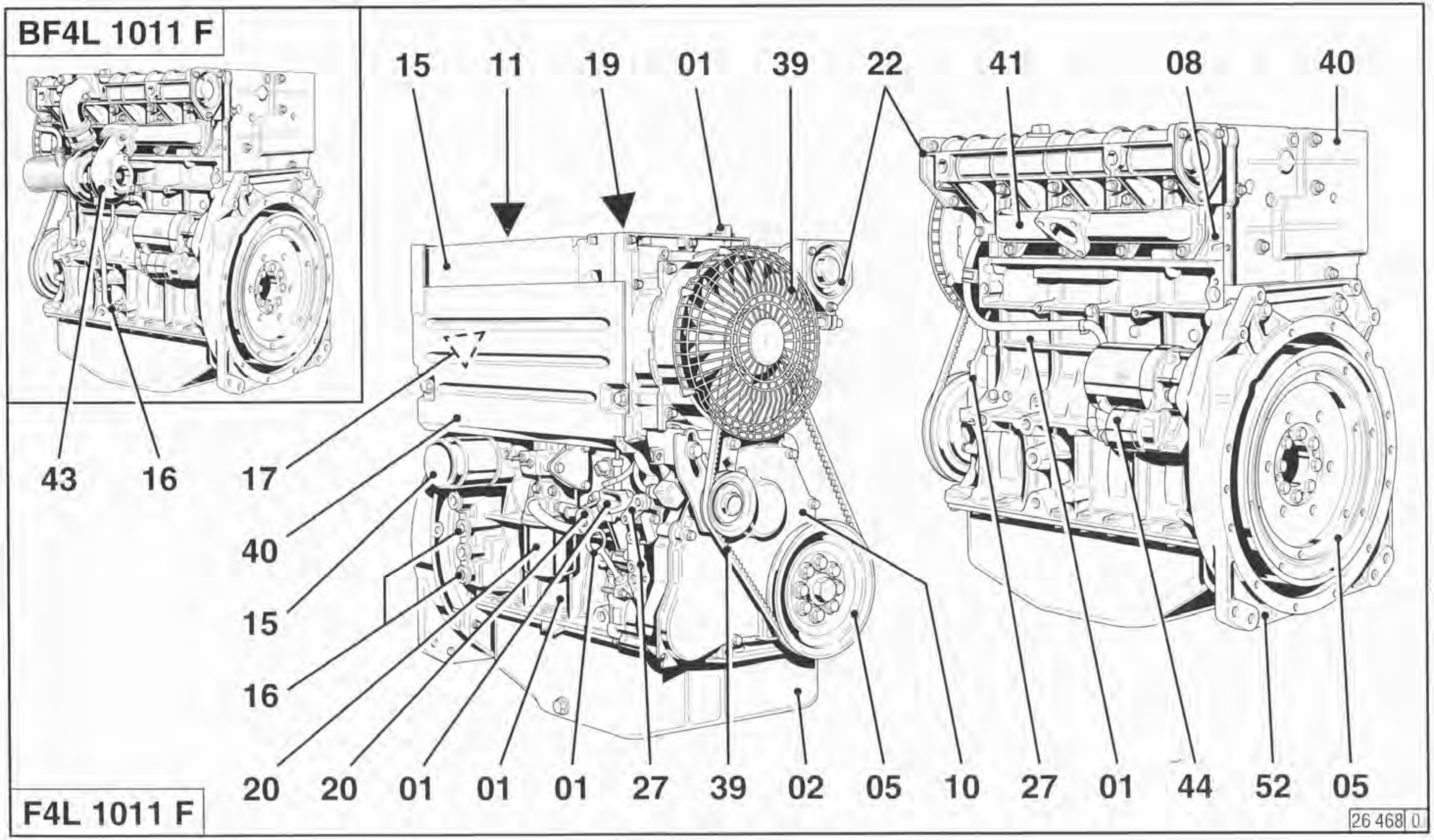
Order-No.: 0297 7445 (CD-ROM)

Obtainable from the local service Partner reponsible for you or from:

DEUTZ AG
Deutz-Mülheimer Str. 147-149
D-51057 Köln

Phone: 0049-221-822-0
Telefax: 0049-221-822-5304
Telex: 8812-0 khd d
http://www.deutz.de

Illustrations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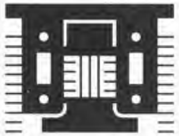

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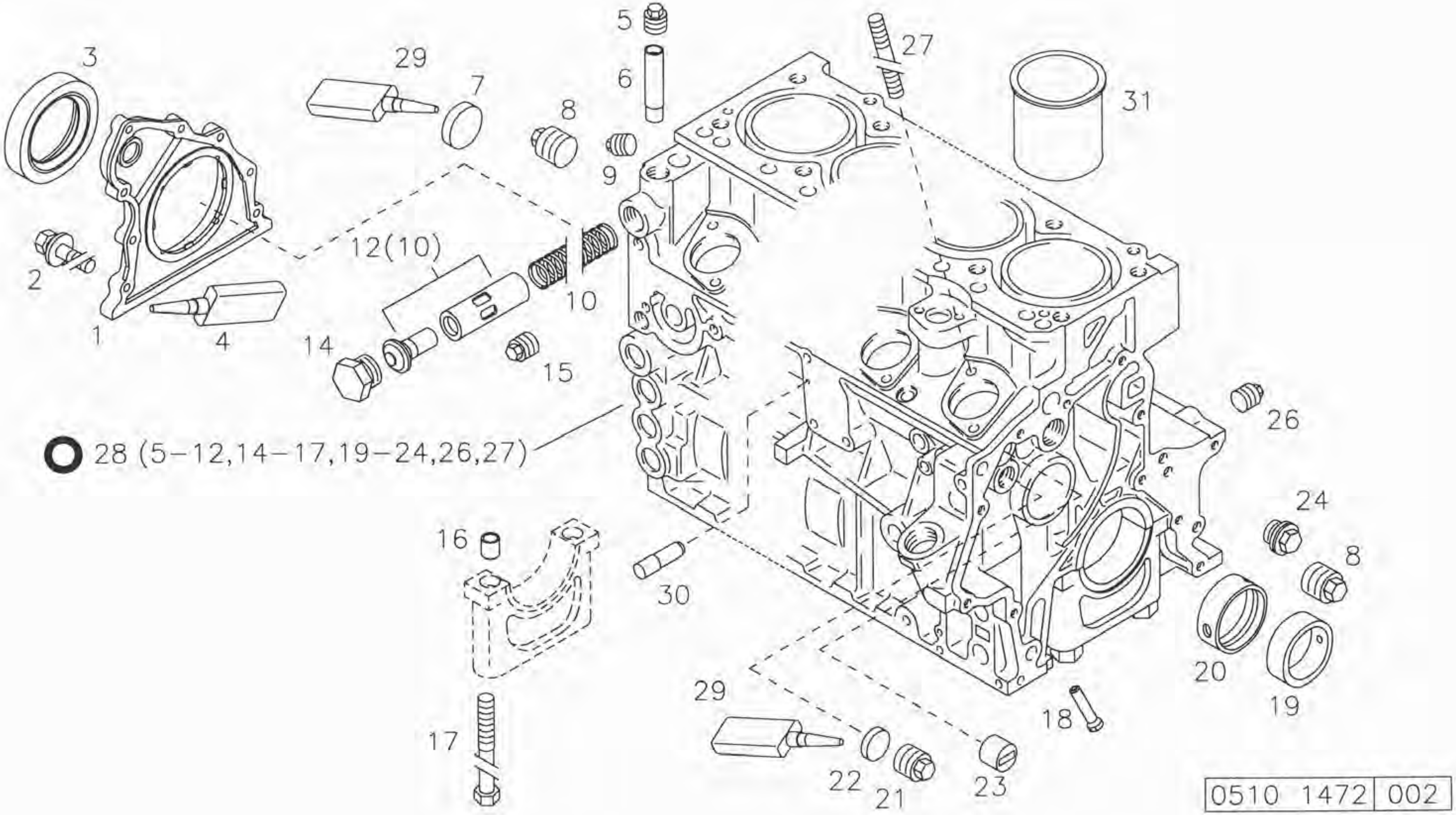
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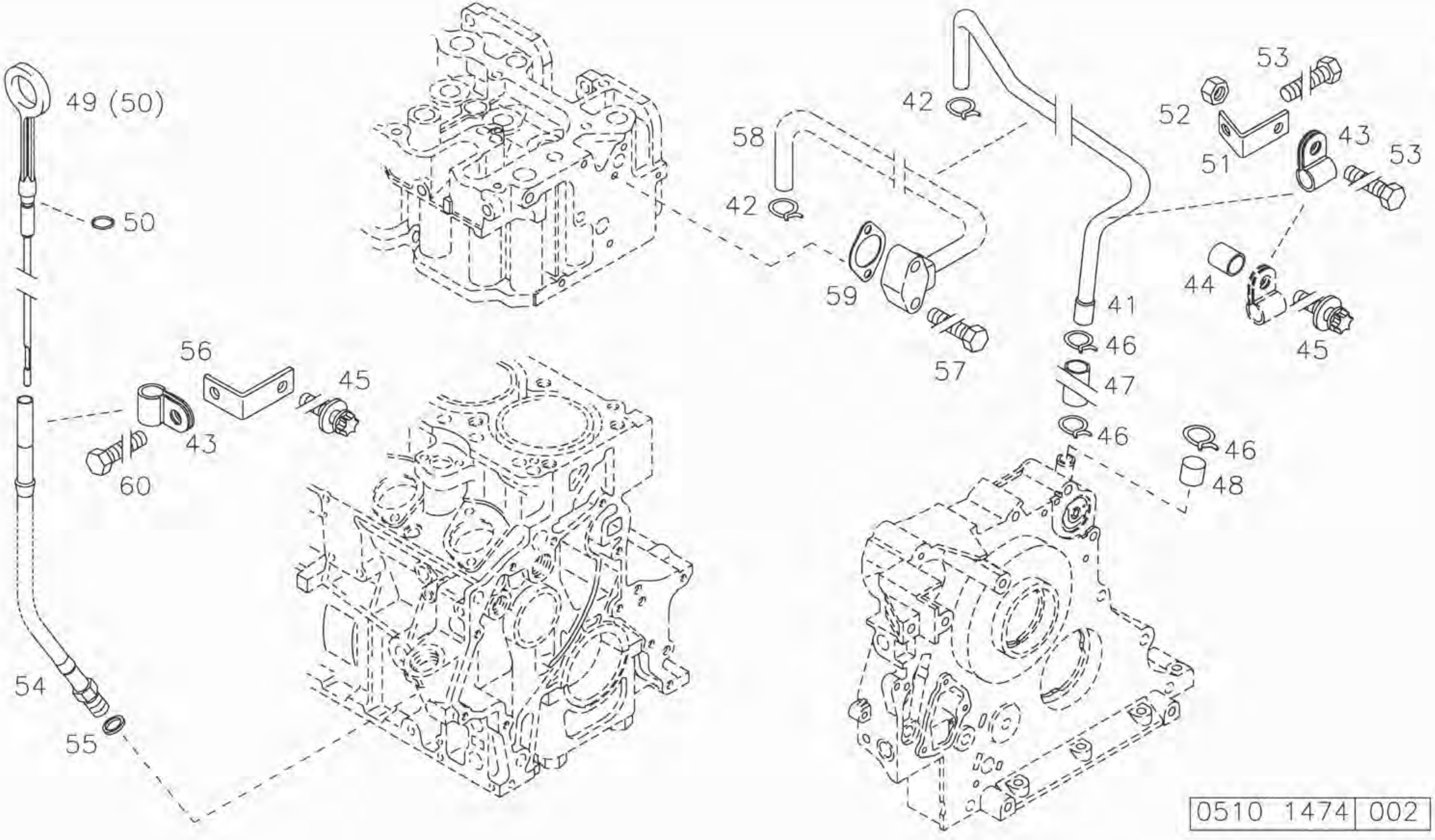
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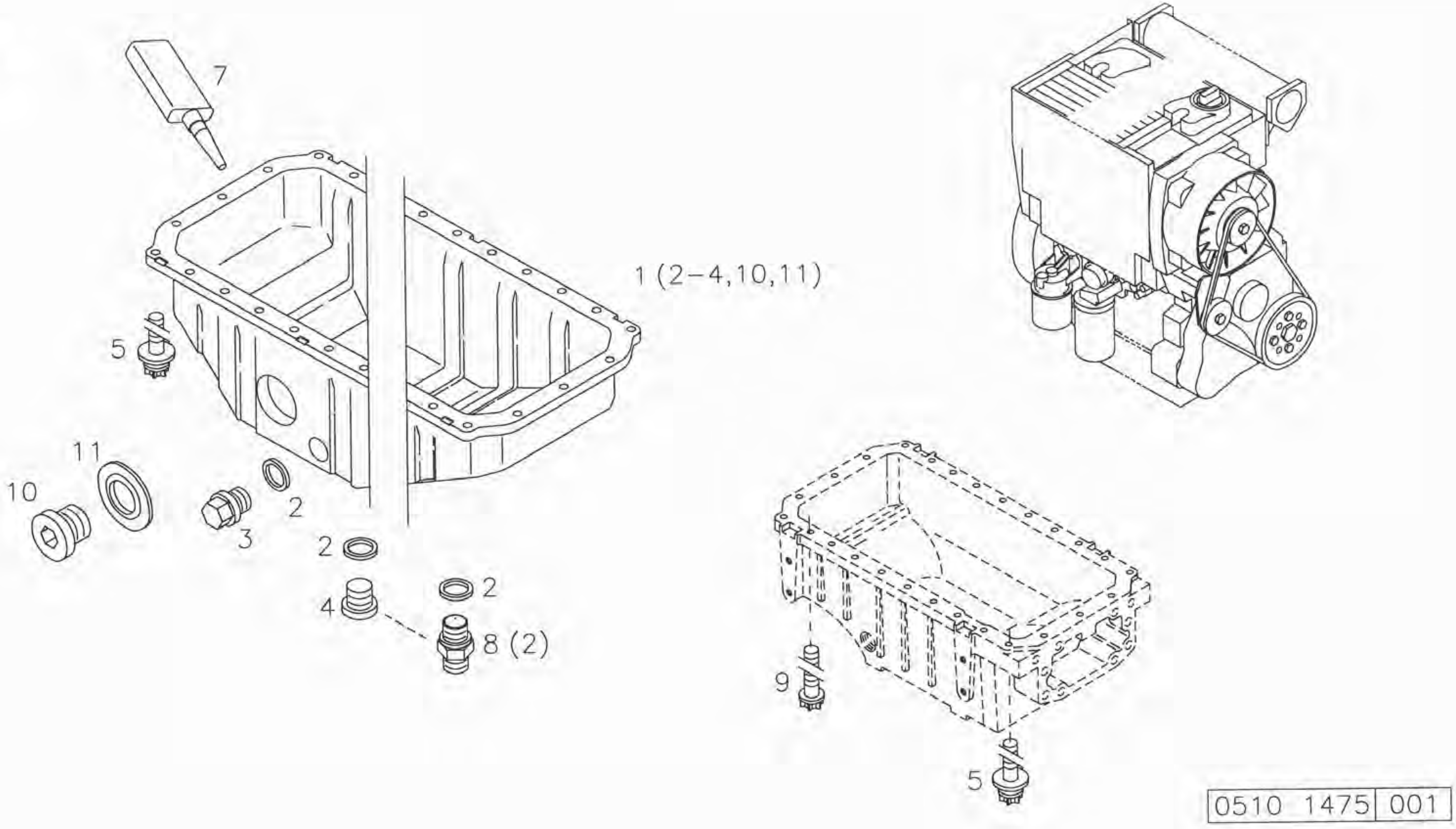

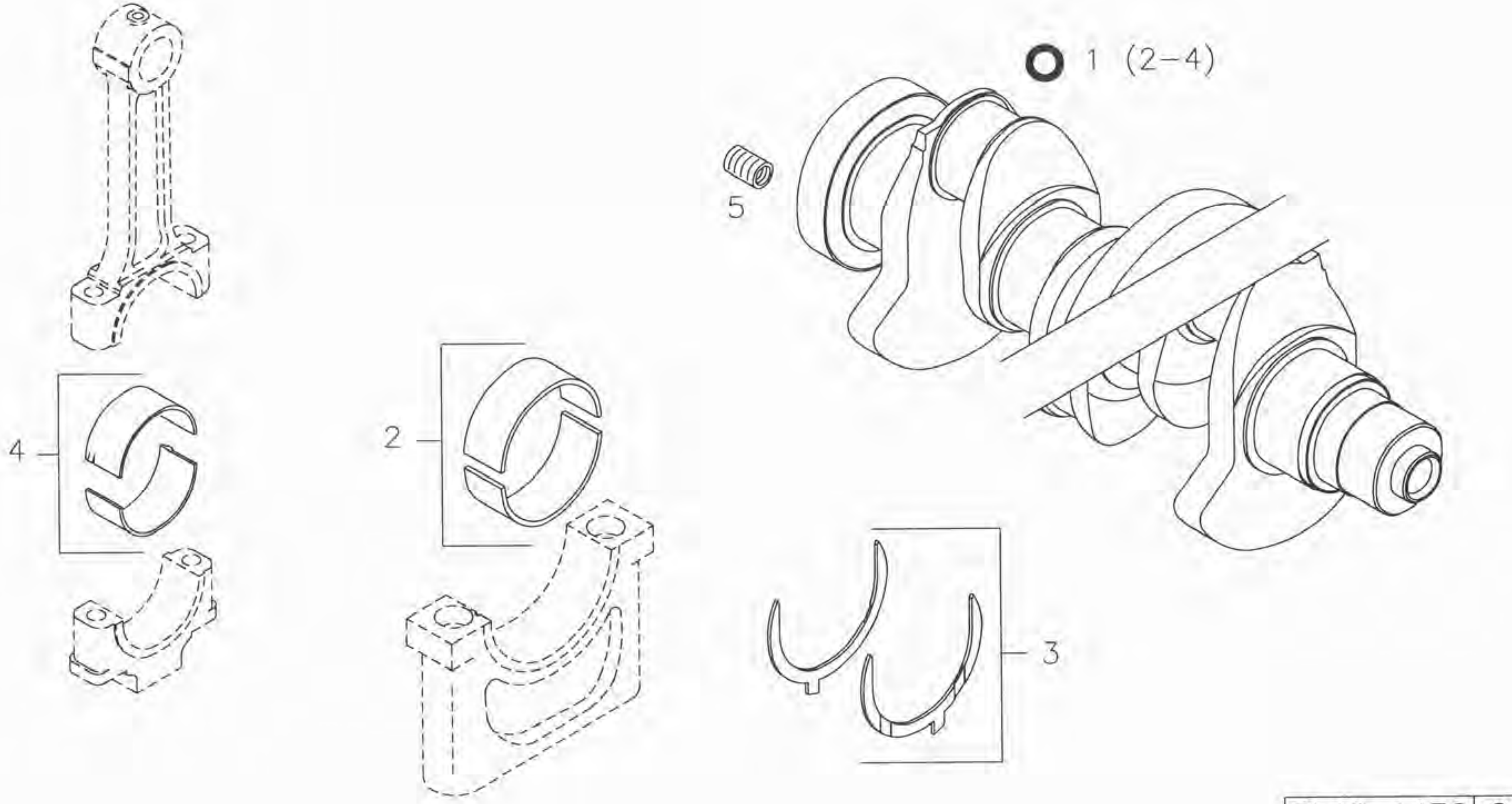
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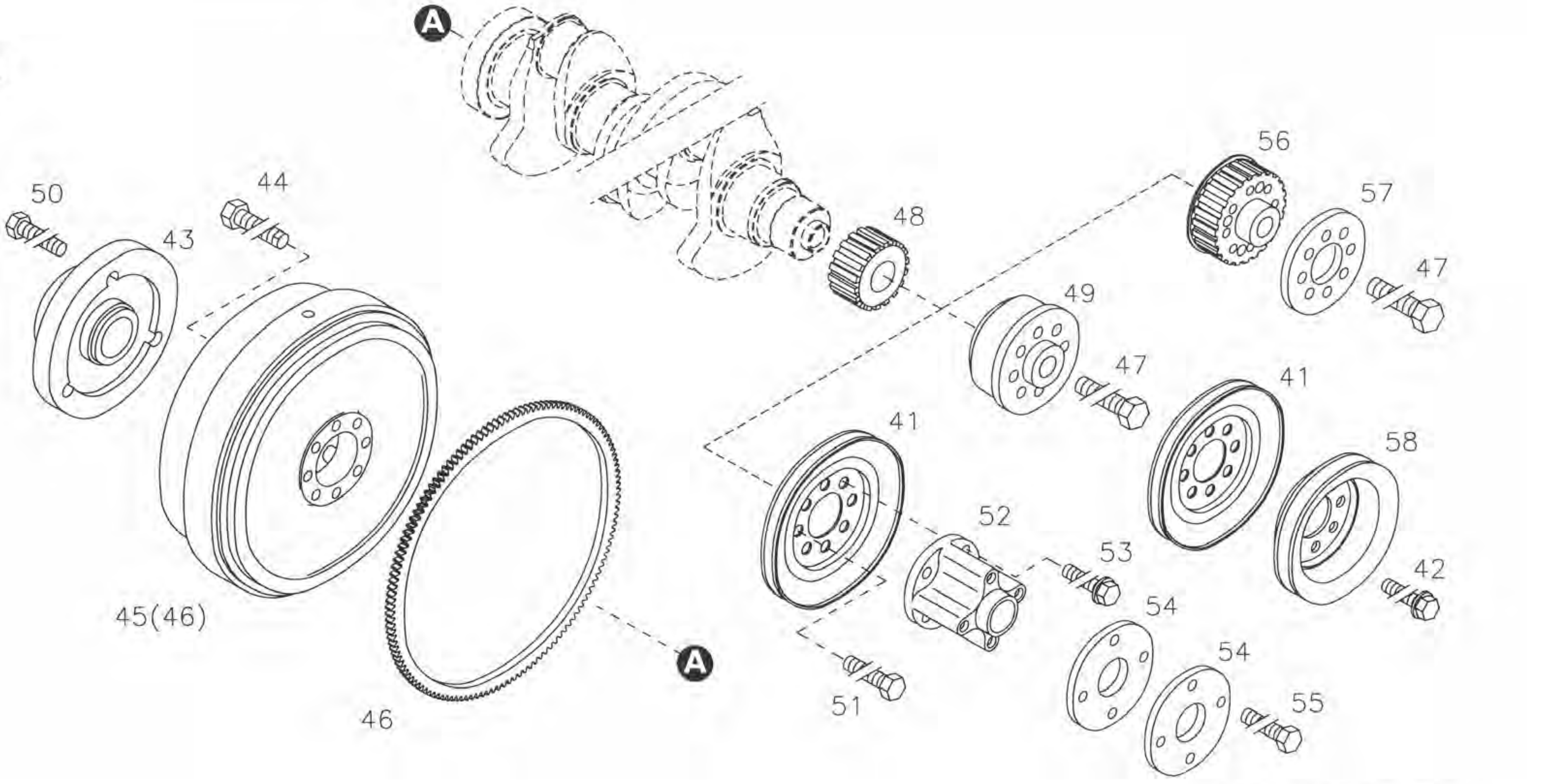

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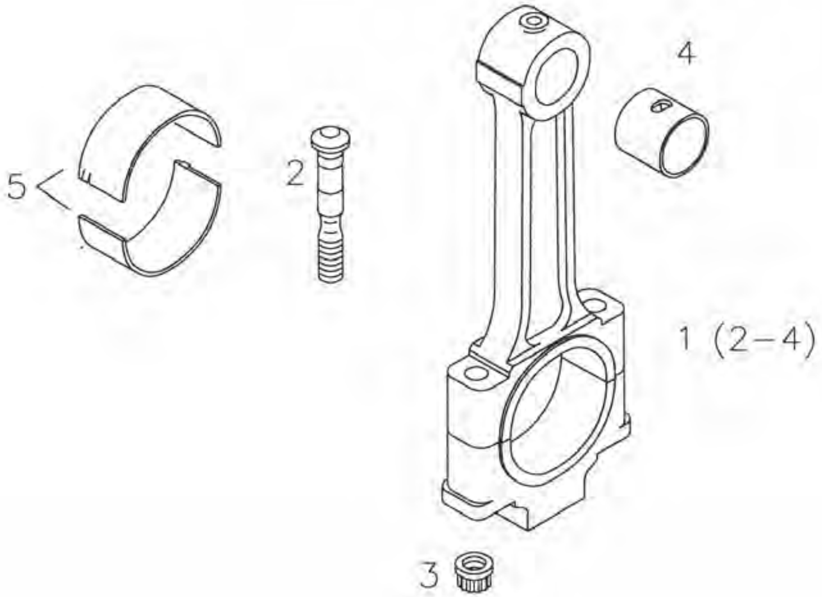

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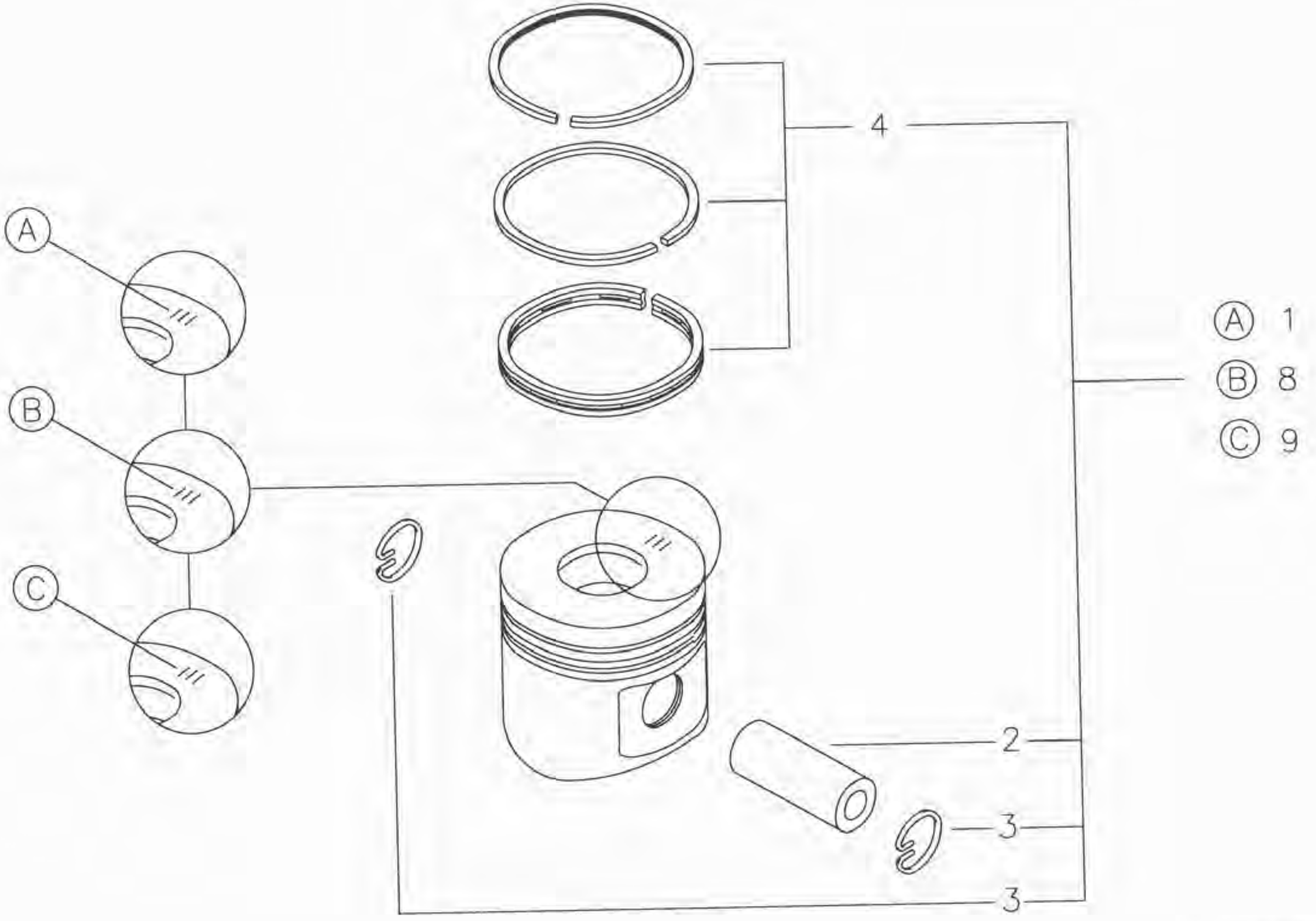

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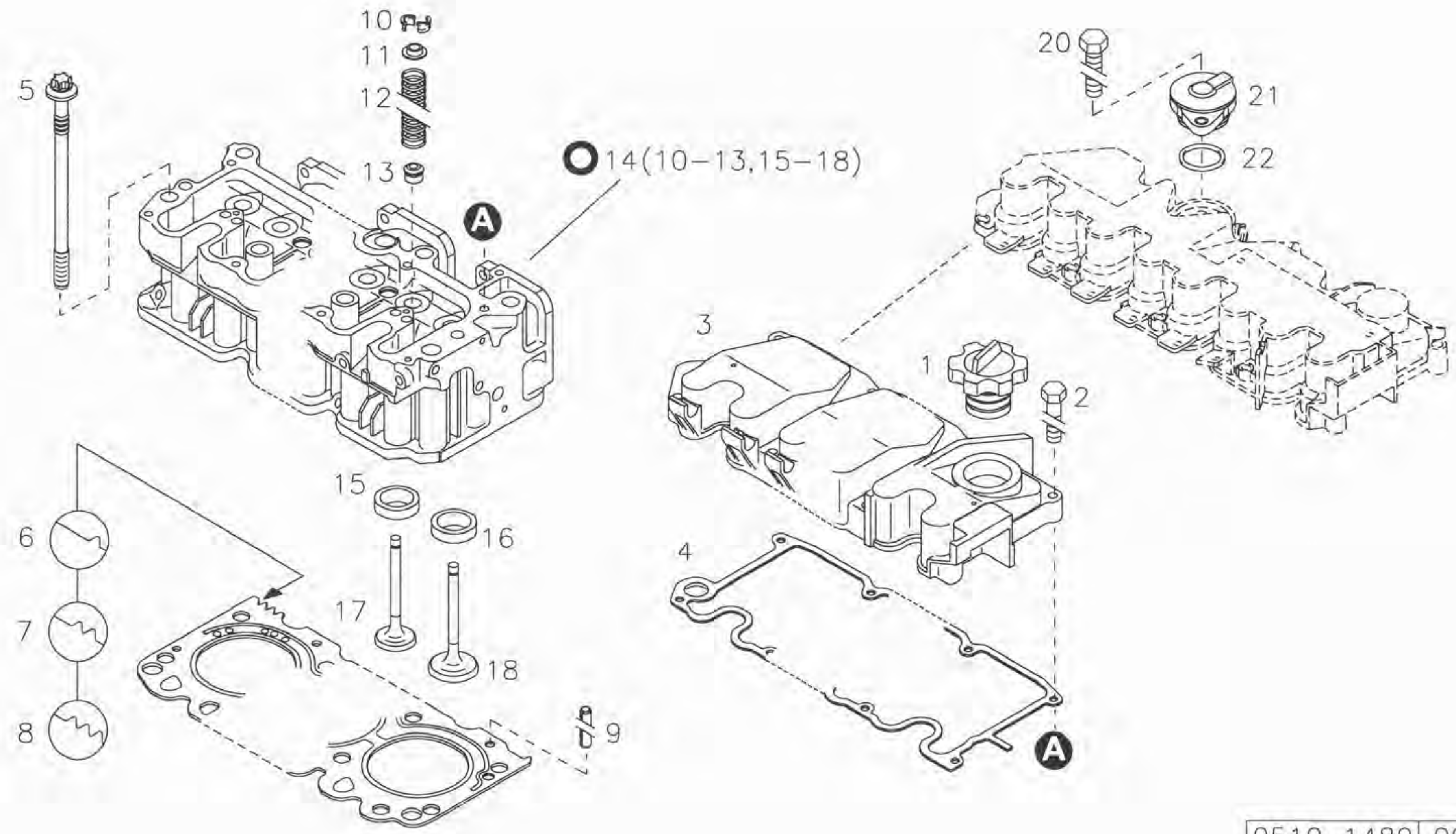

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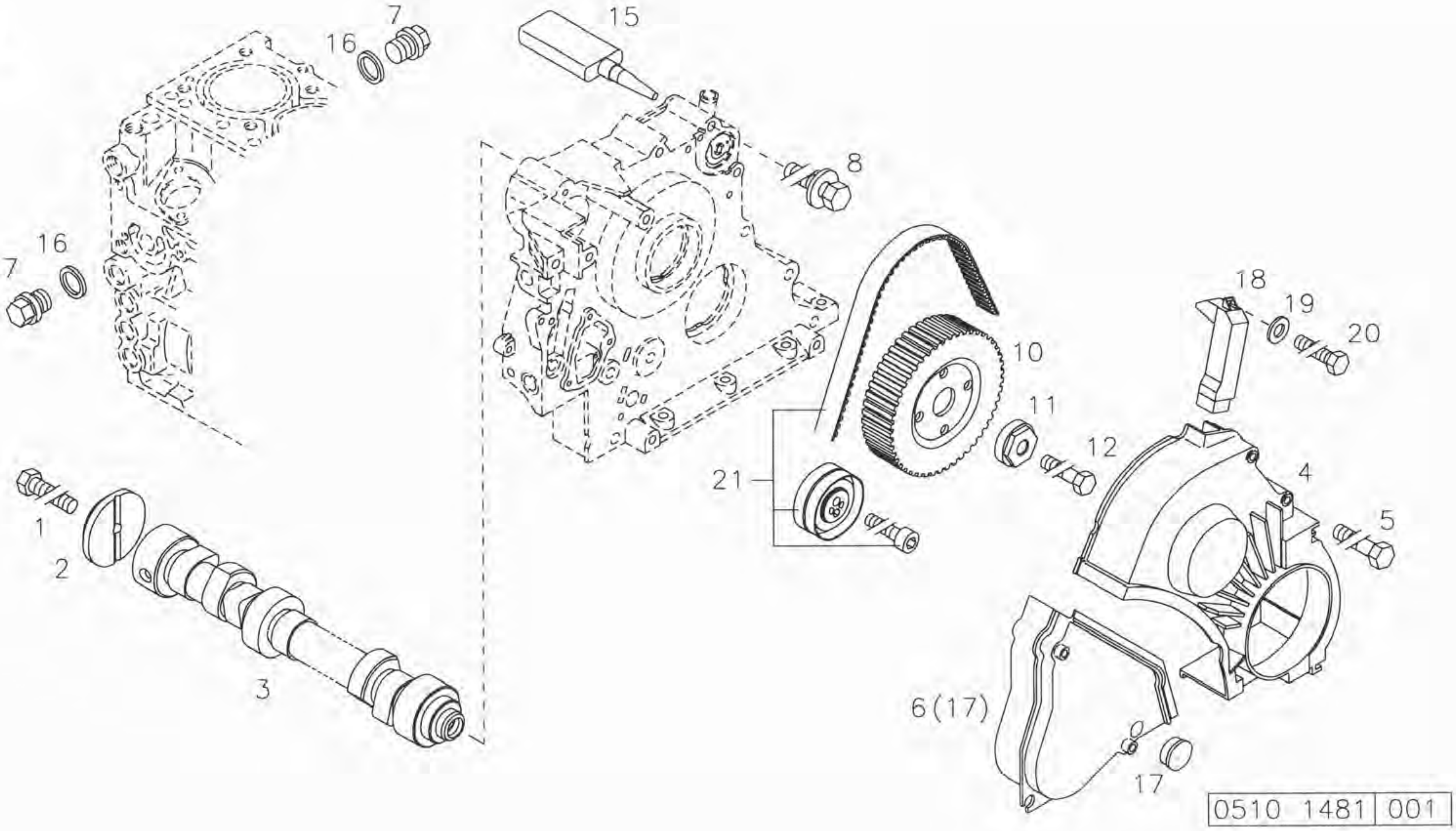
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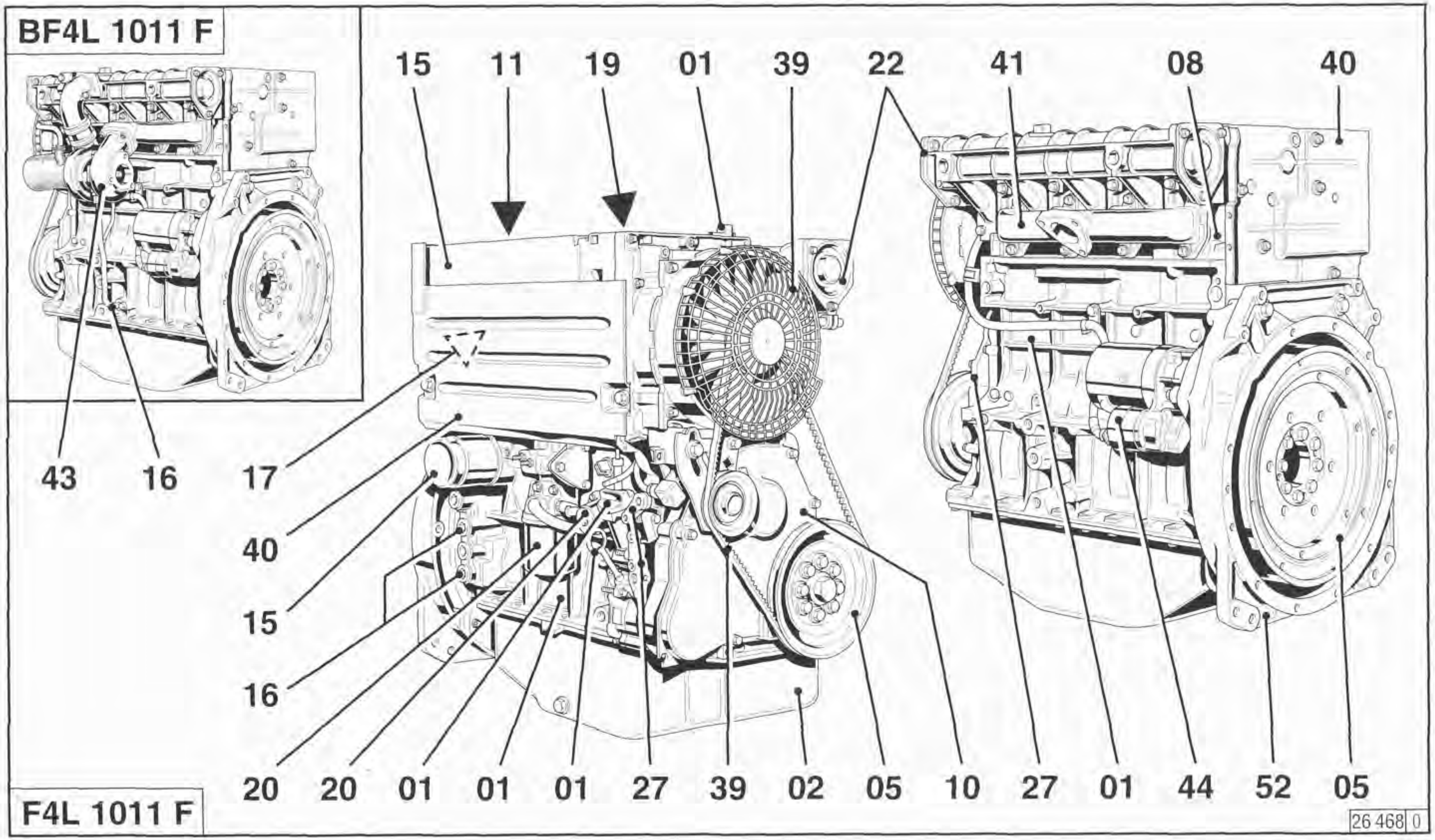
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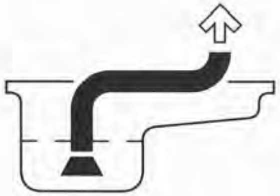

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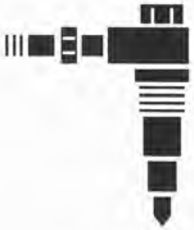

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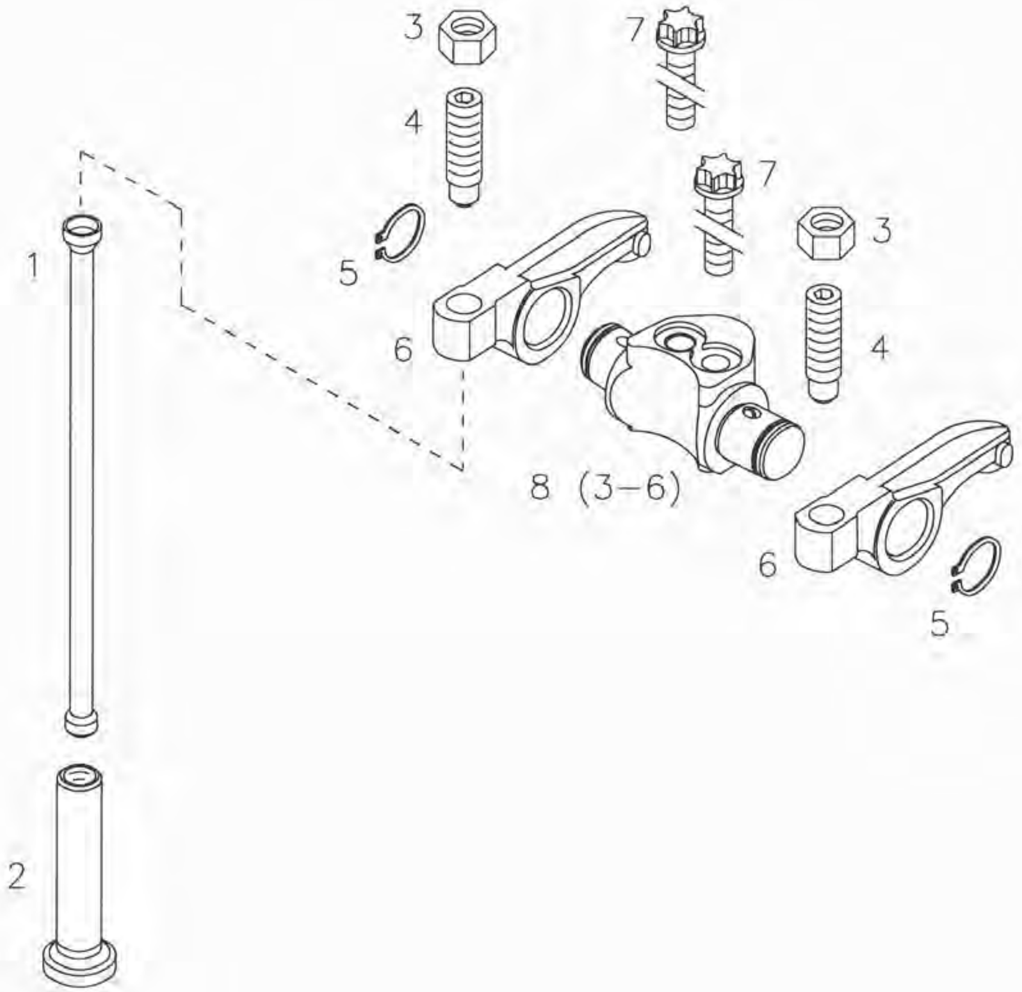

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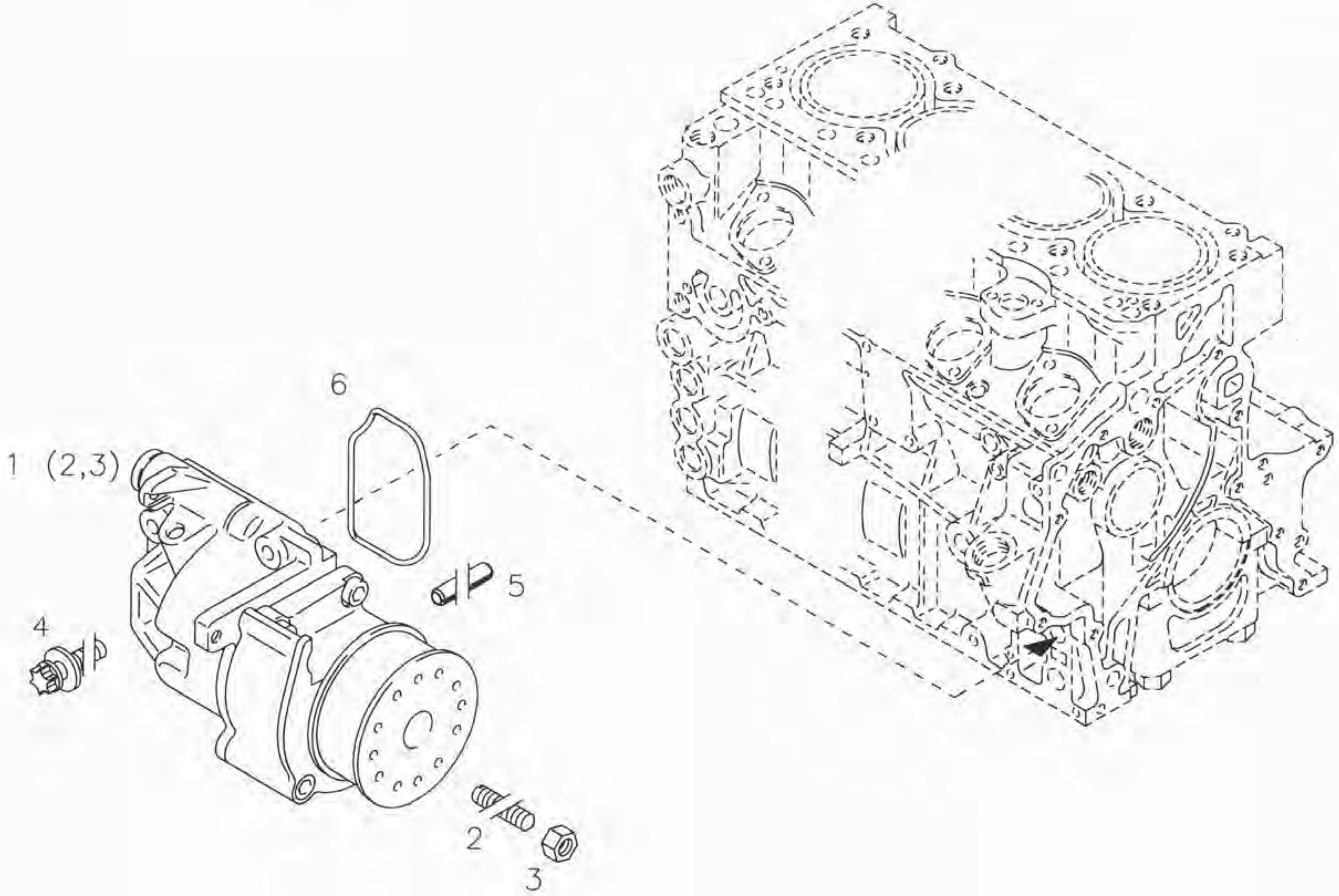

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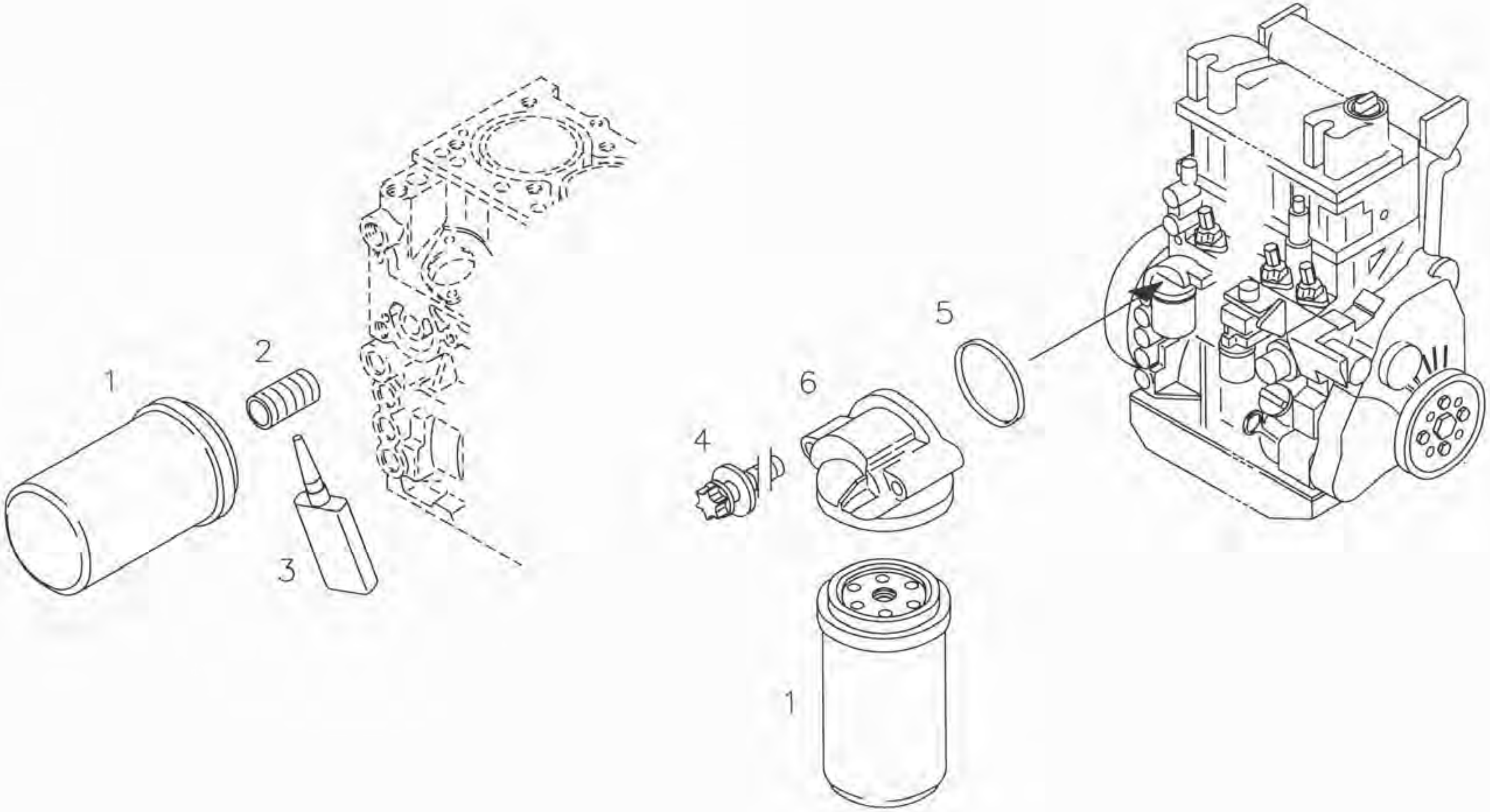

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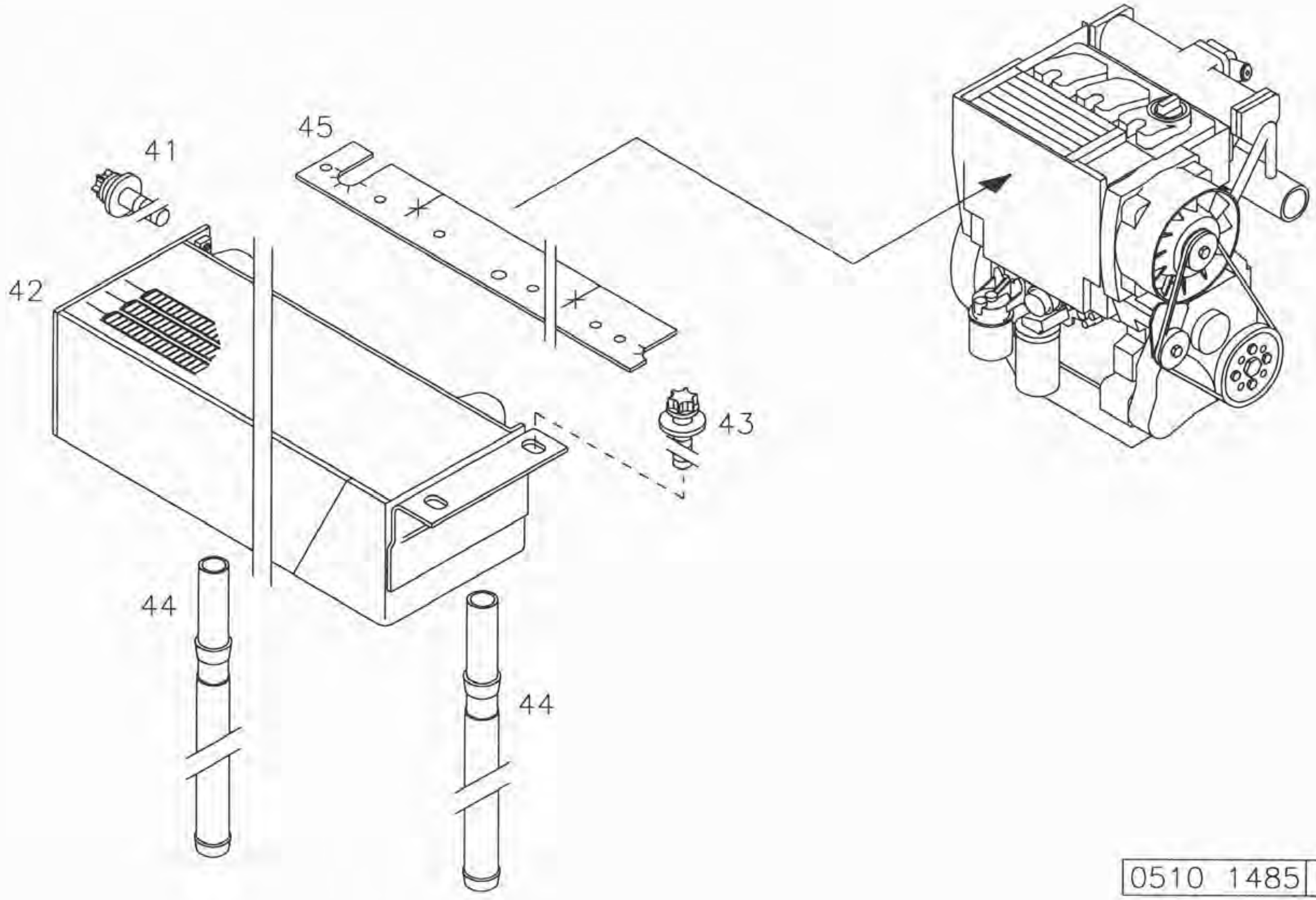

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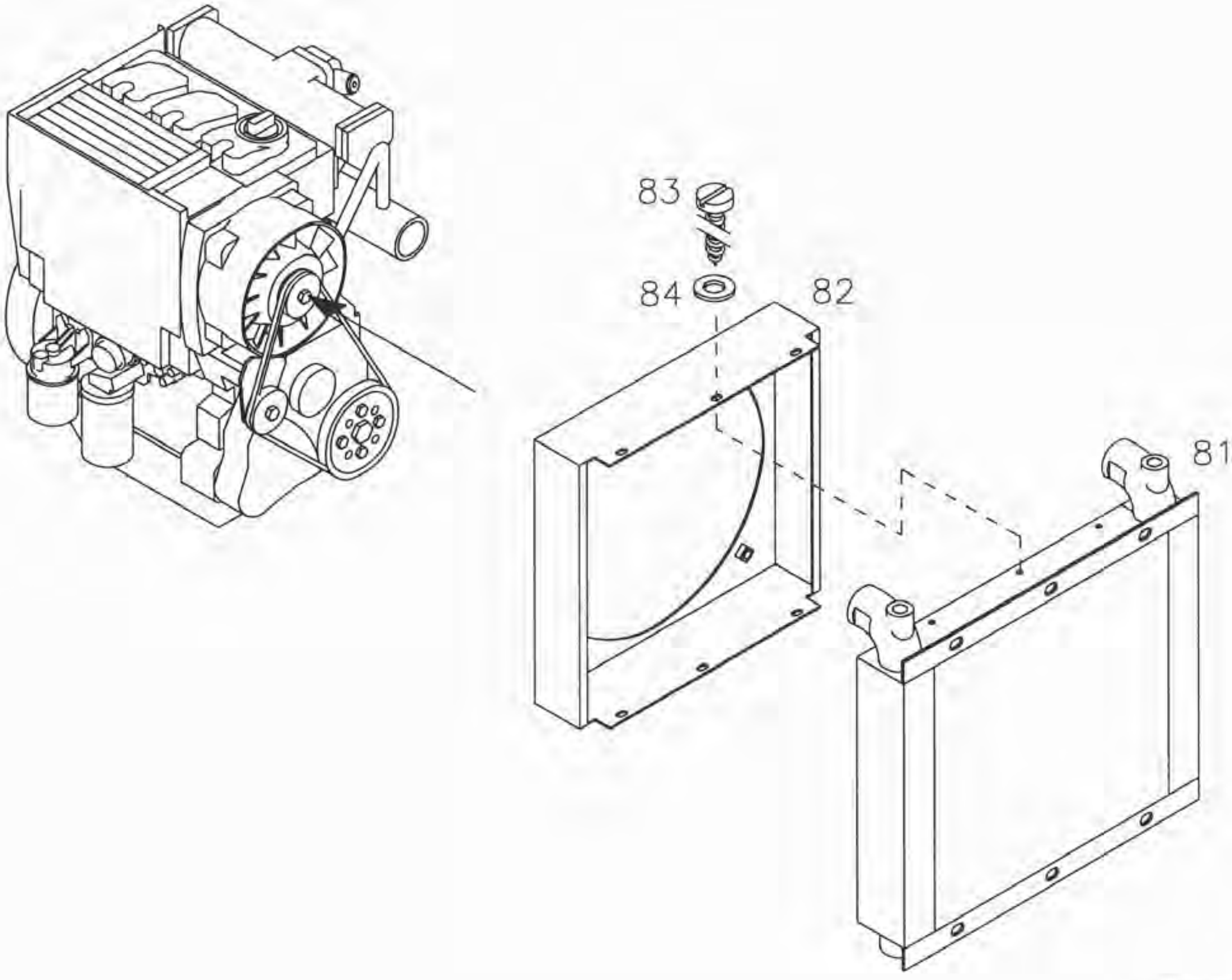

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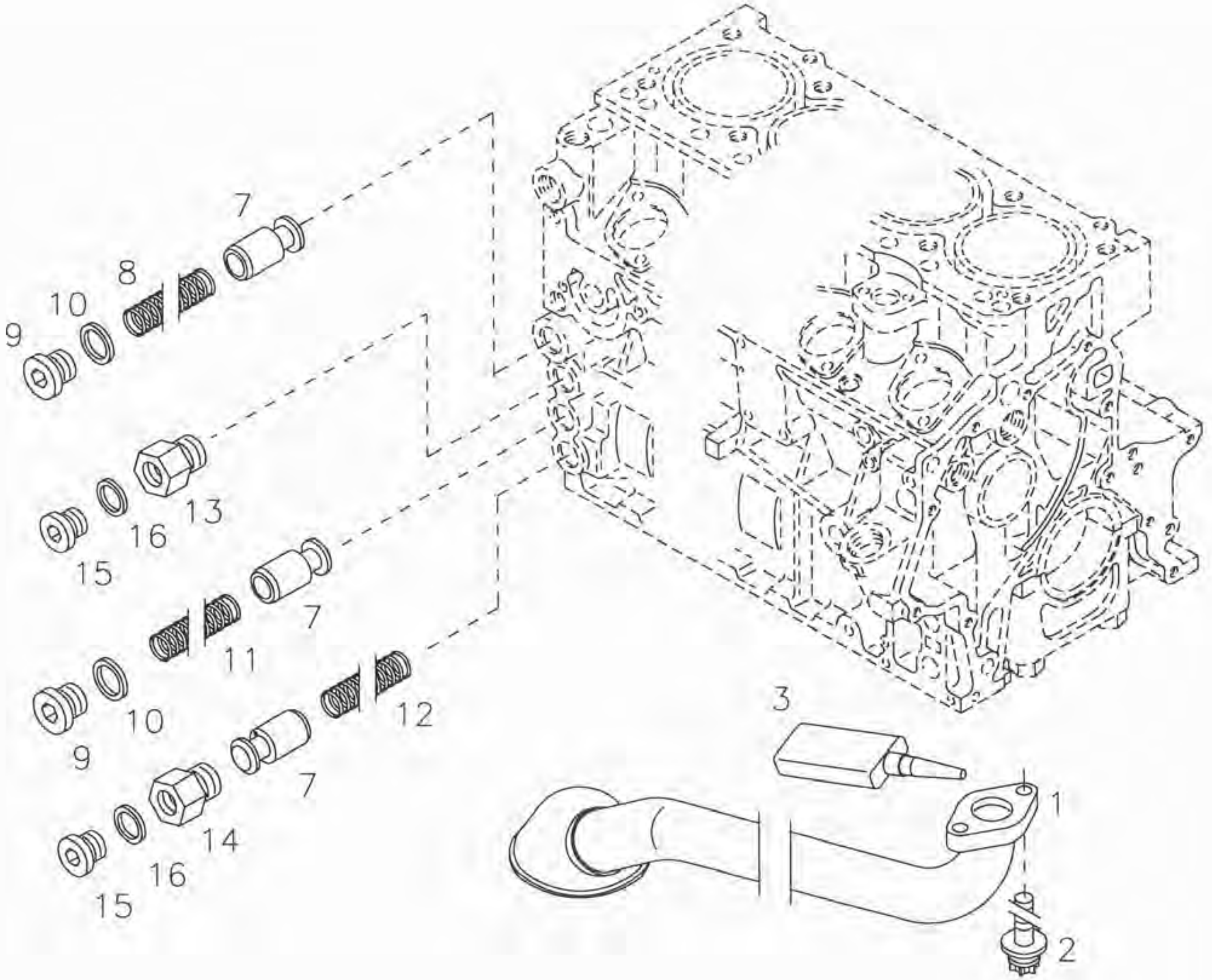

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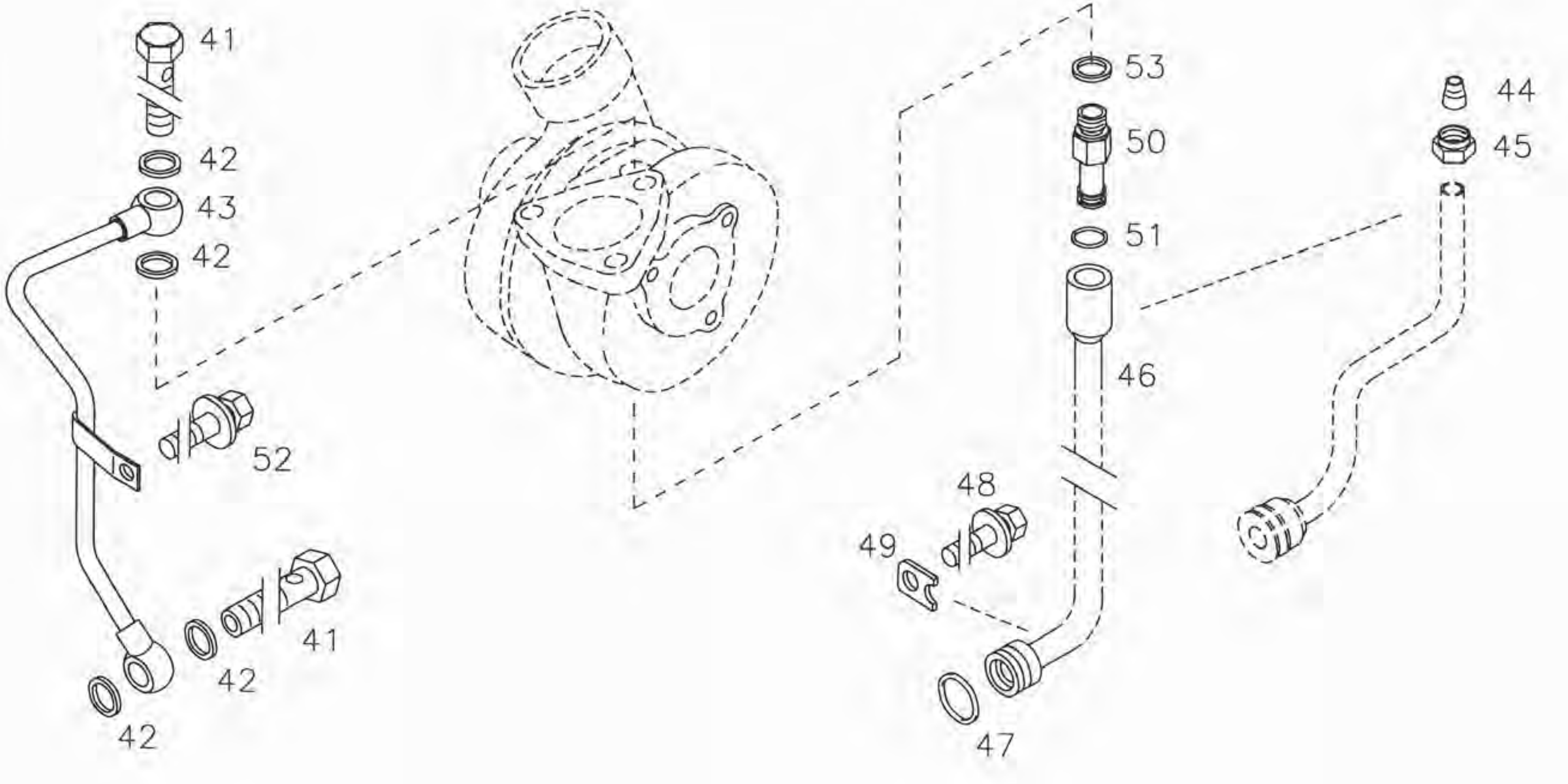

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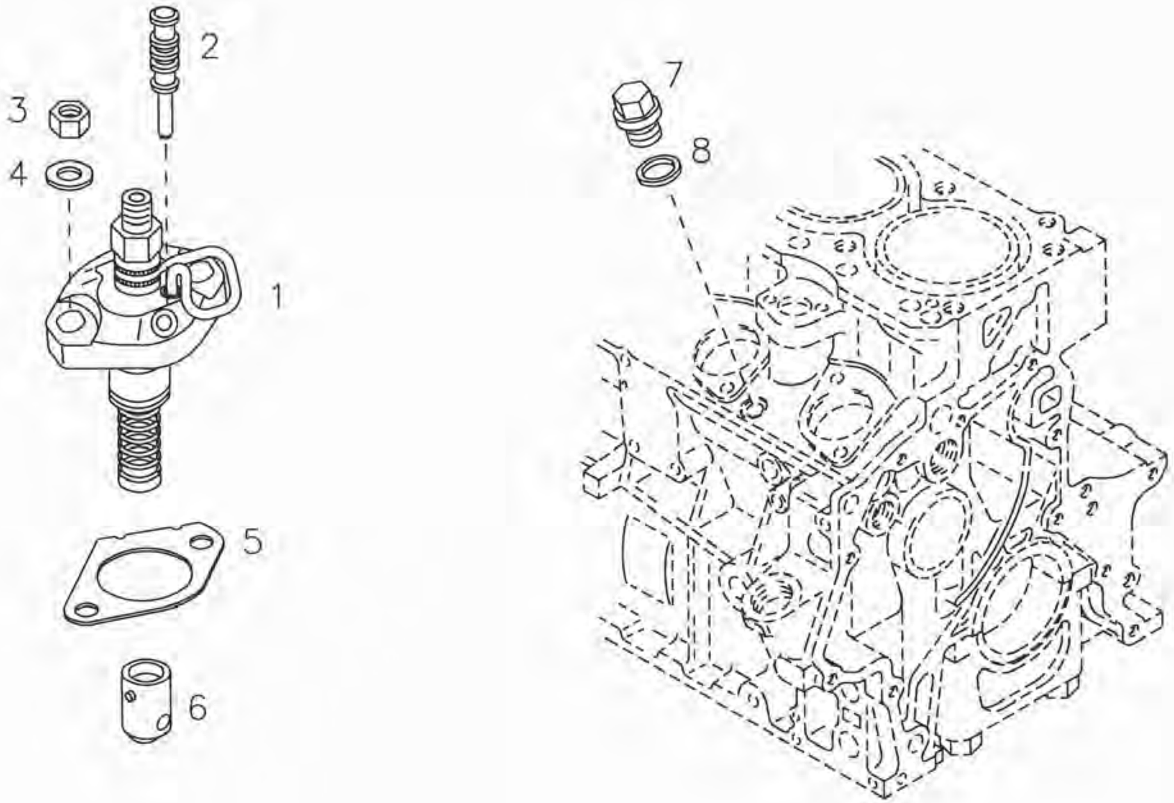

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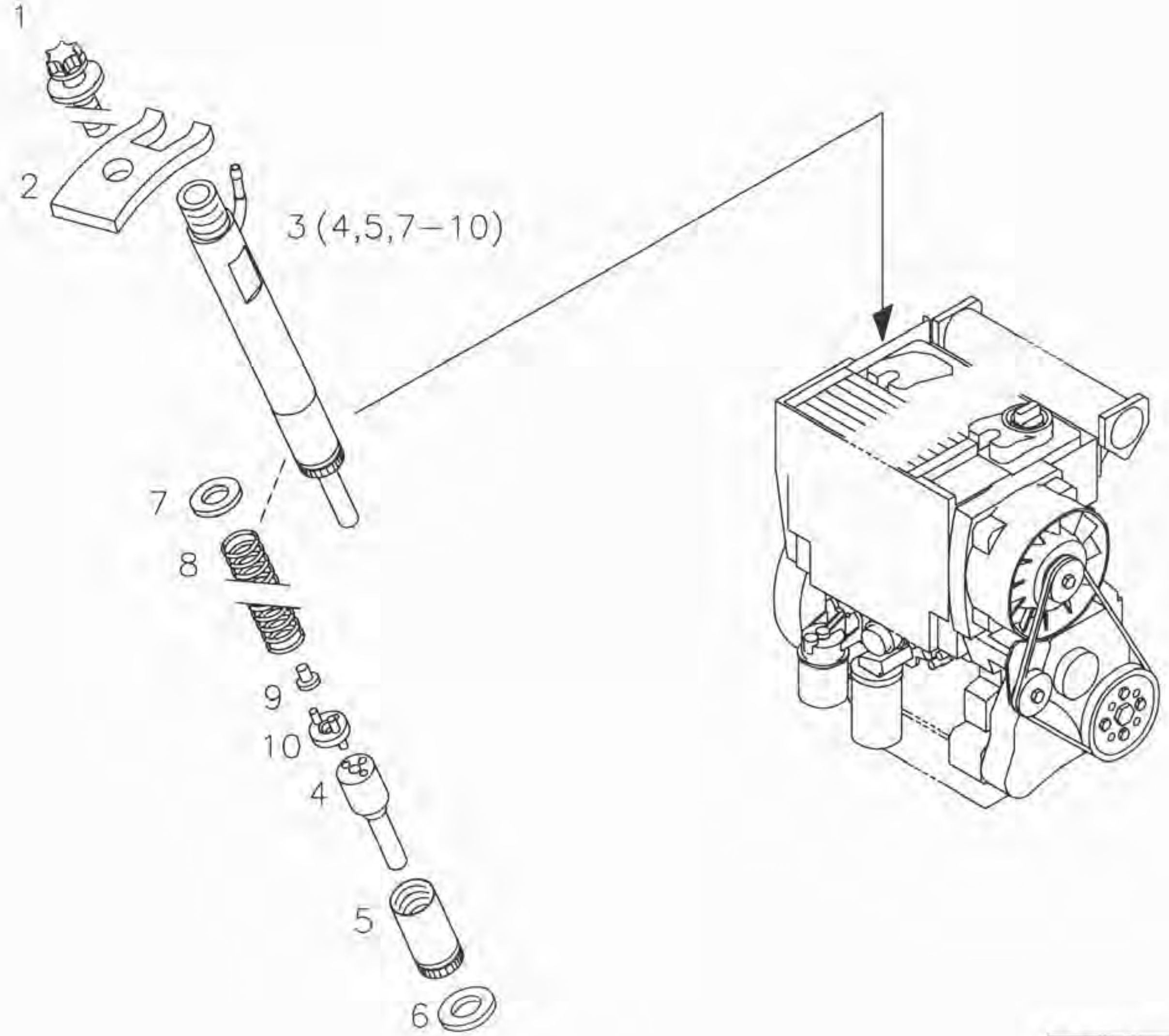

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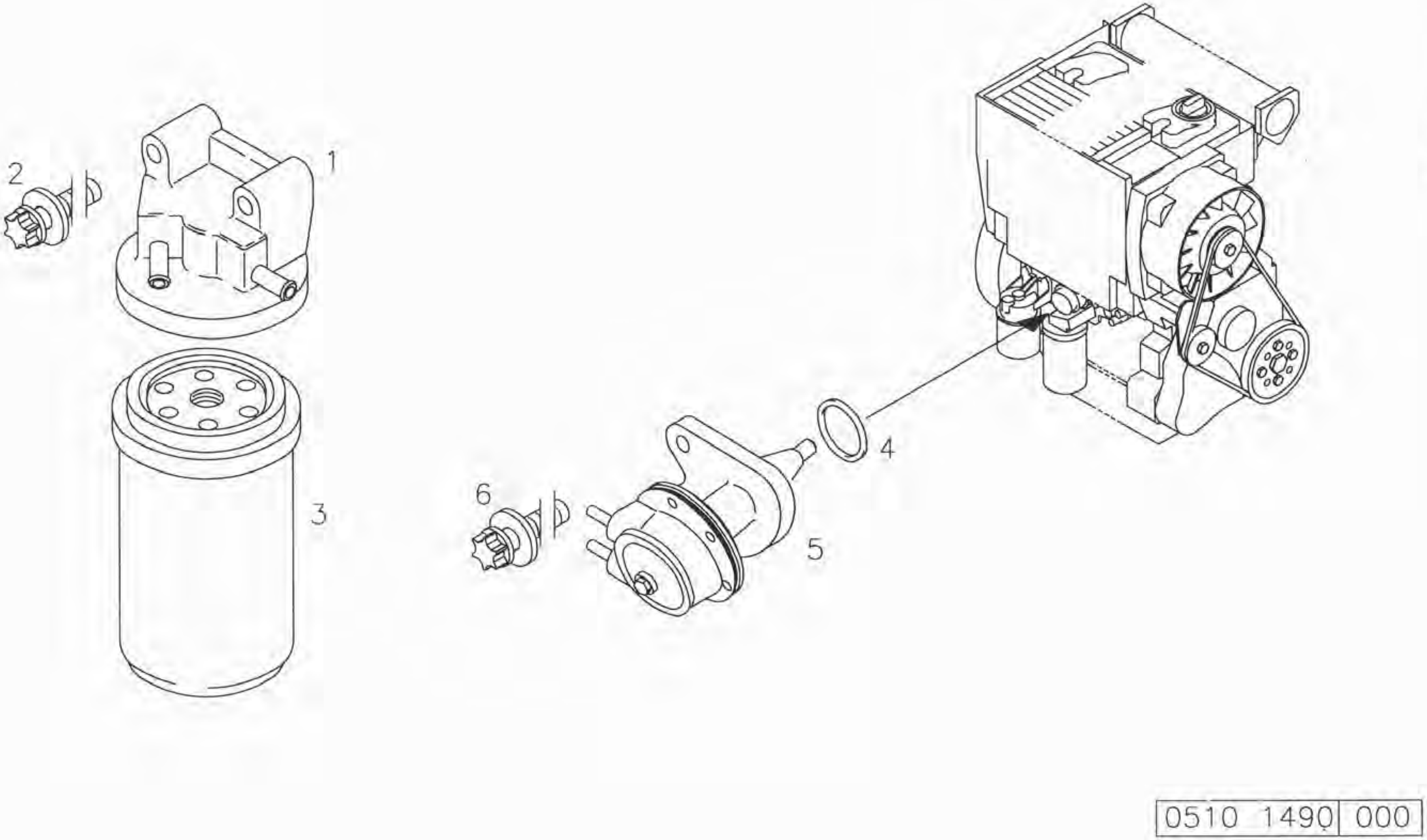
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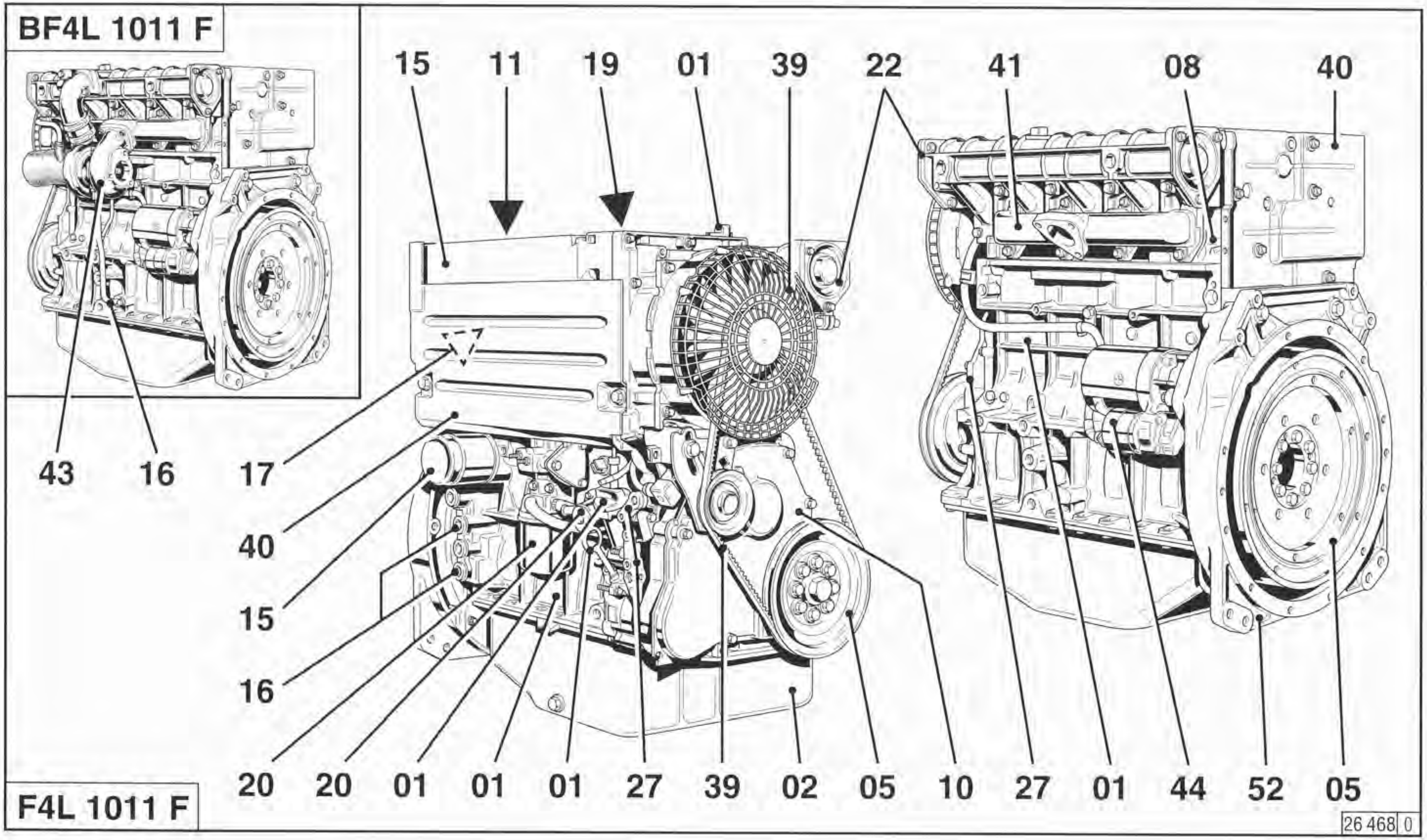
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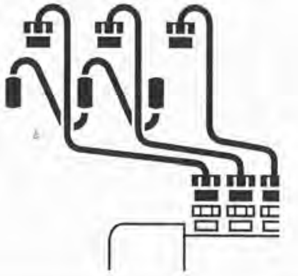

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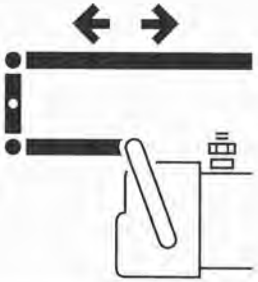

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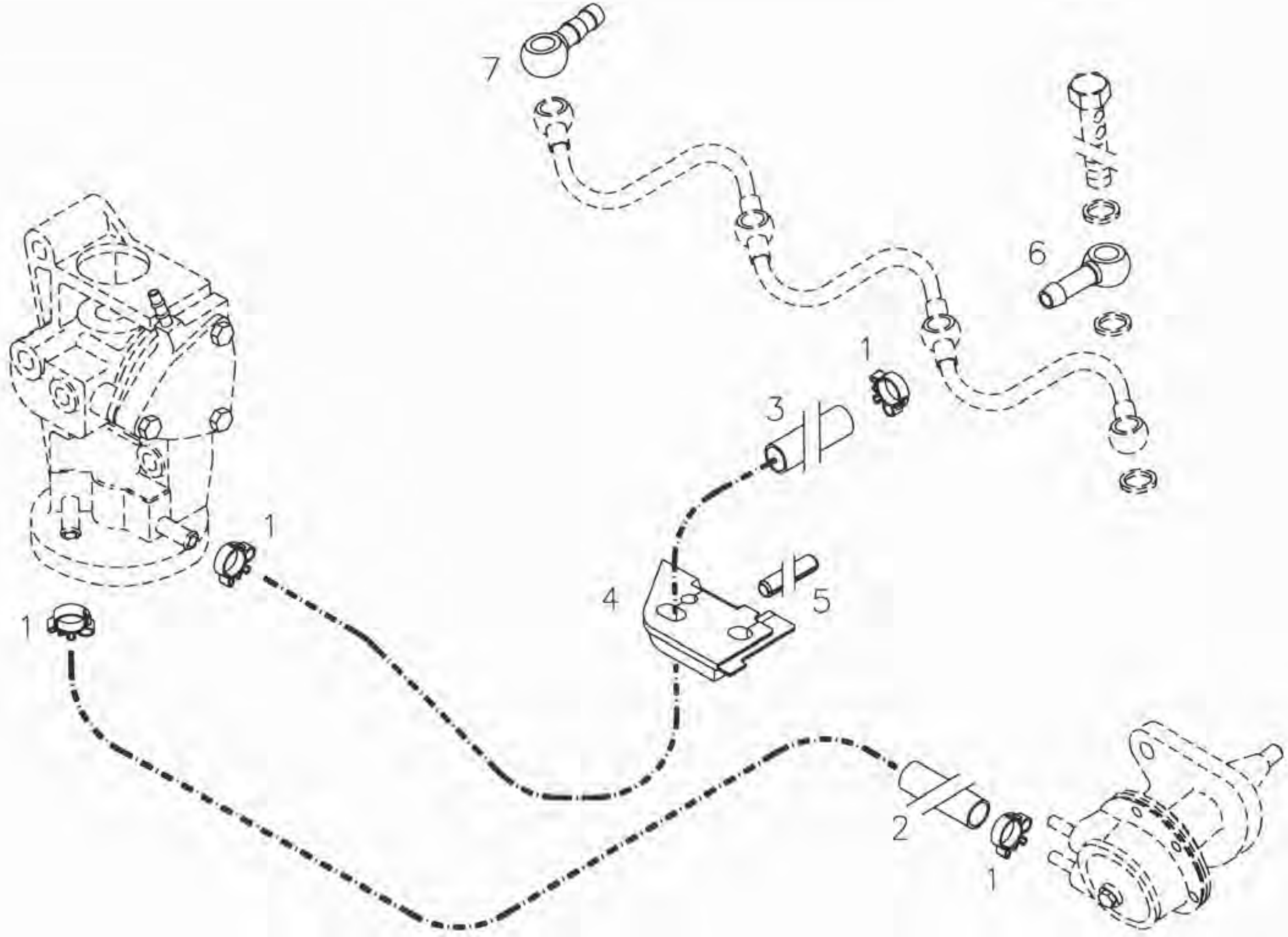

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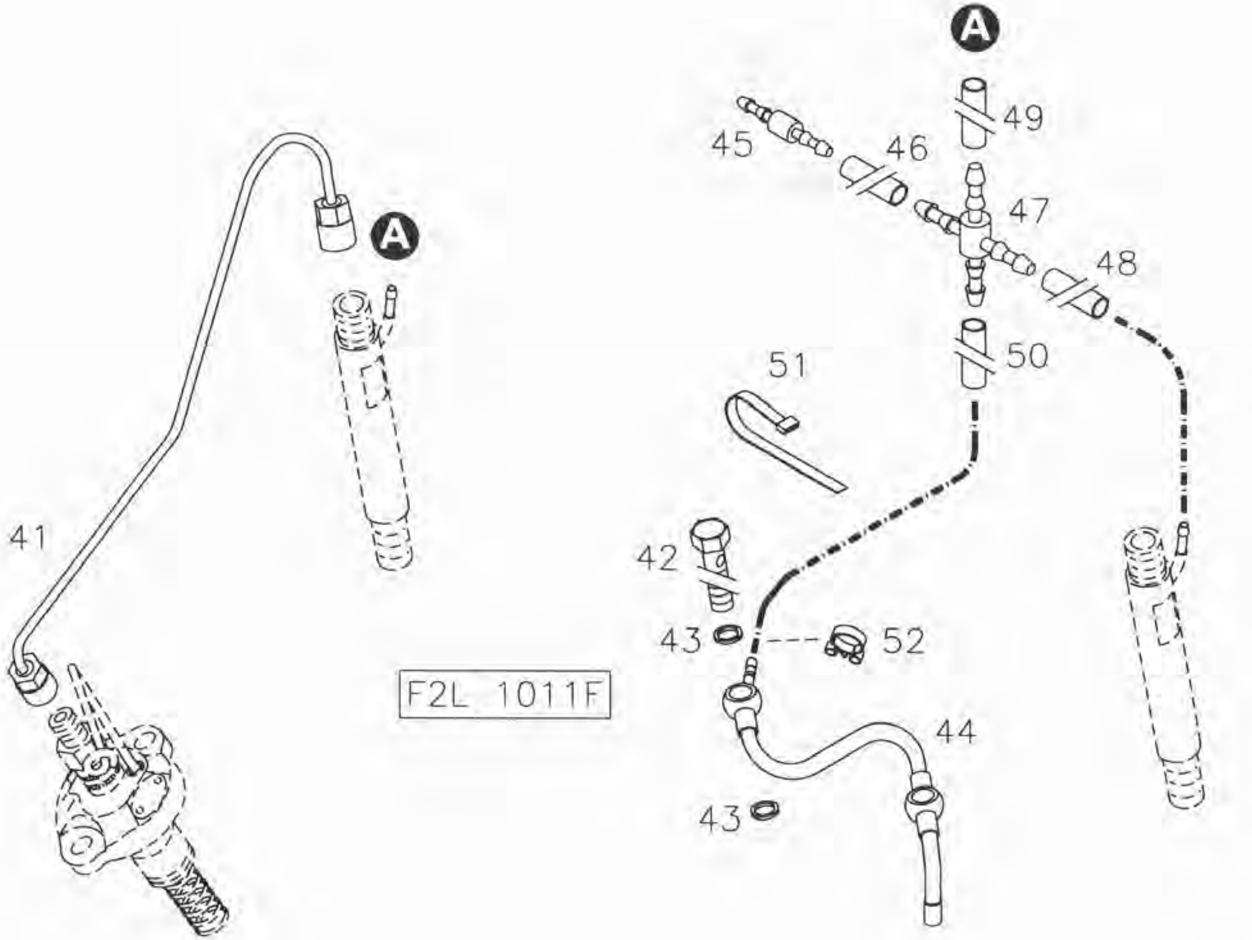

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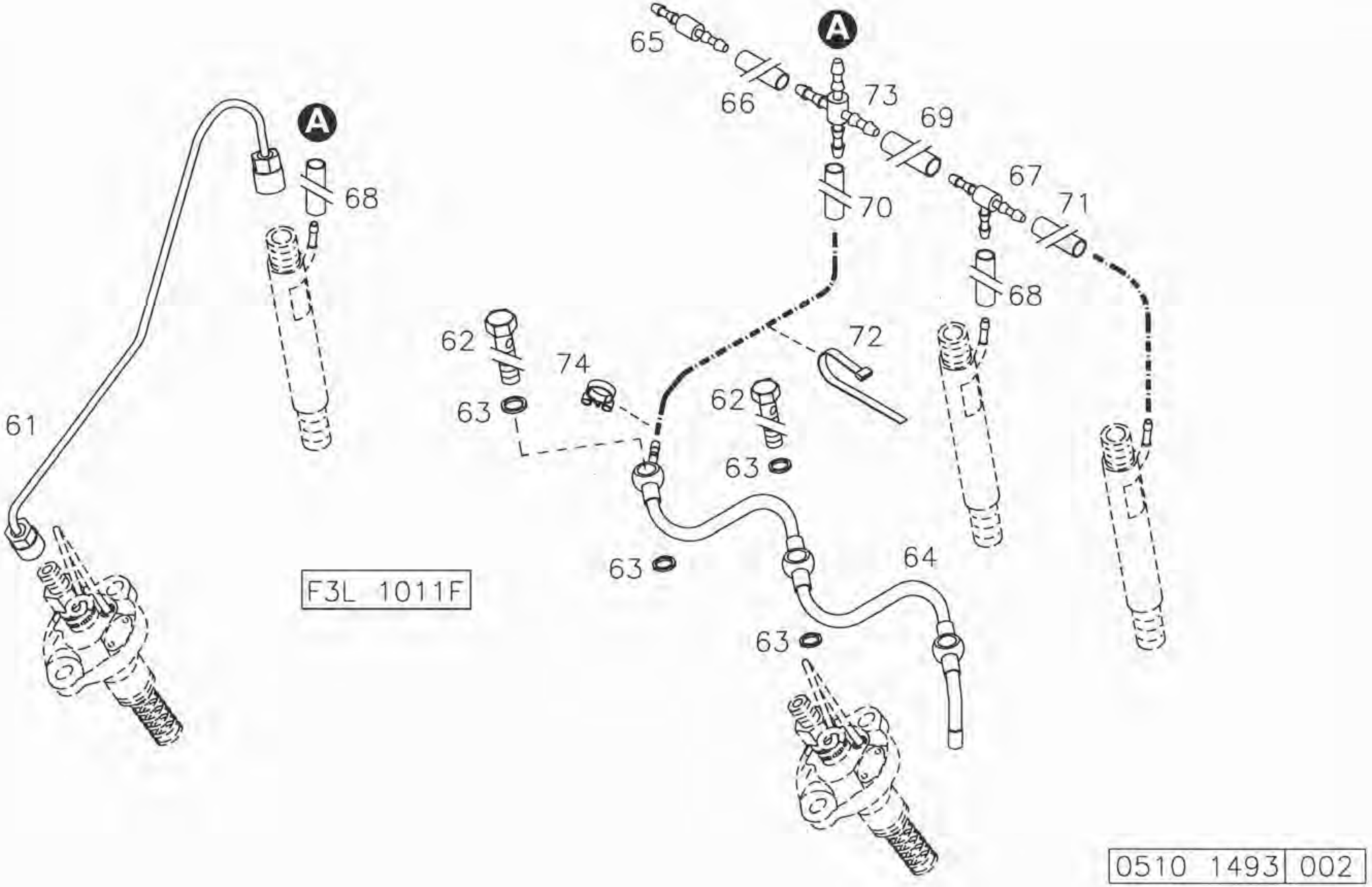
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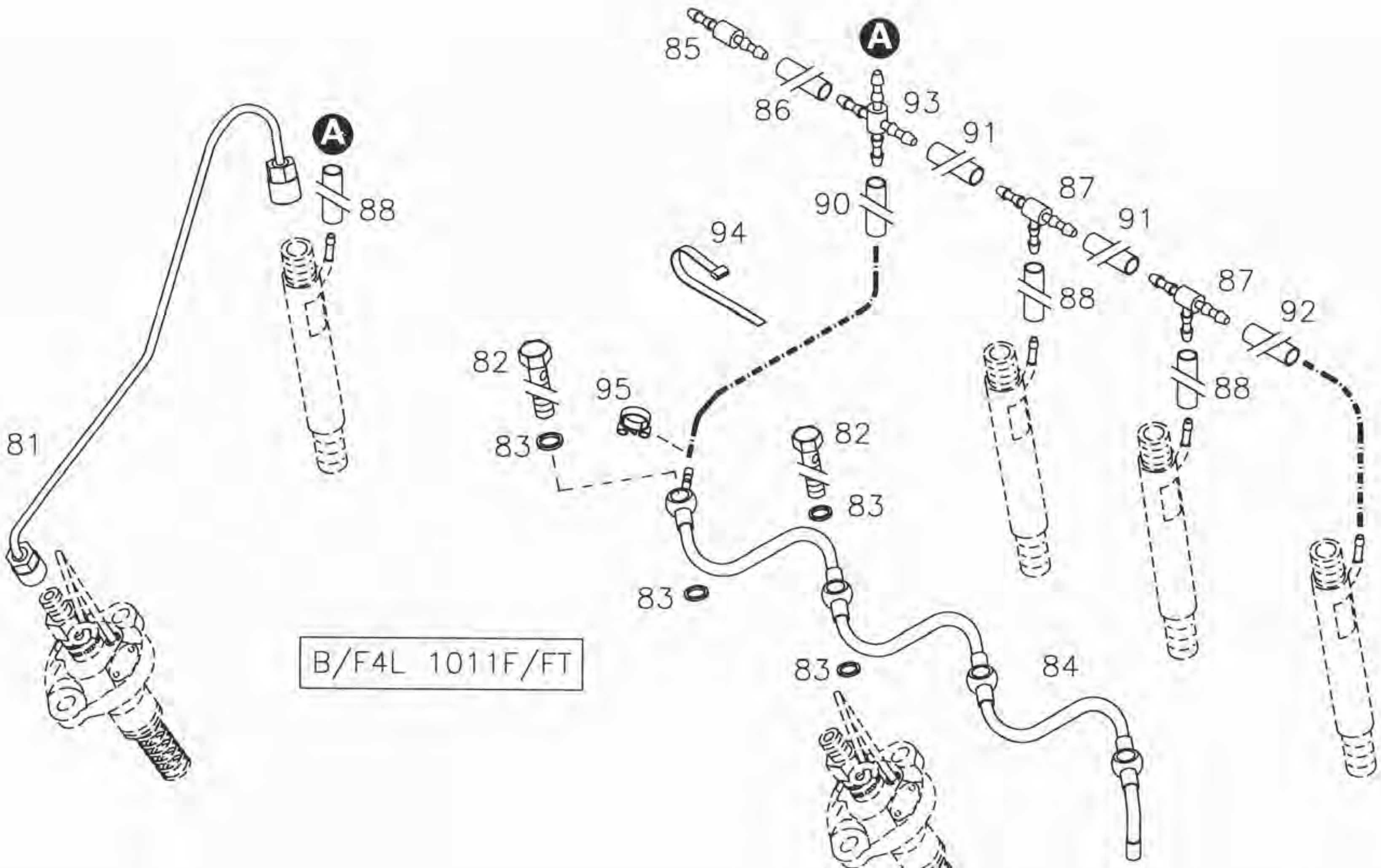

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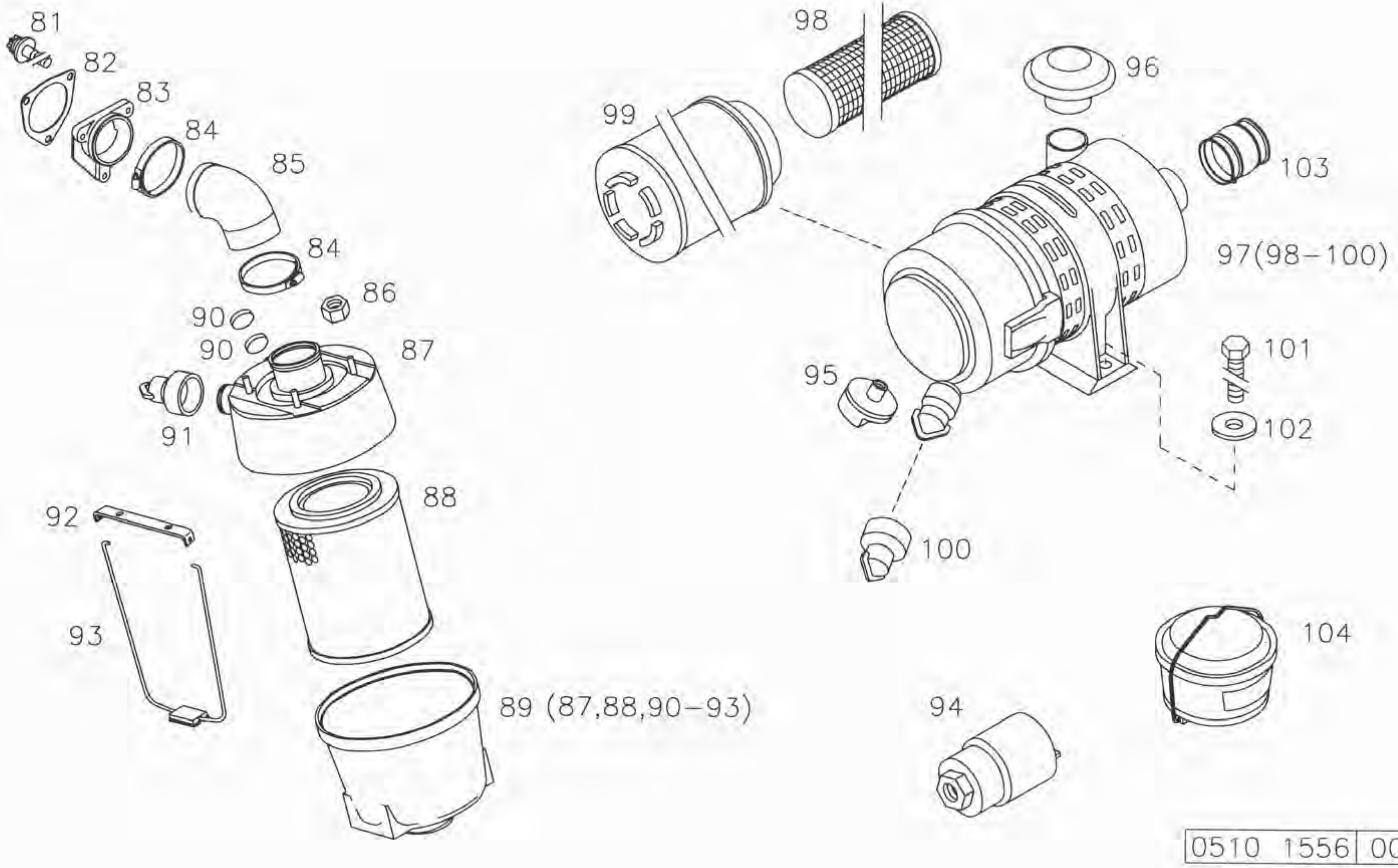
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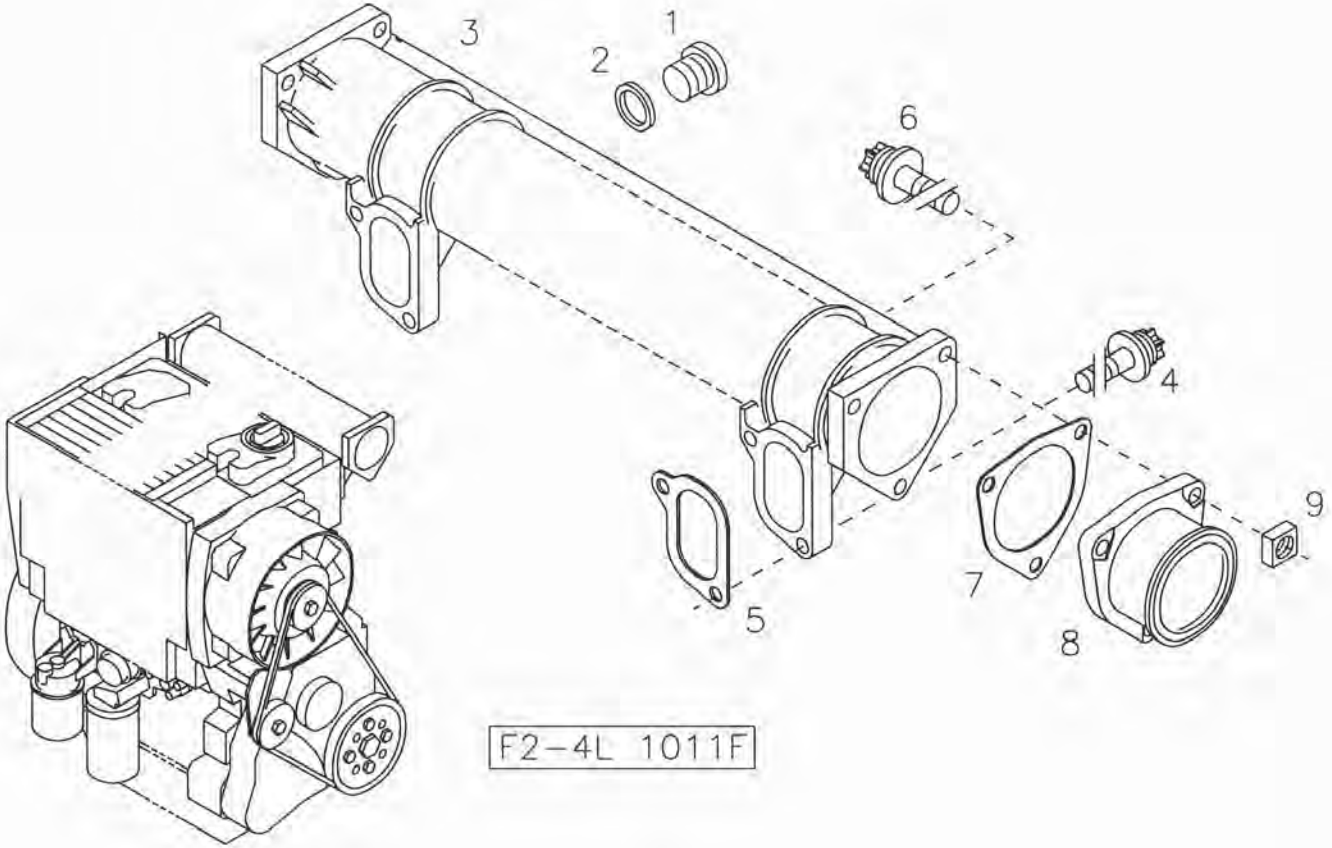

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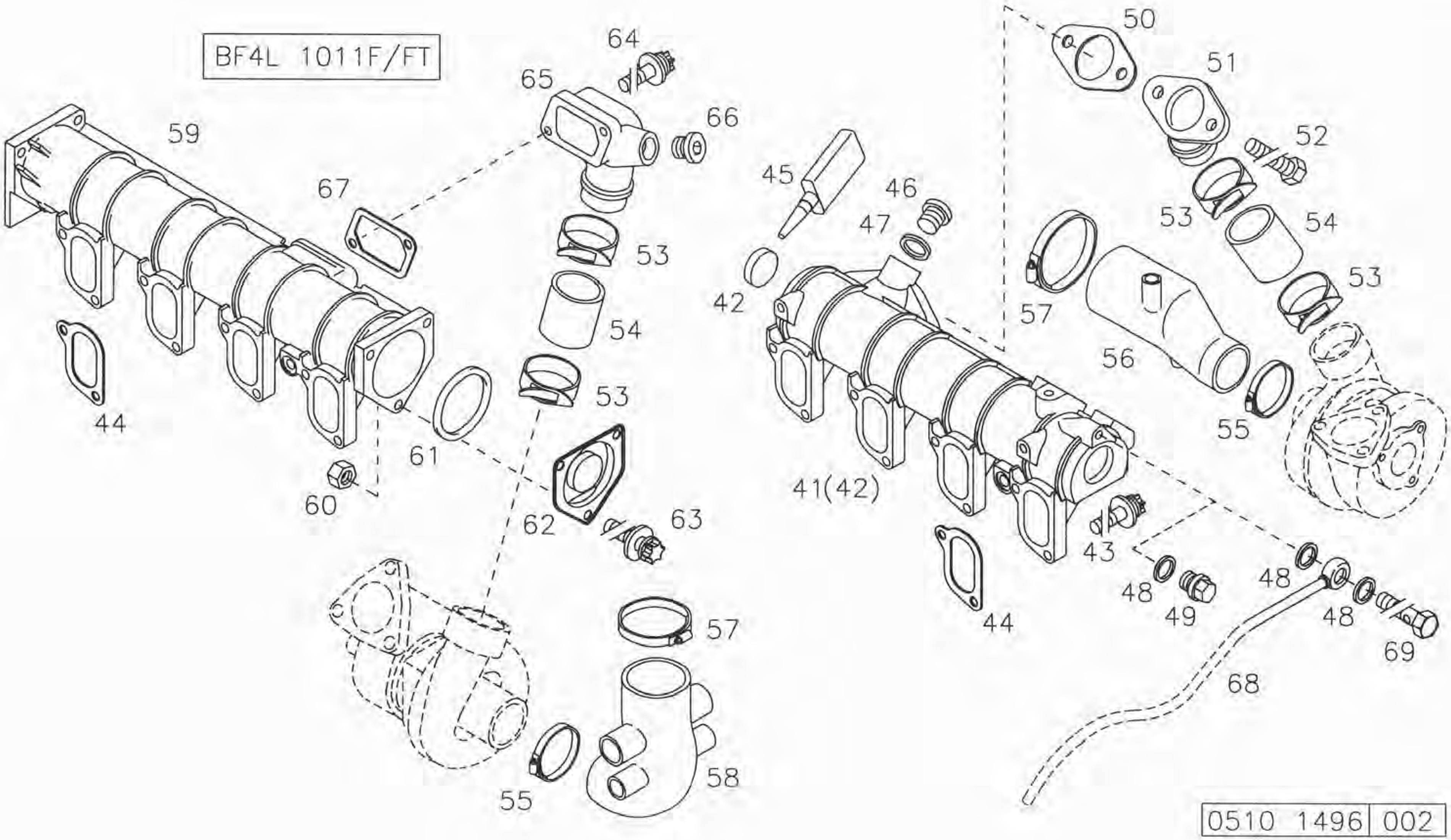
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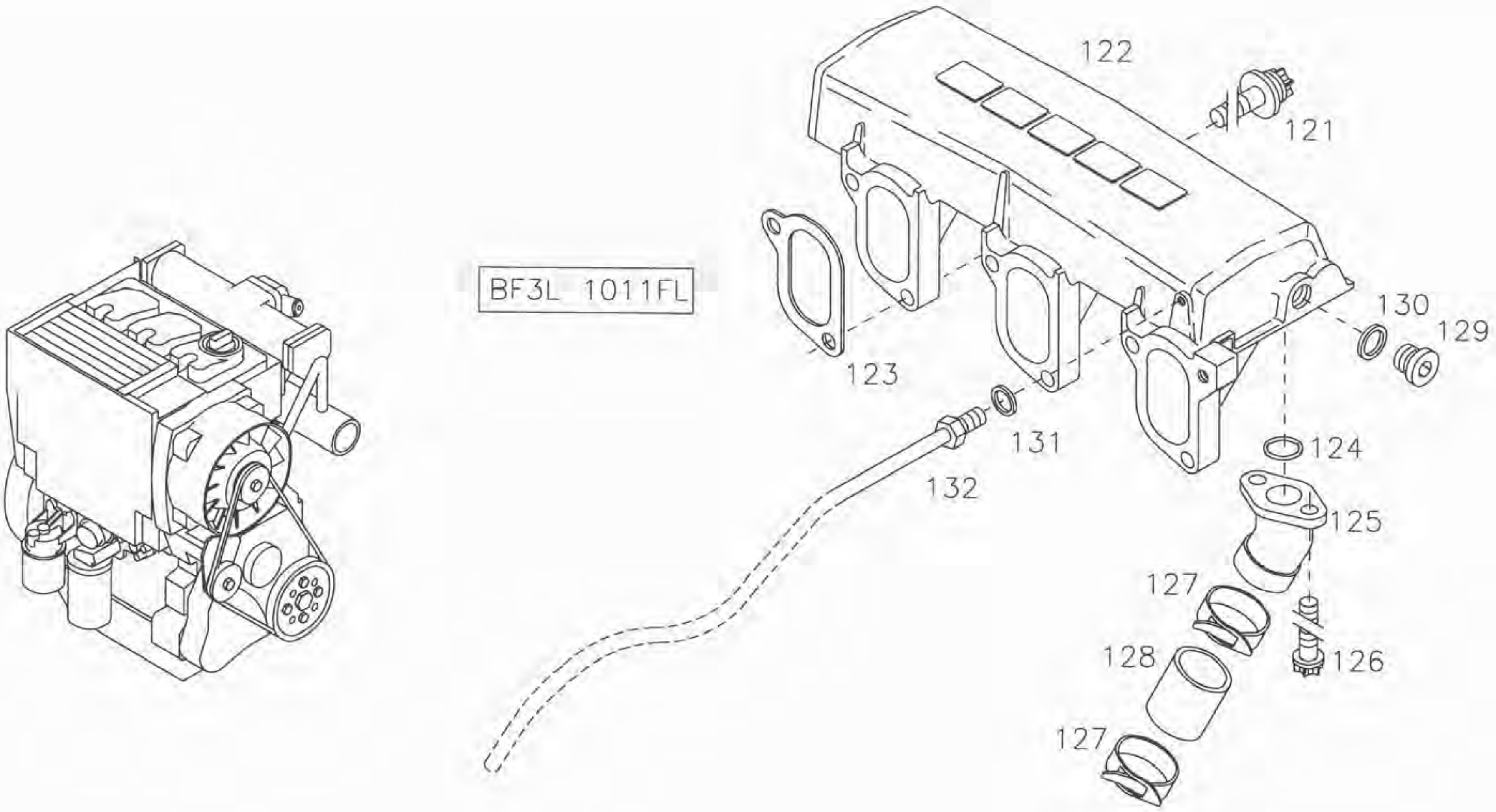

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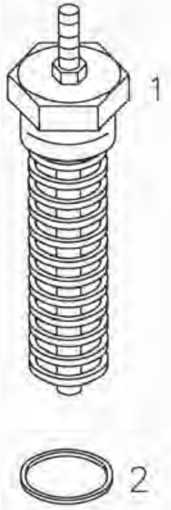

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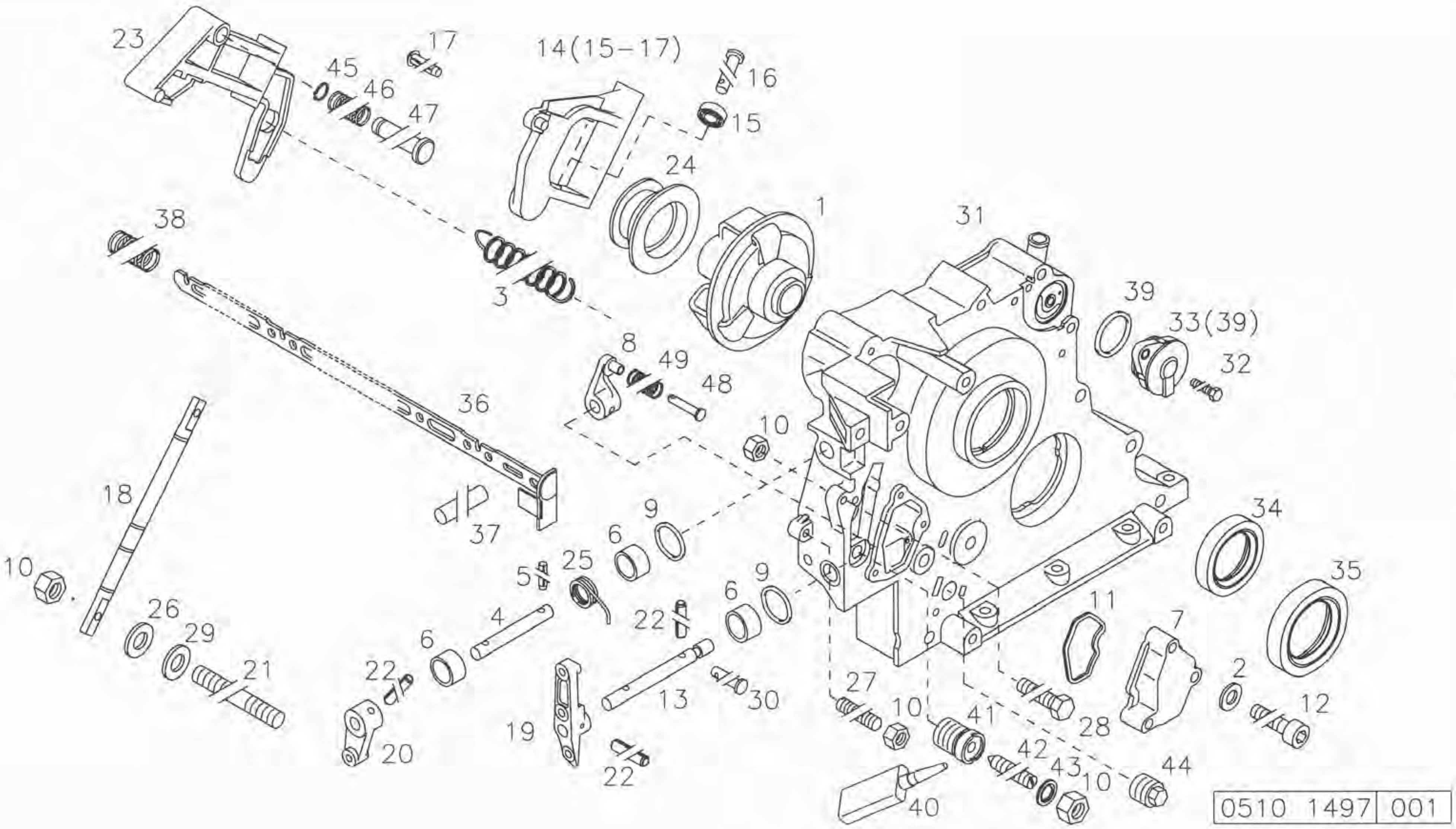
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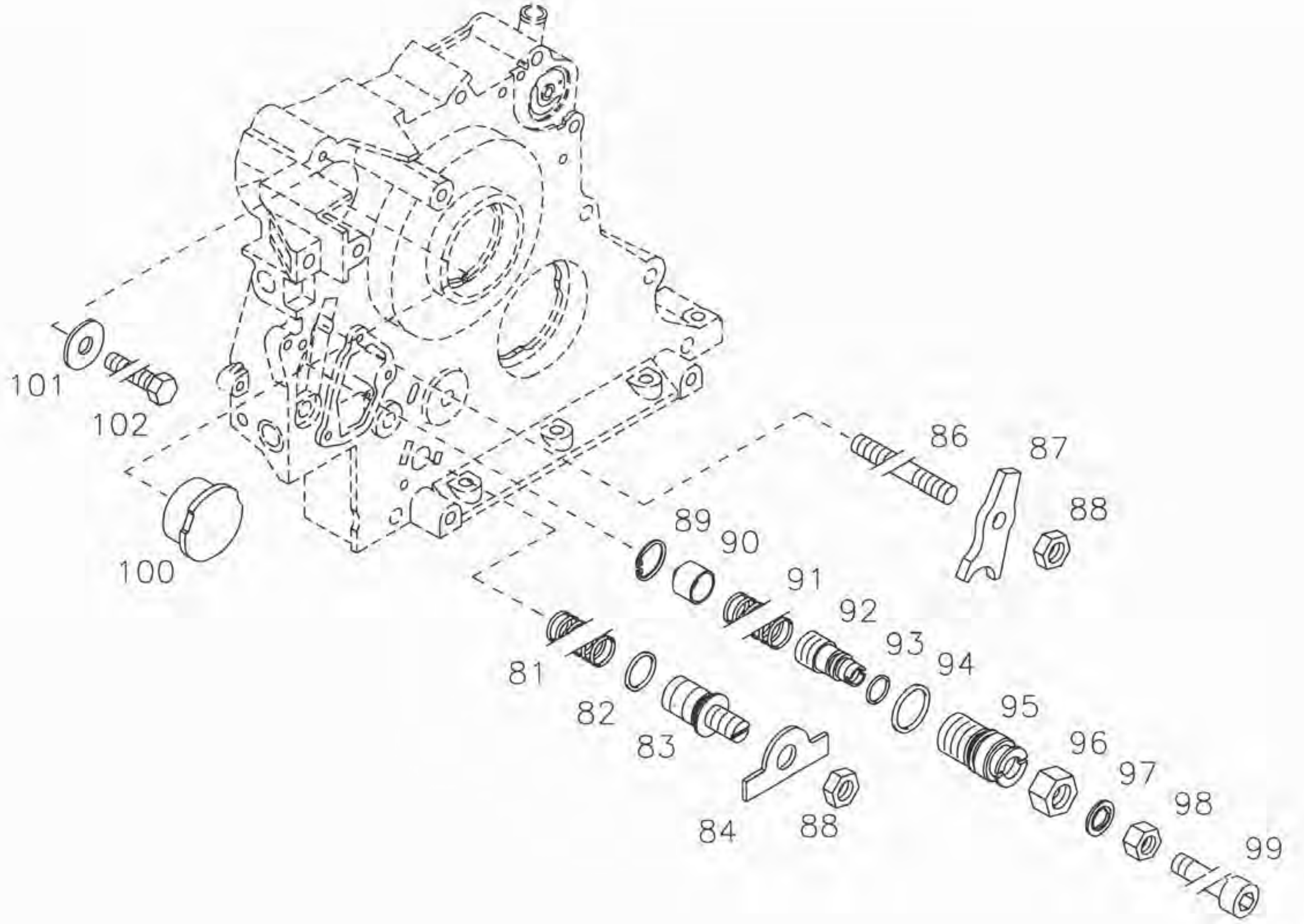

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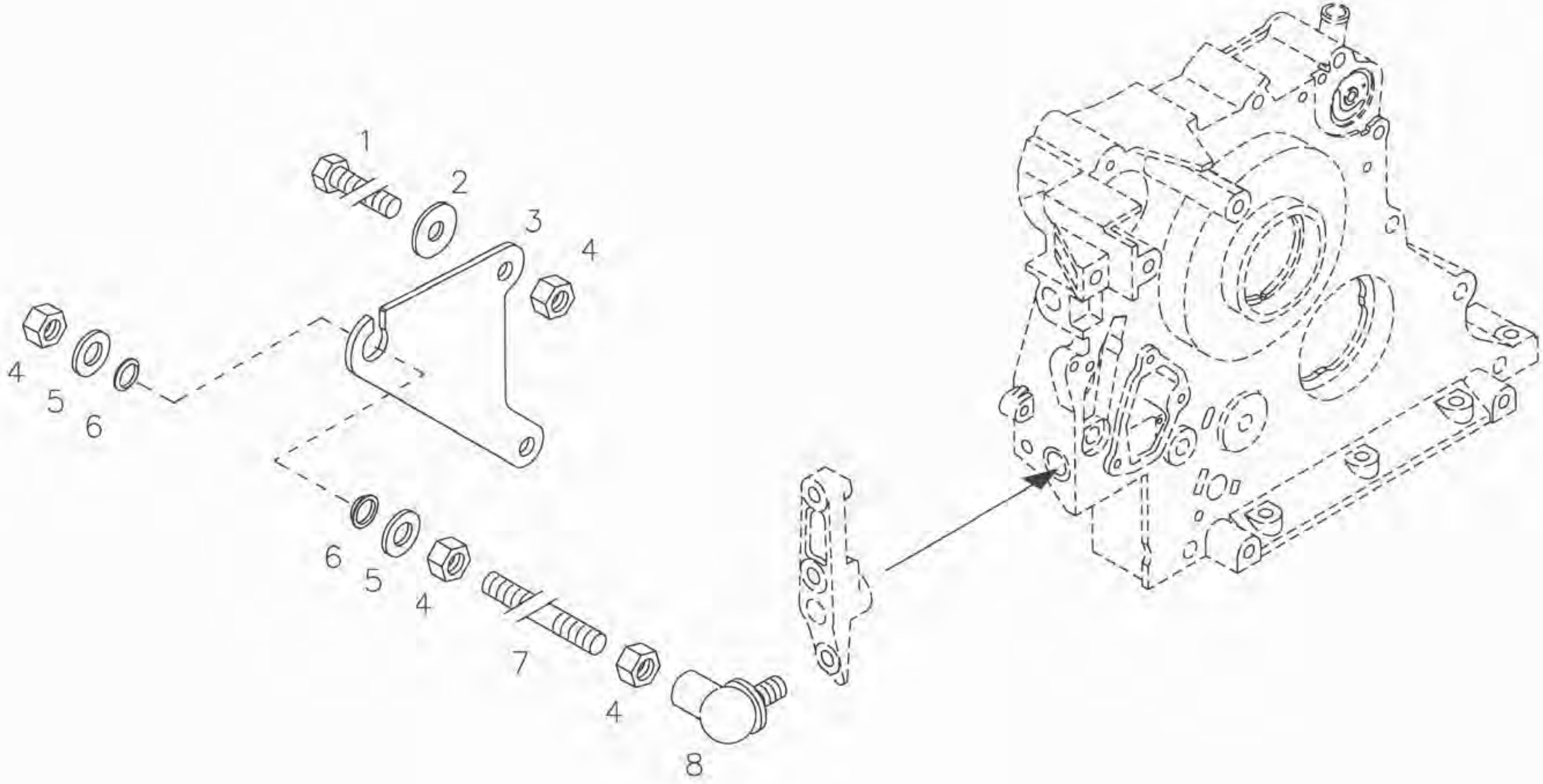

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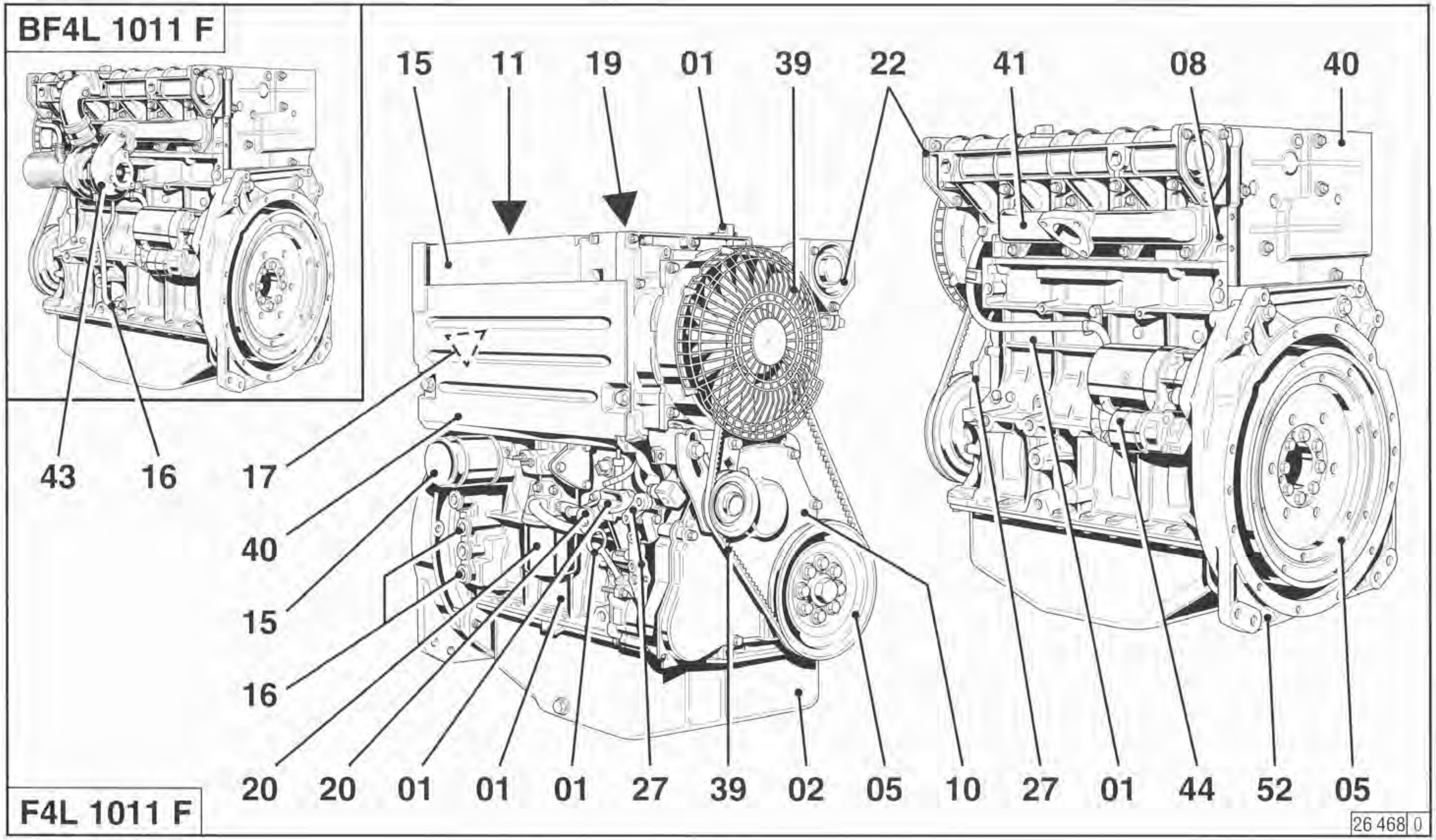
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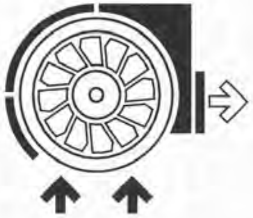

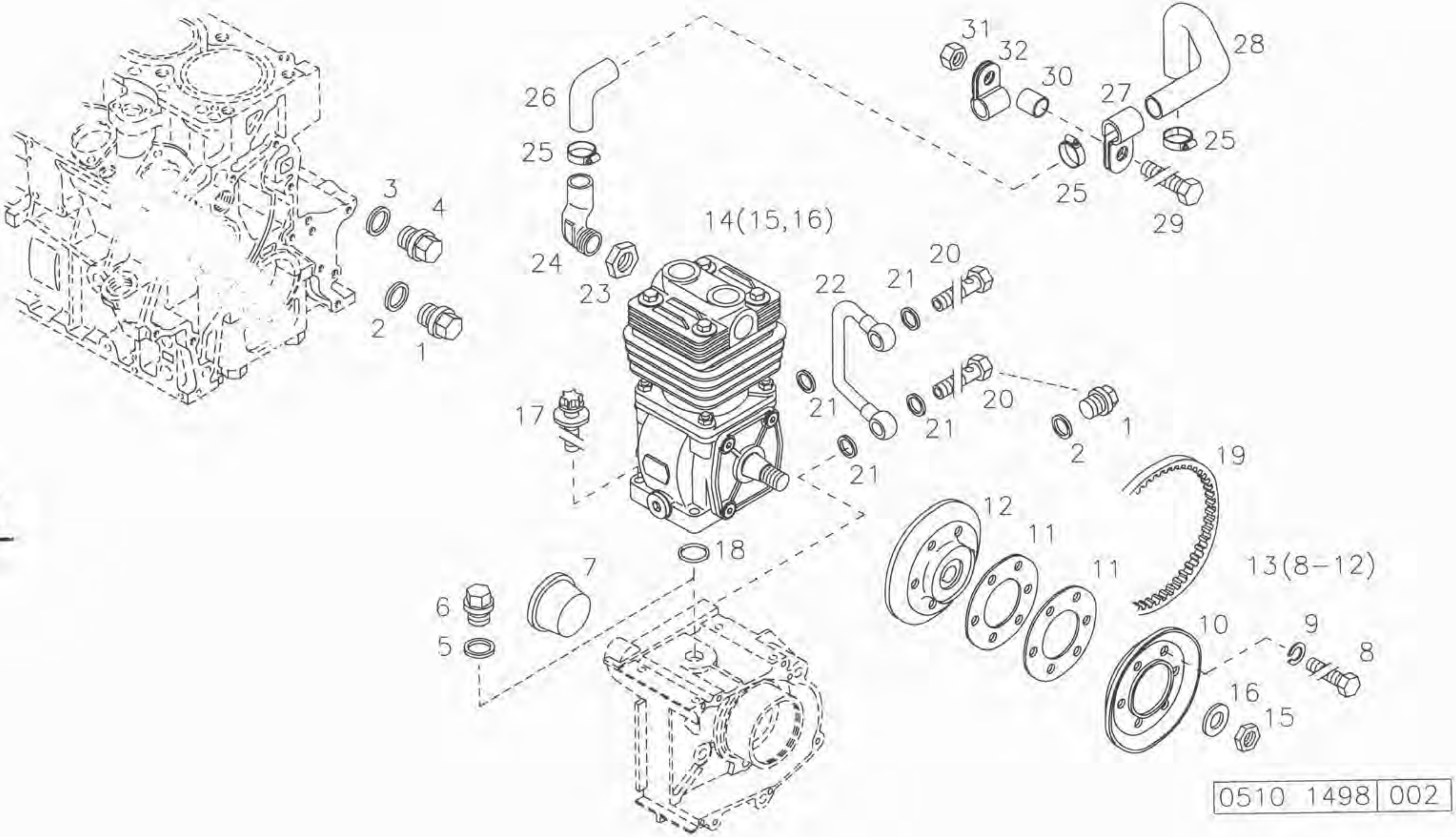
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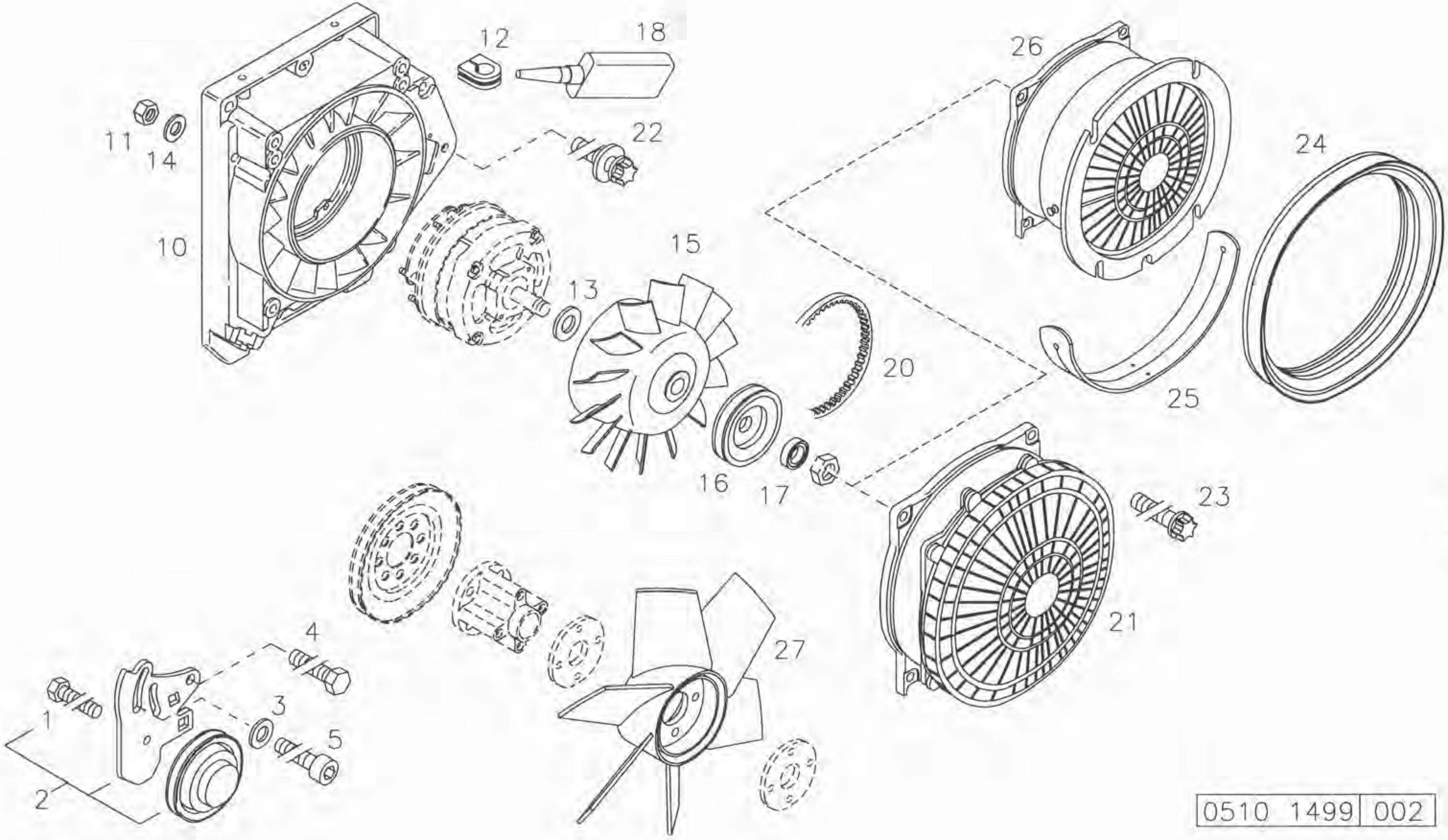
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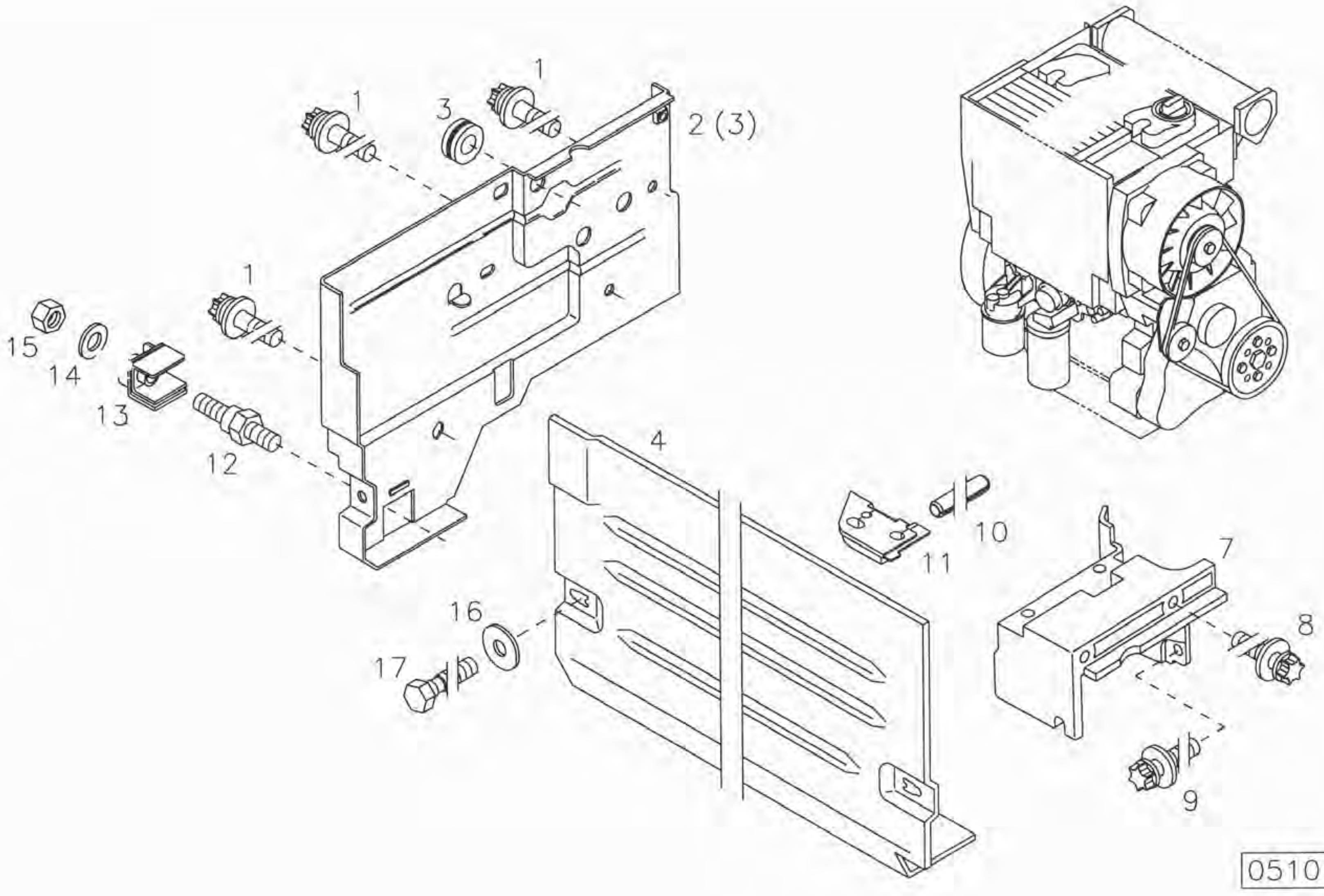
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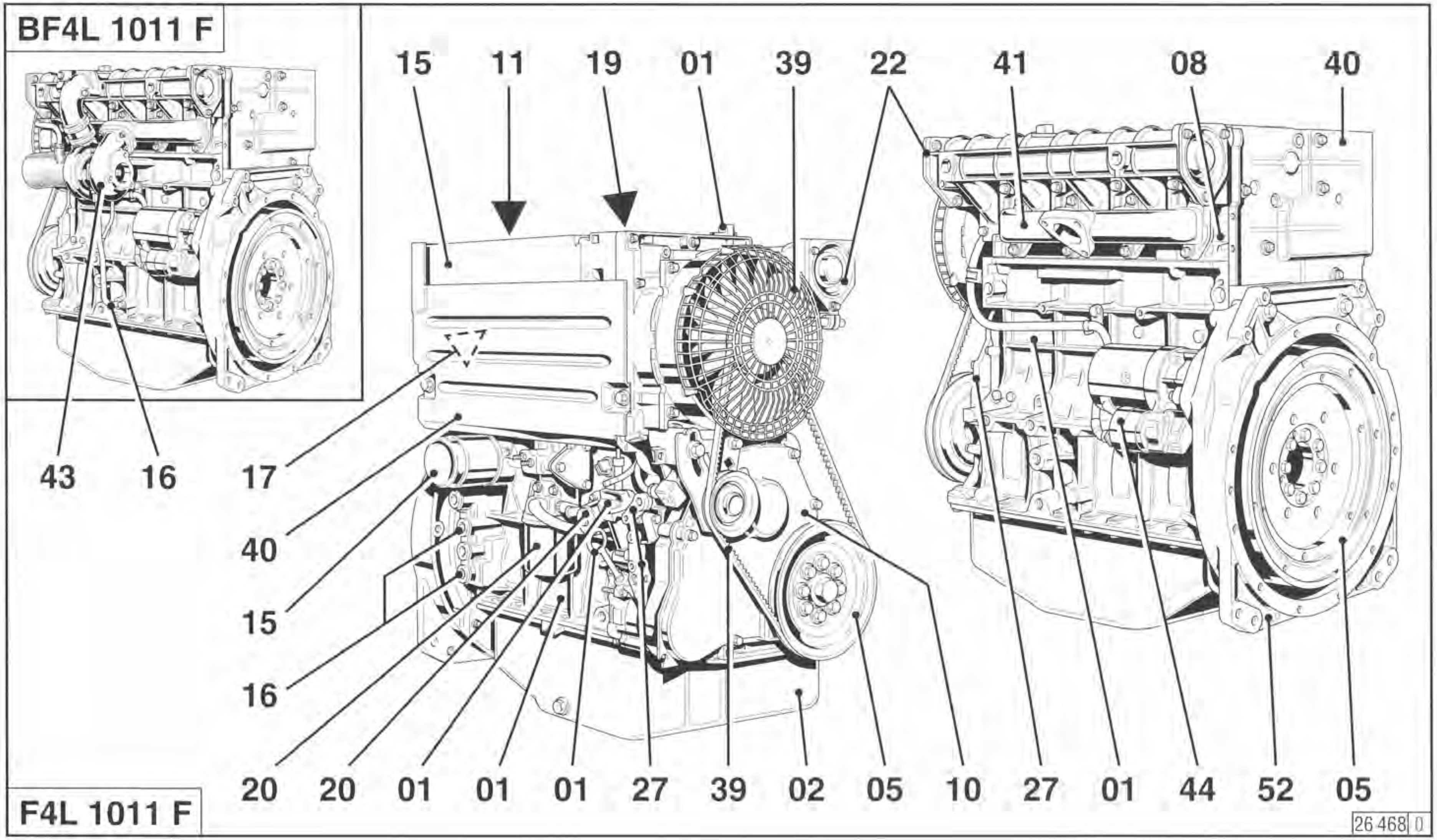
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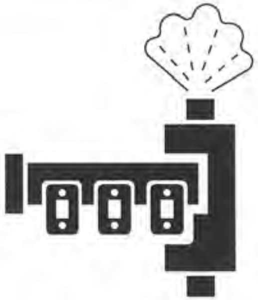

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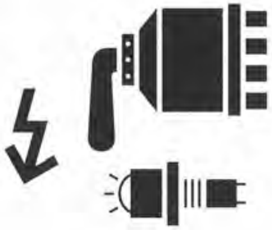

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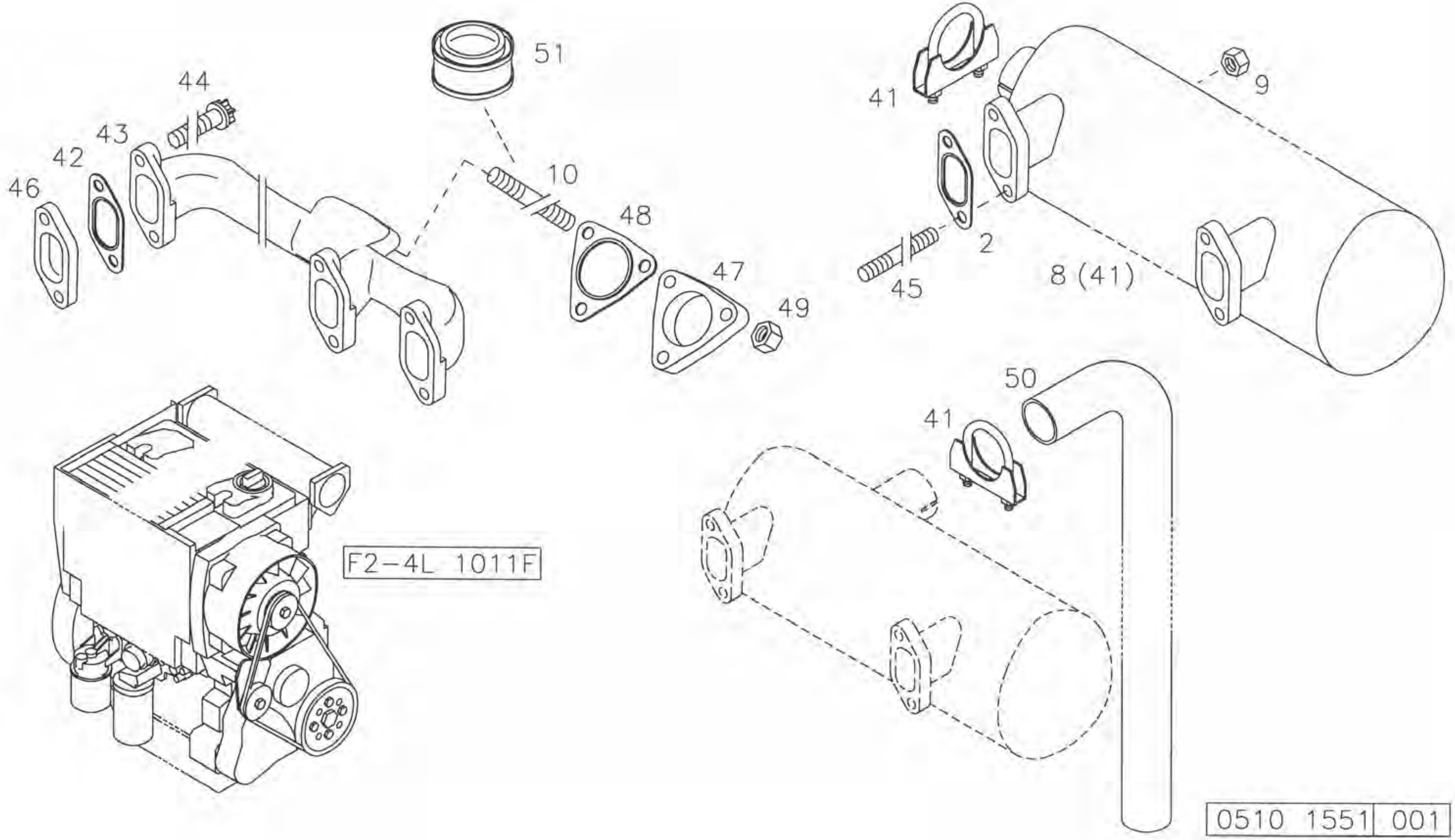
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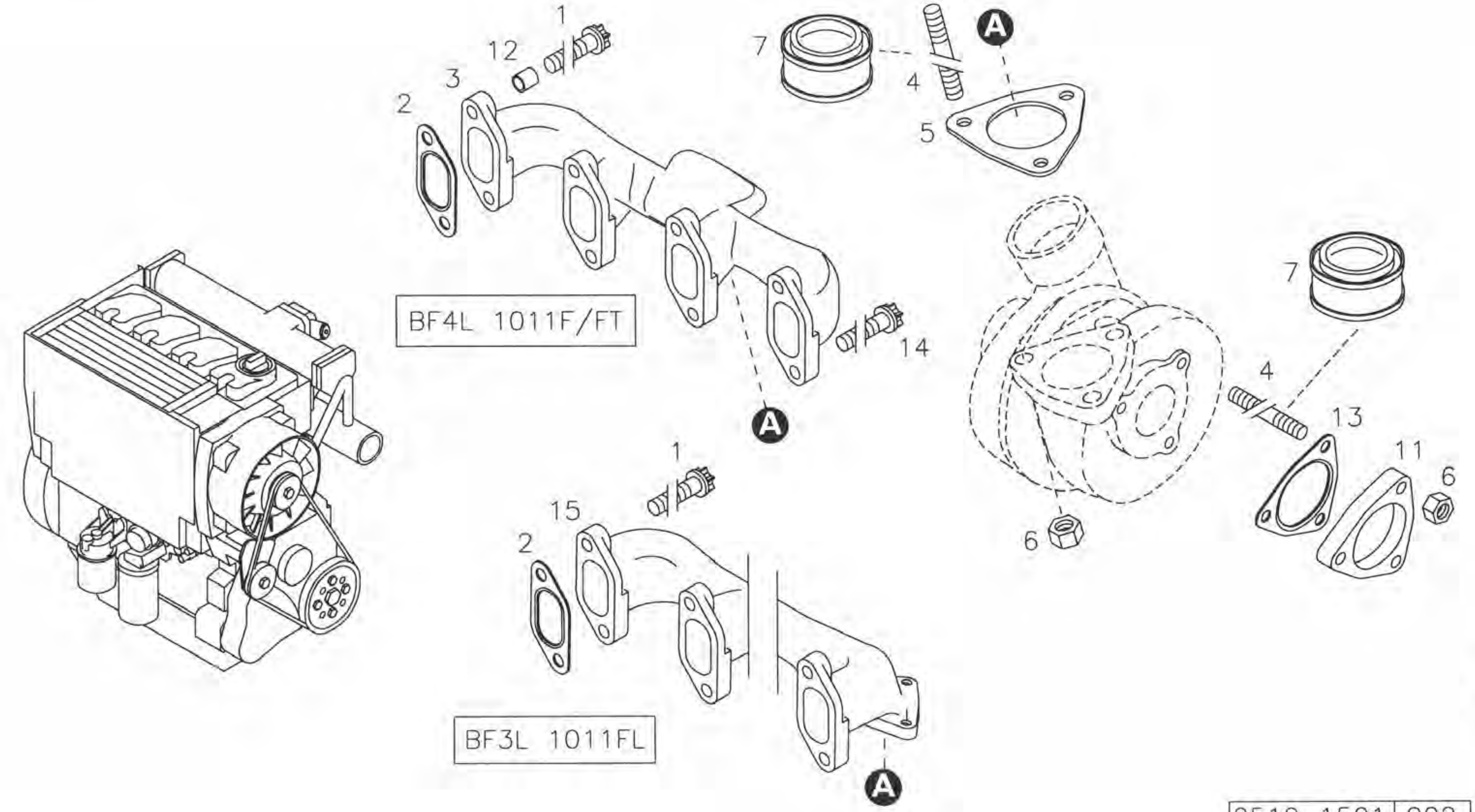

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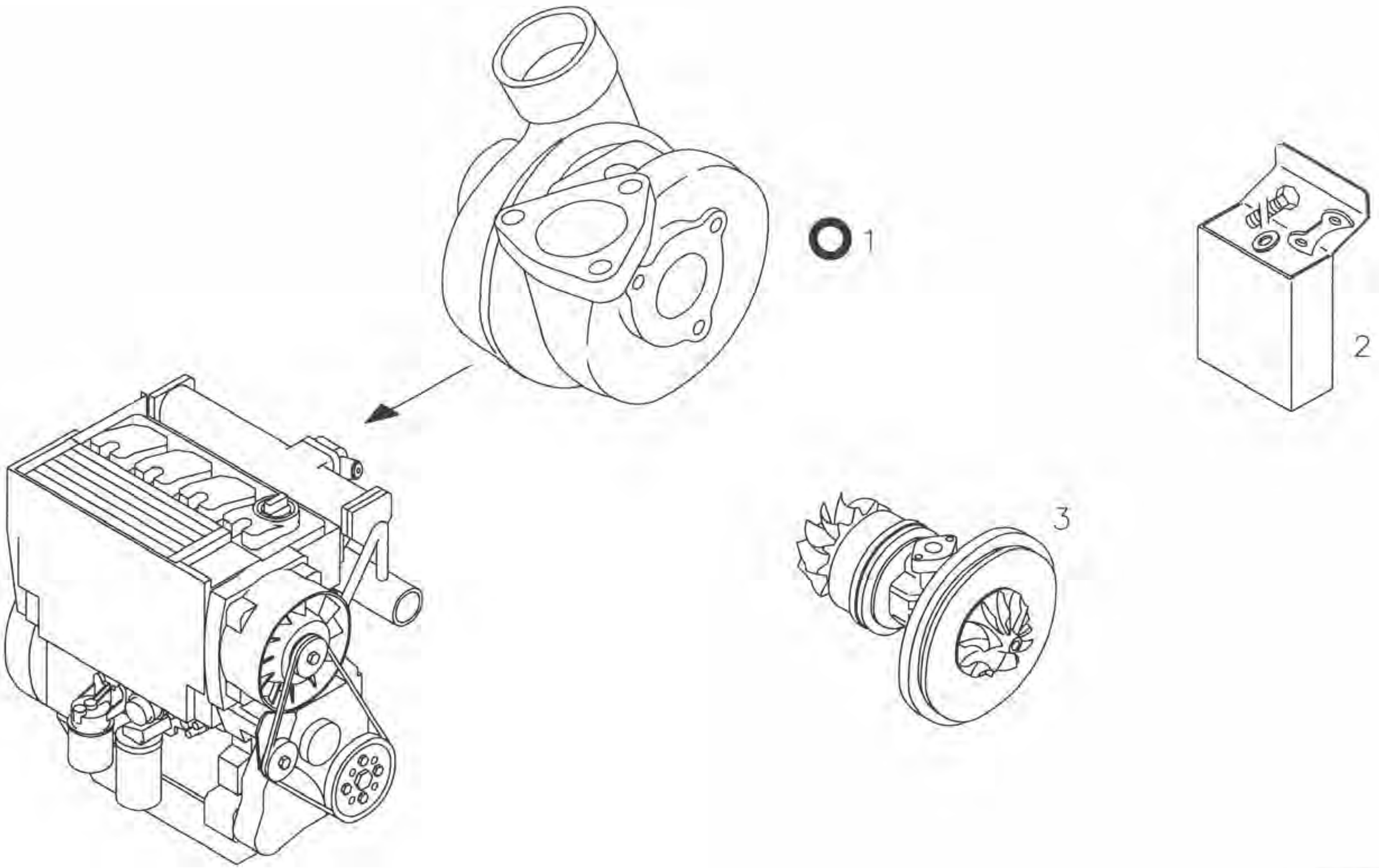

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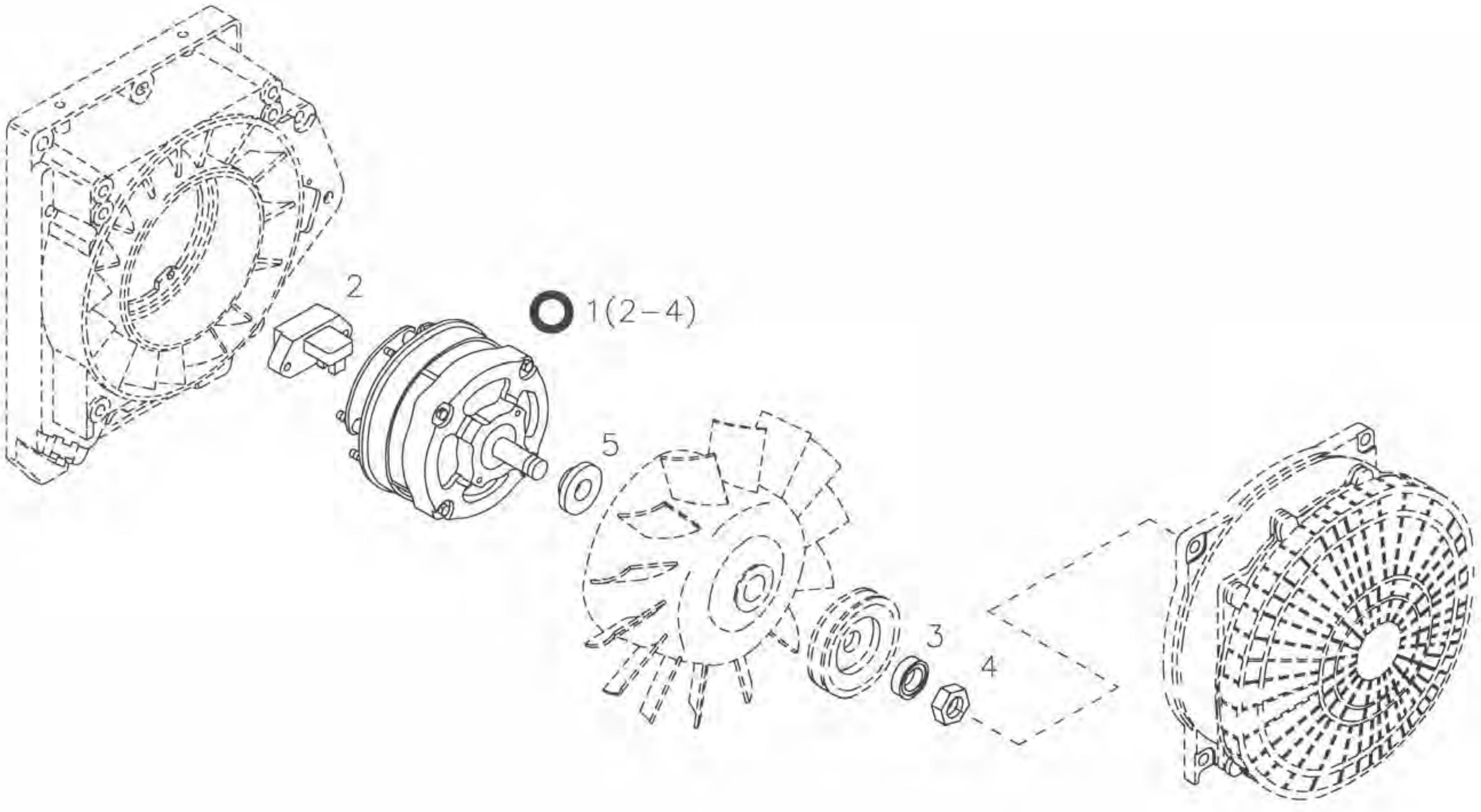

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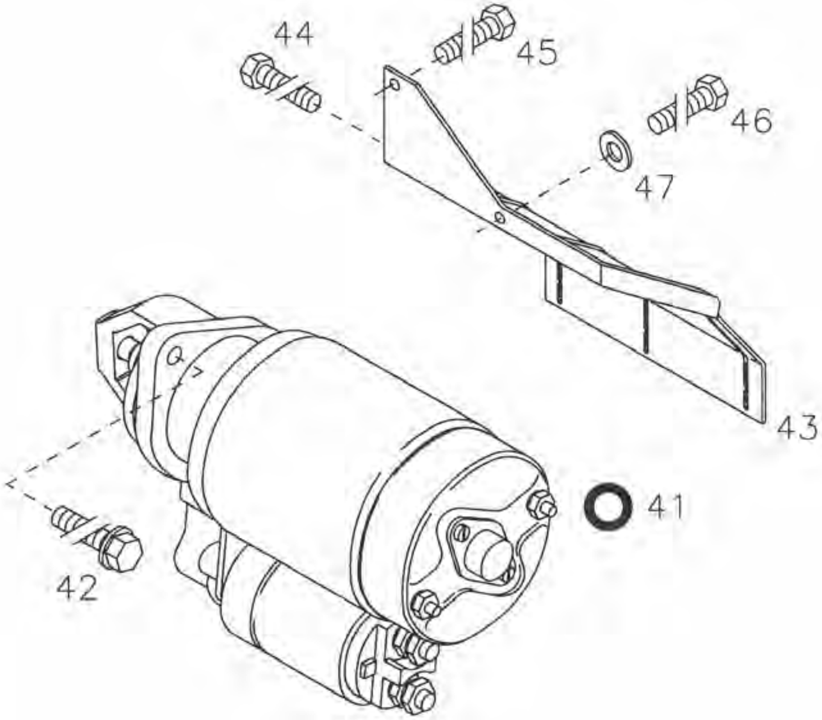

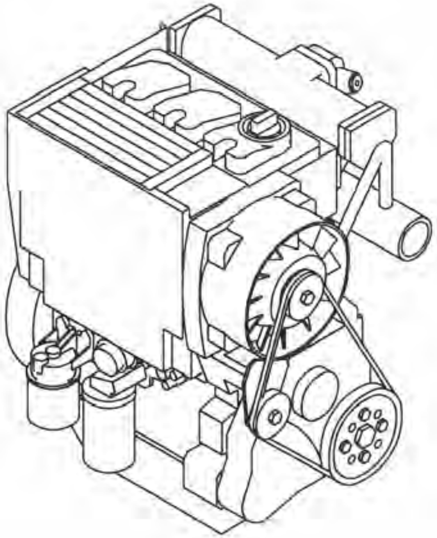

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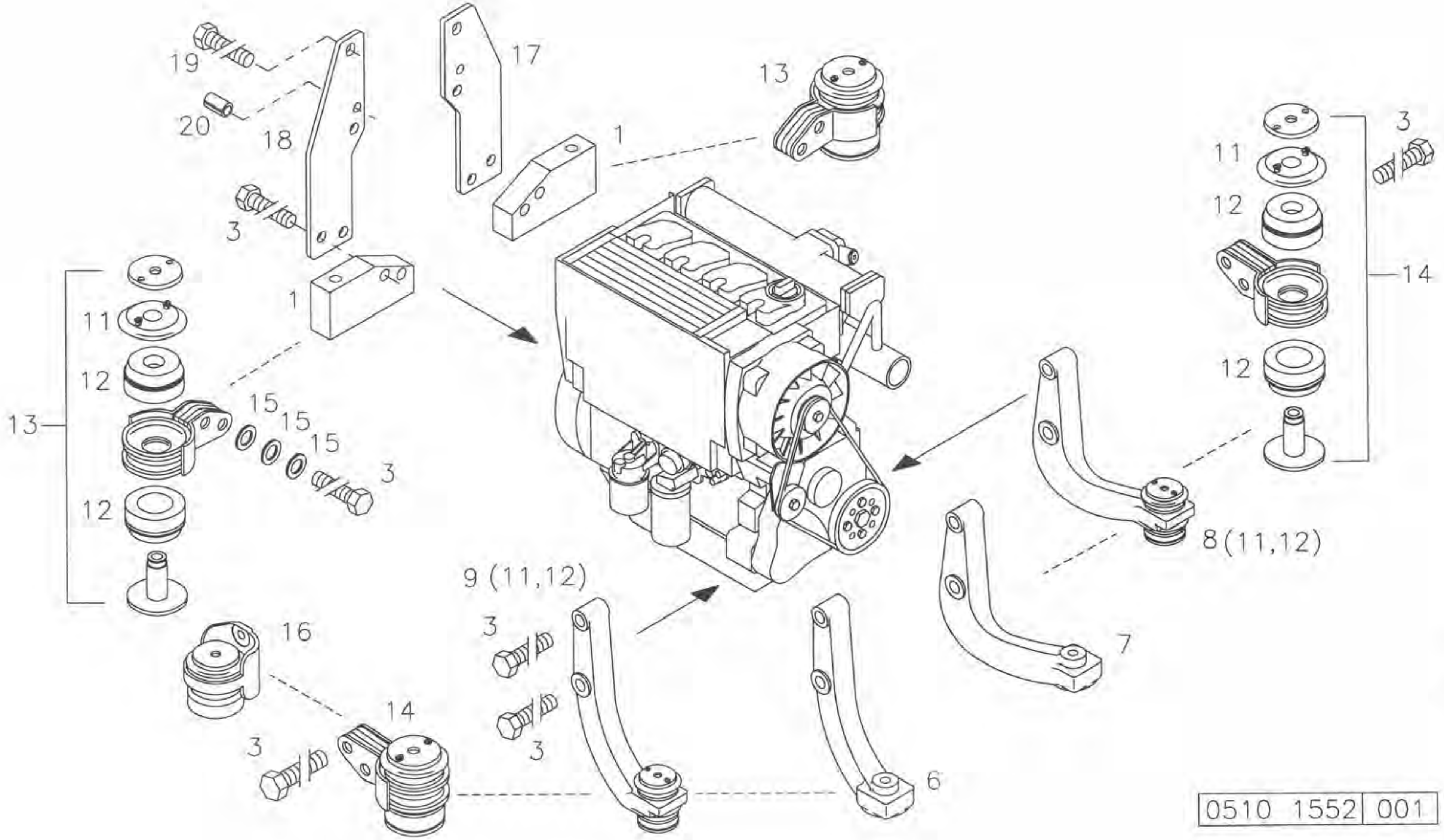
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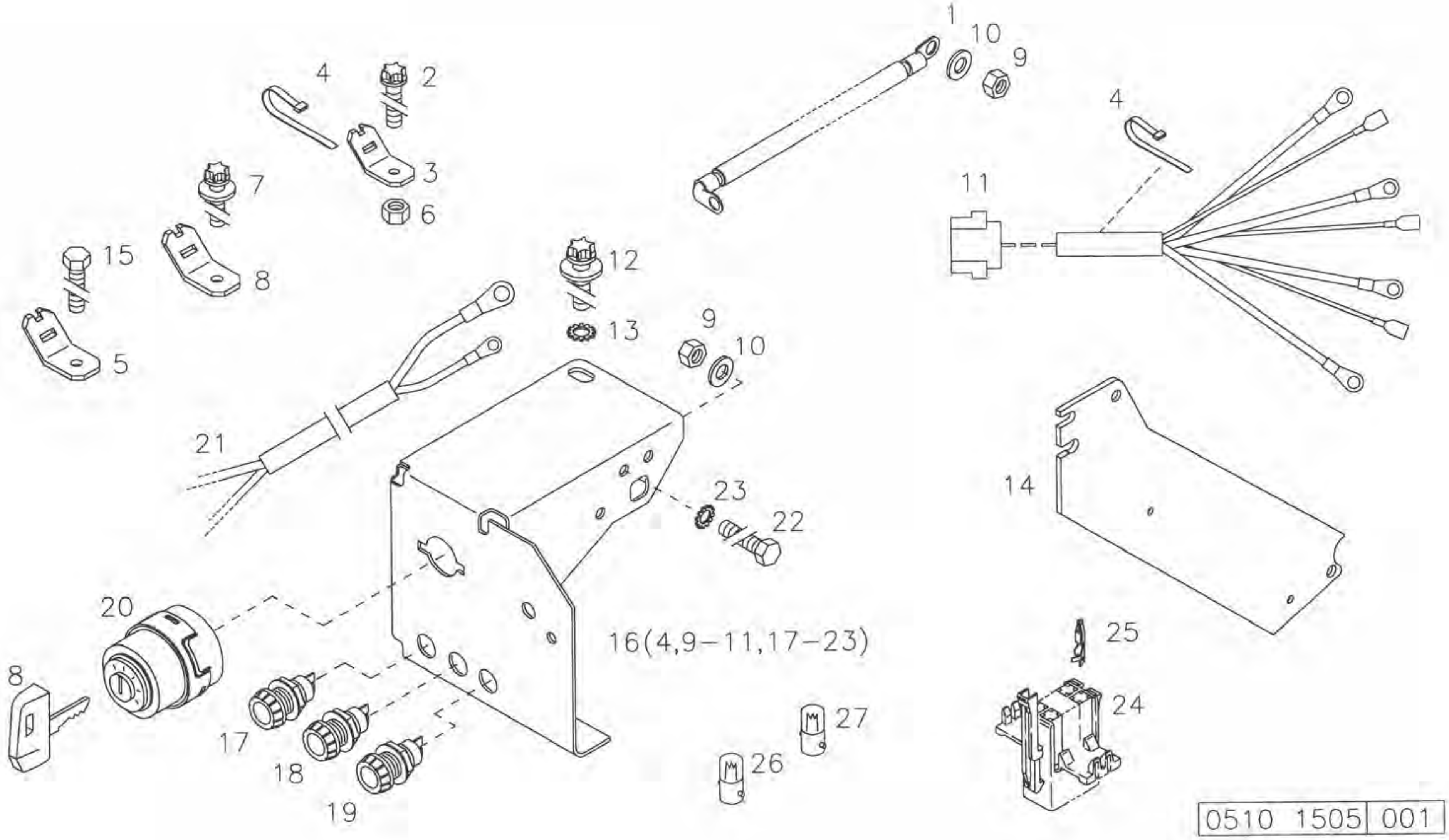
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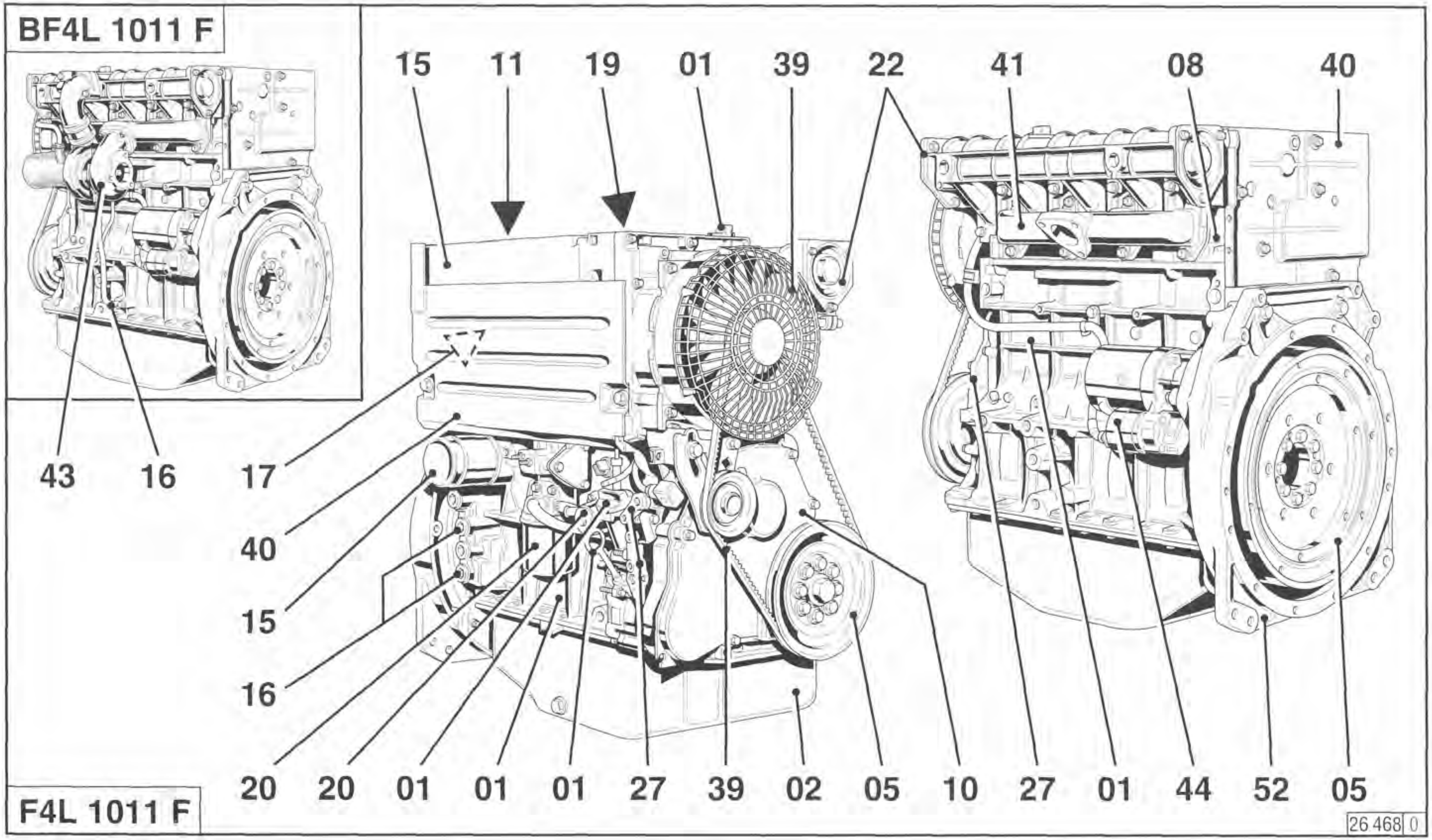
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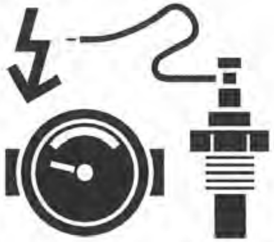

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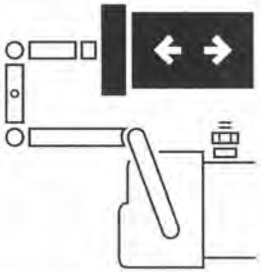

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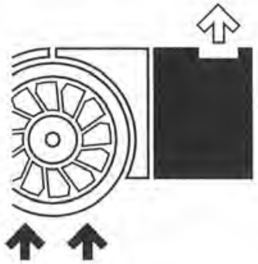

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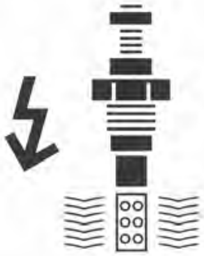

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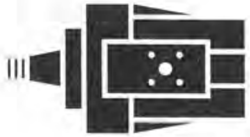

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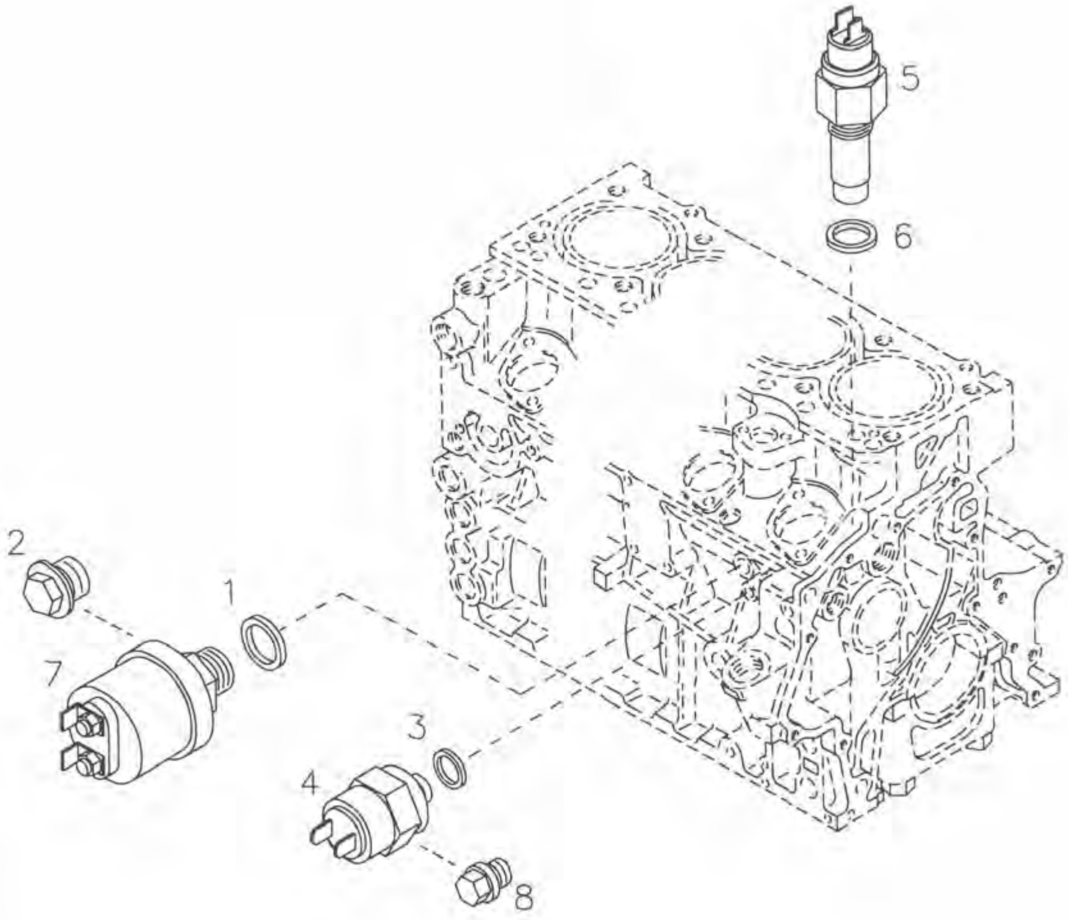

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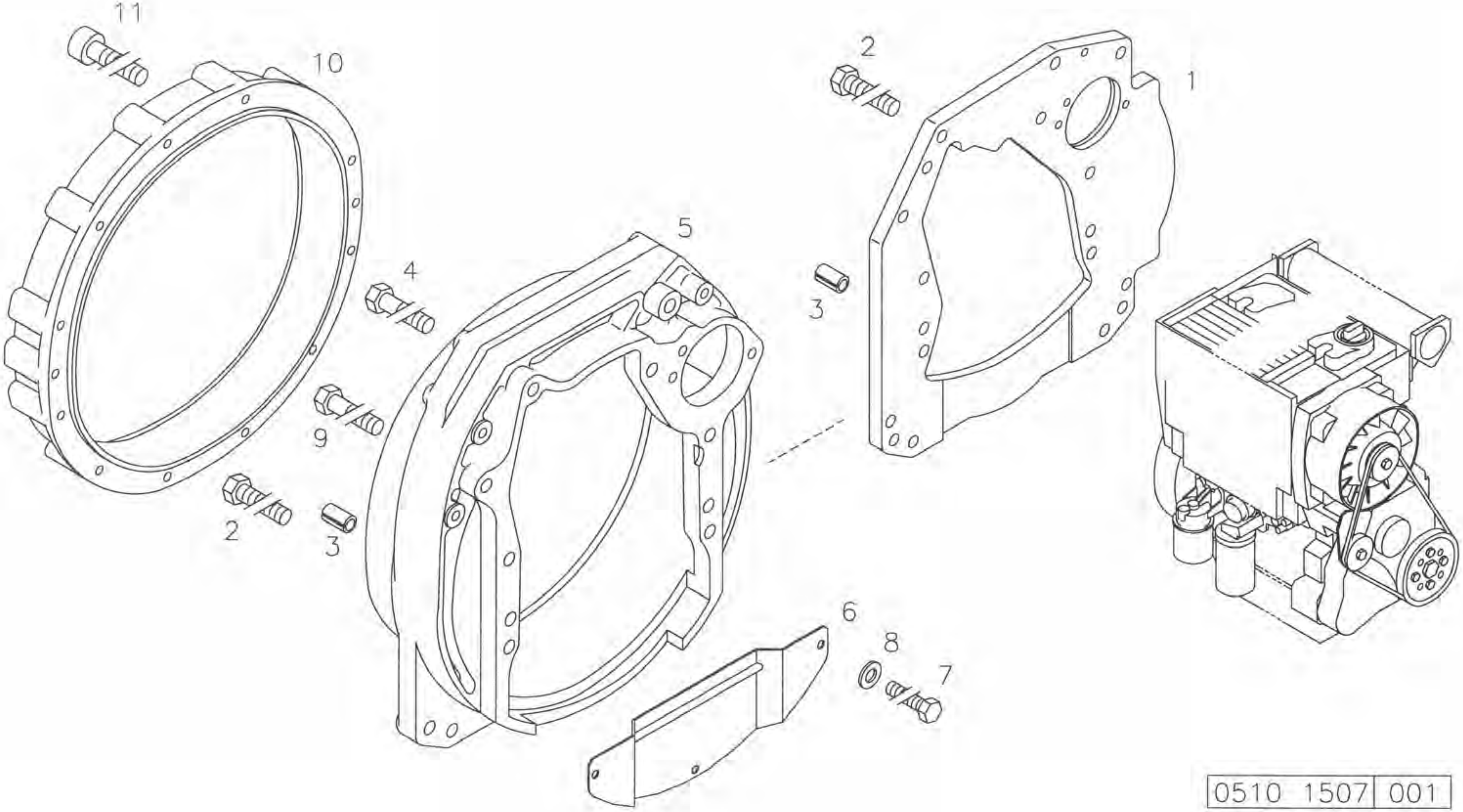

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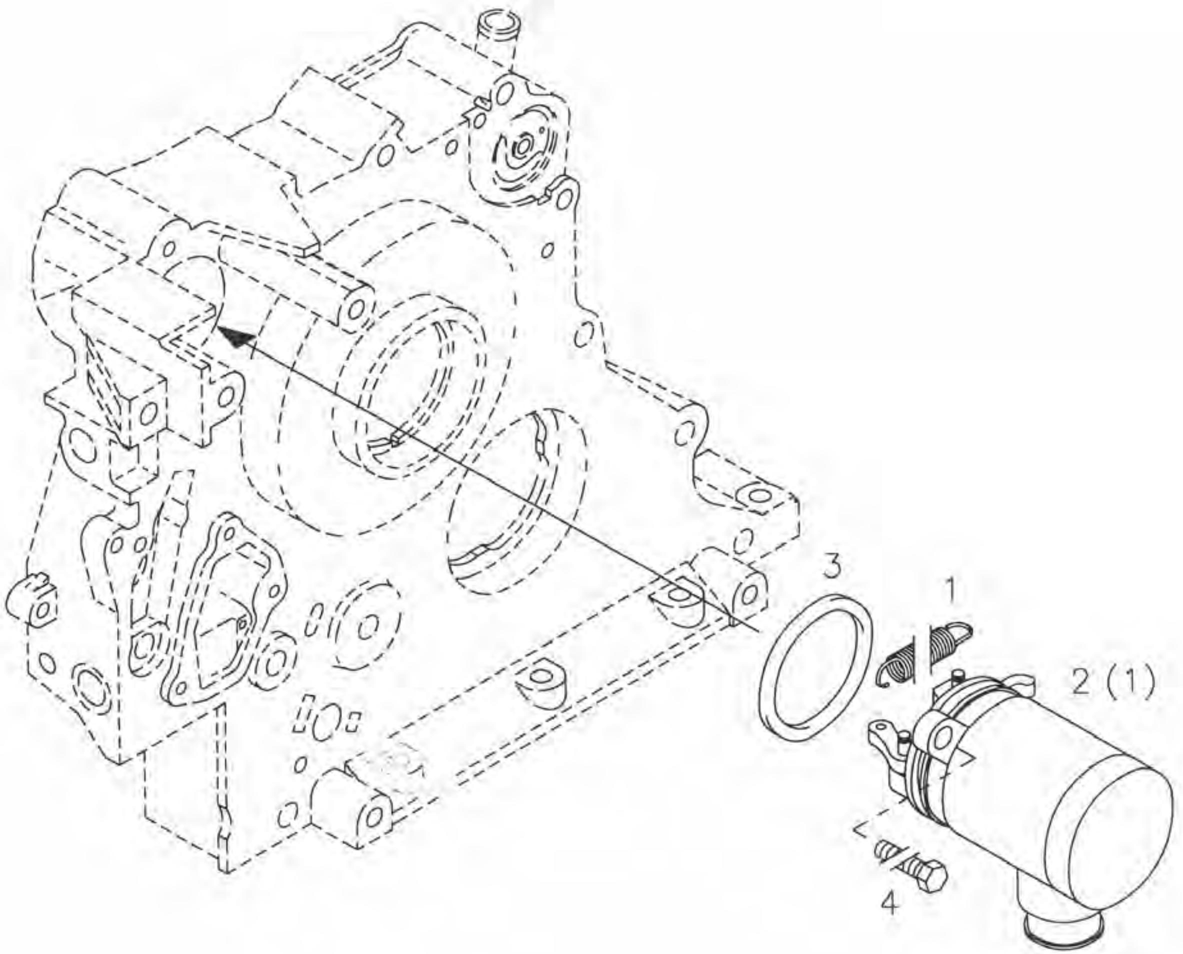

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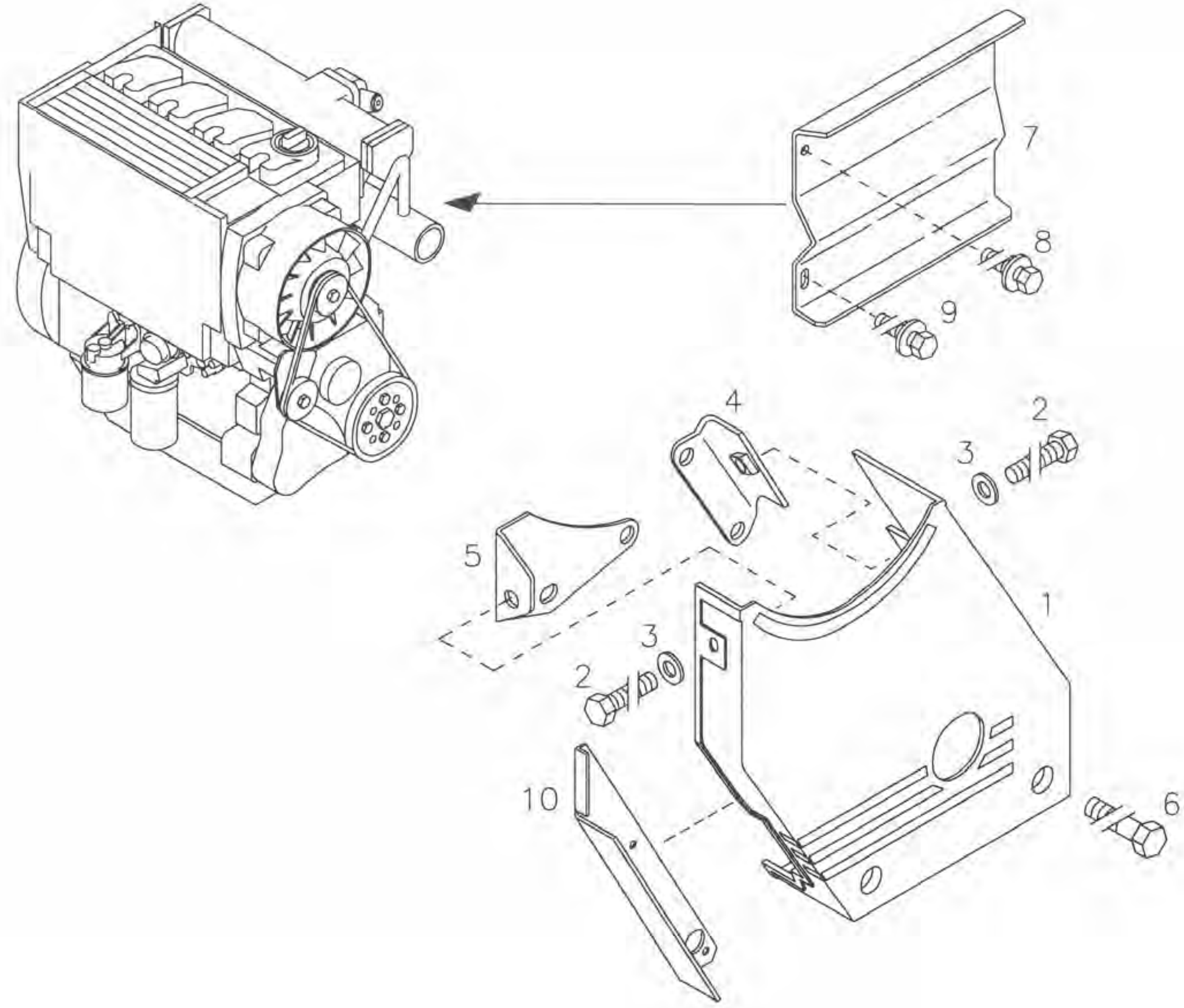

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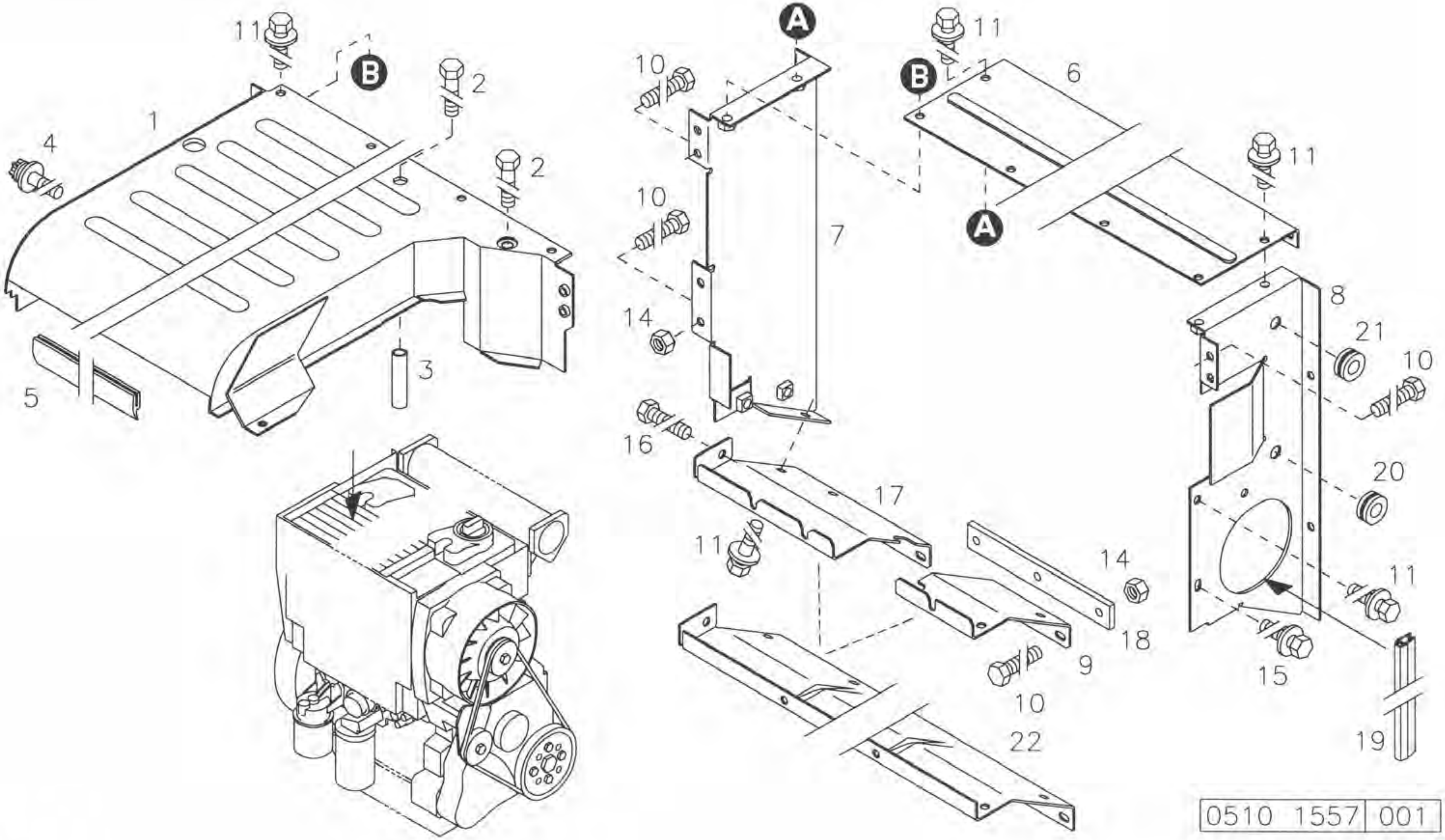
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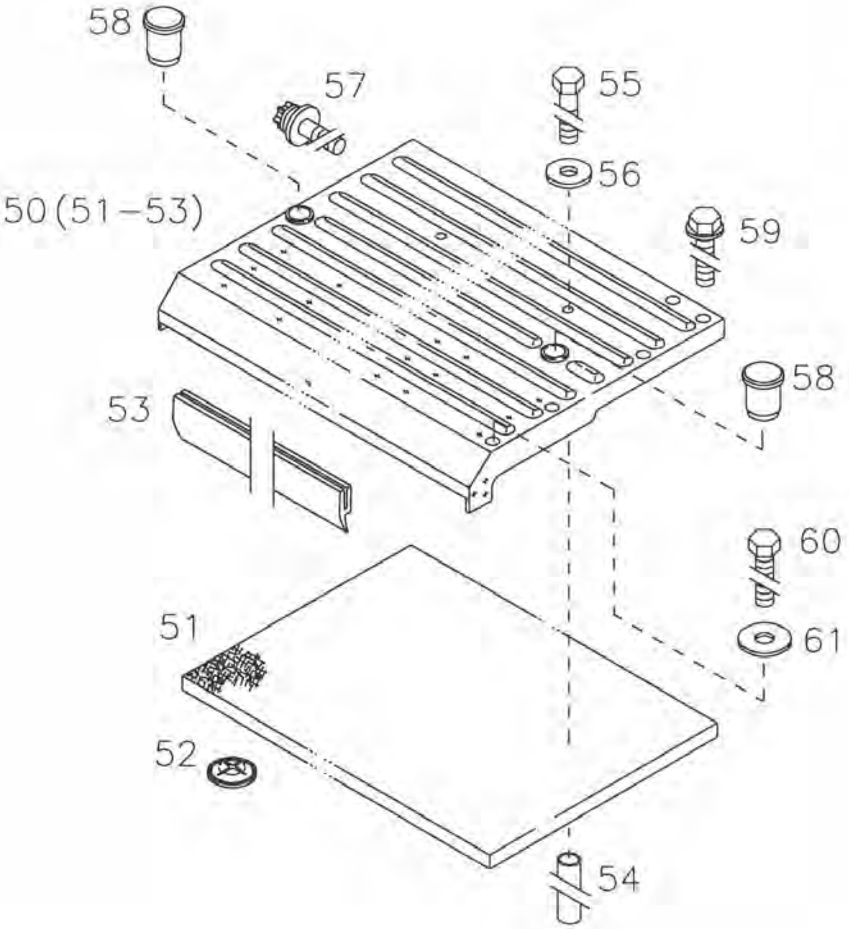

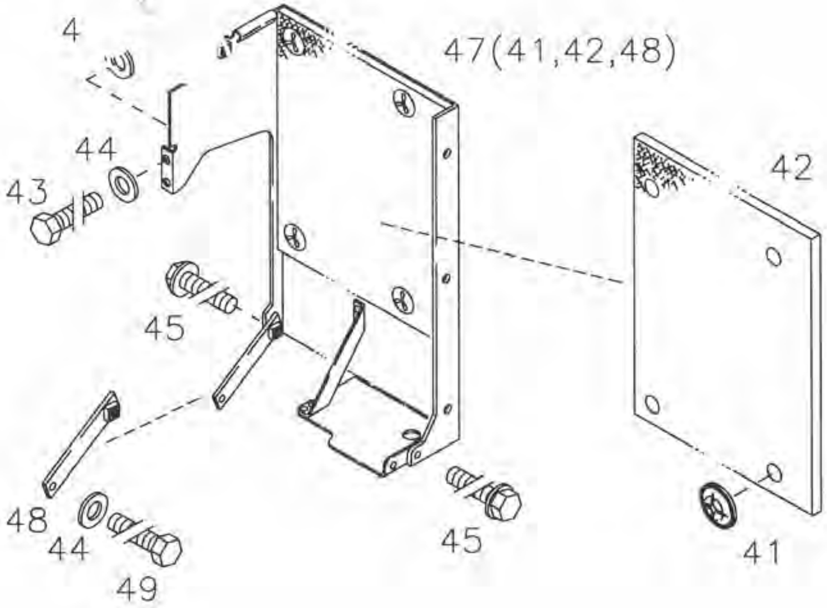

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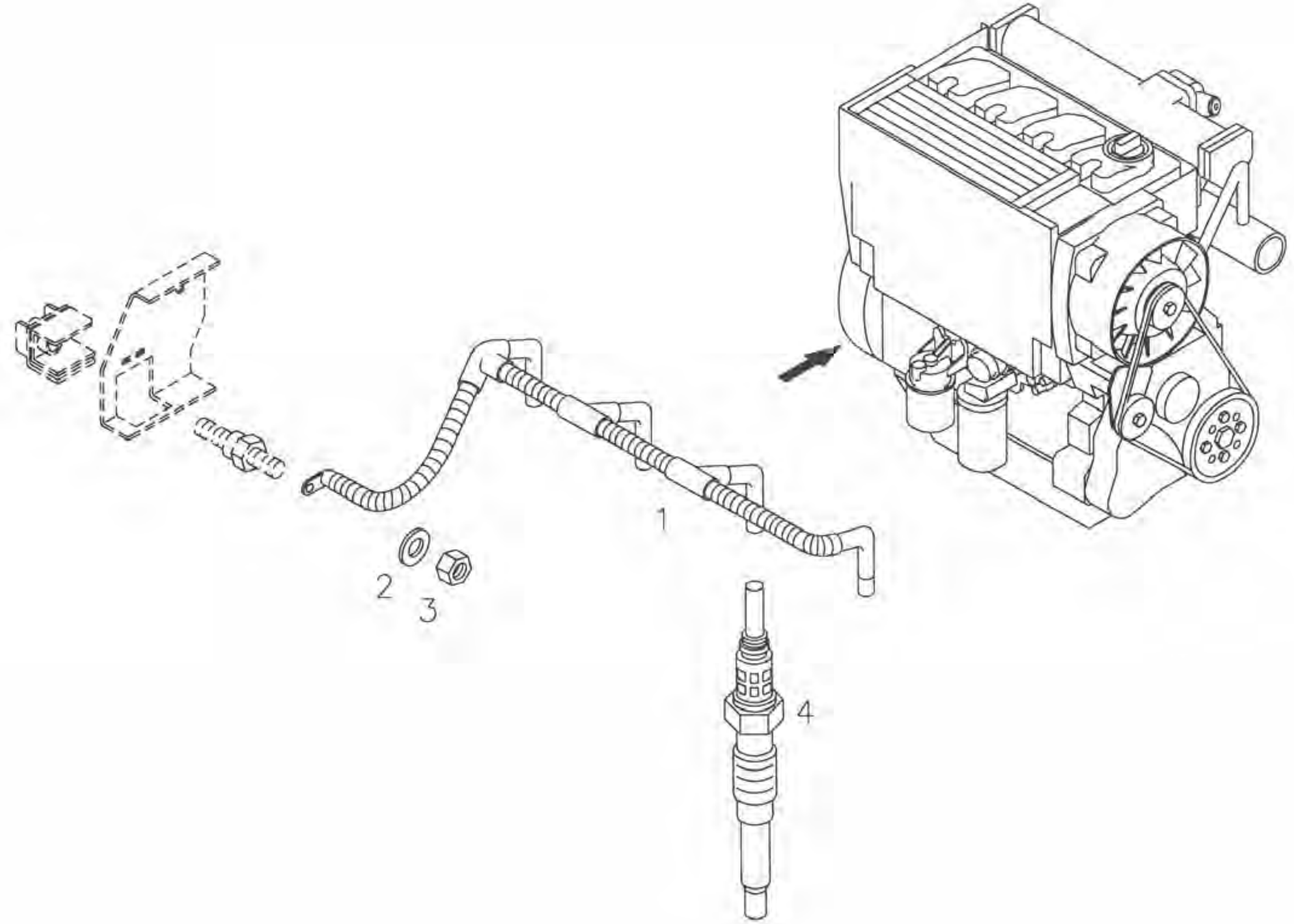

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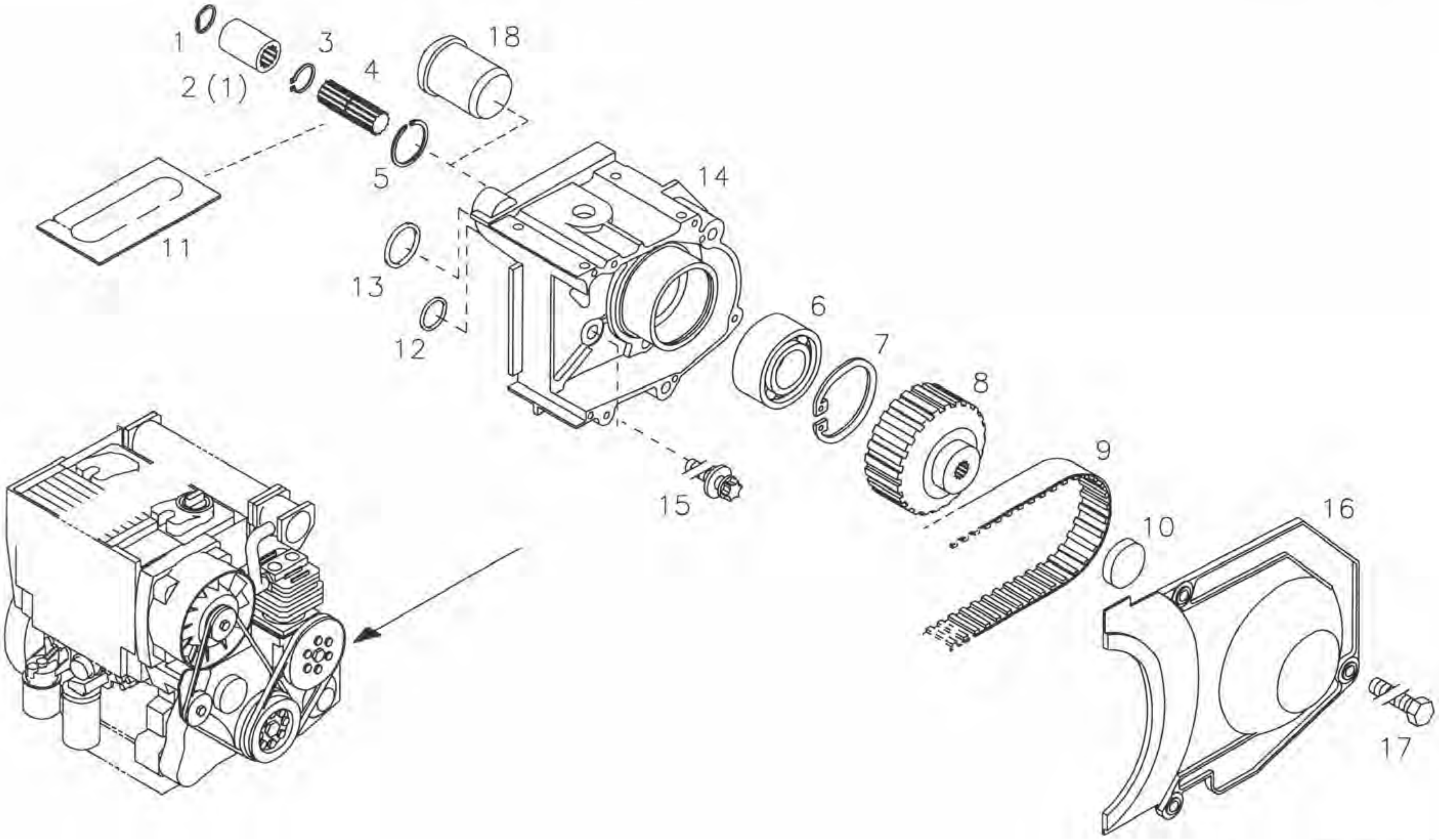

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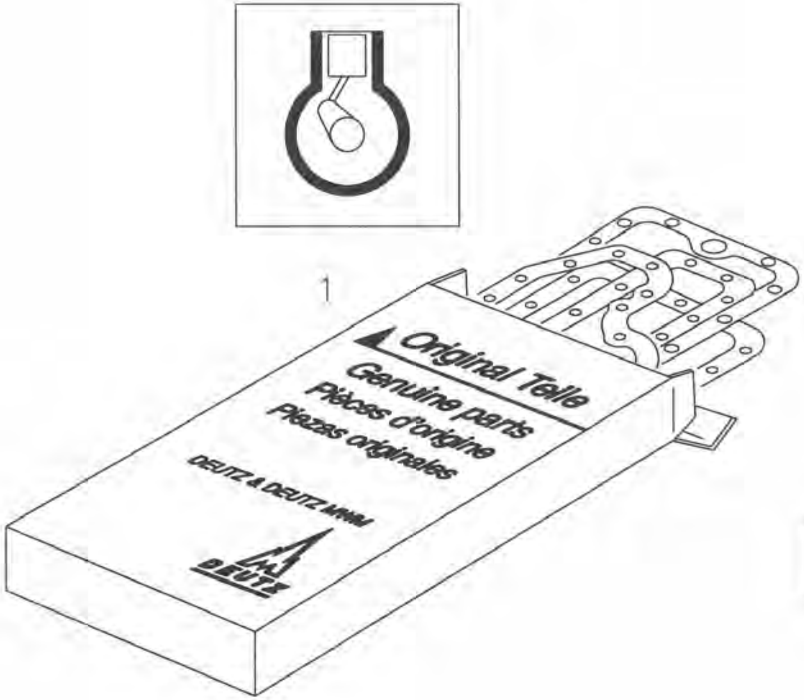

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Pièces d'origine
Piezas originales
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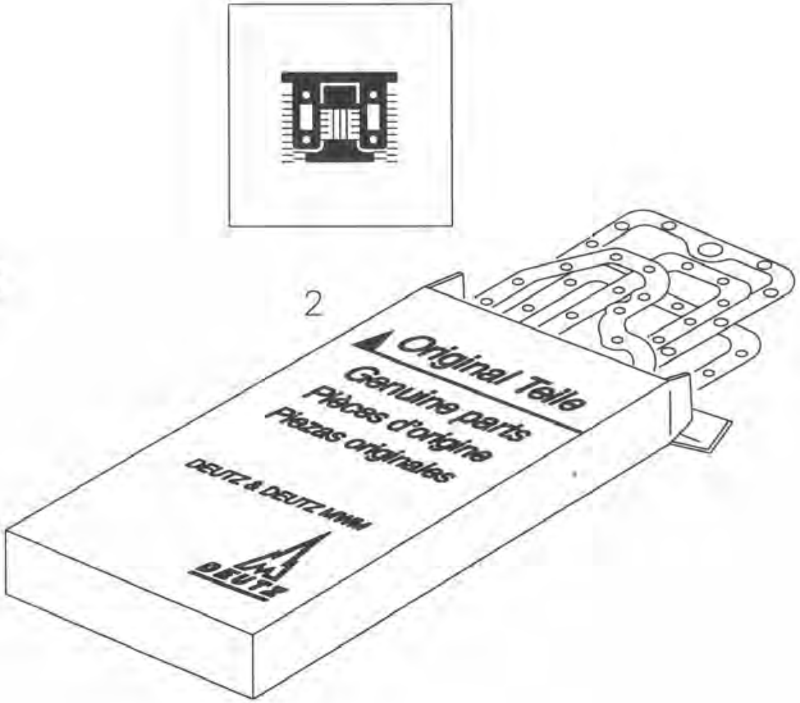
DEUTZ



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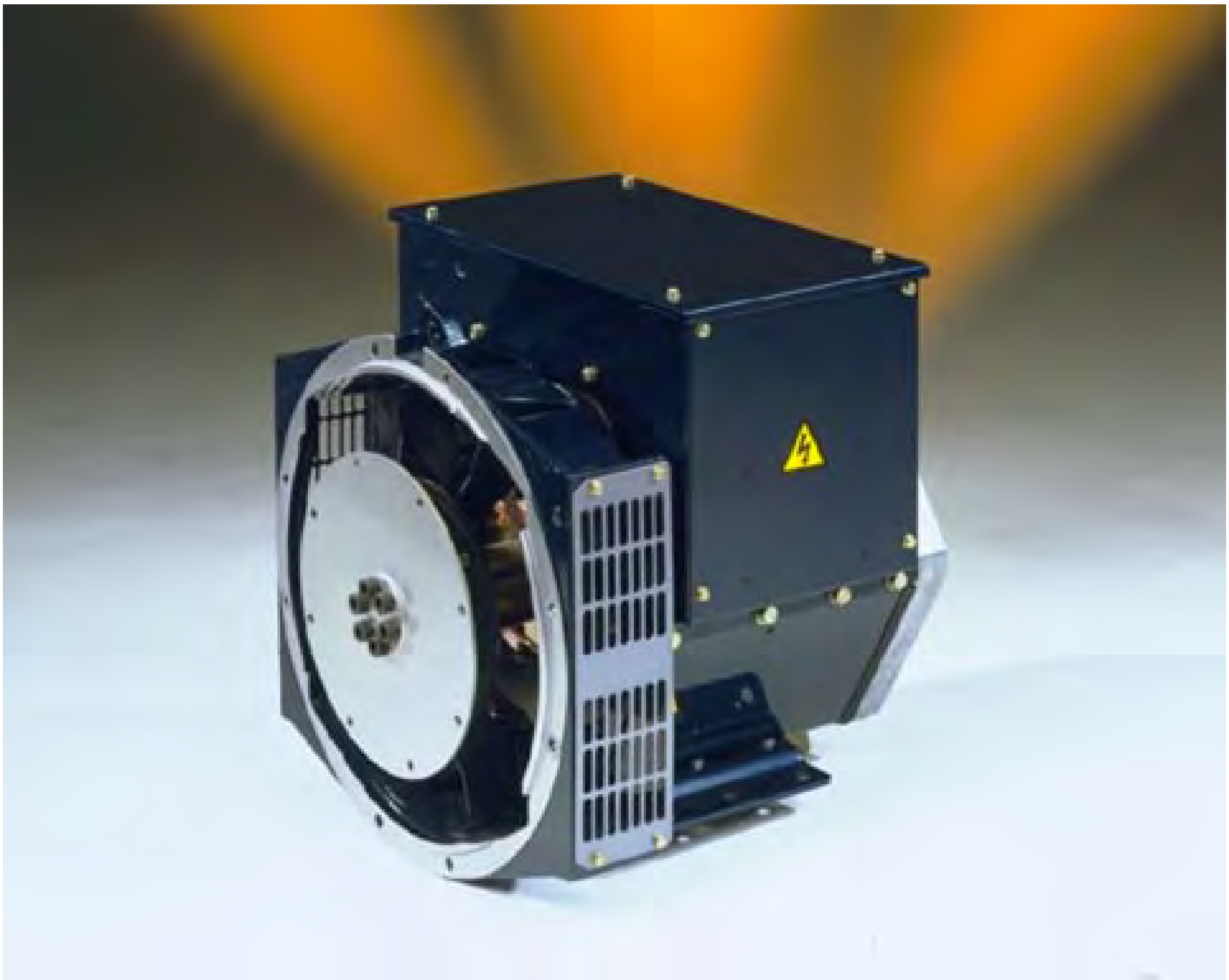
Section 4 - Stamford Alternator

Publication No: BCH-018
12th Edition
01/01

STAMFORD
AC GENERATORS FROM
NEWAGE INTERNATIONAL



Installation, Service & Maintenance Manual

For the BC Range of Generators.

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.**

Front Cover Photograph
This photograph is representative only. Several variations are available within the range of generators covered by this manual.

FOREWORD

The function of this book is to provide the user of the Stamford generator with an understanding of the principles of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures. Specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with **WARNING** and/or **CAUTION** notes, and it is **IMPORTANT** that the contents of this book are read and understood before proceeding to fit or use the generator.

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

Warning ! **Incorrect installation, service or replacement of parts can result in severe personal injury or death, and/or equipment damage . Service personnel must be qualified to perform electrical and mechanical service.**

EC DECLARATION OF INCORPORATION

All Stamford generators are supplied with a declaration of incorporation for the relevant EC legislation, typically in the form of a label as below.

EC DECLARATION OF INCORPORATION

IN ACCORDANCE WITH THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1992
AND THE SUPPLY OF MACHINERY (SAFETY) (AMENDMENT) REGULATIONS 1994
IMPLEMENTING THE EC MACHINERY DIRECTIVE 89/392/EEC AS AMENDED BY 91/368/EEC.

THIS **STAMFORD A.C. GENERATOR** WAS
MANUFACTURED BY OR ON BEHALF OF
NEWAGE INTERNATIONAL LTD
BARNACK ROAD STAMFORD LINCOLNSHIRE ENGLAND.

THIS COMPONENT MACHINERY MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORATED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1995/MACHINERY DIRECTIVE.

FOR AND ON BEHALF OF NEWAGE INTERNATIONAL LIMITED

NAME: **LAWRENCE HAYDOCK**
POSITION: **TECHNICAL DIRECTOR**
SIGNATURE:

THIS COMPONENT MACHINERY CARRIES THE CE MARK FOR COMPLIANCE WITH THE STATUTORY REQUIREMENTS FOR THE IMPLEMENTATION OF THE FOLLOWING DIRECTIVES

The EMC Directive 89/336/EEC
WARNING! This Component Machinery shall not be used in the Residential, Commercial and Light Industrial environment unless it also conforms to the relevant standard (EN 50081 - 1) REFER TO FACTORY FOR DETAILS

ii) The Low Voltage Directive 73/23/EEC as amended by 93/68/EEC

When this manual is supplied to support a specific generator at point of sale, the generator identity is clearly displayed on the front cover of this book.

ELECTROMAGNETIC COMPATIBILITY

Additional Information

European Union
Council Directive 89/336/EEC

For installations within the European Union, electrical products must meet the requirements of the above directive, and Newage ac generators are supplied on the basis that:

- They are to be used for power-generation or related function.
- They are to be applied in one of the following environments:

  Portable (open construction - temporary site supply)
  Portable (enclosed - temporary site supply)
  Containerised (temporary or permanent site supply)
  Ship-borne below decks (marine auxiliary power)
  Commercial vehicle (road transport / refrigeration etc)
  Rail transport (auxiliary power)
  Industrial vehicle (earthmoving, cranes etc)
  Fixed installation (industrial - factory / process plant)
  Fixed installation (residential, commercial and light industrial home / office / health)
  Energy management (Combined heat and power and/or peak lopping)
  Alternative energy schemes

- The standard generators are designed to meet the 'industrial' emissions and immunity standards. Where the generator is required to meet the residential, commercial and light industrial emissions and immunity standards reference should be made to Newage document reference N4/X/011, as additional equipment may be required.
- The installation earthing scheme involves connection of the generator frame to the site protective earth conductor using a minimum practical lead length.
- Maintenance and servicing with anything other than factory supplied or authorised parts will invalidate any Newage liability for EMC compliance.
- Installation, maintenance and servicing is carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives

CONTENTS

CONTENTS

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

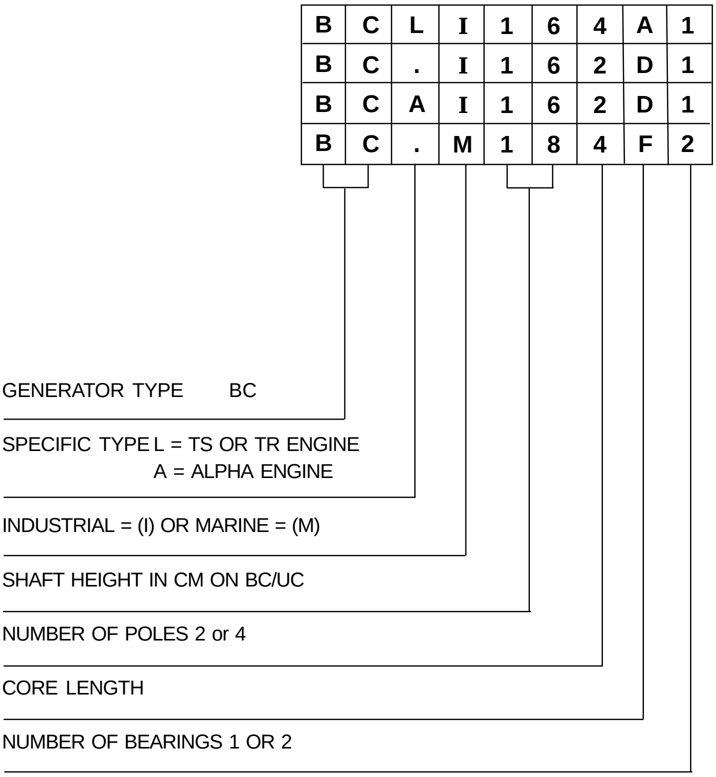
The BC16/18 range of generators is of brushless rotating field design, available up to 660V/50Hz (1500 rpm, 4 pole and 3000 rpm, 2 pole) or 60Hz (1800 rpm, 4 pole and 3600 rpm, 2 pole), and built to meet B.S. 5000 Part 3 and international standards.

The BC16/18 range are self-excited with excitation power derived from the main output windings, using either the SX460/SA465 AVR or transformer controlled excitation system.
The BC184 may be supplied fitted with an auxiliary winding in the main stator, using the SA465 AVR.

Detailed specification sheets are available on request.

1.2 DESIGNATION

To provide standardisation of systems with minimal change to customers.



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1.3 PACKAGED LOOSE ADAPTOR HARDWARE

Several adaptors are only partially fitted to generators to simplify removal prior to engine-generator assembly. The remaining hardware is contained within a plastic bag located in the terminal box.

Adaptor Types

SAE2
SAE3
SAE5 Spacer Rings
SAE6
Coupling Plate Dowel Pins

1.4 SERIAL NUMBER LOCATION

Each generator has its unique serial number stamped into the upper section of the non-drive end frame.

Inside the terminal box two adhesive rectangular labels have been fixed, each carrying the generator's unique identity number. One to the inside of the terminal box sheet metal work, and the second label fixed to the main frame of the generator.

1.5 RATING PLATE AND CE MARK

The generator has been supplied with a self adhesive rating plate label to enable fitting after final assembly and painting. It is intended that this label will be stuck to the outside of the terminal box on the left hand side when viewed from the drive-end. To assist with squarely positioning the label, location protrusions have been made in the sheet metalwork.

A CE Mark label is also supplied loose for fitment after final assembly and painting. This should be attached to an external surface of the Generator at a suitable location where it will not be obscured by the customer's wiring or other fittings. Before fitting the CE Mark label the genset builder must address the requirements of the relevant EC legislation to ensure the compliance of the genset as a whole. CE compliance will also need to be addressed when installed on site.

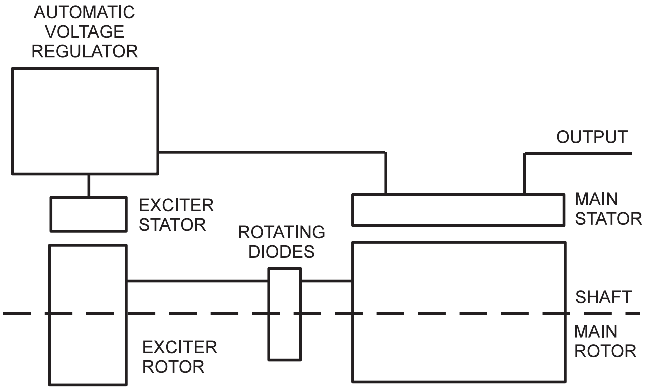
The surface on the area where a label is to be stuck must be flat, clean and any paint finish must be fully dry before attempting to attach label. Recommended method for attaching label is peel and fold back sufficient of the backing paper to expose some 20mm of label adhesive along the edge which is to be located against the sheet metal protrusions. Once this first section of label has been carefully located and stuck into position the backing paper can be progressively removed, as the label is pressed down into position. The adhesive will achieve a permanent bond in 24 hours.

SECTION 2

PRINCIPLE OF OPERATION

2.1 SELF-EXCITED AVR CONTROLLED GENERATORS

2.1.1 MAIN STATOR POWERED AVR



The main stator provides power for excitation of the exciter field via the SX460 (SA465) AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

The AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

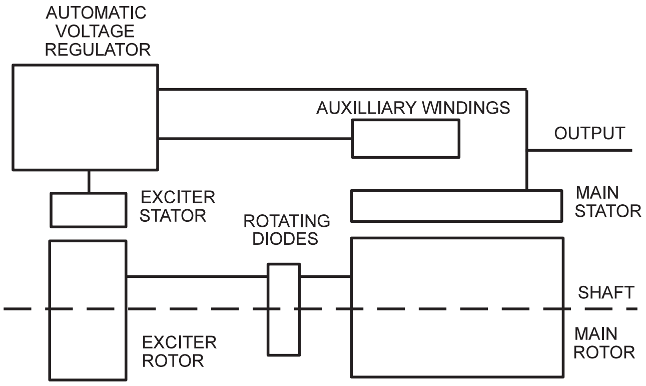
The detailed function of the AVR circuits and their adjustment are covered in the load testing section.

In addition the SA465 AVR incorporates circuits which, when used in conjunction with accessories, can provide for parallel operation either with 'droop' or 'astatic' control and VAR/PF control.

Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

Separate instructions are provided with other accessories available for control panel mounting.

2.1.2 AUXILIARY WINDING POWERED AVR



The auxiliary winding provides power for excitation of the exciter field via the SA465 AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature. The AVR senses average voltage on two phases ensuring close regulation. In addition, it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

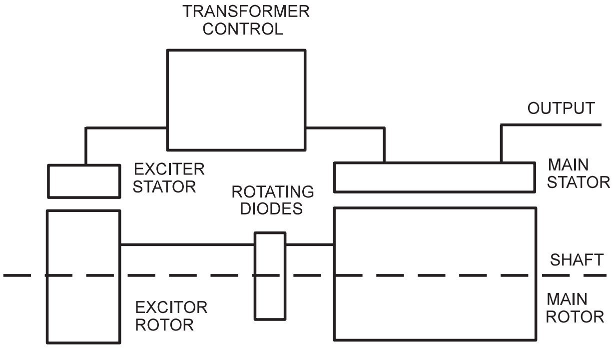
Under fault conditions on the main stator output the auxiliary winding continues to generate voltage from the harmonic content of the magnetic field in the main stator core providing the necessary power via the SA465 AVR, to maintain short circuit fault currents.

The detailed function of the AVR circuits and their adjustment are covered in the load testing section.

Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

Separate instructions are provided with other accessories available for control panel mounting.

2.2 TRANSFORMER CONTROLLED GENERATORS



The main stator provides power for excitation of the exciter field via a transformer rectifier unit. The transformer combines voltage and current elements derived from the main stator output to form the basis of an open-loop control system, which is self regulating in nature. The system inherently compensates for load current magnitude and power factor and provides short circuit maintenance in addition to a good motor starting performance.

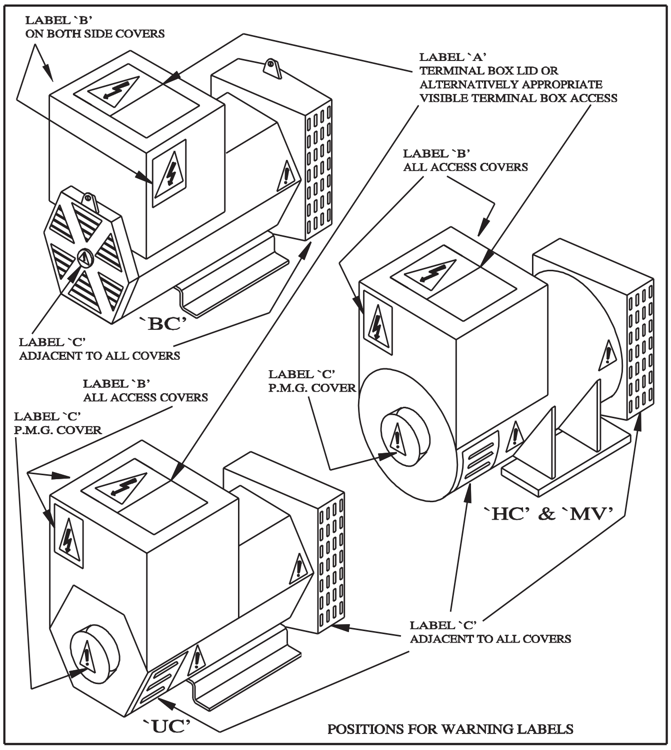
Three phase generators normally have a three phase transformer control for improved performance with unbalanced loads but a single phase transformer option is available.

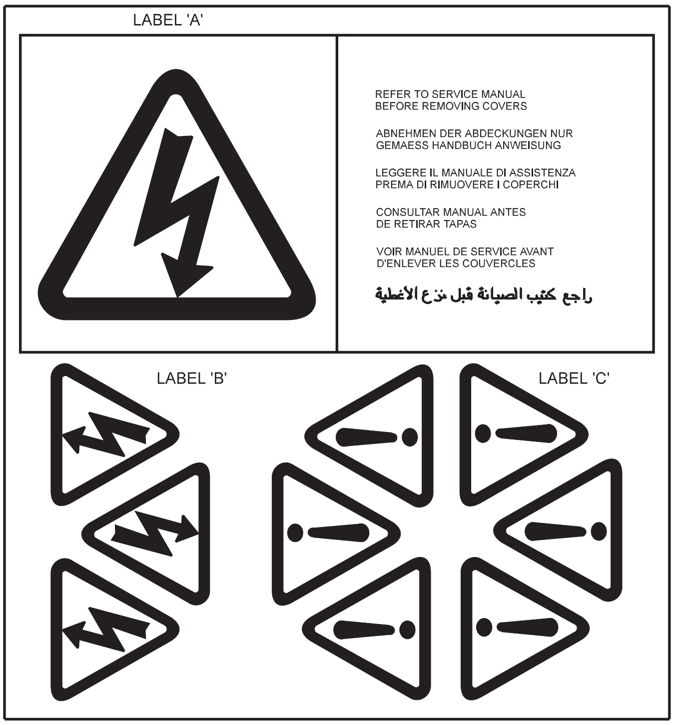
No accessories can be provided with this control system.

SECTION 3

APPLICATION OF THE GENERATOR

The generator is supplied as a component part for installation in a generating set. It is not, therefore, practicable to fit all the necessary warning/hazard labels during generator manufacture. The additional labels required are packaged with this Manual, together with a drawing identifying their locations.





It is the responsibility of the generating set manufacturer to ensure that the correct labels are fitted, and are clearly visible.

The generators have been designed for use in a maximum ambient temperature of 40°C and altitude less than 1000 metres above sea level in accordance with BS 5000.

Ambients in excess of 40°C and altitudes above 1000 metres can be tolerated with reduced ratings - refer to the generator nameplate for rating and ambient. In the event that the generator is required to operate in an ambient in excess of the nameplate value or at altitudes in excess of 1000 metres above sea level, refer to the factory.

The generators are of air-ventilated screen protected drip-proof design and are not suitable for mounting outdoors unless adequately protected by the use of canopies. Anti-condensation heaters are recommended during storage and for standby duty to ensure winding insulation is maintained in good condition.

When installed in a closed canopy it must be ensured that the ambient temperature of the cooling air to the generator does not exceed that for which the generator has been rated.

The canopy should be designed such that the engine air intake to the canopy is separated from the generator intake, particularly where the radiator cooling fan is required to draw air into the canopy. In addition the generator air intake to the canopy should be designed such that the ingress of moisture is prohibited, preferably by use of a 2 stage filter.

The generator air intake is through the non drive end cover and the generating set and canopy design must be such that the intake is not restricted. It is recommended that a minimum clearance of 50mm is allowed between the generator air intake and any vertical flat surface.

The air intake/outlet must be suitable for the air flow given in the following table with additional pressure drops less than or equal to those given below:

Frame	Air Flow		Additional (intake/outlet) Pressure Drop
	50Hz	60Hz	
BC164	0.071 m³/sec	0.09 m³/sec	3mm water gauge (0.1")
	150 cfm	190 cfm	
BC184 EFG	0.095 m³/sec	0.119 m³/sec	
	200 cfm	250 cfm	
BC184 HJ	0.15 m³/sec	0.19 m³/sec	
	318 cfm	403 cfm	
BC162	0.19 m³/sec	0.23 m³/sec	
	403 cfm	487 cfm	
BC182	0.254 m³/sec	0.304 m³/sec	
	538 cfm	644 cfm	

If specified at the time of ordering, the generator itself may be fitted with air filters.

The BCL construction has no fan fitted to the generator. The engine flywheel fan draws air through the generator and additional restrictions on air flow such as filters on the generator or canopies are not permissible.

Important ! **Reduction in cooling air flow or inadequate protection to the generator can result in damage and/or failure of windings.**

Dynamic balancing of the generator rotor assembly has been carried out during manufacture in accordance with BS 6861 Part 1 Grade 2.5 to ensure vibration limits of the generator are in accordance with BS 4999 Part 142.

The main vibration frequencies produced by the component generator are as follows:-

4 pole	1500 r.p.m.	25 Hz
4 pole	1800 r.p.m.	30 Hz
2 pole	3000 r.p.m.	50 Hz
2 pole	3600 r.p.m.	60 Hz

However, vibrations induced by the engine are complex and contain frequencies of 1, 3, 5 or more times the fundamental frequency of vibration. These induced vibrations can result in generator vibration levels higher than those derived from the generator itself. It is the responsibility of the generating set designer to ensure that the alignment and stiffness of the bedplate and mountings are such that the vibration limits of BS 5000 Part 3 are not exceeded.

In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified in BS 5000 can be tolerated, up to a maximum of 18mm/sec.

Two bearing generators require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment. Close coupling of engine to generator can increase the overall rigidity of the set. For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 125ft.lb. (17 kgm). A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise torsional effects.

Belt driven applications of two bearing generators require the pulley diameter and design to be such that the side load or force applied to the shaft is central to the extension and does not exceed the values given in the table below:-

Frame 2/4 Pole	Side Load		Shaft extension mm
	kgf	N	
BC16	92	900	82
BC18	173	1700	82

In instances where shaft extensions greater than specified in the table have been supplied, reference must be made to the factory for appropriate loadings.

Alignment of single bearing generators is critical and vibration can occur due to the flexing of the flanges between the engine and generator. As far as the generator is concerned the maximum bending moment at this point must not exceed 125ft.lb. (17 kgm).

Single bearing generators require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment.

It is expected that the generator will be incorporated into a generating set operating in an environment, where the maximum shock load experienced by the generator will not exceed 3g. in any plane. If shock loads in excess of 3g are to be encountered, anti-vibration mountings must be incorporated into the generating set to ensure they absorb the excess.

The maximum bending moment of the engine flange must be checked with the engine manufacturer.

Important ! **Single bearing drive end brackets are designed to be bolted to the engine flywheel housing using cap head screws.**

Torsional vibrations occur in all engine-driven shaft systems and may be of a magnitude to cause damage at certain critical speeds. It is therefore necessary to consider the torsional vibration effect on the generator shaft and couplings.

It is the responsibility of the generator set manufacturer to ensure compatibility, and for this purpose drawings showing the shaft dimensions and rotor inertias are available for customers to forward to the engine supplier. In the case of single bearing generators coupling details are included.

Important ! **Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components.**

The terminal box is constructed with removable panels for easy adaptation to suit specific glanding requirements. Within the terminal box there are insulated terminals for line and neutral connections and provision for earthing. A hole is provided on the generator foot which may be tapped to give an additional earthing point.

The neutral is NOT connected to the frame.

The main stator winding has 12 leads brought out to the terminals in the terminal box.

Warning ! **No earth connections are made on the generator and reference to site regulations for earthing must be made. Incorrect earthing or protection arrangements can result in personal injury or death.**

Fault current curves (decrement curves), together with generator reactance data, are available on request to assist the system designer to select circuit breakers, calculate fault currents and ensure discrimination within the load network.

Warning ! **Incorrect installation and/or protective systems can result in personal injury and/or equipment damage. Installers must be qualified to perform electrical installation work.**

SECTION 4

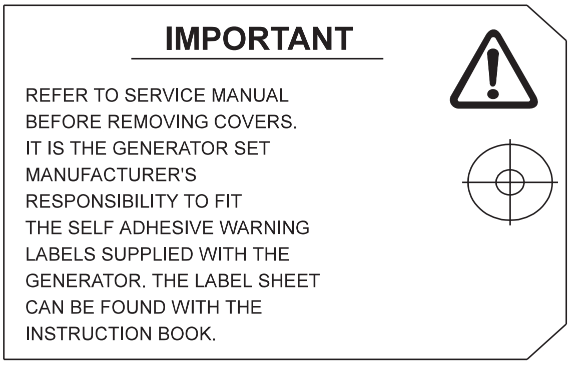
INSTALLATION - PART 1

4.1 LIFTING

Warning ! **Incorrect lifting or inadequate lifting capacity can result in severe personal injury or equipment damage. MINIMUM LIFTING CAPACITY REQUIRED IS 250kg. Generator lifting lugs should not be used for lifting the complete generator set.**

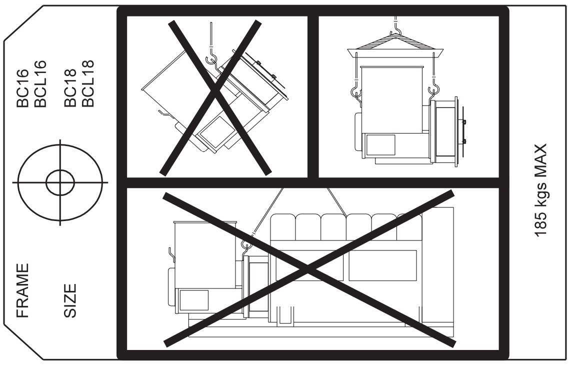
Lifting lugs are provided at each end of the generator for use with a shackle and pin type lifting aid or lifting hooks. Chains of suitable length and lifting capacity, with spreader bar to avoid damage to the terminal box, must be used.

The correct lifting arrangement is shown on a label attached to the generator. A typical example is shown below.



IMPORTANT

REFER TO SERVICE MANUAL
BEFORE REMOVING COVERS.
IT IS THE GENERATOR SET
MANUFACTURER'S
RESPONSIBILITY TO FIT
THE SELF ADHESIVE WARNING
LABELS SUPPLIED WITH THE
GENERATOR. THE LABEL SHEET
CAN BE FOUND WITH THE
INSTRUCTION BOOK.



BCL generators have no fan to support the drive end and are supplied fitted with a transit strap clamping the coupling hub to the drive end adaptor ring.

Once the transit strap is removed the rotor is free to move in the frame, and care is needed during coupling and alignment to ensure the frame is kept in the horizontal plane.

4.2 ASSEMBLY TO ENGINE

ENGINE TO GENERATOR COUPLING ASSEMBLY

During the assembly of the Generator to the Engine it will be necessary to firstly carefully align, then rotate, the combined Generator rotor - Engine crankshaft assembly, as part of the construction process, to allow location, insertion and tightening of the coupling bolts. This requirement to rotate the combined assemblies exists for both single and two bearing units.

During the assembly of single bearing units it is necessary to align the generator's coupling holes with the engine flywheel holes: it is suggested that two diametrically opposite location dowel pins are fitted to the engine flywheel, over which the generator coupling can slide into final location into the engine flywheel spigot recess. The dowels must be removed and replaced by coupling bolts before the final bolt tightening sequence.

While fitting and tightening the coupling bolts it will be necessary to rotate the Engine crankshaft - Generator rotor assembly. Care should be taken to ensure that rotation is carried out in an approved manner that ensures safe working practice when reaching inside the machine to insert or tighten coupling bolts, and that no component of the assembly is damaged by non-approved methods of assembly rotation.

Engine Manufacturers have available a proprietary tool designed to enable manual rotation of the crankshat assembly. This tool must always be used, having been engineered as an approved method of assembly rotation, by engaging the manually driven pinion with the engine flywheel starter ring-gear.

UNDER NO CIRCUMSTANCES SHOULD A LEVER BE USED AGAINST THE FAN BLADES OR BAFFLE TO ROTATE THE GENERATOR ROTOR / ENGINE CRANKSHAFT ASSEMBLY.

Danger ! **Before working inside the generator, during the aligning and fitting of coupling bolts, care should be taken to lock the assembly to ensure there is no possibility of assembly rotational movement.**

4.2.1 TWO BEARING GENERATORS

A flexible coupling should be fitted and aligned in accordance with the coupling manufacturer's instruction.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the generator up to the engine. Shim the generator feet if necessary. Ensure adaptor guards are fitted after generator/engine assembly is complete. Open coupled sets require a suitable guard, to be provided by the set builder.

In the case of belt driven generators, ensure alignment of drive end and driven pulleys to avoid axial load on the bearings. Screw type tensioning devices are recommended to allow accurate adjustment of belt tension whilst maintaining pulley alignment.

Belt and pulley guards must be provided by the set builder.

Important ! **Incorrect belt tensioning will result in excessive bearing wear.**

Caution ! **Incorrect guarding and/or generator alignment can result in personal injury and/ or equipment damage.**

4.2.2 SINGLE BEARING GENERATORS

Alignment of single bearing generators is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

For transit and storage purposes the generator frame spigot and rotor coupling plates have been coated with a rust preventative. 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.

For coupling to the various engine flywheel housings, the generators can be supplied with an endbracket-adaptor arrangement as outlined below.

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

EndBracket/Adaptor

SAE5
SAE4
SAE3
SAE2
SAE5 Plus SAE6 Adaptor Ring

Important ! **Drive end adaptors are designed for use with cap head screws.**
BC18 generators fitted with an SAE 5 drive end adaptor must also be fitted with a reduced diameter fan and must be operated at reduced output.
Fan securing screws should be tightened to 0.59kgm (6Nm 4.4lb. ft.)

The sequence of assembly to the engine should generally be as follows:

1. On the engine check the distance from the coupling mating face on the flywheel to the flywheel housing mating face. This should be within 0.5mm of nominal dimension. This is necessary to ensure that a thrust is not applied to the a.c. generator bearing or engine bearing.
2. Check that the bolts securing the coupling disc to the coupling hub are tight and locked into position. Torque tightening is 7.6kgm (75Nm; 55 lb ft).
3. Remove covers from the drive end of the generator to gain access to coupling disc and adaptor bolts.
4. Check that coupling disc is concentric with adaptor spigot. This can be adjusted by suspending the rotor by means of a rope sling through the adaptor opening.
5. Offer the a.c. generator to engine and engage both coupling disc and housing spigots at the same time, finally pulling home by using the housing and coupling bolts.Use heavy gauge washers between bolt head and discs on disc to flywheel bolts.
6. Tighten coupling disc to flywheel. Refer to engine manual for torque setting of disc to flywheel bolts.

Important ! **When fitting drive disc ensure that flywheel fixing bolt holes fall between fan blades to allow access for flywheel bolts. Use engine pulley to turn rotor.**

4.2.2.1 SINGLE BEARING 4-POLE & 2-POLE GENERATORS

Generators offered in the BCA range can be specified to suit different engine build configurations of specific flywheel and flywheel housing combinations.

Important ! **It is most important that the appropriate generator build is ordered with prior knowledge of the intended engine flywheel/ housing arrangement.**

Important ! **During assembly, loss of residual voltage may occur. Refer to subsection 7.4.3 for field flashing.**

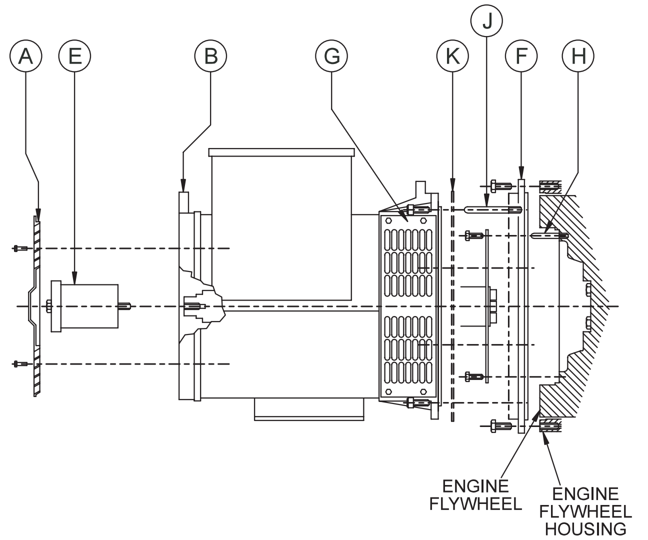
GENERATOR TO ENGINE ASSEMBLY INSTRUCTIONS

1. Remove louvered cover "A" from non-drive endbracket "B".
2. Assemble locating bar "E" (Newage No AF1609) by screwing into shaft.
3. Remove transit bar "K".
4. Remove side screens "G".
5. If the adaptor ring is an individual item, as indicated "F", bolted to the generator D.E. bracket, remove from generator and fit to engine flywheel housing.
6. Thread two locating pins "H" into two top flywheel holes.
7. Fit two locating pins "J" into two top holes of the engine flywheel housing/adaptor location holes.
8. Pick up generator by the cast lifting lugs on both ends with 1/2 ton shackles (TO BS3032) or lifting hooks (Newage No.LE130) using suitable lifting equipment.
9. Rotate generator rotor such that two top holes of coupling disc are in close axial alignment.
10. Push the generator rotor forward only half (50mm) the available movement provided by locating bar "E". It may be necessary to tap bar "E" with a hide mallet to ease the bearing out of housing.

Important ! **Do not push the rotor forward too far. There is a risk that the rotor will rest on the stator winding outhang resulting in winding damage especially if any rotational movement occurs during alignment with pins "H".**

11. Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes over support pins "H". Locating bar "E" will allow the rotor to move forward a further 50mm, the total movement bar "E" allows being 100mm. With coupling discs positioned against flywheel location fit securing screws and washers. Remove pins "H" and fit two final securing screws and washers.
12. Push generator onto engine guiding adaptor over locating pins "J" and onto engine flywheel housing location, or ring "F", secure with screws and washers. Remove pins and replace with two screws and washers.

13. Remove locating bar "E". Replace M10 screw "C" for barring purposes.
14. Remove lifting tackle and replace side screens "G" and louvered cover "A".



4.2.2.2 SINGLE BEARING 2-POLE GENERATOR TO ENGINE ASSEMBLY INSTRUCTIONS (WITH DOWELED FLYWHEELS)

1-5. Follow steps 1-5 from 4 pole instruction procedure.

6. Fit the two location dowels pins into appropriate diametrically opposite holes in engine flywheel, leaving sufficient parallel diameter exposed to allow for positive location of the disc-spacer-ring and coupling discs.

7. Fit the disc-spacer-ring over the two dowel pins and position firmly against the flywheel face.

8. Follow steps 6-8 from 4 pole instruction procedure.

9. Rotate generator rotor such that the two coupling disc dowel holes align with flywheel dowel pins, and two top holes of coupling discs are in close axial alignment with the two flywheel location pins "H".

10. Follow step 10 from 4 pole instruction procedure.

11. Support the weight of the rotor at the coupling end whilst sliding the rotor forward to locate coupling disc holes over support pins "H".

Important ! **Ensure coupling disc dowel pin holes are in correct alignment.**

With the coupling disc positioned against flywheel location fit securing screws and washers.

Remove pins "H" and fit two final securing screws and washers.

12. Follow steps 12-14 from 4 pole instruction procedure.

4.2.3 TAPER SHAFT ARRANGEMENTS

This arrangement is used on the BCL style generators.

As with single bearing generators alignment is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

The following procedure should be adopted to assemble the generator to the engine:-

1. Remove louvred endcover "G" from non drive endbracket "H" and M10 Hex Nut "D" from shaft securing stud "AA".“ Remove transit bar "E" and withdraw stub shaft/shaft securing stud "A/B" from rotor.

2. Ensure alternator, engine flywheel and flywheel housing locating spigots, faces and recesses are free from paint or preservatives.

3. Locate stub shaft/shaft securing stud assembly "A"/"B" on engine flywheel spigot and secure with studs "J", M12 hex. nut "L" or bolts. Refer to engine manual for torque settings.

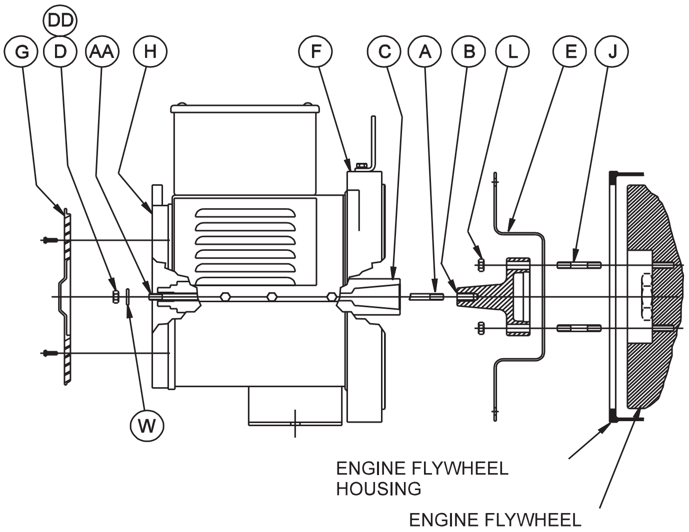
4. Ensure both tapers are clean and free of burrs, oil or grease. Slide alternator complete with rotor towards engine, ensuring that shaft securing stud "A" enters central hole in rotor shaft. Refer to engine manual for torque settings.

5. Secure alternator adaptor "F" to engine flywheel housing. Tap adaptor into place before tightening. Refer to engine manufacturer for torque setting.

6. Fit M10 Binx nut "DD" to protruding shaft securing stud "AA". M10 Binx nut tightening torque 45.0Nm (33.0 lbs.ft).

7. Fit louvred endcover "G" to non drive endbracket "H".

8. Check for excessive vibration at time of initial run-up.



Caution! **Incorrect guarding and/or generator alignment can result in personal injury and /or equipment damage**

4.3 EARTHING

The generator frame should be solidly bonded to the generating set bedplate. If anti vibration mounts are fitted between the generator frame and its bedplate a suitably rated earth conductor (normally one half of the cross sectional area of the main line cables) should bridge across the anti vibration mount.

Warning ! **Refer to local regulations to ensure that the correct earthing procedure has been followed.**

4.4 PRE-RUNNING CHECKS

4.4.1 INSULATION CHECK

Before starting the generating set, both after completing assembly and after installation of the set, test the insulation resistance of windings.

The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output lead terminal U, V or W to earth. The insulation resistance reading should be in excess of 5MΩ to earth. Should the insulation resistance be less than 5MΩ the winding must be dried out as detailed in the Service and Maintenance section of this Manual.

Important ! **The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage levels i.e. Test Voltage= 0.8 (2 X Rated Voltage + 1000)**

4.4.2 DIRECTION OF ROTATION & PHASE ROTATION

BC generators can rotate efficiently in either direction. However phase rotation is fixed for clockwise rotation as viewed from the drive end. If the generator is to be rotated in a counter-clockwise direction it will be necessary for the customers to adjust their cabling to the output terminals accordingly. Refer to the factory for a reverse wiring diagram.

4.4.3 VOLTAGE AND FREQUENCY

Check that the voltage and frequency levels required for the generating set application are as indicated on the generator nameplate.

Three phase generators normally have a 12 ends out reconnectable winding. If it is necessary to reconnect the stator for the voltage required, refer to diagrams in the back of this manual.

4.4.4 AVR INITIAL SETTINGS

To make AVR selections remove the AVR cover and refer to the following sections depending upon type of AVR fitted.

Reference to the generator nameplate will indicate AVR type.

AVR type SX460 - Refer to Section 4.4.4.1
AVR type SA465 - Refer to Section 4.4.4.2

Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running test. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions. Refer to section 4.7 for details.

4.4.4.1 TYPE SX460 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 1 for location of selection links.

1. Frequency selection

50Hz operation	LINK C-50
60Hz operation	LINK C-60

2. External hand trimmer selection

No external hand trimmer - LINK 1-2
External hand trimmer required - REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.

3. AVR Input Selection

High Voltage	(220/240V)	INPUT	No Link
Low Voltage	(110/120V)	INPUT	LINK 3-4

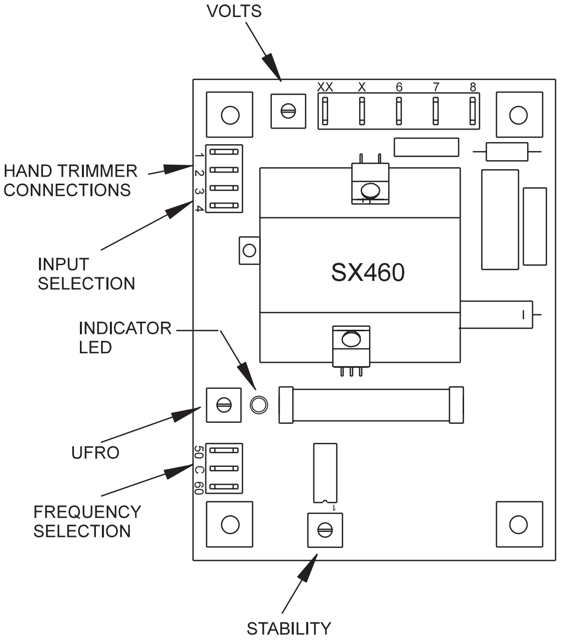


Fig. 1

4.4.4.2 TYPE SA465 AVR

The following switch and jumper connections on the AVR should be checked to ensure they are correctly set for the generating set application.
Refer to Fig. 2 for selector locations.

1. Frequency selection

50Hz operation	Set Switch SW1 to position 5
60Hz operation	Set Switch SW1 to position 6

2. External Hand Trimmer selection

No external hand trimmer	LINK 1-2
External hand trimmer required	REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.

3. AVR Input Selection

High Voltage	(220/240V)	INPUT	No Link
Low Voltage	(110/120V)	INPUT	LINK L-L

4. Stability selection

Set switch SW2 to position 4

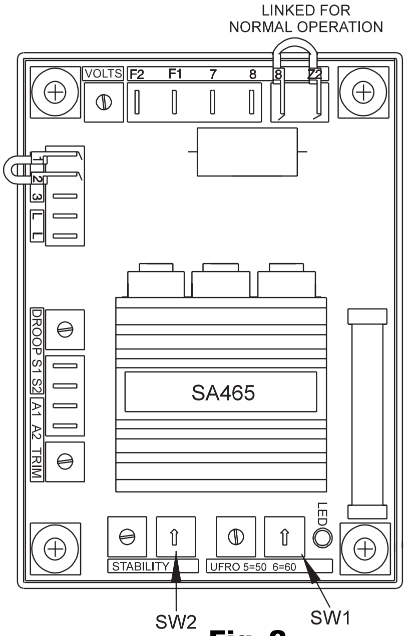


Fig. 2

4.4.5 TRANSFORMER CONTROLLED EXCITATION SYSTEM

This control system is identified by the word 'TRANSF' against AVR type on the nameplate.

The excitation control is factory set for the specific voltage shown on the nameplate and requires no adjustment.

4.5 GENERATOR SET TESTING

Warning !

During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments.

4.5.1 TEST METERING/CABLING

Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors.

Minimum instrumentation for testing should be line - line or line to neutral voltmeter, Hz meter, load current metering and kW meter. If reactive load is used a power factor meter is desirable.

Important ! **When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the generator rated voltage. The load cable termination should be placed on top of the winding lead termination and clamped with the nut provided.**

Caution!

Check that all wiring terminations for internal or external wiring are secure, and fit all terminal box covers and guards. Failure to secure wiring and/or covers may result in personal injury and/or equipment failure.

4.6 INITIAL START-UP

Warning !

During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Important ! **Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.**

In addition remove the AVR access cover (on AVR controlled generators) and turn VOLTS control fully anti-clockwise. Start the generating set and run on no-load at nominal frequency. Slowly turn VOLTS control potentiometer clockwise until rated voltage is reached. Refer to Fig. 1, 2 or 3 for control potentiometer location.

Important ! **Do not increase the voltage above the rated generator voltage shown on the generator nameplate.**

The STABILITY control potentiometer should be set to the midway position (refer to fig 1, 2 or 3 for its location) and with the stability selection correctly set should not normally require adjustment. Should adjustment be required, usually identified by oscillation of the voltmeter proceed as follows:-

On SA465 major adjustment of the stability can be made by selection on switch SW2.

Switch position 8 will give SLOW AVR response
Switch position 0 will give FAST AVR response

1. Run the generating set on no-load and check that speed is correct and stable.

2. Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable. The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

4.7 LOAD TESTING

Warning !

During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

4.7.1 AVR CONTROLLED GENERATORS - AVR ADJUSTMENTS

Refer to Fig. 1, 2 or 3 for control potentiometer locations.

Having adjusted VOLTS and STABILITY during the initial start-up procedure, the AVR control function UFRO should not normally need adjustment.

If however, poor voltage regulation on-load is experienced, refer to the following paragraph to a) check that the symptoms observed do indicate adjustment is necessary, and b) to make the adjustment correctly.

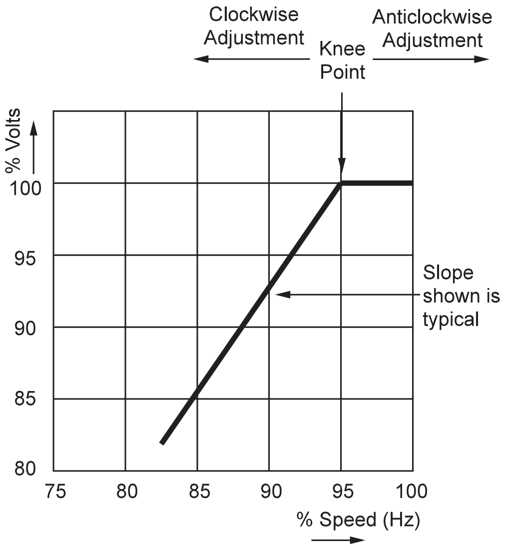
4.7.1.1 UFRO (Under Frequency Roll Off)

The AVR incorporates an underspeed protection circuit which gives a voltage/speed (Hz) characteristic as shown:

The UFRO control potentiometer sets the "knee point".

Symptoms of incorrect setting are a) the light emitting diode (LED) indicator, adjacent to the UFRO Control potentiometer, being permanently lit when the generator is on load, and b) poor voltage regulation on load, i.e. operation on the sloping part of the characteristic.

Clockwise adjustment lowers the frequency (speed) setting of the "knee point" and extinguishes the LED. For Optimum setting the LED should illuminate as the frequency falls just below nominal frequency, i.e. 47Hz on a 50Hz generator or 57Hz on a 60Hz generator.



4.7.2 TRANSFORMER CONTROLLED GENERATORS - TRANSFORMER ADJUSTMENT

Normally no adjustment is required but should the no-load voltage and/or on-load voltage be unacceptable, adjustment of the transformer air gap can be made as follows.

Stop the generator. Remove transformer cover box. (Normally left hand side of the terminal box when viewed from the non drive end).

Slacken the three transformer mounting bolts along the top of the transformer, and the two bolts holding the mounting bracket to the base plate.

Start the set with a voltmeter connected across the main output terminals.

Adjust the air gap between the transformer top lamination section and the transformer limbs to obtain required voltage on no-load. Slightly tighten the three mounting bolts. Switch load 'on' and 'off' two or three times. Application of load will normally raise the voltage setting slightly. With the load 'off' recheck the no-load voltage.

Readjust air gap and finally tighten mounting bolts.

Refit the access cover.

Danger !

Failure to refit covers can result in operator personal injury or death.

4.8 ACCESSORIES

Refer to the "ACCESSORIES" - Section 6 of this Manual for setting up procedures related to generator mounted accessories.

If there are accessories for control panel mounting supplied with the generator refer to the specific accessory fitting procedures inserted inside the back cover of this book.

SECTION 5

INSTALLATION - PART 2

5.1 GENERAL

The extent of site installation will depend upon the generating set build, e.g. if the generator is installed in a canopied set with integral switchboards and circuit breaker, on site installation will be limited to connecting up the site load to the generating set output terminals . In this case reference should be made to the generating set manufacturer's instruction book and any pertinent local regulations.

If the generator has been installed on a set without switchboard or circuit breaker the following points relating to connecting up the generator should be noted.

5.2 GLANDING

The terminal box will normally be supplied with the right hand side panel, viewed from the non drive end, available for cable exit. The side panel is removable for drilling/punching to suit glands or glanding boxes. Should the cable exit be required from the left hand side of the generator when viewed from the non drive end, the left and right hand panels may be interchanged. Sufficient length of wiring to the AVR has been provided for this purpose.

Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set so as to avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable.

Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Should the insulation resistance be less than 5MW the windings must be dried out as detailed in the Service and Maintenance section of this manual.

When making connections to the terminals the incoming cable termination should be placed on top of the winding lead termination(s) and clamped with the nut provided.

Important ! **To avoid the possibility of swarf entering any electrical components in the terminal box, panels <u>must</u> be removed for drilling.**

5.3 EARTHING

The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. Should it be required to operate with the neutral earthed a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. A hole is provided on the generator foot which may be tapped to give an additional earthing point. The feet should be already bonded to the generating set bedplate by the generating set builder, but will normally be required to be connected to the site earth system.

Caution ! **Reference to local electricity regulations or safety rules should be made to ensure correct earthing procedures have been followed.**

5.4 PROTECTION

It is the responsibility of the end user and his contractors/ sub-contractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority or safety rules, pertaining to the site location.

To enable the system designer to achieve the necessary protection and/or discrimination, fault current curves are available on request from the factory, together with generator reactance values to enable fault current calculations to be made.

Warning ! **Incorrect installation and/or protective systems can result in personal injury and/or equipment damage. Installers must be qualified to perform electrical installation work.**

5.5 COMMISSIONING

Ensure that all external cabling is correct and that all the generating set manufacturer's pre-running checks have been carried out before starting the set.

The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment. Should adjustment on site be necessary refer to Section 4 for AVR details and/or Section 6 for paralleling adjustments.

Should malfunction occur during commissioning refer to Service and Maintenance section 'Fault Finding' procedure.

SECTION 6

ACCESSORIES

Generator control accessories may be fitted, as an option, in the generator terminal box. If fitted at the time of supply, the wiring diagram(s) in the back of this book shows the connections. When the options are supplied separately, fitting instructions are provided with the accessory.

Accessories available are droop transformer for parallel operation applicable to generators with SA465 AVR, and remote voltage adjust (hand trimmer). The latter being available for all AVR types but not fitted on the generator.

NOTE:

None of the accessories can be fitted with a transformer controlled generator.

6.1 REMOTE VOLTAGE ADJUST (all AVR types).

A remote voltage adjust can be fitted to the control panel.

Remove link 1-2 on the AVR and connect adjuster to terminals 1 and 2.

6.2 PARALLEL OPERATION

Understanding of the following notes on parallel operation is useful before attempting the fitting or setting of the droop kit accessory. When operating in parallel with other generators or the mains, it is essential that the phase sequence of the incoming generator matches that of the busbar and also that all of the following conditions are met before the circuit breaker of the incoming generator is closed on to the busbar (or operational generator).

1 Frequency must match within close limits.
2. Voltages must match within close limits.
3. Phase angle of voltages must match within close limits.

A variety of techniques, varying from simple synchronising lamps to fully automatic synchronisers, can be used to ensure these conditions are met.

Important ! **Failure to meet conditions 1, 2, and 3 when closing the circuit breaker, will generate excessive mechanical and electrical stresses, resulting in equipment damage.**

Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, watt meter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share kW in relation to engine ratings and kVAr in relation to generator ratings.

It is important to recognise that

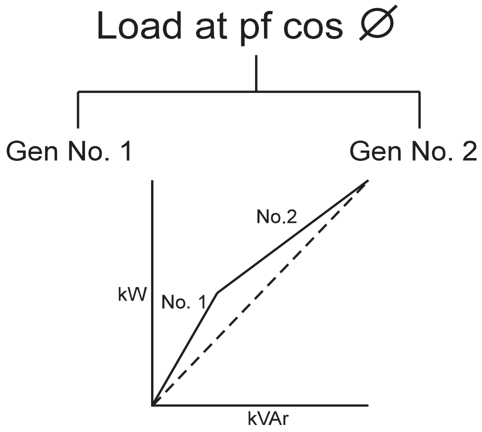
1. kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets**.**

2. kVAr are derived from the generator, and excitation control characteristics determine the kVAr sharing. Reference should be made to the generating set manufacturer's instructions for setting the governor controls.

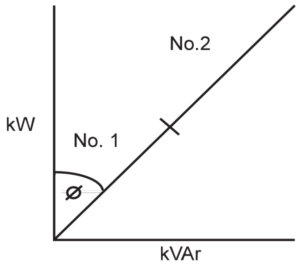
6.2.1 DROOP

The most commonly used method of kVAr sharing is to create a generator voltage characteristic which falls with decreasing power factor (increasing kVAr). This is achieved with a current transformer (C.T.) which provides a signal dependent on current phase angle (i.e. power factor) to the AVR. The current transformer has a burden resistor on the AVR board, and a percentage of the burden resistor voltage is summed into the AVR circuit. Increasing droop is obtained by turning the DROOP control potentiometer clockwise.

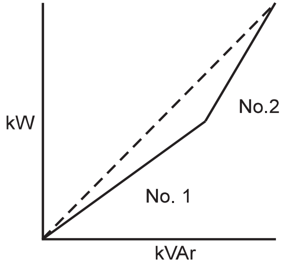
The diagrams below indicate the effect of droop in a simple two generator system:-



No. 1 Droop Greater than No. 2 Droop



No. 1 and No. 2 Droop Equal



No. 1 Droop less than No. 2 Droop

Generally 5% droop at full load current zero p.f. is sufficient to ensure kVAr sharing.

If the droop accessory has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal level of droop. The final level of droop will be set during generating set commissioning.

The following setting procedure will be found to be helpful.

6.2.1.1 SETTING PROCEDURE

Depending upon available load the following settings should be used - all are based on rated current level.

0.8 P.F. LOAD	(at full load current)	SET DROOP TO 3%
0 P.F. LOAD	(at full load current)	SET DROOP TO 5%

Setting the droop with low power factor load is the most accurate.

Run each generator as a single unit at rated frequency or rated frequency + 4% depending upon type of governor and nominal voltage. Apply available load to rated current of the generator. Adjust 'DROOP' control potentiometer to give droop in line with above table. Clockwise rotation increases amount of droop. Refer to Fig 2, Fig 3, for potentiometer location. After adjustment check NO LOAD voltage level and adjust if necessary.

Note 1) Reverse polarity of the C.T. will raise the generator voltage with load. The polarities S1-S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1-S2 to be reversed.

Note 2) The most important aspect is to set all generators equal. The precise level of droop is less critical.

Note 3) A generator operated as a single unit with a droop circuit set at rated load 0.8 power factor is unable to maintain the usual % regulation. A shorting switch can be connected across S1-S2 to restore regulation for single running.

Important ! **LOSS OF FUEL to an engine can cause its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker. LOSS OF EXCITATION to the generator can result in large current oscillations with consequent damage to generator windings. Excitation loss detection equipment should be fitted to trip main circuit breaker.**

6.2.2 ASTATIC CONTROL

The 'droop' current transformer can be used in a connection arrangement which enables the normal regulation of the generator to be maintained when operating in parallel.

This feature is only supplied from the factory as a fitted droop kit, however, if requested at the time of order, the diagrams inside the back cover of this book will give the necessary site connections. The end user is required to provide a shorting switch for the droop current transformer secondary.

Should the generator be required to be converted from standard droop to 'astatic' control, diagrams are available on request.

The setting procedure is exactly the same as for DROOP. (Subsection 6.2.1.1).

Important ! **When using this connection arrangement a shorting switch is required across each C.T. burden (terminals S1 and S2). The switch must be closed a) when a generating set is not running and b) when a generating set is selected for single running.**

SECTION 7

SERVICE AND MAINTENANCE

7.1 WINDING CONDITION

Warning !

Service and fault finding procedures present hazards which can result in severe personal injury or death. Only personal injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures.

Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

Guidance of Typical Insulation Resistance [IR] Values

The following is offered as general information about IR values and is aimed at providing guidance about the typical IR values for generators from new through to the point of refurbishment.

New Machines

The generators Insulation Resistance, along with many other critical factors, will have been measured during the alternator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assemblers works. Where we expect it to be stored in a suitable location protected from adverse environmental conditions.

However, absolute assurance that the generator will arrive at the Gen-set production line with IR values still at the factory test levels of above 100 MΩ cannot be guaranteed.

At Generating Set Manufacturers Works

The generator should have been transported and stored such that it will be delivered to the assembly area in a clean dry condition. If held in appropriate storage conditions the generator IR value should typically be 25 MΩ.

If the unused/new generators IR values fall below 10 MΩ then a drying out procedure should be implemented by one of the processes outlined below before being despatched to the end customer's site. Some investigation should be undertaken into the storage conditions of the generator while on site.

Generators in Service

Whilst It is known that a generator will give reliable service with an IR value of just 1.0 MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

Any temporarily reduction in IR values can be restored to expected values by following one of the drying out procedures.

7.1.1 WINDING CONDITION ASSESSMENT

CAUTION! **The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.**

The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth.

Measurement of winding insulation should be carried out: -

1. As part of a periodic maintenance plan.
2. After prolonged periods of shutdown.
3. When low insulation is suspected, e.g. damp or wet windings.

Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] Insulation Resistance should be established using a low voltage (500V) megger type instrument. If manually powered the handle should initially be turned slowly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

Procedure for Insulation Testing

Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the [RTD's] Resistance Temperature Detection devices if fitted. Short out the diodes on the rotating diode assembly. Be aware of all components connected to the system under test that could cause false readings or be damaged by the test voltage.

Carry out the insulation test in accordance with the 'operating instructions for the test equipment.

The measured value of insulation resistance for all windings to earth and phase to phase should be compared with the guidance given above for the various 'life stages' of a generator. The minimum acceptable value must be greater than 1.0 MΩ.

If low winding insulation is confirmed use one or more of the methods, given below, for drying the winding should be carried out.

7.1.2 METHODS OF DRYING OUT GENERATORS

Cold Run

Consider a good condition generator that has not been run for some time, and has been standing in damp, humid conditions. It is possible that simply running the gen set unexcited - AVR terminals K1 K2 open circuit - for a period of say 10 minutes will sufficiently dry the surface of the windings and raise the IR sufficiently, to greater than 1.0 MΩ , and so allow the unit to be put into service.

Blown Air Drying

Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture.

Direct hot air from two electrical fan heaters of around 1 – 3 kW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid over heating and damage to the insulation.

Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled, 'Typical Drying Out Curve', are met.

Remove the heaters, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest prior to running.

Short Circuit Method

NOTE: This process should only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question.

Ensure the generator is safe to work on, initiate all mechanical and electrical safety procedures pertaining to the genset and the site.

Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.

Disconnect the cables from terminals “X” and “XX” of the AVR.

Connect a variable dc supply to the “X” (positive) and “XX” (negative) field cables. The dc supply must be able to provide a current up to 2.0 Amp at 0 - 24 Volts.

Position a suitable ac ammeter to measure the shorting link current.

Set the dc supply voltage to zero and start the generating set. Slowly increase the dc voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generators rated output current.

After every 30 minutes of this exercise:
Stop the generator and switch off the separate excitation supply, and measure and record the stator winding IR values, and plot the results. The resulting graph should be compared with the classic shaped graph. This drying out procedure is complete when the parameters covered in the section entitled 'Typical Drying Out Curve' are met.

Once the Insulation Resistance is raised to an acceptable level - minimum value 1.0 MΩ – the dc supply may be removed and the exciter field leads “X” and “XX” re-connected to their terminals on the AVR.

Rebuild the genset, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

TYPICAL DRYING OUT CURVE

Whichever method is used to dry out the generator the resistance should be measured every half-hour and a curve plotted as shown. (fig 6.)

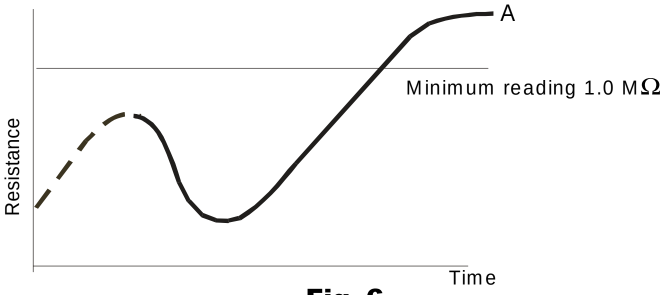


Fig. 6

The illustration shows a typical curve for a machine that has absorbed a considerable amount of moisture. The curve indicates a temporary increase in resistance, a fall and then a gradual rise to a steady state. Point ‘A’, the steady state, must be greater than 1.0 MΩ. (If the windings are only slightly damp the dotted portion of the curve may not appear).

For general guidance expect that the typical time to reach point 'A' will be:

1 hour for a BC16/18,
2 hours for a UC22/27
3 hours for an HC4,5,6&7
Drying should be continued after point “A” has been reached for at least one hour.

It should be noted that as winding temperature increases, values of insulation resistance may significantly reduce. Therefore, the reference values for insulation resistance can only be established with windings at a temperature of approximately 20°C.

If the IR value remains below 1.0 MΩ, even after the above drying methods have been properly conducted, then a Polarisation Index test [PI] should be carried out.

If the minimum value of 1.0 MΩ for all components cannot be achieved rewinding or refurbishment of the generator will be necessary.

The generator must not be put into service until the minimum values can be achieved.

Important ! **The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.**

After drying out, the insulation resistances should be rechecked to verify minimum resistances quoted above are achieved.
On re-testing it is recommended that the main stator insulation resistance is checked as follows:-
Separate the neutral leads

Ground	V and W	phase and megger	U phase to ground
Ground	U and W	phase and megger	V phase to ground
Ground	U and V	phase and megger	W phase to ground

If the minimum value of 1.0MΩ is not obtained, drying out must be continued and the test repeated.

7.2 BEARINGS

All bearings are supplied sealed for life and are, therefore, not regreasable.

Important ! **The life of a bearing in service is subject to the working conditions and the environment**.

Important ! **Long stationary periods in an environment where there is vibration can cause false brinnelling which puts flats on the ball and grooves on the races.**
Very humid atmospheres or wet conditions can emulsify the grease and cause corrosion.

Important ! **High axial vibration from the engine or misalignment of the set will stress the bearing.**

The bearing, in service, is affected by a variety of factors that together will determine the bearing life. We recommend that the health of the bearings be monitored, using ‘spike energy’ vibration monitoring equipment. This will allow the timely replacement of bearings, that exhibit a deteriorating trend, during a major engine overhaul.

If excessive heat, noise or vibration is detected, change the bearing as soon as practicable. Failure to do so could result in bearing failure.

In the event that ‘spike energy’ vibration monitoring equipment is not available, it is strongly recommend that consideration be given to changing the bearing during each ‘major engine overhaul’.

Belt driven application will impose an additional load on bearings. The bearing life will therefore be significantly affected. It is important that the side load limits given in SECTION 3 are not exceeded and the health of the bearing is monitored more closely.

7.3 AIR FILTERS

Danger !

Removal of filter elements enables access to LIVE parts. Only remove elements with the generatorout of service.

The frequency of filter maintenance will depend upon the severity of the site conditions. Regular inspection of the elements will be required to establish when cleaning is necessary.

7.3.1 CLEANING PROCEDURE

Remove the filter elements from the filter frames. Immerse or flush the element with a suitable degreasing agent until the element is clean.

Alternatively, after removing the filter elements a high pressure water hose with a flat nozzle can be used. Sweep the water spray back and forth across the element from the clean side (fine mesh side of element) hoding the nozzle firmly against the element surface. Cold water may be adequate depending upon type of contamination although hot water is preferable.

The element can be inspected for cleanliness by looking through the filter towards the light. When thoroughly clean, no cloudy areas will be seen.
Dry elements thoroughly before attempting to carry out the recharging procedure.

7.3.2 RECHARGING (Charging)

Charging is best done by totally immersing the dry element into a dip tank containing "Filterkote Type K" or commercial lubricating oil SAE 20/50. Oils of higher or lower viscosity are not recommended.

Allow elements to completely drain before refitting the elements into the frames and putting into service.

7.4 FAULT FINDING

Important ! **Before commencing any fault finding procedures examine all wiring for broken or loose connections.**

Three excitation control systems can be fitted to the range of generators covered by this manual, identified by the last digit of the generator frame size designation. Refer to the nameplate then proceed to the appropriate subsection as indicated below:-

SERIES	EXCITATION CONTROL	SUBSECTION
4	SA465 AVR	7.4.1
5	Transformer control	7.4.2
6	SX460 AVR	7.4.1

7.4.1 ALL AVR TYPES - FAULT FINDING

No voltage build-up when starting set	1. Check speed 2. Check residual voltage. - Refer to subsection 7.4.3. 3. Follow separate excitation test procedure to check generator and AVR. Refer to subsection 7.5.
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow separate excitation procedure to check generator and AVR. Refer to subsection 7.5.

7.4.2 TRANSFORMER CONTROL - FAULT FINDING

No voltage build-up when starting set	1. Check transformers rectifiers. 2. Check transformer secondary winding for open circuit.
Low voltage	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2.
High voltage	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2. 3. Check transformer secondary winding for short circuited turns.
Excessive voltage drop on-load	1. Check speed drop on-load. 2. Check transformer rectifiers. Check transformer air gap setting. Refer to subsection 4.7.2.

7.4.3 RESIDUAL VOLTAGE CHECK (Field Flashing)

This procedure applies to all generators fitted with AVR control. With the generator set stationary remove AVR access cover and leads F1 and F2 from the AVR.

Start the set and measure voltage across AVR terminals 7-8. A minimum level of 5 volts is required at these terminals. If the voltage is less than 5 volts stop the set,because it will be necessary to carry out the following **Field Flashing** procedure. Replace leads F1 and F2 on the AVR terminals. Using a 12 volt d.c. battery as a supply, clip leads from battery negative to AVR terminal F2, and from battery positive through a diode to AVR terminal F1. See Fig 5.

Important ! **A diode must be used as shown below to ensure the AVR is not damaged.**

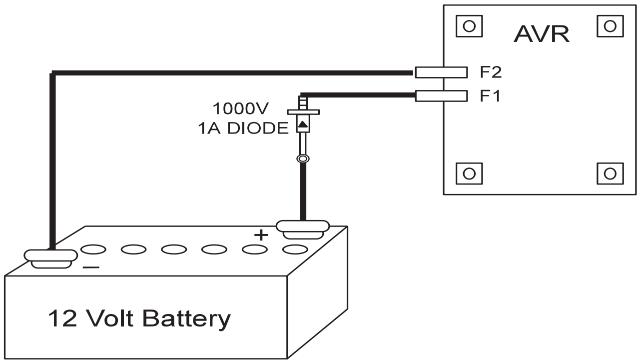


Fig. 5

Important ! **If the generating set battery is used for field flashing, the generator main stator neutral must be diconnected from earth.**

Restart the set and note output voltage from the main stator, which should be approximately nominal voltage, or voltage at AVR terminals 7 and 8 which should be between 170 and 250 volts.

Stop the set and unclip battery supply from terminals F1 and F2. Restart the set. The generator should now operate normally. If no voltage build-up is obtained it can be assumed a fault exists in either the generator or the AVR circuits. Follow the SEPARATE EXCITATION PROCEDURE to check generator windings, rotating diodes and AVR. Refer to subsection 7.5.

7.5 SEPARATE EXCITATION TEST PROCEDURE

The generator windings, diode assembly and AVR can be checked using this procedure.

1. With the generating set stationary remove AVR access cover and leads F1 and F2 from the AVR. On transformer controlled generators remove the terminal box lid for access and remove leads F1 and F2 from the control rectifier bridge.

2. Connect a 60W 240 volt household lamp (or two 120V lamps in series) to AVR terminals F1 and F2. (Only required for section 7.5.2.1). On transformer controlled generators refer to sub section 7.5.2.2 for transformer checks.
3. Connect a 0-12 volt, 1.0 Amp d.c. supply to leads F1 and F2. The positive of the d.c. supply is connected to the lead marked F1 and the negative to the lead marked F2.

The procedure is simplified by dividing into two sections:

7.5.1 GENERATOR WINDINGS AND ROTATING DIODES, and

7.5.2 EXCITATION CONTROL TEST.

7.5.1 GENERATOR WINDINGS AND ROTATING DIODES

Important! **The resistances quoted apply to a standard winding. For generators having windings or voltages other than those specified refer to factory for details. Ensure all disconnected leads are isolated and free from earth.**

This procedure is carried out with leads F1 and F2 disconnected at the AVR or transformer control rectifier bridge and using a 12 volt d.c. supply to leads F1 and F2.

Start the set and run at rated speed, on no-load.

Measure the voltages at the main output terminals U, V and W. These should be balanced and within 10% of the generator nominal voltage.

On generators fitted with an auxiliary winding in the main stator, applicable only with the SA665 AVR, the voltage at AVR terminals 8 and Z2 should be approximately 150 volts a.c.

7.5.1.1 BALANCED MAIN TERMINAL VOLTAGES

If all voltages are balanced within 1% at the main terminals, it can be assumed that all exciter windings, main windings and main rotating diodes are in good order, and the fault is in the AVR or transformer control. Refer to subsection 7.5.2 for test procedure.

If voltages are balanced but low, there is a fault in the main excitation windings or rotating diode assembly. Proceed as follows to identify:-

Rectifier Diodes

The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions.

Replacement of Faulty Diodes

The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries 3 diodes, the negative plate carrying negative biased diodes and the positive plate carrying positive biased diodes. Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate. When fitting the diodes to the plates they must be tight enough to ensure a good mechanical and electrical contact, but should not be overtightened. The recommended torque tightening is 4.06 - 4.74Nm (36-42lb in).

Surge Suppressor

The surge suppressor is a metal-oxide varistor connected across the two rectifier plates to prevent high transient reverse voltages in the field winding from damaging the diodes. This device is not polarised and will show a virtually infinite reading in both directions with an ordinary resistance meter. If defective this will be visible by inspection, since it will normally fail to short circuit and show signs of disintegration. Replace if faulty.

Main Excitation Windings

If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Resistance Charts), as the fault must be in one of these windings. The exciter stator resistance is measured across leads F1 and F2. The exciter rotor is connected to six studs which also carry the diode lead terminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

Resistance values should be within 10% of the values given in the table below:-

Frame Size	Main Rotor	Exciter Stator			Exciter Rotor
		Type 1	Type 2*	Type 3**	
BC164A	0.44	19	26	110	0.26
BC164B	0.48	19	26	110	0.26
BC164C	0.52	19	26	110	0.26
BC164D	0.56	19	26	110	0.26
BC184E	0.64	20	27	115	0.21
BC184F	0.74	22	30	127	0.23
BC184G	0.83	22	30	127	0.23
BC184H	0.89	24	-	-	0.24
BC184J	0.96	24	-	-	0.24
BC162D	0.81	18	-	-	0.26
BC162E	0.89	18	-	-	0.26
BC162F	0.95	18	-	-	0.26
BC162G	1.09	19	-	-	0.27
BC182H	1.17	20	-	-	0.21
BC182J	1.28	20	-	-	0.21
BC182K	1.4	20	-	-	0.21
BCA162L	1.55	20	-	-	0.21

* Used with 1 phase transformer controlled 3 phase or 1 phase generators

** Used with 3 phase transformer controlled 3 phase generators.

Generators fitted with auxiliary stator windings.

Frame Size	Main Rotor	Exciter Stator	Exciter Rotor
BC184E	0.64	8	0.21
BC184F	0.74	8	0.23
BC184G	0.83	8	0.23
BC184H	0.89	8	0.24
BC184J	0.96	8	0.24

Incorrect resistances indicate faulty windings and component replacement is necessary. Refer to removal and replacement of component assemblies, subsection 7.5.3.

7.5.1.2 UNBALANCED MAIN TERMINAL VOLTAGES

If voltages are unbalanced, this indicates a fault on the main stator winding or main cables to the circuit breaker. NOTE: Faults on the stator winding or cables may also cause noticeable load increase on the engine when excitation is applied. Disconnect the main cables and separate the winding leads U1-U2, U5-U6, V1-V2, V5-V6, W1-W2, W5-W6 to isolate each winding section.

Measure each section resistance - values should be balanced and within 10% of the value given below:-

AVR CONTROLLED GENERATORS			
Frame Size	SECTION RESISTANCES		
	Winding 311	Winding 05	Winding 06
BC164A	0.81	0.41	0.31
BC164B	0.51	0.30	0.19
BC164C	0.36	0.21	0.13
BC164D	0.3	0.32	0.21
BC184E	0.20	0.20	0.13
BC184F	0.13	0.14	0.09
BC184G	0.11	0.11	0.07
BC184H	0.085	0.041	0.029
BC184J	0.074	0.034	0.024
BC162D	0.68	0.30	0.25
BC162E	0.42	0.21	0.15
BC162F	0.31	0.17	0.11
BC162G	0.21	0.10	0.095
BC182H	0.16	0.075	0.055
BC182J	0.13	0.06	0.042
BC182K	0.10	0.047	0.030
BCA162L	0.65	0.03	0.02

Generators fitted with auxiliary stator windings.

AVR CONTROLLED GENERATORS		
Frame Size	AVR CONTROLLED GENERATORS	
	Main Stator Winding 71	Auxilliary
BC184E	0.19	1.88
BC184F	0.13	1.44
BC184G	0.1	1.32
BC184H	0.08	-
BC184J	0.066	-

TRANSFORMER CONTROLLED GENERATORS							
SECTION RESISTANCES							
Frame Size	3 Phase Windings					1 Phase Windings	
	380V	400V	415V	416V	460V	240V	240V
BC164A	2.4	2.56	2.62	1.98	2.36	0.37	0.25
BC164B	1.68	1.75	1.81	1.36	1.7	0.26	0.17
BC164C	1.16	1.19	1.21	0.91	1.16	0.17	0.12
BC164D	0.83	0.84	0.87	0.74	0.93	0.28	0.22
BC184E	0.59	0.60	0.63	0.48	0.61	0.16	0.12
BC184F	0.41	0.43	0.45	0.35	0.43	0.15	0.08
BC184G	0.33	0.34	0.36	0.26	0.33	0.09	0.07
BC184H	-	-	-	-	-	-	-
BC184J	-	-	-	-	-	-	-

Measure insulation resistance between sections and each section to earth.

Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary. Refer to removal and replacement of component assemblies subsection 7.5.3.

7.5.2 EXCITATION CONTROL TEST

7.5.2.1 AVR FUNCTION TEST

All types of AVR'S can be tested with this procedure:

1. Remove exciter field leads X &XX (F1 & F2) from the AVR terminals X & XX (F1 & F2).
2. Connect a 60W 240V household lamp to AVR terminals X & XX (F1 & F2).
3. Set the AVR VOLTS control potentiometer fully clockwise.
4. Connect a 12V, 1.0A DC supply to the exciter field leads X & XX (F1 & F2) with (F1) to the positive.
5. Start the generating set and run at rated speed.
6. Check that the generator output voltage is within +/- 10% of rated voltage.

Voltages at AVR terminals 7-8 on SX460 AVR or P2-P3 on SX421 AVR SHOULD BE BETWEEN 170 AND 250 VOLTS. If the generator output voltage is correct but the voltage on 7-8 (or P2-P3) is low, check auxiliary leads and connections to main terminals.

The lamp connected across X-XX should glow. In the case of the SX460 and SA465 AVRs the lamp should glow continuously. Failure to turn off indicates faulty protection circuit and the AVR should be replaced. Turning the "VOLTS" control potentiometer fully anti-clockwise should turn off the lamp with all AVR types.

Should the lamp fail to light the AVR is faulty and must be replaced.

Important ! **After this test turn the VOLTS control potentiometer fully anti-clockwise.**

7.5.2.2 TRANSFORMER CONTROL

The transformer rectifier unit can only be checked by continuity, resistance checks and insulation resistance measurement.

Rectifier Diodes

Separate primary leads T1-T2-T3-T4 and secondary leads 10-11. Examine windings for damage. Measure resistances across T1-T2 and T3-T4. These will be a low value but should be balanced. Check that there is resistance in the order of 5 ohms between leads 10 and 11. Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary resistance, open or short circuited winding sections, indicates the transformer unit should be replaced.

Three phase transformer

Separate primary leads T1-T2-T3 and secondary leads 6-7-8 and 10-11-12.

Examine windings for damage. Measure resistances across T1-T2, T2-T3, T3-T1. These will be low but should be balanced. Check that resistances are balanced across 6-10, 7-11 and 8-12 and in the order of 8 ohms.

Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary or secondary winding resistances, open or short circuited winding sections indicates the transformer unit should be replaced.

Rectifier units - Three phase and single phase

With the leads 10-11-12-F1 and F2 removed from the rectifier unit (lead 12 is not fitted on single phase transformer rectifier units), check forward and reverse resistances between terminals 10-F1, 11-F1, 12-F1, 10-F2, 11-F2 and 12-F2 with a multimeter.

A low forward resistance and high reverse resistance should be read between each pair of terminals. If this is not the case the unit is faulty and should be replaced.

7.5.3 REMOVAL AND REPLACEMENT OF COMPONENT ASSEMBLIES

Important ! **The following procedures assume that the generator has been removed from the generating set.**
On single bearing generators before removal from the engine, position the rotor such that a full pole face is at bottom dead centre. Use engine pulley to turn rotor.
Metric threads are used throughout.

Caution ! **When lifting single bearing generators, care is needed to ensure the generator frame is kept in the horizontal plane. The rotor is free to move in the frame and can slide out if not correctly lifted. Incorrect lifting can cause serious personal injury.**

7.5.3.1 REMOVAL OF BEARINGS

Important ! **Position the main rotor so that a full pole face of the main rotor core is at the bottom of the stator bore.**

Removal of bearings may be effected either after the rotor assembly has been removed or simply by removal of endbracket(s).

Refer to main rotor assembly section 7.5.3.2.
The bearings are pre-packed with grease and sealed for life.

1. The bearing(s) are a press fit on the shaft and can be removed with standard tooling, i.e. 2 or 3 legged manual or hydraulic bearing pullers.
2. Remove circlip from shaft at non drive end (only fitted on single bearing machines).

When fitting new bearings use a bearing heater to expand the bearing before fitting to the shaft. Tap the bearing into place ensuring that it contacts the shoulder on the shaft.

Refit the retaining circlip on single bearing generators.

7.5.3.2 MAIN ROTOR ASSEMBLY

Single Bearing Generator

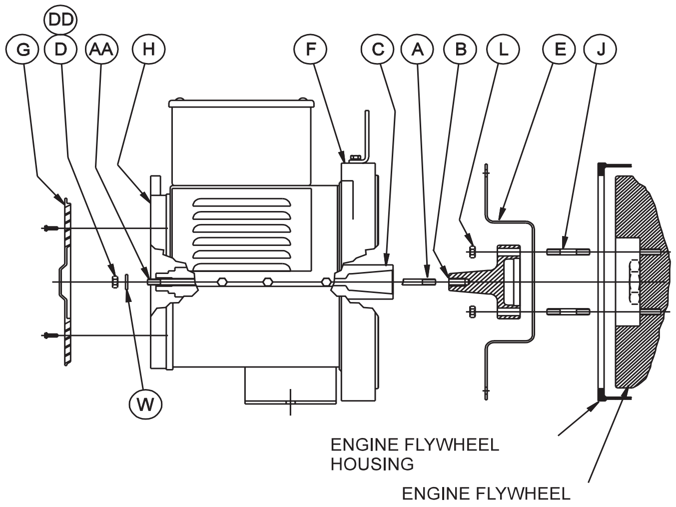
1. Remove four screws securing louvred cover at non drive end and remove cover.
2. Remove the screws and covers on each side of adaptor.
3. Ensure that rotor is supported at D.E. on a sling.
4. Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and its retaining 'O' ring.
5. Continue to push rotor through stator bore, gradually moving sling along rotor as it is withdrawn, to ensure full support at all times.

Important ! **When re-assembing position the rotor such that full pole face is at bottom dead centre.**

Two Bearing Generator

1. Remove eight bolts securing the close coupling adaptor to the drive endbracket.
2. Tap off adaptor after supporting weight with sling.
3. Remove the screens and louvres (if fitted) on either side of drive end adaptor. Turn rotor until a full pole face is at bottom dead centre.
4. Remove eight cap head screws securing the drive end bracket to the drive end adaptor.
5. Tap off drive end bracket from drive end adaptor.
6. Support rotor at drive end with a sling.
7. Remove four screws securing louvred cover at non-drive end and remove cover.
8. Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and its retaining 'O' ring.
9. Continue to push rotor through stator bore, gradually moving sling along rotor, as it is withdrawn, to ensure full support at all times.

Tapered Shaft Generator (BCL)



1. Remove louvred endcover 'G' from non drive endbracket 'H'.
2. Remove M10 "BINX" self locking nut "DD".
3. The shaft securing stud "AA" has been treated with a thread locking agent before being screwed into the stub shaft "B". This may make removal of shaft securing stud "AA" difficult.
4. If the shaft securing stud "AA" can be removed follow steps 5 to 12 to remove generator from engine.

   If the shaft securing stud "AA" cannot be removed follow steps 13 to 18 to remove complete generator from engine.
5. Locate a steel rectangular bar (or similar), with a central 15mm. hole, flush with rear vertical face of non-drive endbracket 'H'. Ensure that hole is aligned with tapped hole in shaft end.
6. Insert M14 X 25 hex. bolt through bar hole and screw into shaft end.

   The rotor will be drawn towards non-drive end thus releasing contact with engine taper stub shaft.
7. Remove M14 X 25 hed. hd. bolt.
8. Remove 10 bolts securing adaptor to engine.
9. Withdraw generator from engine.
10. Ensure rotor is supported at D.E. on a sling.
11. Tap the rotor from non-drive end bearing housing to push the bearing clear of the endbracket and a retaining 'O' ring.
12. Continue to push rotor through stator bore, gradually moving sling along rotor as it is withdrawn, to ensure full support at all times.
13. If it has not been possible to remove the shaft securing stud the following procedure is necessary.
14. Remove the 10 bolts securing adaptor to engine.
15. Using a hide mallet tap the sides of the non drive end bracket in order to release the generator adaptor from engine fly wheel housing spigot.
    Sometimes it is possible that the action of taping the sides of the non drive end bracket with the hide mallet will in fact free the taper-lock of the rotor shaft to stub shaft.
16. If stator frame assembly is freed from the engine flywheel housing, yet the rotor is still firmly fixed to the stub shaft the stator frame assembly should be supported by a crane and carefully pulled back over the rotor assembly, taking care not to damage any winding outhangs.
17. With the rotor now exposed it will be possible to apply a sharp blow to the rotor pole face with a hide mallet to shock the rotor free of the taper stub shaft.

    It may be necessary to apply the sharp blow to more than just one rotor pole.

    To ensure the rotor when released cannot fall and do damage, the M10 binx nut should be re-fitted finger tight to the shaft securing stud leaving at least some 2 mm clearance between nut and rotor shaft end face.
18. With the "Taper Lock" now broken the rotor can be removed from the stub-shaft, once the binx nut has been removed.

Care should be taken to ensure the rotor weight can be supported during removal in a manner which ensures no damage will occur to the rotor assembly.

Replacement of rotor assemblies is a reversal of the procedures above.

7.5.3.3 RE-ASSEMBLY OF GENERATOR ENGINE

Before commencing re-assembly, components should be checked for damage and bearing(s) examined for loss of grease.

Fitting of new bearing(s) is recommended during major overhaul.

Before re-assembling to the engine drive shafts and couplings or drive disc shold be checked for damage or wear.

Where fitted the drive disc should be examined for cracks, signs of fatigue or elongation of fixing holes.

Ensure that the disc to shaft end fixing bolts are fitted with the pressure plate and are torque tightened to 7.6Kgm (75Nm 55lbs.ft).

Taper shaft drive end arrangements should be checked for damage to the taper on both shaft and coupling hub. Ensure both tapers are free from oil before refitting.

Refer to 4.2.3. for assembly to engine.

NOTE:
The M10 "BINX" nut should always be renewed. Tightening torque 4.6Kgm; (45Nm; 33lbs.ft.)

Damaged or worn components must be replaced.

7.6 RETURNING TO SERVICE

After rectification of any faults found, remove all test connections and reconnect all control system leads.

Restart the set and adjust VOLTS control potentiometer on AVR by slowly turning clockwise until rated voltage is obtained.

Refit all terminal box covers/access covers and reconnect heater supply.

Caution! **Failure to refit all guards, access covers and terminal box covers can result in personal injury or death.**

SECTION 8

SPARES AND AFTER SALES SERVICE

8.1 RECOMMENDED SPARES

Service parts are conveniently packaged for easy identification. Genuine parts may be recognised by the Nupart name.

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

8.1.1 AVR CONTROLLED GENERATORS

1.	Diode Set (6 diodes with surge suppressor)	**RSK**	**1101**
2.	SA465 AVR	**E000**	**24650**
	SX460 AVR	**E000**	**24602**
3.	Non drive end Bearing	**051**	**01058**
4.	BC16 & BC18 Drive end Bearing	**051**	**01032**

8.1.2 TRANSFORMER CONTROLLED GENERATORS

1.	Diode Set (6 diodes with surge suppressor)	**RSK**	**1101**
2.	Diode Assembly	**E000**	**22006**
3.	Non drive end Bearing	**051**	**01058**
4.	BC16 & BC18 Drive end Bearing	**051**	**01032**

When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description. For location of these numbers see paragraph 1.4.

Orders and enquiries for parts should be addressed to:

Newage International Limited
Nupart Department
PO Box 17, Barnack Road
STAMFORD
Lincolnshire
PE9 2NB
ENGLAND

Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 766074

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

8.1.3 ASSEMBLY TOOLS

Locating Bar (Single Bearing)	AF1609.
8mm Rachet Box Wrench (for M10 socket screws)	AF1599.

8.2 AFTER SALES SERVICE

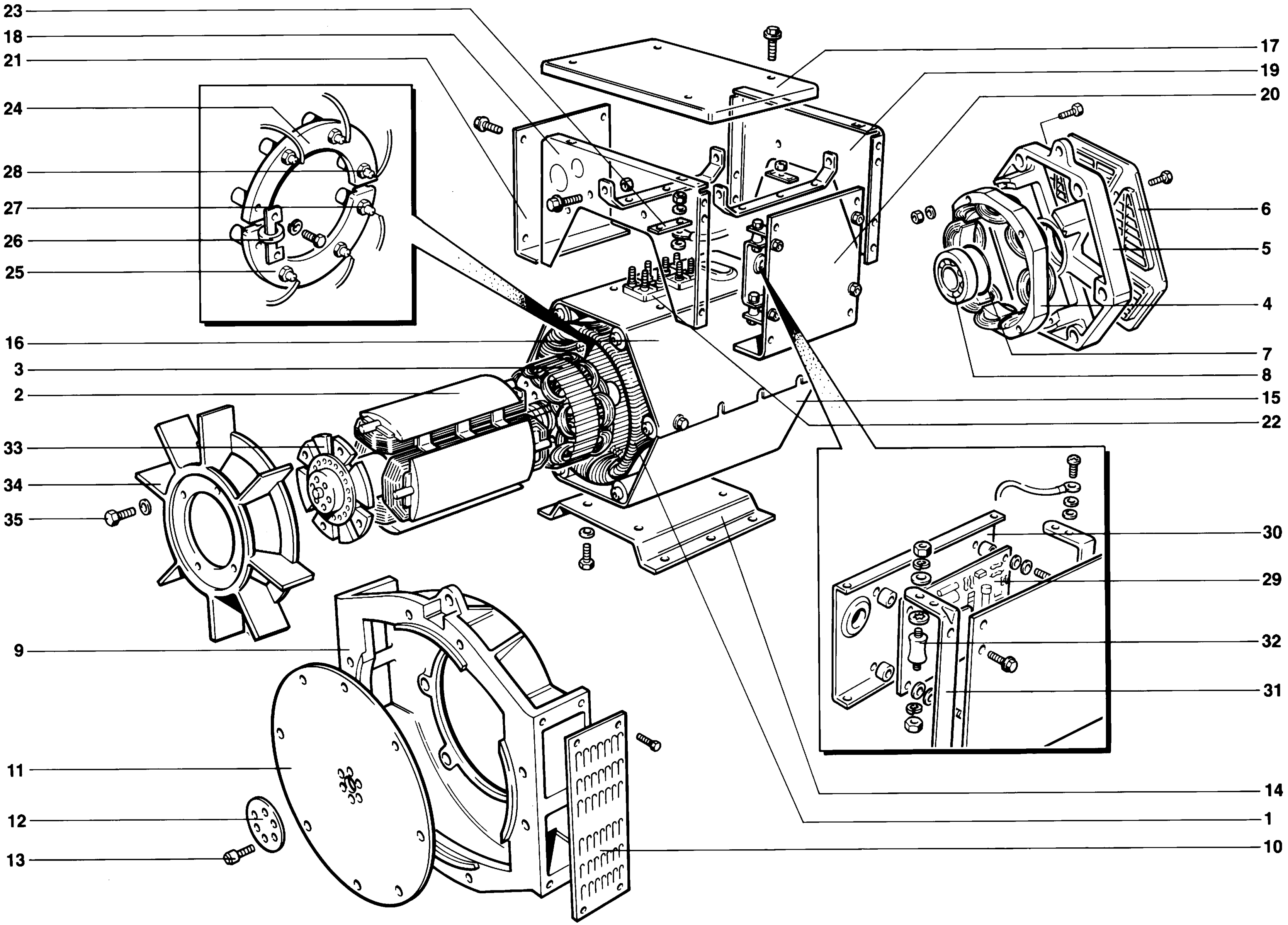
A full technical advice and on-site service facility is available from our Service Department at Stamford or through our Subsidiary Companies. A repair facility is also available at our Stamford Works.

PARTS LIST
TYPICAL SINGLE BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode Reverse Polarity
4	Exciter Stator	28	Diode Forward Polarity
5	N.D.E. Endbracket	29	AVR
6	Cover N.D.E.	30	AVR Mounting Plate
7	Bearing 'O' Ring N.D.E.	31	AVR Mounting Bracket
8	Bearing N.D.E.	32	AVM
9	D.E. Adaptor	33	Fan Hub
10	D.E. Screen	34	Fan
11	Coupling Hub	35	Fan Securing Screw
12	Pressure Plate		
13	Coupling Bolt		
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Terminal Box Lid		
18	Endpanel D.E.		
19	Endpanel N.D.E.		
20	Side Panel (AVR)		
21	Side Panel		
22	Main Terminal Panel		
23	Terminal Link		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
AVR	Automatic Voltage Regulator
AVM	Anti-Vibration Mount

Fig. 6
TYPICAL SINGLE BEARING GENERATOR

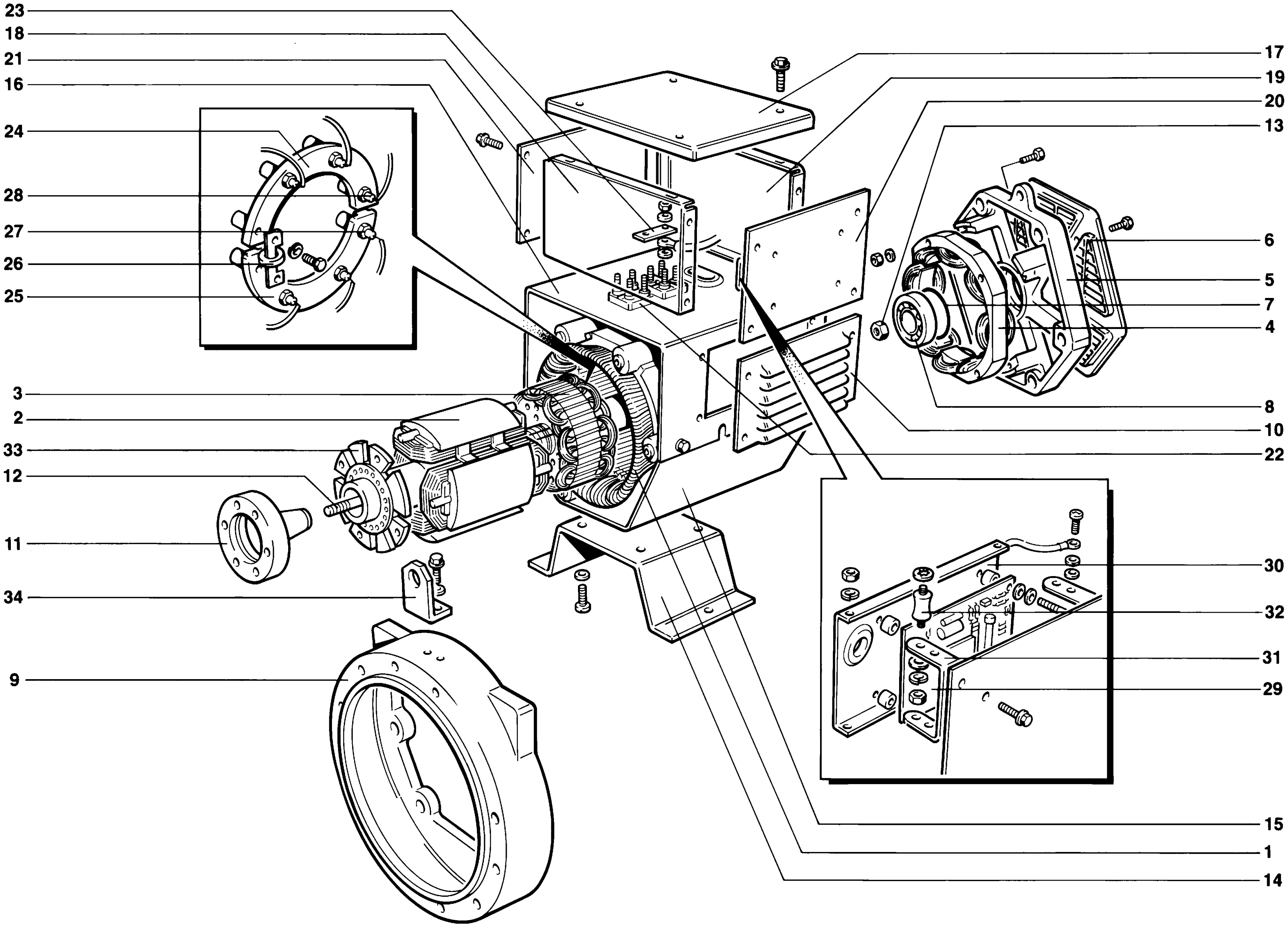


PARTS LIST
TYPICAL SINGLE BEARING GENERATOR - TAPER SHAFT ARRANGEMENT (BCL)

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode Reverse Polarity
4	Exciter Stator	28	Diode Forward Polarity
5	N.D.E. Endbracket	29	AVR
6	Cover N.D.E.	30	AVR Mounting Plate
7	Bearing 'O' Ring N.D.E.	31	AVR Mounting Bracket
8	Bearing N.D.E.	32	AVM
9	D.E. Adaptor	33	Fan Hub (For Balancing Purposes Only)
10	Air Intake Side Panel	34	Lifting Lug
11	Coupling Hub		
12	Rotor Shaft Stud		
13	Binx Nut		
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Terminal Box Lid		
18	Endpanel D.E.		
19	Endpanel N.D.E.		
20	Side Panel (AVR)		
21	Side Panel		
22	Main Terminal Panel		
23	Terminal Link		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
L.A.	Drive End
PMG	Permanent Magnet Generator
AVR	Automatic Voltage Regulator

Fig. 7.
TYPICAL SINGLE BEARING GENERATOR - TAPER SHAFT ARRANGEMENT (BCL)

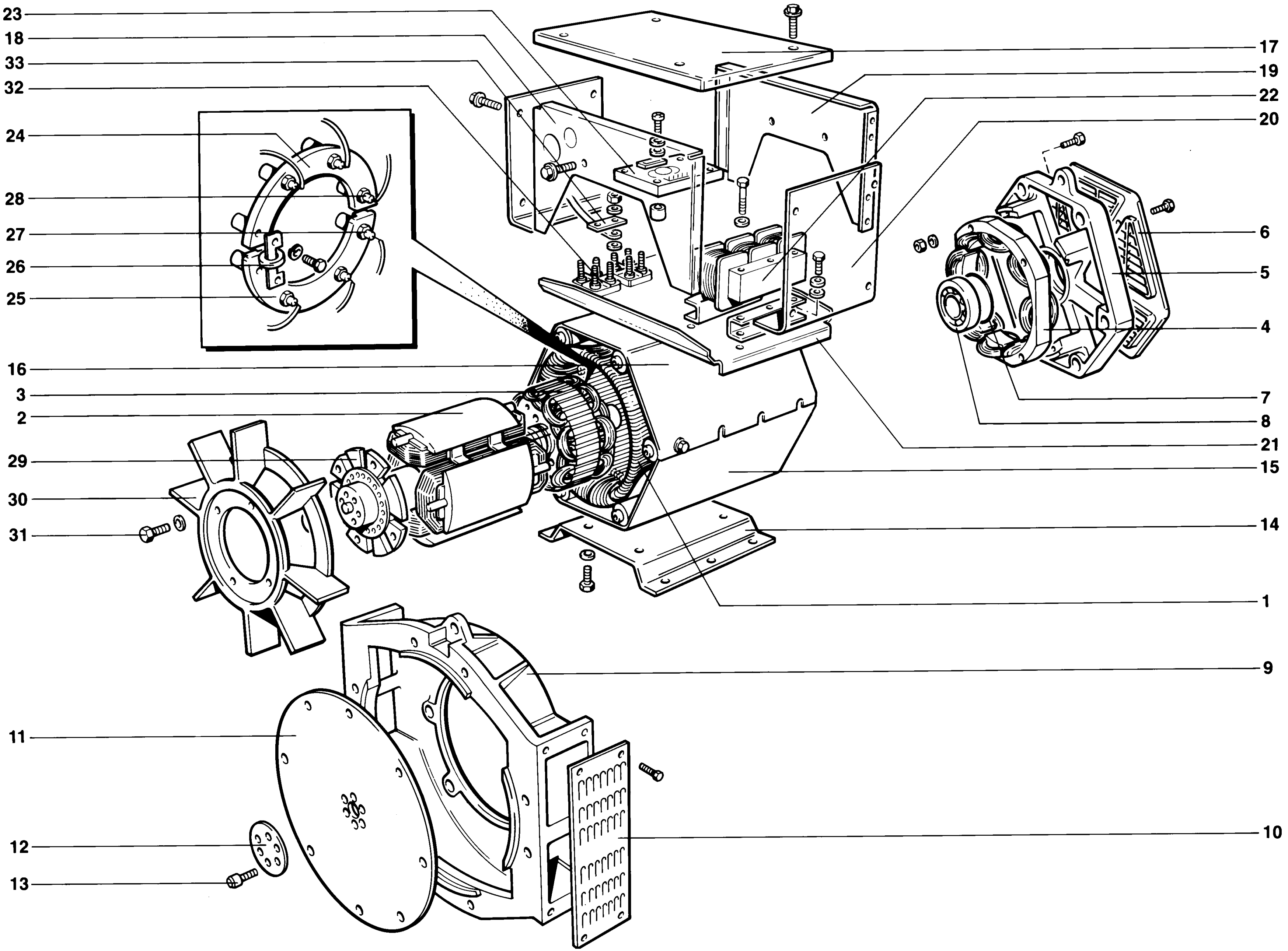


PARTS LIST
TYPICAL SINGLE BEARING (SERIES 5) TRANSFORMER CONTROLLED GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode Reverse Polarity
4	Exciter Stator	28	Diode Forward Polarity
5	N.D.E. Endbracket	29	Fan Hub
6	Cover N.D.E.	30	Fan
7	Bearing 'O' Ring N.D.E.	31	Fan Securing Screw
8	Bearing N.D.E.	32	Main Terminal Panel
9	D.E. Adaptor	33	Terminal Link
10	D.E. Screen		
11	Coupling Disc		
12	Pressure Plate		
13	Coupling Bolt		
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Terminal Box Lid		
18	Endpanel D.E.		
19	Endpanel N.D.E.		
20	Side Panel		
21	Mounting Plate (Series 5)		
22	Transformer Control Assembly (Series 5)		
23	Control Rectifier Assembly		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End

Fig. 8.
TYPICAL SINGLE BEARING (SERIES 5) TRANSFORMER CONTROLLED GENERATOR



PARTS LIST
TYPICAL TWO BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode Reverse Polarity
4	Exciter Stator	28	Diode Forward Polarity
5	N.D.E. Endbracket	29	AVR
6	Cover N.D.E.	30	AVR Mounting Plate
7	Bearing 'O' Ring N.D.E.	31	AVR Mounting Bracket
8	Bearing N.D.E.	32	AVM
9	Bearing D.E.	33	Fan Hub
10	Bearing Wave Washer D.E.	34	Fan
11	D.E. Screen	35	Fan Securing Screw
12	D.E. Adaptor		
13	D.E. Endbracket		
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Terminal Box Lid		
18	Endpanel D.E.		
19	Endpanel N.D.E.		
20	Side Panel (AVR)		
21	Side Panel		
22	Main Terminal Panel		
23	Terminal Link		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
AVR	Automatic Voltage Regulator
AVM	Anti-Vibration Mount

Fig. 9.
TYPICAL TWO BEARING GENERATOR

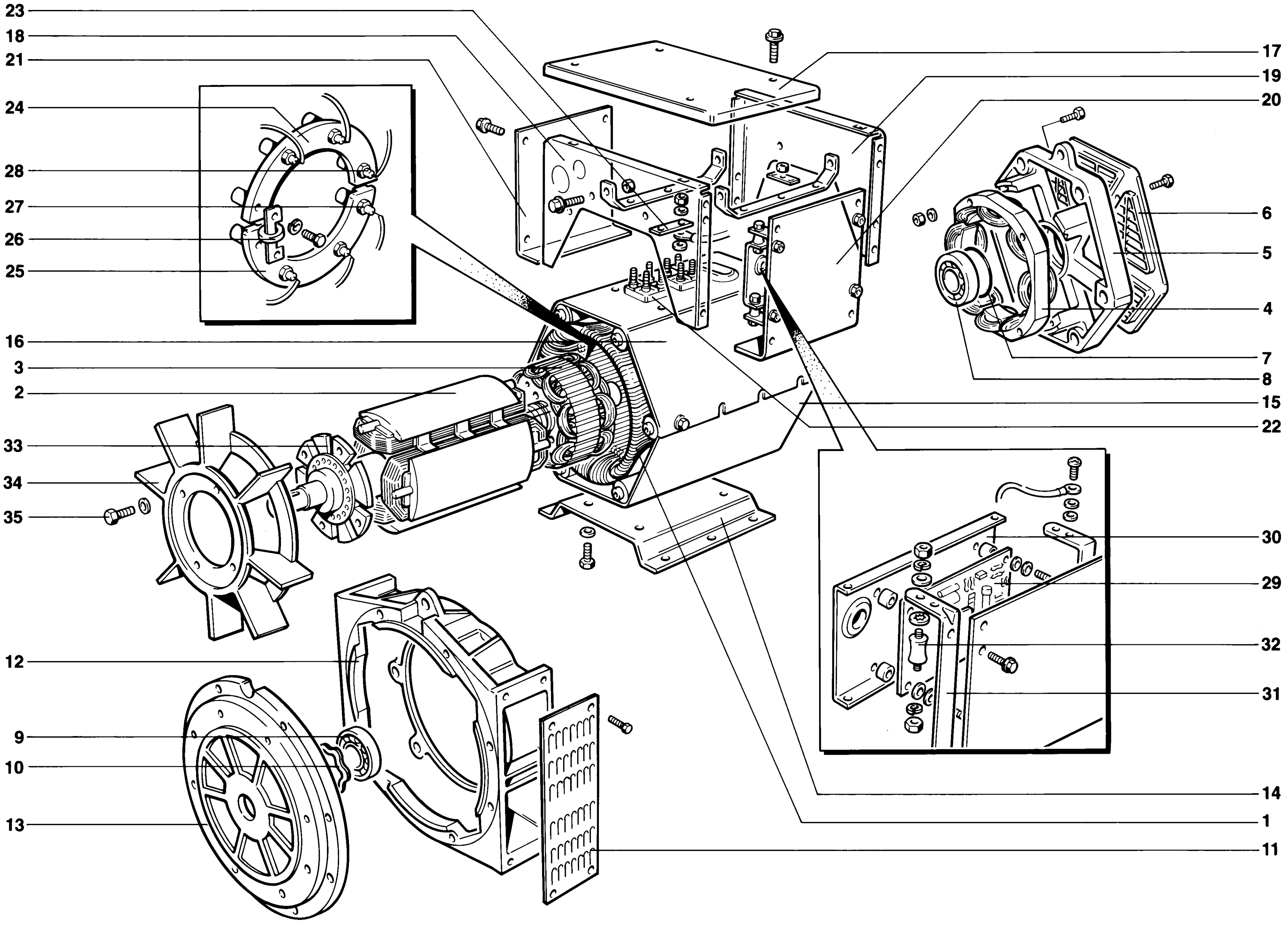


Fig. 10.
ROTATING RECTIFIER ASSEMBLY

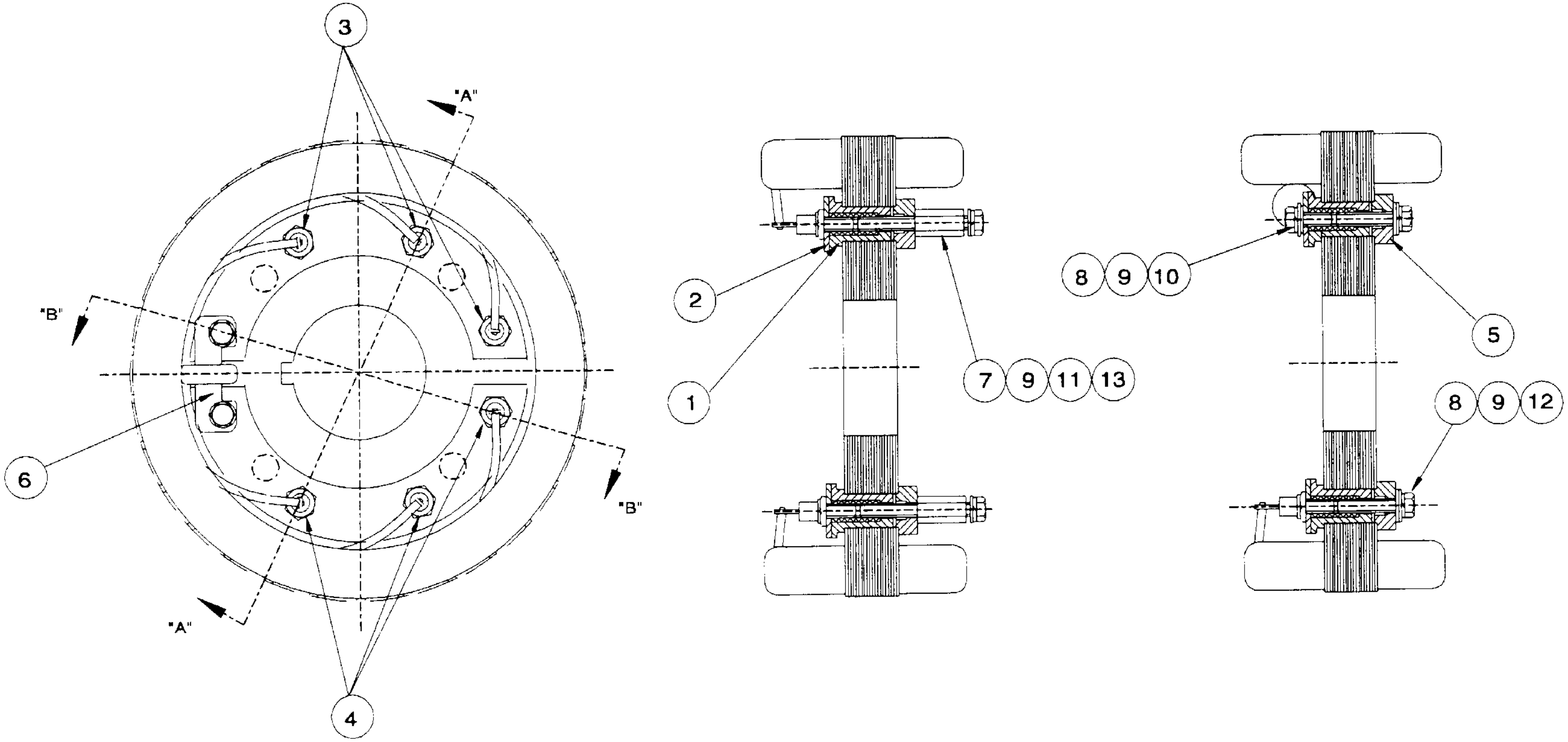


Plate Ref.	Description	Quantity
1	Diode Hub	2
2	Rectifier Fin	2
3	Forward Diode	3
4	Reverse Diode	3
5	Insulating Washer	4
6	Varistor	1
7	M5 Plain Washer	2
8	M5 Plain Washer (Large)	6
9	M5 Lockwasher	6
10	Tornillo hex.	2
11	No. 10 UNF Brass Screw	2
12	No. 10 UNF Brass Screw	2
13	Spacer	2

NOTE:
Underside of diodes to be smeared with Midland Silicons Heat Sink compund type MS2623 Newage Code No 030-02318. This compound must not be applied to diode thread.

Diodes to be tightened to a torque load of 2.03\2.37Nm.

Strip insulation for 10mm from end of cable. If conductor is un-tinned this section should be tinned before threading through hole in diode tag solder in accordance with DD15500.

This manual is available in the following languages on request:
English, French, German, Italian and Spanish.

Denne manual er til rådighed på følgende sprog: engelsk, fransk, tysk, italiensk og spansk.

Denne håndboken er tilgjengelig på de følgende språkene: engelsk, fransk, tysk, italiensk og spansk.

Sur simple demande, ce manuel vous sera fourni dans l'une des langues suivantes: anglais, français, allemand, italien, espagnol.

Dieses Handbuch ist auf Anfrage in den folgenden Sprachen erhältlich: Englisch, Französisch, Deutsch, Italienisch, Spanisch.

Deze handleiding is op verzoek leverbaar in de volgende talen: Engels, Frans, Duits, Italiaans, Spaans.

Este manual pode também ser obtido nas seguintes línguas: inglês, francês, alemão, italiano e espanhol.

Tämä käsikirja on saatavissa pyynnöstä seuraavilla kielillä: Englanti, ranska, saksa, italia, espanja.

Il presente manuale è disponibile, su richiesta, nelle seguenti lingue: inglese, francese, tedesco, italiano e spagnolo.

Este manual también puede solicitarse en los siguientes idiomas: inglés, francés, alemán, italiano e español.

Αυτό το εγχειρίδιο οδηγιών χρήσεως διατίθεται στις ακόλουθες γλώσσες κατόπιν αιτήσενς: Αγγλικά, Γαλλικά Γερμανικά, Ιταλικά, Ισπανικά.

A.C. GENERATOR WARRANTY

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 N.I. or twelve months from the date of first commissioning (whichever is the shorter period).

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, or our works or, if appropriate to the Dealer who supplied the goods.

Any part repaired or replaced, under warranty, will be returned by N.I. 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 N.I. recommended installation practices as detailed in the publications 'N.I. Installation, Service and Maintenance Manual' and 'N.I. 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 fully particulars of the alleged defect, the description of the goods, the date of 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.

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SP240

Section 5 - GE Fanuc PLC

GE Fanuc Automation

Series 90™-30 PLCs

The Series 90™-30 PLCs are a family of controllers, I/O systems and specialty modules designed to meet the demand for versatile industrial solutions. With its single overall control architecture, the Series 90-30 has been the PLC of record in over 200,000 applications, such as high-speed packaging, material handling, complex motion control, water treatment, continuous emissions monitoring, mining, food processing, elevator control, injection molding and many more.

Thanks to its modular design, the Series 90-30 offers unmatched versatility. Configure just the system you need, saving critical space and reducing cost.

With over 100 I/O modules, the Series 90-30 PLC can be adapted to a wide range of applications.

- Digital interfaces for push buttons, switches, proximity sensors, relays, contactors and many other devices
- Analog modules with varying degrees of resolution for flow, temperature or pressure applications
- Direct connect wiring or remote termination
- Local or remote I/O systems

Series 90-30 Ethernet communications provide a real-time link between the plant floor and the boardroom. You can begin with an Ethernet-enabled CPU, or at a later date, choose from our selection of rack-mounted Ethernet modules. The Series 90-30 Ethernet module supports both SRTP and Modbus TCP/IP application protocols.

The scaleable processing power in the Series 90-30 CPU creates a clear upgrade path. Create the system that's ideal today, while leaving open the option of creating a more powerful system tomorrow — without having to change your application software.

Motion control integrated into the Series 90-30 fosters high performance point-to-point applications.

A variety of Series 90-30 field bus interfaces enables distributed control and/or I/O. Choose from Ethernet EGD, Profibus-DP™, Genius®, DeviceNet™ and Interbus-S™ modules. Field Bus interface modules are easy to install and quick to configure. Plug them into an existing system or design a new system around them.

Ease of programming is a strong suit of the Series 90-30. Choose the programming options that meet your needs: Windows®-based IEC programming, advanced C or State Logic®. Floating point math, PID, indirect addressing, array moves and sequencing are just a few of the over 200 instructions available.

The Series 90-30 stands out among small controls for offering redundancy options. The Series 90-30 is the low-cost solution for high availability applications, with redundant CPUs and power supplies.

Easy trouble shooting and machine setup using a handheld PDA. CIMPLICITY® Machine Edition Logic Developer PDA software allows you to interface a Palm® handheld device to your Series 90-30 controller. With Logic Developer PDA, you can monitor/change data, view diagnostics, force ON/OFF, and configure machine setup — saving you time and increasing productivity.

Ordering Information

Description	Catalog Number		Catalog Number	
Discrete Input Modules	IC693MDL230	120 VAC Isolated Input (8 Points)	IC693MDL646	24 VDC Input, Neg/Pos Logic, 1 msec Filter (16 Points)
	IC693MDL231	240 VAC Isolated Input (8 Points)	IC693MDL648	48 VDC Input, Neg/Pos Logic, 1 msec filter, Neg/Pos Logic (16 Points)
	IC693MDL240	120 VAC Input (16 Points)	IC693MDL653	24 VDC Input, Neg/Pos Logic, 2msec Filter (32 Points)
	IC693MDL241	24 VAC/VDC Input (16 Points)	IC693MDL654	5/12 VDC (TTL) Input, Neg/Pos Logic, (32 Points)
	IC693MDL632	125 VDC Input (8 Points)	IC693MDL655	24 VDC Input, Neg/Pos Logic, 1 ms, (32 Points)
	IC693MDL634	24 VDC Input, Neg/Pos Logic (8 Points)	IC693ACC300	Input Simulator Module (8 Points)
	IC693MDL645	24 VDC Input, Neg/Pos Logic (16 Points)		
Discrete Output Modules	IC693MDL310	120 VAC Output, 0.5 Amp (12 Points)	IC693MDL740	12/24 VDC Output, 0.5 Amp, Positive Logic (16 Points)
	IC693MDL330	120/240 VAC Output, 2 Amp (8 Points)	IC693MDL741	12/24 VDC Output, 0.5 Amp, Negative Logic (16 Points)
	IC693MDL340	120 VAC Output, 0.5 Amp (16 Points)	IC693MDL742	12/24 VDC Output, 1 Amp, Positive Logic (16 Points), Fused
	IC693MDL390	120/240 VAC Isolated Output, 2 Amp (5 Points)	IC693MDL748	48 VDC Output, 0.5 Amps, Positive Logic (8 Points)
	IC693MDL730	12/24 VDC Output, 2 Amp, Positive Logic (8 Points)	IC693MDL750	12/24 VDC Output, Negative Logic (32 Points)
	IC693MDL731	12/24 VDC Output, 2 Amp, Negative Logic (8 Points)	IC693MDL751	12/24 VDC Output, Positive Logic (32 Points)
	IC693MDL732	12/24 VDC Output, 0.5 Amp, Positive Logic (8 Points)	IC693MDL752	5/12/24 VDC (TTL) Output, Negative Logic, (32 Points)
	IC693MDL733	12/24 VDC Output, 0.5 Amp, Negative Logic (8 Points)	IC693MDL753	12/24 VDC Output, Positive Logic (32 Points)
	IC693MDL734	125 VDC Output, (6 Points)		
Relay Output Module	IC693MDL930	Relay Output, Isolated, 4 Amp (8 Points)	IC693MDL940	Relay Output, 2 Amp (16 Points)
	IC693MDL931	Relay Output, 8 Amp Form B/C contacts, Isolated in 2 Groups of 4 (8 Points)		
Mixed Discrete Module	IC693MDR390	Mixed I/O, 24 VDC Input (8 points), Relay Output (8 points)	IC693MAR590	Mixed I/O, 120 VAC Input (8 Points), Relay Output (8 Points)
Analog Input Modules	IC693ALG220	Analog Input, Voltage/Current, 4 Channels	IC693ALG222	Analog Input, Voltage 16 Single/8 Differential Channels
	IC693ALG221	Analog Input, Current, 4 Channels	IC693ALG223	Analog Input, Current, 16 Single Channels
Analog Output Modules	IC693ALG390	Analog Output, Voltage, 2 Channels	IC693ALG392	High Density Analog Output (8 Channels)
	IC693ALG391	Analog Output, Current, 2 Channels		
Mixed Analog Modules	IC693ALG442	Analog Combo Module 4IN/2OUT		
Motion Modules	IC693APU300	High Speed Counter (HSC)	IC693APU305	High Speed Counter with Gray Code Encoder or an A QUAD B Encoder Input
	IC693APU301	Axis Positioning Module (APM), 1 Axis	IC693DSM302	Digital Servo Motion Controller, 2 Axis
	IC693APU302	Axis Positioning Module (APM), 2 Axis	IC693DSM314	Digital Servo Motion Controller, 1-2 Axis of Digital Servo or 1-4 Axis Analog Servo
Specialty Modules	IC693MDL760	Solenoid Valve Output (11 Points)/24 VDC Output, 0.5 Amp, Positive Logic (5 Points)	IC693PTM101	Power Transducer Module, CT and PT Interface 120/240 VAC (1m cable)
	IC693PCM301	Programmable Coprocessor Module, 192 KB (47 KB Basic or C Program), 2 Serial Ports	IC693TCM302	Temperature Control Module, (8) TC In and (8) 24 VDC Solid State Outputs
	IC693PCM311	Programmable Coprocessor Module, 640 KB (640 KB Basic or C Program), 2 Serial Ports	IC693TCM303	Temperature Control Module Extended Temperature Range, (8) TC In and (8) 24 VDC Solid State Outputs
	IC693PTM100	Power Transducer Module, CT and PT Interface 120/240 VAC (0.5m Cable)		
Communications Modules	IC693BEM331	Genius Bus Controller (Supports I/O and Datagrams)	IC693PBM200	Profibus DP Master Module
	IC693CMM302	Communication Module, Genius (1 Kbyte) GCM+ (No Datagram Support)	IC693PBM201	Profibus DP Slave Module
	IC693CMM311	Communications Module, CCM, RTU, SNP, and SNPx Protocols	IC693DNM200	DeviceNet Master Module
	IC693CMM321	Ethernet Interface TCP/IP Module, 10Mbs (Supports SRTP and Modbus TCP/IP, No EGD)	IC693DNS201	DeviceNet Slave Module
Controllers	IC693CPU311	5-Slot Base with CPU in Base (6KBytes User Program), Not Expandable	IC693CPU360	CPU 360 Module (240KBytes Configurable User Memory, 4K I/O, 8 Racks), No Built-In Serial Ports, Logic Execution is .22msec/K
	IC693CPU313	5-Slot Base with Turbo CPU in Base (Logic Execution is .6 msec), 1K Registers, (12KBytes User Program), Not Expandable	IC693CPU363	CPU 363 Module (240KBytes Configurable User Memory 4K I/O, 8 Racks), 2 Built-In Serial Ports, Logic Execution is .22msec/K
	IC693CPU323	10-Slot Base with Turbo CPU in Base (Logic Execution is .6 msec) 12Kbytes User Program, Not Expandable	IC693CPU364	CPU 364 Module (240KBytes Configurable User Memory 4K I/O, 8 Racks), No Built-In Serial Ports, Built-In 10Mbs Ethernet, Supports SRTP, Channels and EGD, Logic Execution is .22msec/K
	IC693CPU350	CPU 350 Module (32KBytes User Memory, 4K I/O, 8 Racks), No Built-In Serial Ports, Logic Execution is .22msec/K	IC693CPU374	CPU 374 Module (240KBytes Configurable User Memory), No Built-In Serial Ports, Built-In 10/100Mbs with Built-In Switch, Ethernet Supports SRTP, EGD and No Channel Support; Logic Execution is .22msec/K.
Backplanes	IC693CHS391	Base, CPU, 10 Slots, Use with CPU331/CSE331 and above	IC693CHS397	Base, CPU, 5 Slots (use with CPU331/CSE331 and above)
	IC693CHS392	Base, Expansion, 10 Slots	IC693CHS398	Base, Expansion, 5 Slots
	IC693CHS393	Base, Remote Expansion, 10 Slots (700 ft.)	IC693CHS399	Base, Remote Expansion, 5 Slots (700 ft.)
Power Supplies	IC693PWR321	Power Supply, 120/240 VAC, 125 VDC, Standard, 30 Watts	IC693PWR332	Power Supply, 12 VDC, High Capacity, 30 Watts
	IC693PWR322	Power Supply, 24/48 VDC, Standard, 30 Watts	IC693ACC340	Redundant Power Supply Base (RPSB) with 0.1 meter cable to connect to Power Supply Adapter Module
	IC693PWR328	Power Supply, 48 VDC, Standard, 30 Watts	IC693ACC341	Redundant Power Supply Base with 0.5 meter cable to connect to Power Supply Adapter Module
	IC693PWR330	Power Supply, 120/240 VAC, 125 VDC, High Capacity, 30 Watts	IC693ACC350	Redundant Power Supply Adapter (RPSA) Module. The RPSA replaces the power supply on a CPU base or expansion base and connects to a Redundant Power Supply Base.
	IC693PWR331	Power Supply, 24 VDC, High Capacity, 30 Watts		
Accessories	IC693ACC301	Replacement Battery, CPU & PCM (Qty. 2)	IC693CBL301	Rack to Rack Expansion Cable, 2 Meters
	IC693ACC302	High Capacity Battery Pack	IC693CBL302	Rack to Rack Expansion Cable, 15 Meters
	IC200ACC003	EZ Program Store Flash Device (for CPU374 only)	IC693CBL312	Rack to Rack Expansion Cable, 0.15 Meters, Shielded
	IC693ACC310	Filler Module, Blank Slot	IC693CBL313	Rack to Rack Expansion Cable, 8 Meters
	IC693CBL300	Rack to Rack Expansion Cable, 1 Meter	IC693CBL314	Rack to Rack Expansion Cable, 15 Meters, Shielded
Programming and Trouble Shooting Tools	IC646MPP001	Logic Developer - PLC Professional	IC646MPH101	Logic Developer PDA Software Tool with Cable Adapter
	IC646MPS001	Logic Developer - PLC Standard		

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GE Fanuc Automation Information Centers

USA and the Americas 1-800-648-2001 or (434) 978-5100
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Asia Pacific 86-21-3222-4555

Additional Resources

For detailed technical specifications and product ordering information, please visit the GE Fanuc e-catalog at:

www.gefanuc.com

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10M 08/03

GE Fanuc Automation

Programmable Control Products

Series 90™-30 PLC
Installation and Hardware Manual

GFK-0356Q

August 2002

GFL-002

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CIMPLICITY Control
CIMPLICITY PowerTRAC
CIMPLICITY 90–ADS
CIMSTAR
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Genius PowerTRAC
Helpmate
Logicmaster
Modelmaster
Motion Mate
PowerMotion
ProLoop
PROMACRO
Series Five
Series 90
Series One
Series Six
Series Three
VuMaster
Workmaster

RFI Standards

The Series 90-30 PLC and its associated modules have been tested and found to meet or exceed the requirements of FCC Rule, Part 15, Subpart J. The Federal Communications Commission (FCC) requires the following note to be published according to FCC guidelines.

NOTE

This equipment generates, uses, and can radiate radio frequency energy and if not installed in accordance with this instruction manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules, which are designed to provide reasonable protection against harmful interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

The following note is required to be published by the Canadian Department of Communications.

NOTE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

The following statements are required to appear in the *Series 90_-30 Installation Manual* and the *Series 90_-30 I/O Specifications Manual* for Class I Div 2 Hazardous Locations.

1. EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C, and D, DIV. 2 HAZARDOUS LOCATIONS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.
2. WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2:
3. WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
4. ALL UNUSED SLOTS IN ALL BASEPLATES MUST BE POPULATED WITH FILLER MODULES, IC693ACC310, OR EQUIVALENT.

Preface

This manual describes the GE Fanuc Series 90-30 Programmable Logic Controller (PLC). It contains a description of hardware components and provides basic hardware installation procedures. The Series 90-30 PLC is a member of the Series 90_ family of Programmable Logic Controllers from GE Fanuc.

For a list of product standards, refer to data sheet GFK-0867B or later, *GE Fanuc Approvals, Standards, General Specifications* which lists all of the standards for GE Fanuc products. Installation instructions in this manual are provided for installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see GFK-1179, *Installation Requirements for Conformance to Standards*.

What's New in This Manual

- Added the model 374 CPU, which supports connection to an Ethernet network through two built-in 10BaseT/100BaseTx auto-negotiating full-duplex Ethernet ports. Models 364 (release 9.10 and later) and 374 are the only Series 90-30 CPUs that support Ethernet Global Data. Note that the CPU374 is supported only by the Windows®-based programmers.
- Other corrections and clarifications as necessary.

Related Publications

For more information on Series 90-30 products, refer to these publications. (For a publication to product catalog number cross-reference refer to Appendix G):

GFK-0255 - Series 90™ PCM and Support Software User's Manual

GFK-0256 - MegaBasic™ Programming Reference Manual

GFK-0293 - Series 90™ -30 High Speed Counter User's Manual

GFK-0401 - Workmaster® II PLC Programming Unit Guide to Operation

GFK-0402 - Series 90™ -30 and 90-20 PLC Hand-Held Programmer User's Manual

GFK-0412 - Genius® Communications Module User's Manual

GFK-0466 - Logicmaster 90™ Series 90™ -30/20/Micro Programming Software User's Manual

GFK-0467 - Series 90™ -30/20/Micro Programmable Controllers Reference Manual

GFK-0487 - Series 90™ PCM Development Software (PCOP) User's Manual

GFK-0499 - CIMPLICITY® 90-ADS Alphanumeric Display System User's Manual

GFK-0582 - Series 90™ PLC Serial Communications User's Manual

GFK-0631 - Series 90™ -30 I/O LINK Interface User's Manual

GFK-0641 - CIMPLICITY® 90-ADS Alphanumeric Display System Reference Manual

GFK-0664 - Series 90™-30 PLC Axis Positioning Module Programmer's Manual

GFK-0685 - Series 90™ Programmable Controllers Flow Computer User's Manual

GFK-0695 - Series 90™-30 Enhanced Genius) Communications Module User's Manual

GFK-0726 - Series 90™-30 PLC State Logic Processor User's Guide

GFK-0732 - Series 90™-30 PLC ECLiPS User's Manual

GFK-0747 - Series 90™-30 PLC OnTOP User's Guide

GFK-0750 - OnTop for Series 90™-30 (State Logic) Program User's Manual

GFK-0781 - Motion Mate™ APM300 for Series 90™-30 PLC Follower Mode User's Manual

GFK-0823 - Series 90™ -30 I/O LINK Master Module User's Manual

GFK-0828 - Series 90™ -30 Diagnostic System User's Manual

GFK-0840 - Motion Mate™ APM300 for Series 90™ -30 PLC Standard Mode User's Manual

GFK-0867 - GE Fanuc Product Agency Approvals, Standards, General Specifications

GFK-0898 - Series 90™ -30 PLC I/O Module Specifications

GFK-1028 - Series 90™ -30 I/O Processor Module User's Manual

GFK-1034 - Series 90™ -30 Genius® Bus Controller User's Manual

GFK-1037 - Series 90™ -30 FIP Remote I/O Scanner User's Manual

GFK-1056 - Series 90™ -30 State Logic Control System User's Manual

GFK-1186 - TCP/IP Ethernet Communications for the Series 90_-30 PLC Station Manager Manual

GFK-1179 - Series 90™ PLC Installation Requirements for Conformance to Standards

GFK-1464 - Motion Mate DSM302 for Series 90™-30 PLCs User's Manual

GFK-1466 - Temperature Control Module for the Series 90™-30 PLC User's Manual

GFK-1541 - TCP/IP Ethernet Communications for the Series 90™ PLC User's Manual

Contents

Contents

Contents

Chapter 4 Power Supplies 4-1

Chapter 5 CPUs 5-1

Contents

Contents

Contents

Contents

Contents

Contents

Chapter 1

Overview of the Series 90-30 PLC

The Series 90™-30 Programmable Logic Controller (PLC) is a member of the GE Fanuc Series 90 PLC family.

The Basic Parts of a Series 90-30 PLC

The Series 90-30 PLC is very versatile because (1) it is programmable, and (2) it is assembled from a wide variety of modular, plug-together components. Therefore, by choosing the correct components and developing an appropriate program, the PLC can be used for an almost unlimited variety of applications. Although there are many choices of individual hardware components to use in a system, there are just a few basic categories. Each of these component categories is covered in detail in a separate chapter in this manual. They are introduced in this chapter so you can see how they fit together:

- Baseplates
- Power Supplies
- CPUs
- I/O Modules
- Option Modules
- Cables

Baseplates

The baseplates are the foundation of the PLC system because most other components mount on them. As a basic minimum, every system has at least one baseplate, which usually contains the CPU (in which case, it is referred to as "the CPU Baseplate"). Many systems require more modules than can be mounted on one baseplate, so there are also Expansion and Remote baseplates that connect together. The three categories of baseplates, CPU, Expansion, and Remote, are available in two sizes, 5-slot and 10-slot, named according to the number of modules they can hold.

Power Supply Modules

Every baseplate must have its own power supply. The power supply always mounts in a baseplate's left-most slot. There are several power supply models available to meet a variety of requirements.

CPUs

The CPU is the manager of the PLC. Every PLC system must have one. A CPU uses the instructions in its firmware and application program to direct the PLC's operation and to monitor the system to make sure there are no basic faults. Some Series 90-30 CPUs are built into baseplates, but most are contained in plug-in modules. In some cases, the CPU resides in a Personal Computer using a Personal Computer Interface Card that interfaces to Series 90-30 Input, Output, and Option modules.

Input and Output (I/O) Modules

These modules enable the PLC to interface with input and output field devices such as switches, sensors, relays, and solenoids. They are available in both discrete and analog types.

Option Modules

These modules extend the capability of the PLC beyond the basic functions. These provide such things as communications and networking options, motion control, high speed counting, temperature control, interfacing to operator interface stations, etc.

Cables

These connect the PLC components together or to other systems. Many standard prefabricated cables are available from GE Fanuc. They are primarily used to:

- Interconnect baseplates
- Connect a programmer to the CPU or to an option module
- Connect option modules to field devices or other systems.

Assembling a Basic Series 90-30 PLC System

Let's assemble, on paper, a basic system using the following components:

- Baseplate
- Power Supply module
- CPU module
- Some I/O modules

We'll start with the **baseplate**. To keep it simple, we'll use a 5-slot size. Note that a 5-slot baseplate actually has six slots, but the power supply slot is not numbered. Note also, that this baseplate has a CPU slot, which is slot number 1, and it has an expansion connector on the right end, which is used for connecting to another baseplate if the system has more than one baseplate.

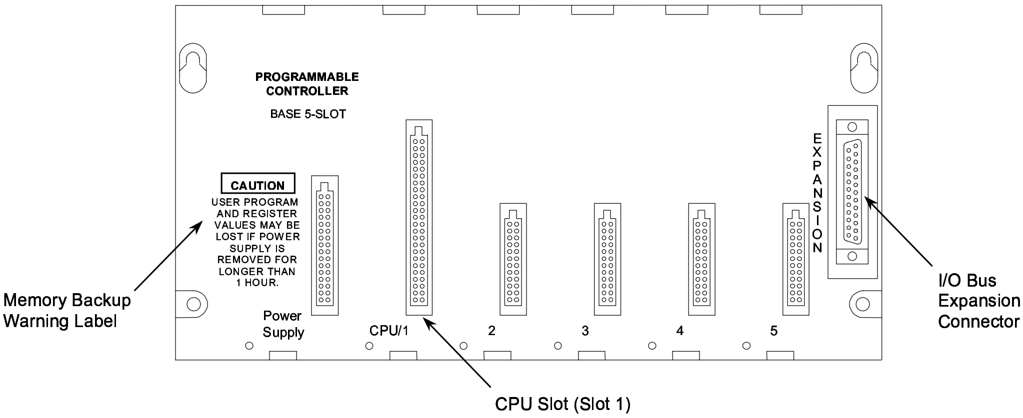


Figure 1-1. Five-Slot CPU Baseplate

Next, we'll add a **power supply** module. It mounts in the unnumbered slot on the left end of the baseplate. This slot has a unique connector that will only fit a power supply module.

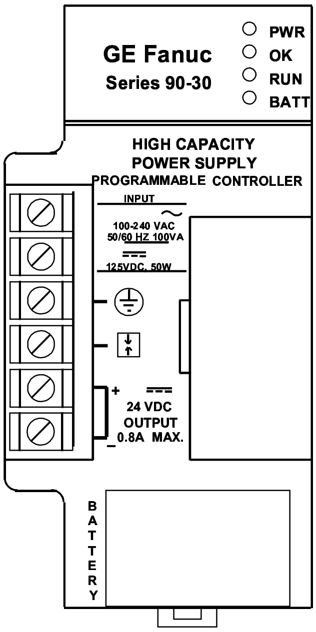


Figure 1-2. Power Supply Module

Then add a **CPU module**. A CPU module can only mount in baseplate slot 1, next to the power supply. Slot 1 has a unique connector that will only fit CPU or special Option modules.

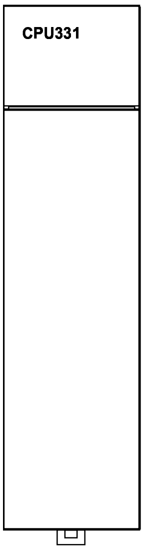


Figure 1-3. CPU Module

To finish, we will add some **I/O modules** to baseplate slots 2 through 5.

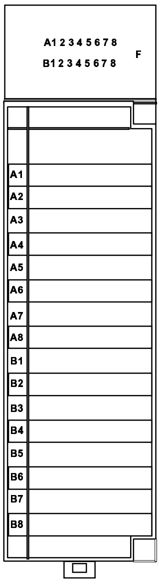


Figure 1-4. I/O Module

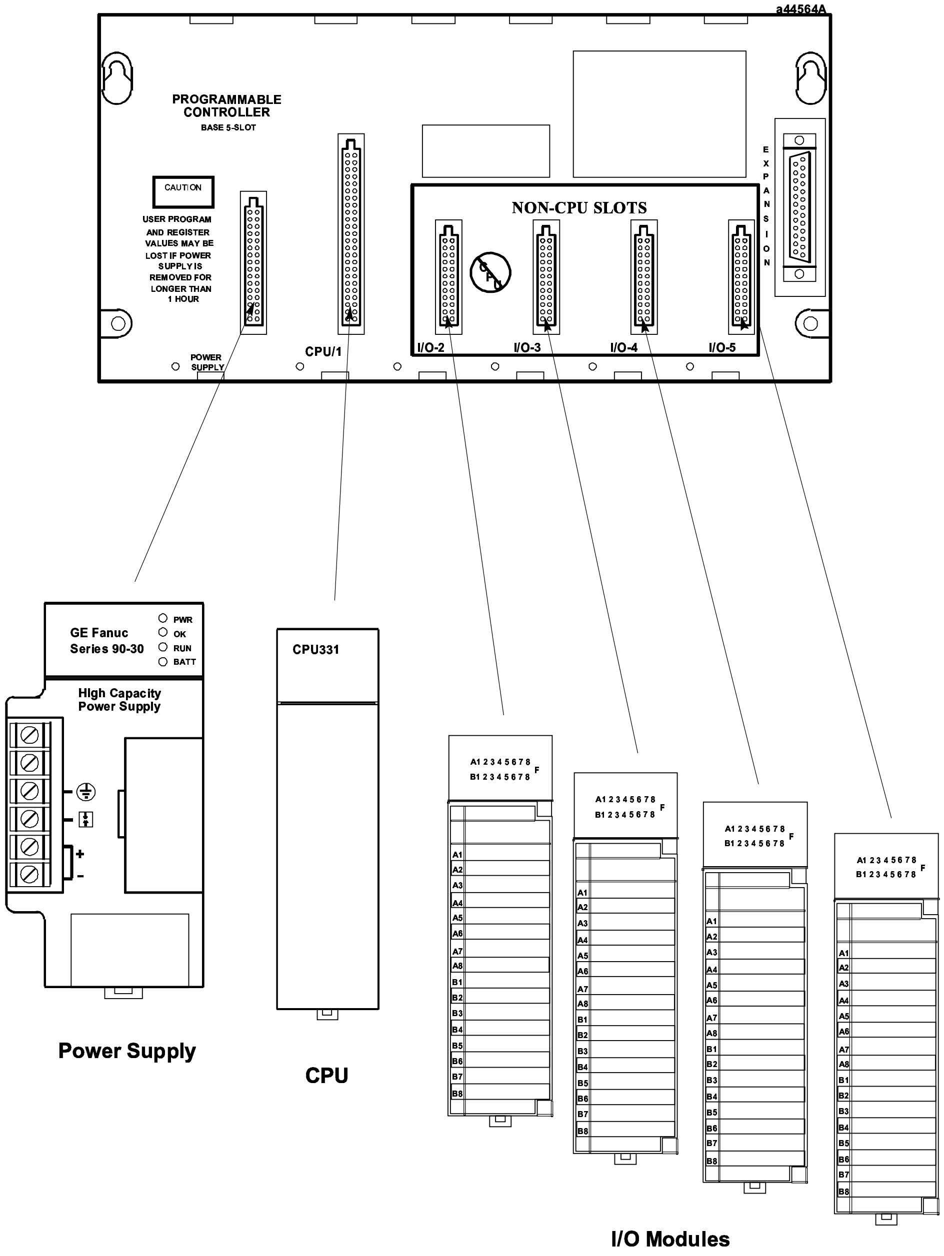


Figure 1-5. Assembling the System

When assembled, the system will look like this:

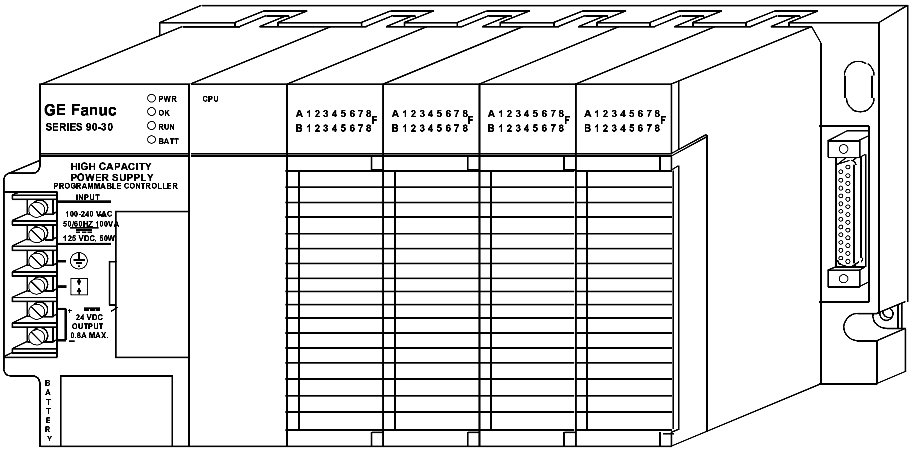


Figure 1-6. A Basic System

An assembly of baseplate and modules such as this one is called a “Rack.”

What else would be needed to make this basic system functional?

To make this basic system functional, you would need:

- **Mounting.** Safe, secure mounting for the PLC in a protective enclosure.
- **Wiring.** This includes properly installed incoming power to the power supply, as well as wiring from the I/O modules to field devices such as switches, sensors, solenoids, relays, etc.
- **Program**. An application program for the PLC to run. This is developed with GE Fanuc PLC programming software.

What if the application requires more than five modules?

You could use a 10-slot baseplate, shown in the next picture:

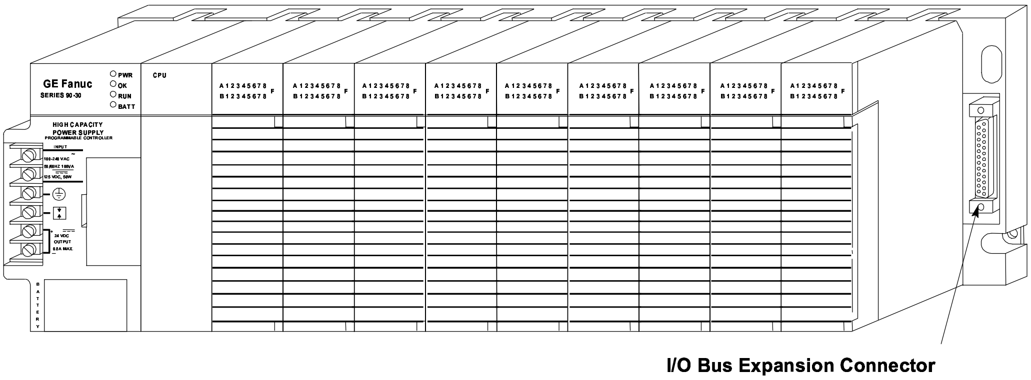


Figure 1-7. Ten-Slot Rack

What if the application requires more than ten modules?

You can add one or more Expansion or Remote racks to this system. Some CPUs can support up to seven additional racks. If you added seven additional 10-slot racks, you could have 70 more modules.

Racks are interconnected in a "daisy-chain" cabling arrangement. This interconnection system is called the "I/O Expansion Bus." The connections are made from one baseplate's I/O Bus Expansion Connector (shown in the figure above) to the next one's. The I/O Bus Expansion Cables, shown below, have a double connector on one end to facilitate these connections.

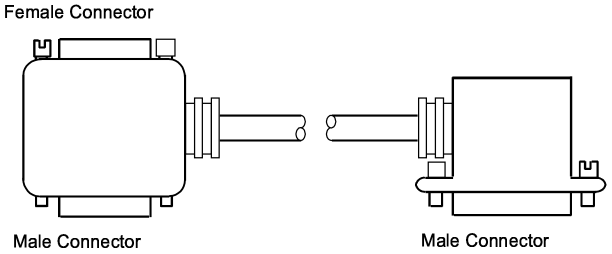


Figure 1-8. I/O Bus Expansion Cable

The next figure shows a system that has a CPU baseplate, one Expansion rack and three Remote racks. Notice that the last rack, the one at the end of the I/O Expansion Bus, must be terminated. A convenient way of terminating the bus is with an IC693ACC307 I/O Bus Terminator Plug, as shown.

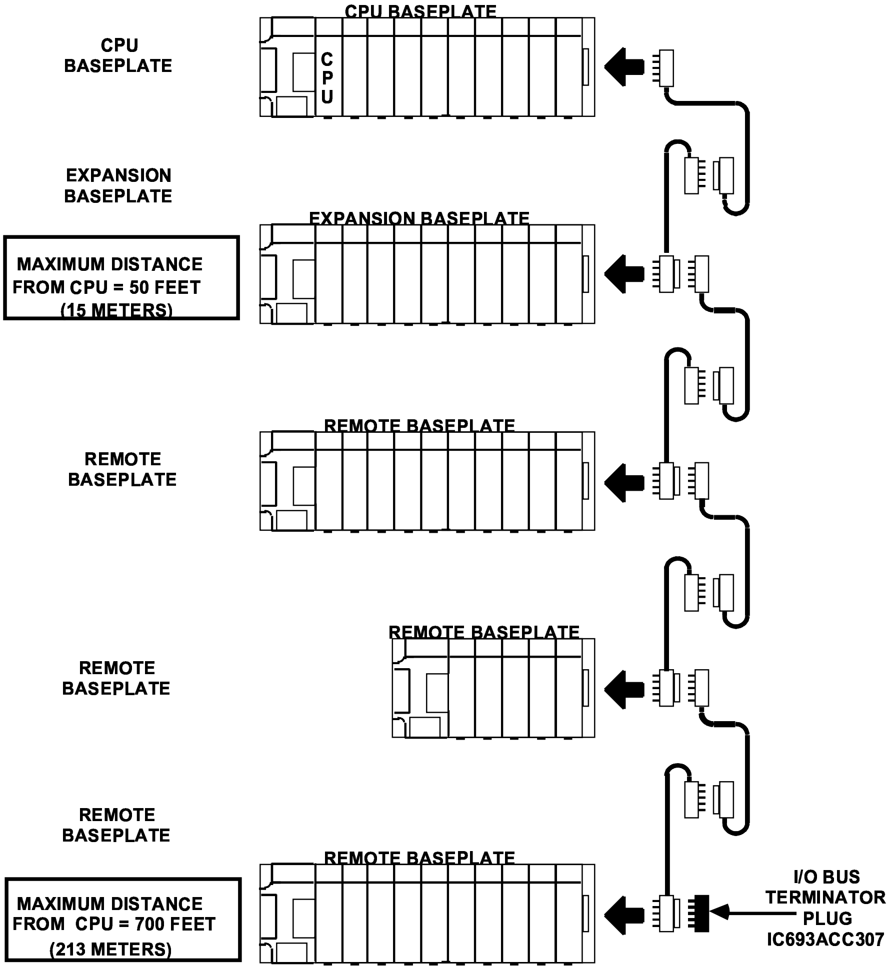


Figure 1-9. Connecting Expansion and Remote Baseplates

What is the Difference Between Expansion and Remote baseplates?

The main factor to consider is distance. How far will the baseplate be from the CPU baseplate? If the cabling distance from the CPU baseplate is 50 feet (15 meters) or less, use an Expansion baseplate. The Expansion baseplate is preferable because of its higher communication speed with the CPU baseplate. However, if a baseplate must be located where it requires a cabling distance from the CPU rack in excess of 50 feet, an Expansion baseplate will not work - a Remote baseplate must be used. The limit for a Remote baseplate is a cabling distance of 700 feet (213 meters) from the CPU baseplate to the farthest Remote baseplate.

What if I need to cover more than 700 feet (213 meters)?

You can cover much greater distances by using Series 90-30 communications option modules. For example, Genius Bus Controller Modules (GBC) can communicate at distances up to 7,500 feet (2,286 meters) over a shielded twisted-pair cable, as shown in Example 1 below. Or, serial communications with Communications Coprocessor Modules (CMM) using the RS-485 standard can cover up to 4,000 feet (1,219 meters), as shown in Example 2 below. And virtually unlimited communication distances can be attained with modems and telephone lines or radio transmitters. Also, there are numerous networking options available such as Ethernet or WorldFIP.

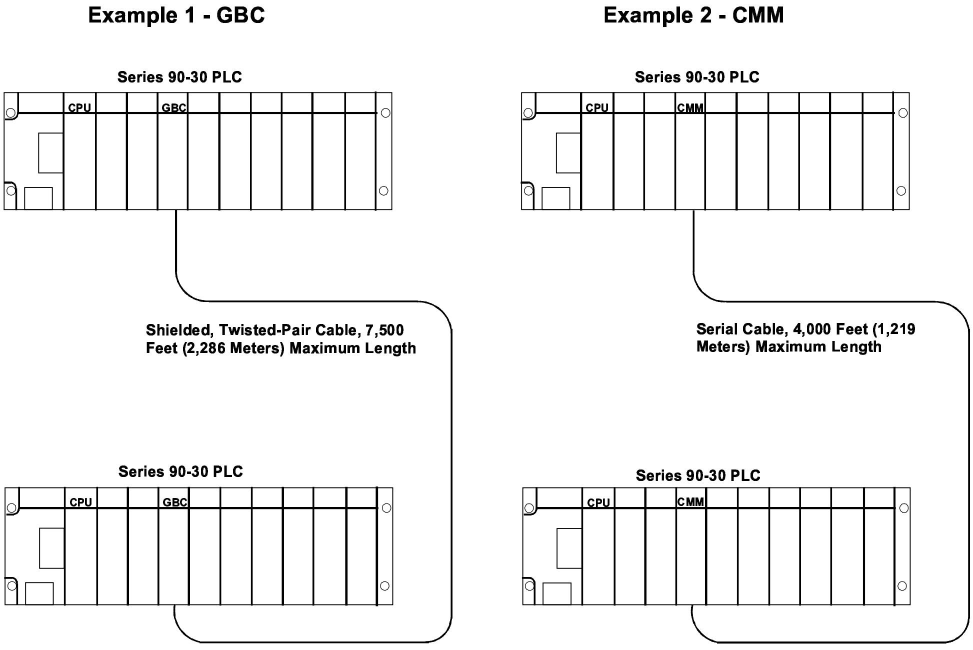


Figure 1-10. Connecting PLCs Using GBC or CMM Modules

Chapter 2

Installation

This chapter discusses installation details only. Other information about the products such as hardware descriptions and specifications, is covered in the applicable chapters.

Important Note

Series 90-30 PLCs must be mounted in a protective enclosure.

The installation instructions described in this chapter apply to PLC installations that do not require special procedures for noisy or hazardous environments. For installations that must conform to more stringent requirements (such as CE Mark), see ***GFK-1179, Installation Requirements for Conformance to Standards.*** *Also see* ***GFK-0867, GE Fanuc Product Agency Approvals, Standards, General Specifications.***

Receiving your Products - Visual Inspection

When you receive your Series 90-30 PLC system, carefully inspect all shipping containers for damage that may have occurred during shipping. If any part of the system is damaged, notify the carrier immediately. The damaged shipping container should be saved as evidence for inspection by the carrier.

As the consignee, it is your responsibility to register a claim with the carrier for damage incurred during shipment. However, GE Fanuc will fully cooperate with you if such action is necessary.

Pre-installation Check

After unpacking Series 90-30 PLC racks, cables, modules, etc., **record all serial numbers**. Serial numbers are printed on the module packaging. Serial numbers are required to make a claim during the warranty period of the equipment. All software product registration cards should be completed and returned to GE Fanuc. See “Module Features” in this chapter for location of module serial numbers. See “Common Baseplate Features” in chapter 3 for location of baseplate serial numbers.

You should verify that all components of the system have been received and that they agree with your order. If the parts received do not agree with your order, call Programmable Control Customer Service at 1-800-432-7521. A Customer Service representative will provide further instructions.

If you require assistance with your installation, GE Fanuc’s Technical Support department offers expert help. Call the support number for your area from the list in Chapter 13, “Maintenance and Troubleshooting.” The GE Fanuc web site support address is *www.gefanuc.com/support/plc.*

Warranty Claims

Record the serial number of the defective item and contact your distributor for instructions.

Working with Series 90-30 Modules

Module Features

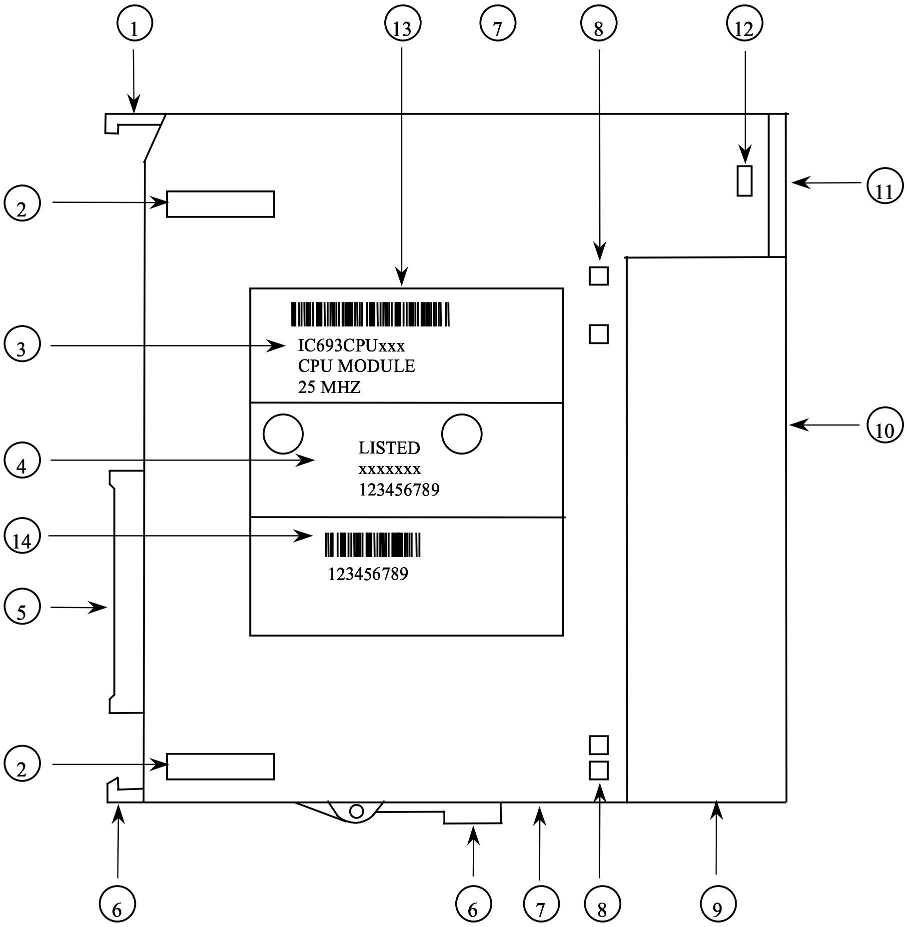


Figure 2-1. Features of Series 90-30 Module

1. Pivot hook
2. Circuit board holding tabs (two on each side of module)
3. Catalog number and description section of label (Includes MAC address for CPU374.)
4. Certification (UL, CE, etc.) section of label
5. Module connector - plugs into baseplate backplane connector
6. Release lever - spring loaded
7. Ventilation openings in module case (top and bottom)
8. Front cover holding tabs (two on each side of module)
9. Front cover (shown) or terminal board (for I/O modules).
10. Front cover faceplate or hinged cover for terminal board.
11. Lens cap (some modules do not have).
12. Lens cap holding tabs (one on each side of module)
13. Module label
14. Serial Number - used to determine module warranty status. (On some modules, the Serial Number may be on a small tag on the back of the module.)

Installing a Module

Warning

Do not insert or remove modules with power applied. This could cause the PLC to stop or malfunction. Injury to personnel and damage to the module or baseplate may result. Also, attempts to force a module into an improper slot type will result in damage to the module and/or the baseplate. Modules will mount in the correct slot type easily, with a minimum of force.

Use the following instructions as a guide when inserting a module into a baseplate slot.

- Check that module catalog number matches slot configuration. Each slot is, or will be, assigned a particular module type during configuration. A Power Supply module must be installed in the left end unnumbered slot only, and a CPU module and some special Option modules can only be installed in Slot 1 of a CPU baseplate. I/O Modules and most Option modules install in slots numbered 2 and higher.
- Grasp the module firmly with terminal board toward you and with rear pivot hook facing away from you.
- Align the module with the desired baseplate slot and connector. Tilt the module upwards so that top rear pivot hook of the module engages the baseplate's top module retainer.
- Swing the module downward until the module's connector engages the baseplate's backplane connector, and the release lever on the bottom of the module snaps into place in the baseplate's bottom module retainer.
- Visually inspect the module to be sure that it properly seated.

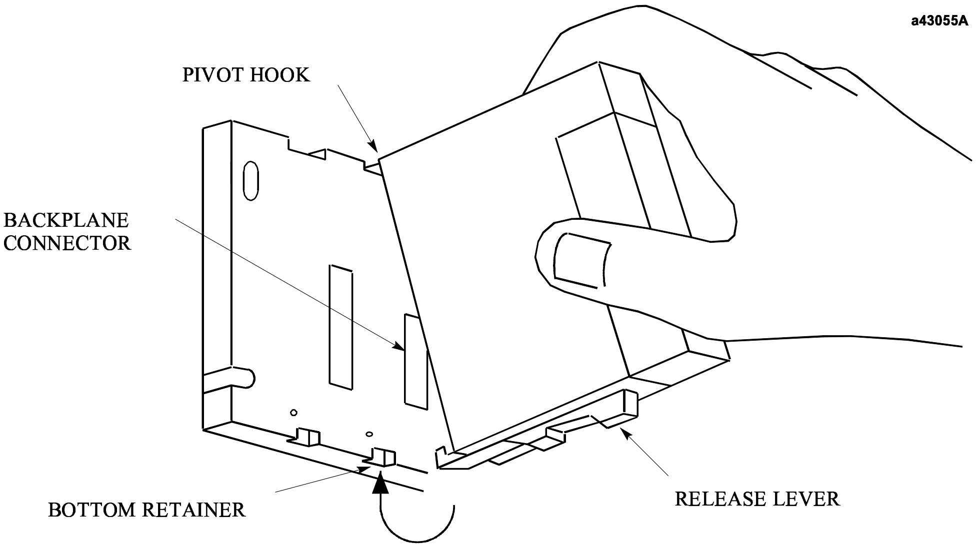


Figure 2-2. Installing a Module

Removing a Module

Warning

Do not insert or remove modules with power applied. This could cause the PLC to stop or malfunction. Injury to personnel and damage to the module or baseplate may result. Also potentially dangerous voltages from user devices may be present on a module's screw terminals even though power to the rack is turned off. Care must be taken any time that you are handling the module's removable terminal board or any wires connected to it.

- If the module has wiring, remove the module's terminal board (NOTE: You do not have to unwire the terminal board) or cables. The procedure for removing a terminal board is described later in this section.
- Locate the release lever at the bottom of the module and firmly press it up, towards the module.
- While holding the module firmly at its top and fully depressing release lever, swing (pivot) the module upward (release lever must be free of its retaining slot).
- Disengage pivot hook at the top rear of the module by moving the module up and away from the baseplate.

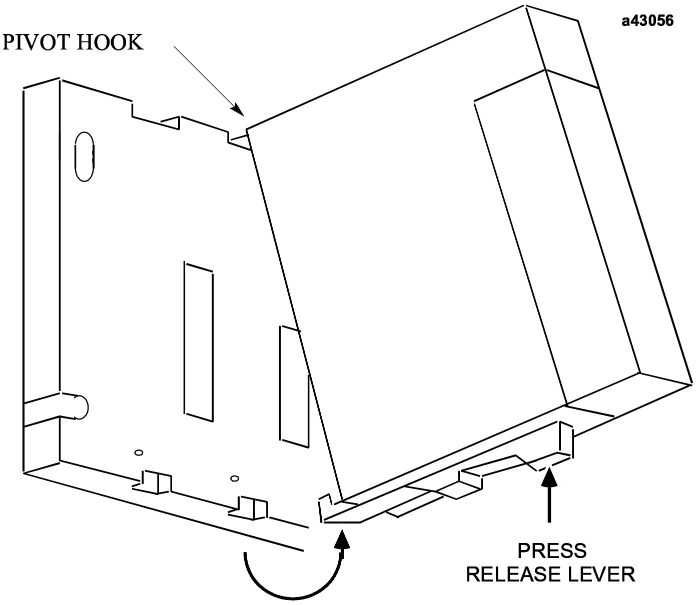


Figure 2-3. Removing a Module

Note

Modules in expansion or remote baseplates can be added, removed, or replaced while the PLC is in RUN mode if power is first removed from the expansion or remote baseplate. I/O data to/from this baseplate will not be updated while power is removed.

Installing a Module's Terminal Board

Note: Modules IC693MDL730F (and later) and IC693MDL731F (and later) have special terminal boards that are equipped with holding screws. For Installation and Removal instructions, please see the section "Installing and Removing Terminal Boards with Holding Screws" later in this chapter.

To install a terminal board (circled numbers refer to drawing below):

- Hook the pivot hook ①, located on the bottom of the terminal board, to the lower slot on the module.
- Push the terminal board toward the module ② until it snaps into place.
- Open the terminal board cover ③ and ensure that the latch on the module is securely holding the terminal board in place.

Caution

Compare the module catalog number on the label on the back of the hinged door (see Figure 2-6) and the label on the side of the module (see below) to ensure that they match. If a wired terminal board is installed on the wrong module type, damage to the module may occur when the system is powered up.

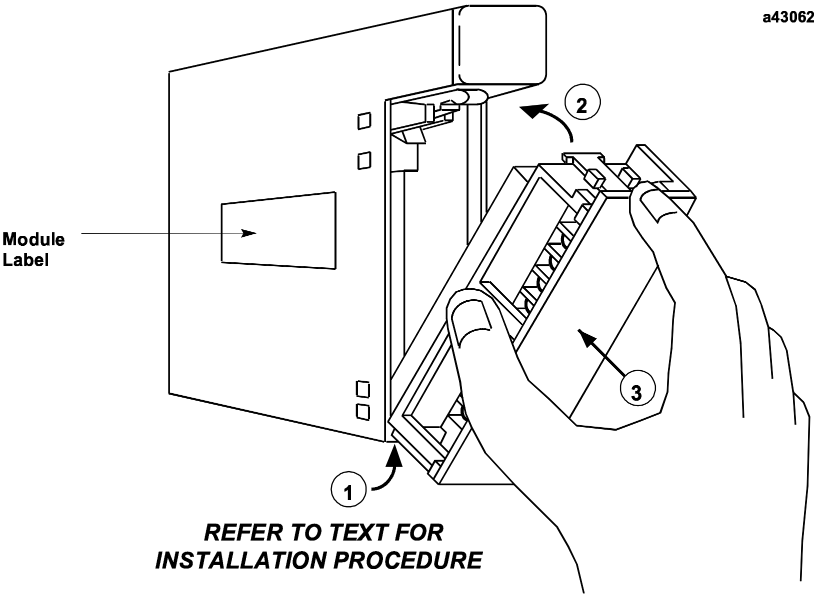
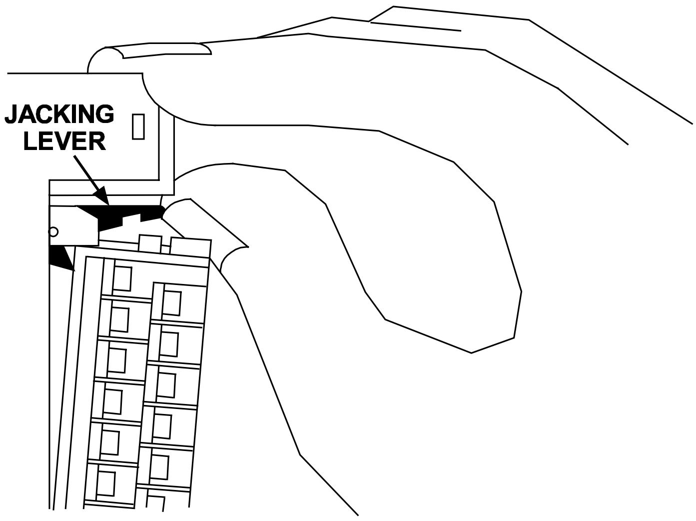


Figure 2-4. Installing an I/O Module's Terminal Board

Removing a Module's Terminal Board

To remove a terminal board:

- Open the plastic terminal board cover.
- Push up on the jacking lever to release the terminal block.



- Grasp pull-tab and pull it towards you until contacts have separated from module housing and bottom pivot hook has disengaged.

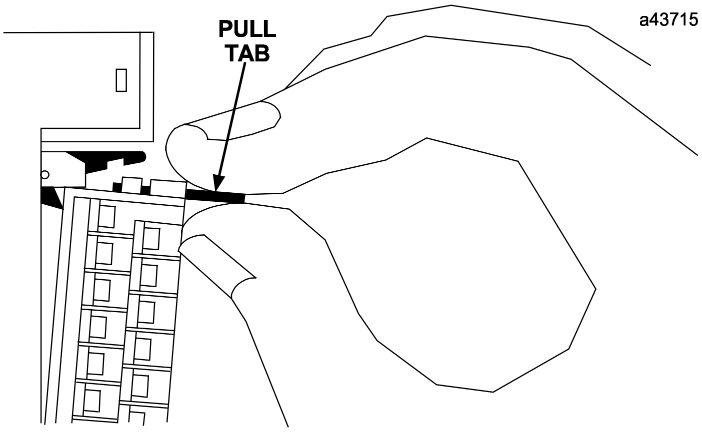


Figure 2-5. Removing a Module's Terminal Board

I/O Module Terminal Board Posts

The terminal board has three posts on the left side. The top and bottom posts hold the terminal board cover in place. The middle post keeps the terminal board wiring in place. If you do not require it to hold the wiring in place, the middle post can be easily snapped off. (Be careful that you do not inadvertently snap it off if you need it to keep your wiring in place.)

Installing and Removing Terminal Boards with Holding Screws

Discrete output modules IC693MDL730F (and later) and IC693MDL731F (and later) have a special terminal board that is equipped with holding screws, shown in the figure below. These screws prevent the terminal board-to-module connections from deteriorating in applications where the PLC is subjected to severe vibration .

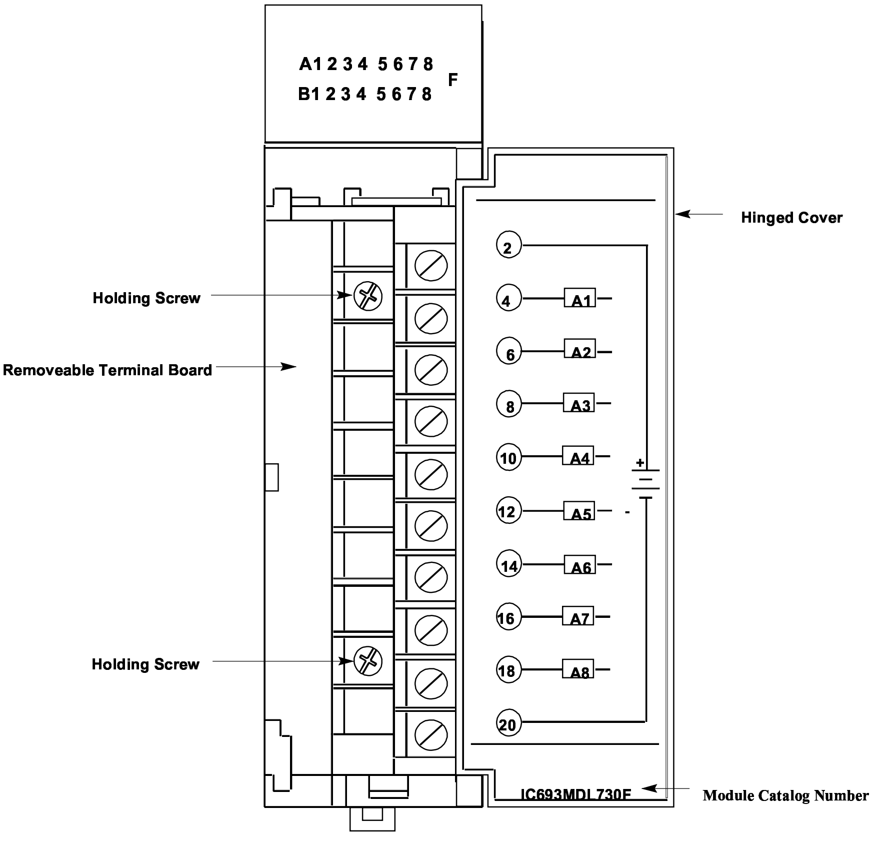


Figure 2-6. Terminal Board with Holding Screws

- **Removing:** To Remove these terminal boards, first loosen the two holding screws on the front of the terminal board, then follow the standard removal instructions in the section "Removing an I/O Module's Terminal Board." The holding screws are held captive in the terminal board and do not have to be completely removed.
- **Installing:** To install these terminal boards, follow the standard installation instructions in the section "Installing an I/O Module's Terminal Board," then tighten the two holding screws to 8 to 10 inch-pounds (1 Newton-meter) of torque.

Baseplate Mounting

Warning

Be sure to follow baseplate grounding instructions in this chapter. Failure to properly ground the PLC can result in improper operation, damage to equipment, and injury to personnel.

Mounting a Baseplate to a Panel

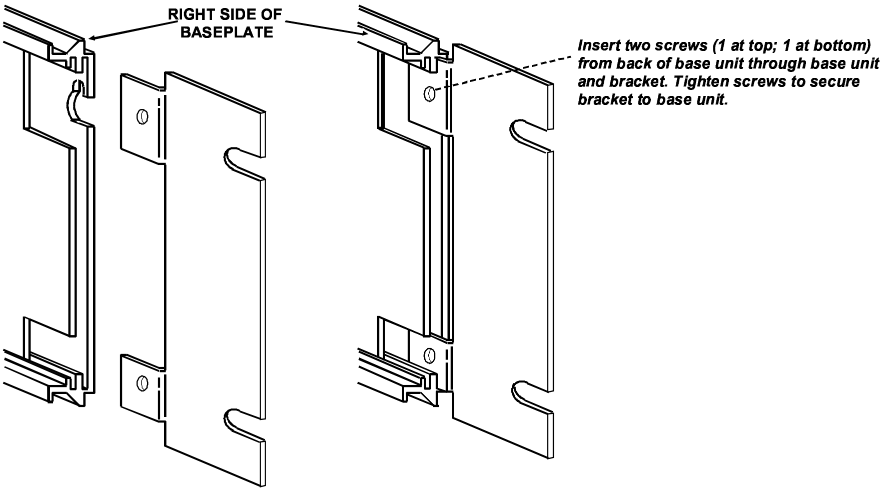
- Use four good-quality 8-32 x 1/2 (4 x 12mm) machine screws, lock washers and flat washers. Install the screws in four tapped holes. The "Baseplates" chapter has the applicable dimensions and mounting clearances. Alternately, 10-slot baseplates can be mounted in standard 19-inch racks by using the appropriate adapter. This is also discussed in the "Baseplates" chapter.
- A vertical mounting orientation is preferred for maximum heat dissipation. Other mounting orientations will require derating the Power Supply current capabilities. See Chapter 12, "System Design," for details.
- All baseplates must be grounded. The "Baseplate Safety Grounding" section of this chapter has details.
- The Rack Number Selection switch must be set on each Expansion or Remote baseplate. A CPU baseplate does not require this switch. Rack numbers should be assigned by the system designer. Failure to set the Rack Number Selection switches properly will result in system malfunction. See the "Baseplates" chapter for details on setting these switches.

Mounting a Baseplate to a 19" Rack

Two optional Baseplate Adapter Brackets allow a 10-slot baseplate to be mounted in a 19 inch rack. Each baseplate installation requires only one of the adapter brackets.

- **IC693ACC308 Front Mount Adapter Bracket.** Used to mount a baseplate to the front face of a 19" rack. Install the adapter bracket by inserting the tabs at the top and bottom of the adapter bracket into the corresponding slots at the top and bottom of the plastic baseplate cover. NOTE: Although Figure 2-7 shows the plastic baseplate cover removed, this is for illustration purposes only. It is not necessary to remove the cover to install the bracket. With the bracket in place, insert and tighten the two screws (included with the bracket) through the back of the baseplate holes into the threaded holes in the bracket.

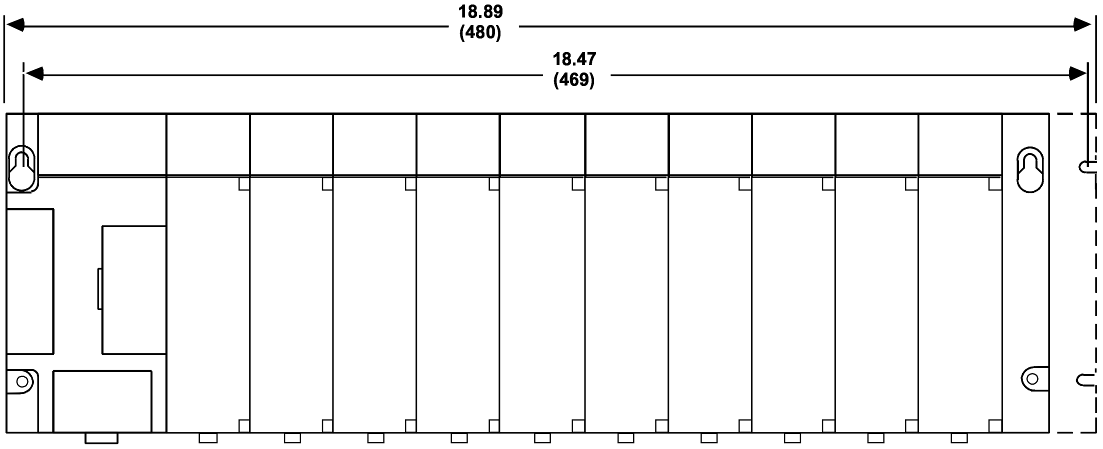
- **IC693ACC313 Recessed Mount Adapter Bracket.** Used to recess mount a baseplate inside a 19" rack. A baseplate mounts on the rear panel of this adapter bracket using four 8-32 (4mm) screws, nuts, lock washers, and flat washers. The Adapter Bracket bolts through its four slotted holes to the face of the 19" rack using applicable hardware (lock washers recommended).



Note: Baseplate is shown with cover removed for illustration purposes. It is not necessary to remove the baseplate cover to install the bracket.

Figure 2-7. IC693ACC308 Front Mount Adapter Bracket Installation

Dimensions for rack mounting a 10-slot baseplate with the IC693ACC308 Front Mount Adapter Bracket are shown in the following figure.



DIMENSIONS IN INCHES (MILLIMETERS IN PARENTHESES)

Figure 2-8. Dimensions for 19-inch Rack Mounting Using IC693ACC308 Adapter Bracket

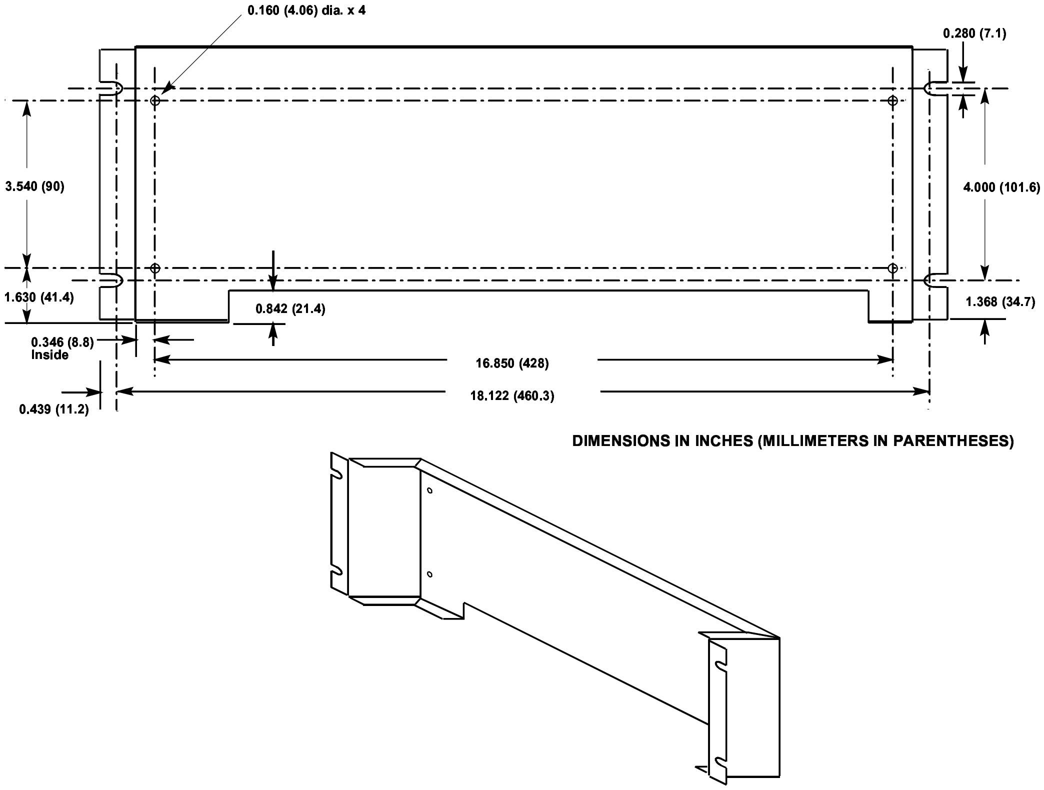


Figure 2-9. IC693ACC313 Recessed Mount Adapter Bracket

Grounding Procedures

System Grounding Procedures

Warning

In addition to the following grounding information, we strongly urge that you follow all applicable codes that apply to your area. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can mean injury or death to personnel, damage to property, or both.

All components of a programmable logic control system and the devices it is controlling must be properly grounded. This is particularly important for the following reasons.

- A low resistance path from all parts of a system to earth minimizes exposure to shock in the event of short circuits or equipment malfunction.
- The Series 90-30 PLC system requires proper grounding for correct operation.

Ground Conductors

- Ground conductors should be connected in a tree fashion with branches routed to a central earth ground point, shown in the figure below. This ensures that no ground conductor carries current from any other branch. This method is shown in the following figure.
- Ground conductors should be as short and as large in size as possible. Braided straps or ground cables (typically green insulation with a yellow tracer - AWG #12 (3.3 mm^2) or larger) can be used to minimize resistance. Conductors must always be large enough to carry the maximum short circuit current of the path being considered.

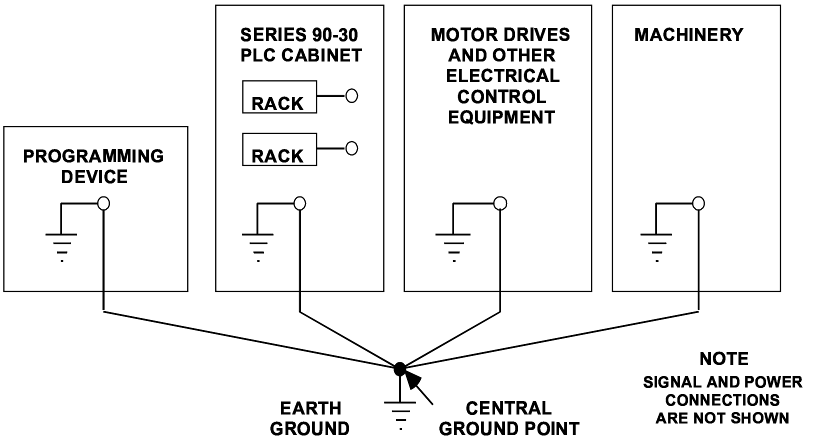


Figure 2-10. Recommended System Grounding

Series 90-30 PLC Equipment Grounding

Equipment grounding recommendations and procedures are listed below. These grounding procedures must be properly followed for safe, proper operation of your Series 90-30 PLC system.

Baseplate Safety Grounding

The following recommendations are offered, but applicable safety codes for your area or equipment type should also be consulted. The baseplate's metal back must be grounded using a separate conductor; the baseplate mounting screws are not considered to an acceptable ground connection by themselves. Use a minimum AWG #12 (3.3 mm^2) wire with a ring terminal and star lock washer under the head of one of the baseplate's two lower mounting holes. These two holes have openings to the side to allow connecting a wire and ring terminal under the head of a mounting screw. Connect the other end of this ground wire to a tapped hole in the panel that the baseplate is mounted to, using a machine screw, star lock washer, and flat washer. Alternately, if your panel has a ground stud, it is recommended you use a nut and star lock washer for each wire on the ground stud to ensure adequate grounding. Where connections are made to a painted panel, the paint should be removed so clean, bare metal is exposed at the connection point. Terminals and hardware used should be rated to work with the aluminum baseplate material.

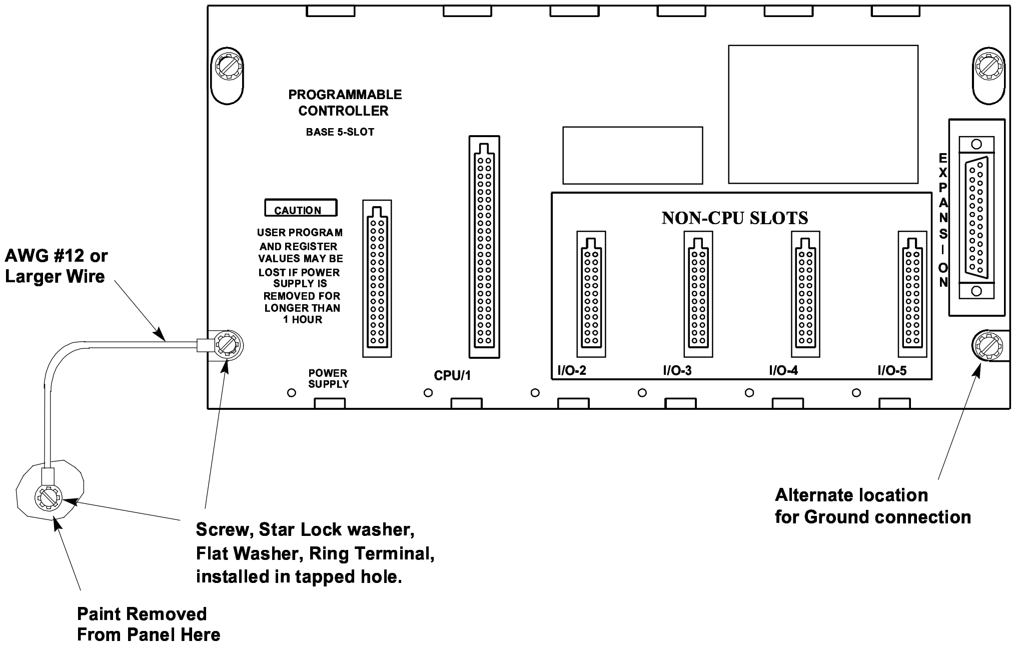


Figure 2-11. Baseplate Grounding

Warning

All baseplates must be grounded to minimize electrical shock hazard. Failure to do so can result in severe personal injury.

All baseplates grouped together in a Series 90-30 PLC system must have a common ground connection. This is especially important for baseplates that are not mounted in the same control cabinet.

Grounding 19" Rack-Mounted Baseplates

There are two Adapter Brackets used for mounting a 10-slot Series 90-30 baseplate to a 19" Rack. Regardless of which of the two Adapter Brackets is used, the 19" Rack should be grounded as per the instructions in "System Grounding Procedures," including Figure 2-10. (For details on the Adapter Brackets, see the "Mounting a Baseplate to a 19" Rack" section earlier in this chapter.)

Nineteen-Inch Rack-mounted PLC baseplates should be grounded according to the guidelines in the "Baseplate Safety Grounding" section, using a separate ground wire from the PLC baseplate as shown in the previous figure (Fig. 2-11).

- If using the **Recessed Mount Adapter Bracket (IC693ACC313)**, the ground wire can be installed as shown in Figure 2-11 with the ground attached to the Recessed Mount Adapter Bracket. An additional ground wire connecting the Adapter Bracket to a solid chassis ground on the 19" Rack should be installed. Use the same or equivalent hardware and paint removal scheme as shown in Figure 2-11.
- If using the **Surface Mount Adapter Bracket (IC693ACC308)**, the ground wire should be run from the baseplate as shown in Figure 2-11, to a solid chassis ground on the 19" Rack. Use the same or equivalent hardware and paint removal scheme as shown in Figure 2-11.

Programmer Grounding

For proper operation, the computer (programmer) running the PLC software must have a ground connection in common with the CPU baseplate. Normally, this common ground connection is provided by ensuring that the programmer's power cord is connected to the same power source (with the same ground reference point) as the baseplate. If it is not possible to ensure this common ground scheme, use a port isolator (IC690ACC903) between the programmer and PLC serial connection. If the programmer ground is at a different potential than the PLC ground, a shock hazard could exist. Also, damage to the ports or converter (if used) could occur when the programmer serial cable is connected between the two.

Warning

Failure to follow programmer grounding recommendations could result in personal injury, equipment damage, or both.

Module Shield Grounding

In general, the aluminum PLC baseplate is used for module shield grounding. On some Series 90-30 modules, shield connections to the user terminal connector on the module are routed to the baseplate through the module's backplane connector. Other modules, such as CPUs 351, 352, 363, 364, and 374 require a separate shield ground. These are discussed in the next several sections.

Shield Grounding Information for CPUs with External Port Connections

CPUs with external port connections, the 351, 352, 363, 364, and 374 must have a separate shield ground connection to provide shielding for these ports. Because the design of the ground connection for the CPU351 and 352 is different from that of the CPU363, 364, and 374, each grounding method is discussed in a separate section.

CPU351 and 352 Shield Grounding

The CPU 351 or 352 module must be connected to frame ground at the slot where it is installed. Two methods are provided for making this ground connection. Each CPU comes with an EMC Grounding Kit (44A737591-G01) that contains a ground wire, grounding bracket, and screws.

1. The connection from the CPU to frame ground can be made using the ground wire (part number 44A735970-001R01) that comes with the module in the EMC Grounding Kit. This wire has a stab-on connector on one end for connection to a mating terminal on the bottom of the CPU, and a ring terminal on the other end for connection to a grounded enclosure. Where the ring terminal contacts a painted enclosure panel, either a star lock washer can be installed between the terminal and the panel to cut through the paint, or the paint can be scraped away down to clean, bare metal to ensure a good contact. **Note: The star lock washer method is suitable for a shield ground, but not suitable for a safety ground.**

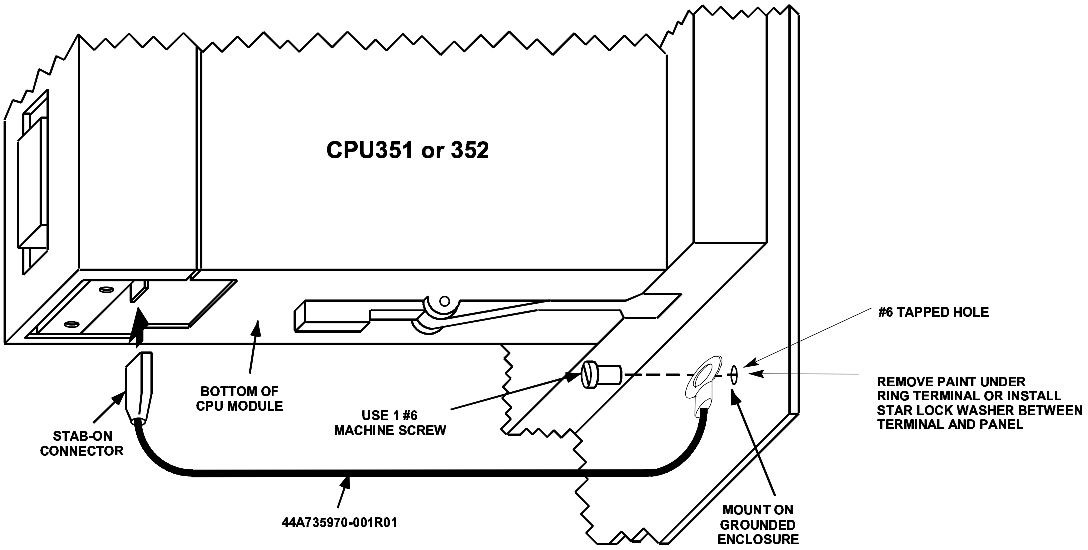


Figure 2-12. CPU 351 or 352 - Attaching Shield Ground Wire

2. The second method, which can be used for systems in noisy environments consists of installing the green ground wire ***and*** the optional grounding bracket (part number 44C715646-001R01). This bracket attaches to the CPU using two #4 thread-rolling screws (part number N666P9004B6) and to the grounded enclosure using two #6 thread-rolling screws (part number N666P13006B6). Two holes must be drilled in the enclosure for mounting this bracket. Also, if the bracket will be attached to a painted surface, the paint should be removed down to bare metal under the bracket to ensure good contact between the bracket and the surface. See the next figure.

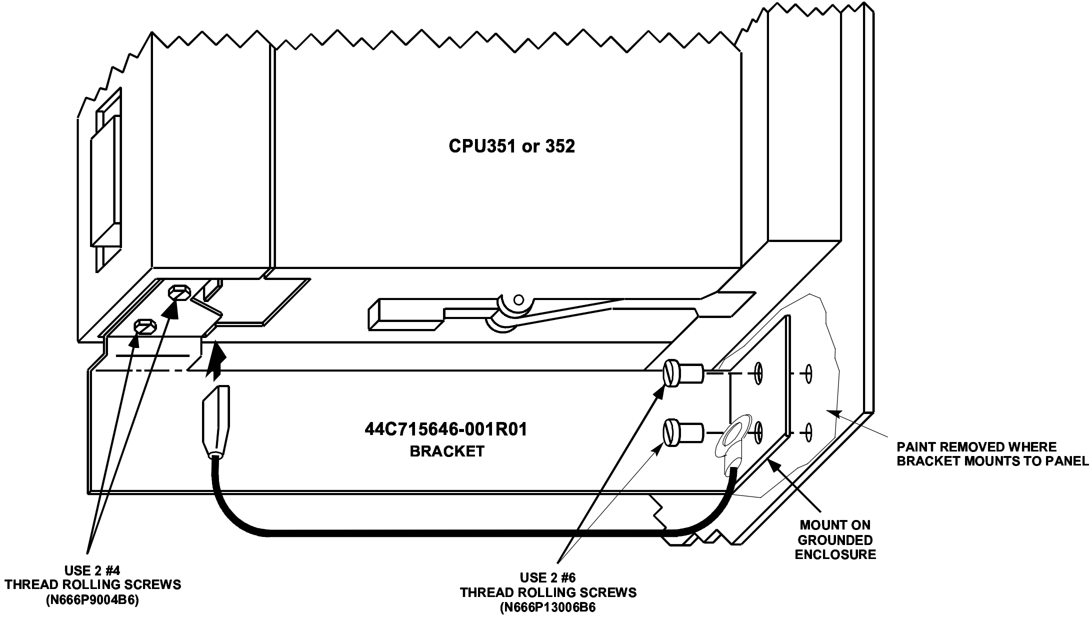


Figure 2-13. CPU 351 or 352 - Mounting the Shield Grounding Bracket and Wire

Note: When the grounding bracket is used, pin 1 of the cable connector that plugs into the Port 2 connector should not be connected. A metal connector shell must be used on the cable for this port, and the cable shield must be terminated at the metal shell instead of pin 1 of the connector.

CPU363, CPU364, and CPU374 Shield Grounding

The CPU363, CPU364, and CPU374 modules must be connected to frame ground at the slot where they are installed. Each module comes with a grounding wire for this purpose. These modules do not support or require the use of a grounding bracket. If the ring terminal on the grounding wire is to be mounted to a painted surface, remove the paint under the ring terminal to ensure good contact, or place a star lock washer between the ring terminal and the painted surface. See the next figure. **Note: The star lock washer method is suitable for a shield ground, but <u>not suitable for a safety ground</u>.**

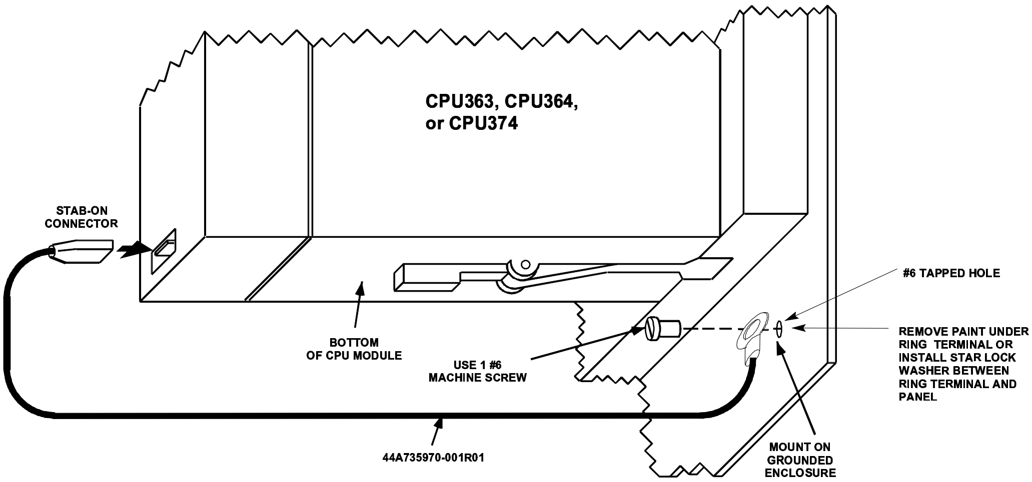


Figure 2-14. CPU 363, CPU364, or CPU374 - Attaching Ground Wire

Additional Modules with Shield Grounding Requirements

Some of the Series 90-30 Option modules, such as the FIP Remote I/O Scanner (IC693BEM330), and DSM modules (IC693DSM302 and IC693DSM314) also have shield grounding requirements. These modules come equipped with suitable grounding hardware. Please refer to each module's user's manual for grounding instructions. Appendix G contains a product to publication cross-reference to help you identify the correct manual.

General Wiring Guidelines

Warning

In addition to the following wiring suggestions, we strongly urge that you follow all wiring and safety codes that apply to your area or your type of equipment. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can lead to personal injury or death, property damage or destruction, or both.

Color Coding Wires

These color codes are commonly used in industrial equipment manufactured in the United States. They are cited here as a reference. Where they are in conflict with codes that apply to your area or your type of equipment, you should follow your applicable codes instead. Besides satisfying code requirements, wire color coding makes testing and troubleshooting safer, faster, and easier.

- Green or green with stripe- Ground
- Black - Primary AC
- Red - Secondary AC
- Blue - DC
- White - Common or neutral
- Yellow - Secondary power source not controlled by the main disconnect. Alerts maintenance personnel that there may be power present (from an external source) even if the equipment is disconnected from its main power source.

Wire Routing

To reduce noise coupling among PLC wires, it is recommended you keep electrically noisy wiring, such as AC power wiring and Discrete Output Module wiring, physically separated from low-level signal wiring such as DC and Analog Input module wiring or communications cables. This can be accomplished by grouping separately, where practical, the following categories of wiring:

- **AC power wiring.** This includes the AC input to the PLC power supply, as well as other AC devices in the control cabinet.
- **Analog Input or Output Module wiring**. This should be shielded to further reduce noise coupling. See the *Series 90-30 I/O Module Specifications Manual*, GFK-0898 for details.
- **Discrete Output Module wiring.** These often switch inductive loads that produce noise spikes when switched off.
- **DC Input Module wiring.** Although suppressed internally, these low-level inputs should be further protected against noise coupling by observing these wiring practices.
- **Communications Cables.** Wiring such as Genius Bus or serial cables should be kept away from noise-producing wiring.

Where AC or Output wiring bundles must pass near noise-sensitive signal wiring bundles, avoid running them beside each other. Route them so that, if they have to cross, they do so at a right angle. This will minimize coupling between them.

Grouping Modules to Keep Wires Segregated

If practical, grouping similar modules together in the PLC racks can help keep wiring segregated. For example, one rack could contain only AC modules, and a different rack only DC modules, with further grouping in each rack by input and output types. For smaller systems, as an example, the left end of a rack could contain Analog modules, the middle could contain DC modules, and the right end could contain AC modules.

Discrete I/O Module Connection Methods

- For modules with 16 points or less, the standard method is to use the removable terminal board which comes with these modules. The removable terminal board makes it easy to prewire field wiring to the user supplied input and output devices, and to replace modules in the field without disturbing existing field wiring.
- Some discrete 16-point I/O modules can be used with an optional Terminal Block Quick Connect (TBQC) assembly. This assembly contains a module faceplate, with built-in connector, that replaces the removable terminal board. The assembly also contains a DIN-rail mounted terminal block and a cable to connect the module to the terminal block. The advantage of this method is that it saves about two hours of wiring time per module compared with hand wiring from a module's removable terminal board to a user-supplied, panel-mounted terminal block or strip.
- Older 32-point I/O modules have one 50-pin connector on the front of the module that is either connected by a cable with a connector on each end to a Weidmuller panel-mounted terminal block (Weidmuller catalog no. 912263), or is connected by a cable with stripped, tinned leads to a user-supplied terminal block or strip.
- Newer 32-point I/O modules have two 24-pin connectors on the front of the module. These module may be wired in one of three ways. (1) Use a pair of cables (IC693CBL327/328 - see data sheet in "Cables" chapter) to connect the module to a user-supplied, panel-mounted terminal block or strip. These cables have a 24-pin connector on one end, and stripped, tinned leads with wire markers on the other end. (2) Use a pair of dual-connector cables to connect the module to a Terminal Block Quick Connect (TBQC) terminal block (IC693ACC377). See Appendix H for details. (3) Make your own custom cables. Instructions are found in the IC693CBL327/328 data sheet in Chapter 10.

Connections to I/O Module Terminal Boards

Series 90-30 PLC I/O terminal boards have either 10 or 20 screw terminals that will accept from two AWG #22 (0.36 mm^2) to two AWG #16 (1.3 mm^2), or one AWG #14 (2.1 mm^2) copper 90°C (194°F) wire(s). Each terminal can accept solid or stranded wires, but the wires into any given terminal should be the same type (both solid or both stranded) to ensure a good connection. Wires are routed to and from the terminals out of the bottom of the terminal board cavity. The suggested torque for the I/O terminal board connection screws is from 9.6 in-lbs to 11.5 in-lbs (1.1–1.3 Newton-meters).

For 24 volt DC input modules, an internal 24 volt power connection is provided on the terminal board to supply a limited number of input devices. Also, a 24 volt DC output is available on the power supply module's terminal board to supply a limited number of output devices.

Terminal Block Quick Connect Installation for 16-Point Discrete Modules

The Terminal Block Quick Connect (TBQC) Assembly is an option for certain Series 90-30 discrete I/O modules. See Appendix H for more information.

- Remove standard terminal board from module.
- Install TBQC faceplate (it has a 24-pin connector).
- Mount the TBQC terminal block. It has a 24-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect a TBQC cable between the TBQC faceplate connector on the module and the connector on the TBQC terminal block.
- Wire I/O devices to the terminal block.

Installation of 32-Point Discrete, 50-Pin Connector Modules

These 50-Pin modules are an older design and are not generally used on new systems, unless to fulfill standardization requirements. They are mainly used as replacements for existing installations. For new installations, we recommend the dual 24-pin connector style because they have additional features not found on the older modules (LED indicators, TBQC), and it is much easier to fabricate custom-length cables for them. Installation information is provided here for the convenience of those still using these modules.

Using Weidmuller #912263 Terminal Block

Note: The TBQC is not available for these modules, but you may purchase a Weidmuller #912263 from your electronics distributor for this application.

- Mount the Weidmuller#912263 terminal block. It has a 50-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect an IC693CBL306/307 cable between the module's faceplate connector and the connector on the Weidmuller terminal block. See Chapter 10 for cable data.
- Wire I/O devices to the terminal block. See the *Series 90-30 PLC I/O Module Specifications Manual*, GFK-0898, for pin-out information.

Using a Generic Terminal Block or Strip

- Mount terminal block/strip to the enclosure panel.
- Connect an IC693CBL308 or 309 cable, or a custom made cable, to the module's faceplate connector and wire the stripped ends of the cable to the terminal block/strip. See Chapter 10 for cable data.
- Wire I/O devices to the terminal block/strip.

Direct Method

- Connect an IC693CBL308 or 309 cable, or a custom made cable, to the module's faceplate connector and wire the stripped ends of the cable directly to the field devices. See Chapter 10 for cable data. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

Installation of Discrete 32-Point, Dual 24-Pin Connector Modules

Using a TBQC

- Mount two TBQC terminal blocks. Each has a 24-pin connector and a terminal strip, and mounts on a standard 35 mm DIN-rail.
- Connect a pair of TBQC cables (IC693CBL329 - 334) between the module's faceplate connector and the connectors on the two TBQC terminal blocks. Note that both a right side and left side cable is required. See Appendix H for a list of cables.
- Wire I/O devices to the terminal blocks. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

The Terminal Block Quick Connect (TBQC) Assembly is an option for certain Series 90-30 discrete I/O modules. See Appendix H for more information.

With a Generic Terminal Block/Strip

- Mount terminal block/strip to the enclosure panel.
- Connect an IC693CBL327/328 cables, or a custom made cables, to the module's faceplate connectors, and wire the stripped ends of the cables to the terminal block/strip. Note that both a right side and left side cable is required. See Appendix H for a list of cables. See Chapter 10 for cable data sheets.
- Wire I/O devices to the terminal block/strip. See the Series 90-30 PLC I/O Module Specifications Manual, GFK-0898, for pin-out information.

Direct Method

- Connect an IC693CBL327/328 cable, or a custom made cable, to the module's faceplate connectors, and wire the stripped ends of the cable directly to the field devices. See Chapter 10 for cable data. See the *Series 90-30 PLC I/O Module Specifications Manual*, GFK-0898, for pin-out information.

General Wiring Methods for Analog Modules

Twisted, shielded instrumentation cable is strongly recommended for analog module input or output signal connections. Proper grounding of the shield is also important. For maximum electrical noise suppression, the cable shield should only be grounded at one end of the cable. For Input modules, ground the end that is in the noisiest environment (which often is at the field device end). For Output modules, ground at the module end. See GFK-0898, *Series 90-30 PLC I/O Module Specifications,* for more shield grounding information.

Analog Input Module Wiring Methods

Correcting electrical noise problems can sometimes be a trial-and-error routine. However, in general, it is generally best to ground the cable shield as close to the source of the noise as possible, which is usually at the device end. In troubleshooting noise problems, sometimes it is beneficial to experiment with the shield grounding point location. Remember, the cable shield should be grounded at one end only. Also, it is best to keep the length of stripped cable leads as short as possible to minimize the length of unshielded conductors that will be exposed to the noisy environment. See the *Series 90-30 PLC I/O Module Specifications Manual,* GFK-0898 for additional details.

Using a Generic Terminal Block or Strip

- Mount a terminal strip inside the control enclosure and run a shielded cable from the terminal strip to each input circuit on the module's terminal board terminals.
- Connect each cable's shield to the metal panel next to the terminal strip. Do not connect the shields at the module end (cut shield off at module end of cable and insulate with shrink tubing).
- Wire the field device to the terminal strip with a shielded cable, grounding the shield at the device end only (cut shield off at terminal strip end of cable and insulate with shrink tubing). Also, keep the length of exposed (outside of shield) leads at the terminal strip and device ends as short as possible.

Direct Method

- Run a shielded cable from the field device (transducer, potentiometer, etc.) directly to the module.
- Connect the conductors to the applicable screws on the module's terminal board.

- Ground the shield at the field device end, exposing a minimum amount of conductor to the noisy environment. Do not connect the shield at the module end (cut shield off at module end of cable and insulate with shrink tubing).

TBQC not Recommended for Analog Modules

The Terminal Block Quick Connect (TBQC) Assembly is not recommended for use with analog modules due to cable shielding requirements.

Analog Output Module Wiring

General

Each output should be connected using a good quality shielded wire with the cable shield grounded at the module end. See GFK-0898, *Series 90-30 PLC I/O Module Specifications,* for more information.

Using a Generic Terminal Block or Strip

- Mount a terminal strip inside the control enclosure and run a shielded cable from the terminal strip to each output circuit on the module's terminal board terminals.
- Ground each cable's shield at the module end only. Do not connect the shields at the terminal strip end (cut shields off at terminal strip end of cables and insulate with shrink tubing).
- Wire the field device to the terminal strip with shielded cables, grounding the shields at the terminal strip end only (cut shields off at field device end of cables and insulate with shrink tubing). Also, keep the length of exposed (outside of shield) leads at the terminal strip and device ends as short as possible.

Direct Method

- Run a shielded cable from each field device (transducer, potentiometer, etc.) directly to the module.
- Connect the conductors to the applicable screws on the module's terminal board.
- Ground the shield at the module end only, exposing a minimum amount of conductor to the noisy environment. Do not connect the shield at the device end (cut shield off at device end of cable and insulate with shrink tubing).

TBQC not Recommended for Analog Modules

The Terminal Block Quick Connect (TBQC) Assembly is not recommended for use with analog modules due to cable shielding requirements.

AC Power Source Connections

AC Input Wiring to AC/DC Power Supplies

Warning

If the same AC power source is used to provide AC power to other baseplates in a Series 90-30 PLC System, ensure that all AC input connections are identical at each rack. Do not cross Line 1 (L1) and Line 2 (L2). A resulting difference in potential can injure personnel or cause damage to equipment. Each baseplate must be connected to a common ground.

Ensure that the protective cover is installed over all terminal boards. During normal operation with an AC power source either 120 VAC or 240 VAC is present on the AC Power Supply. The cover protects against accidental shock hazard which could cause severe or fatal injury to the operator or maintenance personnel.

Both the Standard (IC693PWR321) and High Capacity (IC693PWR330) AC/DC power supplies currently have six terminals for user connections. Early versions of some Series 90-30 power supplies had five terminals (see next figure). The wiring methods for both five-terminal and six-terminal types is similar, except that step 3 below does not apply to the five-terminal type.

The power supply terminal boards will accept one AWG #14 (2.1 mm^2) or two AWG #16 (1.3 mm^2) copper 75_ C (167_ F) wires. Each terminal can accept solid or stranded wires, but the wires in any given terminal should be the same type. The suggested torque for the power supply terminal board is 12 in-lbs (1.36 Newton-meters). Open the door protecting the terminal board and make the following connections from the AC power source, and ground connections (system grounding requirements are described in detail later in this chapter).

1. These are wide range supplies that can operate from an AC power source within the nominal range of 100 VAC to 240 VAC at 50/60 Hz. This may vary -15% to +10% for a total maximum range of 85 VAC to 264 VAC. These are auto-ranging supplies that do not require jumper or switch settings for selection of power source voltage.
2. Connect the hot and neutral wires or lines L1 and L2 to the upper two terminals on the terminal board. Connect the safety ground wire to the ground terminal, which is the third terminal from the top, and is marked with a ground symbol.
3. For power supplies with six terminals, the factory jumper between the 3rd and 4th terminals (see figure below), should be left in place for normal installations. However, this jumper must be removed and external surge suppressors installed in installations with a "Floating Neutral" input. Please see the section "Special Instructions for Floating Neutral (IT) Systems" later in this chapter for details.
4. After all connections to Power Supply terminal board have been completed, the protective cover plate should be carefully reinstalled.

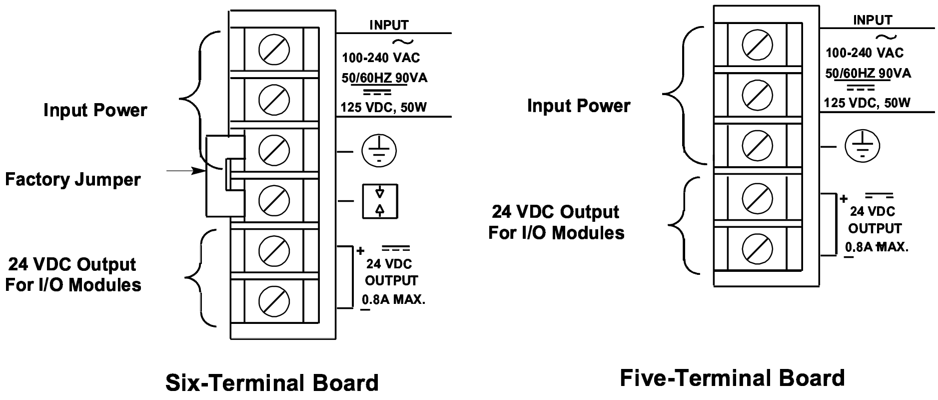


Figure 2-15. Power Supply Terminal Boards

Power Supply Overvoltage Protection Devices

The overvoltage protection devices for this power supply are connected internally to pin 4 on the user terminal board. This pin is normally connected to frame ground (pin 3) with the supplied jumper strap which is installed at the factory. If overvoltage protection is not required *or* is supplied upstream, this feature can be disabled by leaving pin 4 unconnected by removing the jumper strap. Also, this jumper must be removed and external surge suppressors installed in installations with a “Floating Neutral” input, please see the following section “Special Instructions for Floating Neutral (IT) Systems” later in this chapter.

If you want to Hi-pot test this supply, overvoltage protection *must be disabled* during the test by removing the terminal board strap. Re-enable overvoltage protection after testing by reinstalling the strap.

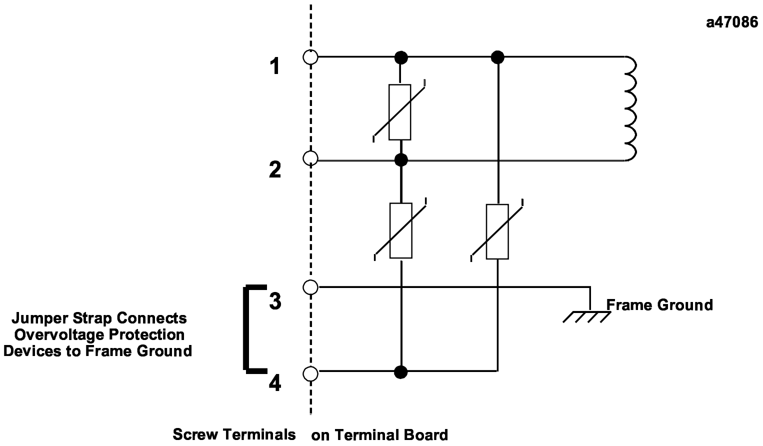


Figure 2-16. Overvoltage Protection Devices and Jumper Strap

Special Installation Instructions for Floating Neutral (IT) Systems

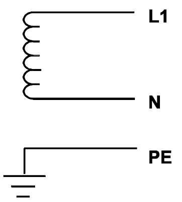
When the AC input power supplies listed below are installed in a system where the Neutral line is **not** referenced to Protective Earth Ground, these special installation instructions must be followed to prevent damage to the power supply.

IC693PWR321S (or later version)
IC693PWR330A (or later version)

Definition of Floating Neutral Systems

A *Floating Neutral System* is a system of power distribution wiring where Neutral and Protective Earth Ground are **not** tied together by a negligible impedance. In Europe this is referred to as an **IT** system (see IEC950). In a *Floating Neutral System*, voltages measured from input terminals to protective earth ground may exceed the 264 Volts AC maximum input voltage specified in the power supply specifications in Chapter 24in this manual.

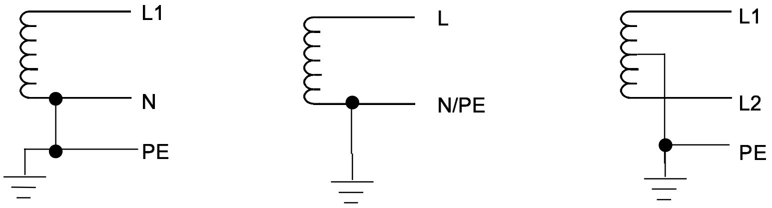
Example of Floating Neutral System



This system **must** be installed using the special installation instructions on the following page.

Systems in which one leg of the power distribution wiring is tied to Protective Earth or a tap between two legs of the power distribution wiring is tied to Protective Earth are **not** *Floating Neutral Systems*.

Examples of Non-Floating Neutral System



These non-floating neutral systems **do not** require these special installation instructions.

Use These Special Installation Instructions for Floating Neutral Systems

1. The input power terminals should be wired according to the instructions in the “AC Power Source Connections” section of this chapter.
2. The factory installed jumper between terminals 3 and 4 of the Power Supply module **must** be removed if using one of the Power Supplies that have this feature. See the “Overvoltage Protection Devices” section of the “Power Supplies” chapter for details.
3. Voltage surge protection devices, such as MOVs, **MUST** be installed between the following terminals:
   - From L1 to earth ground
   - From L2 (Neutral) to earth ground

The voltage surge devices must be rated such that the system is protected from power line transients that exceed $Line\ voltage + 100V + (N\text{-}PE)_{MAX.}$

The expression *N-PE* refers to the voltage potential between neutral and Protective Earth (PE) ground.

For example, in a 240 Volt AC system with neutral floating 50V above earth ground, the transient protection should be rated at:

240V + 100V +50V = 390V

DC Power Source Connections

DC Input Wiring to AC/DC and DC-Only Power Supplies

DC Input power can range from 12 to 30 VDC for the 24 VDC supply, 18 to 56 VDC for the 24/48 VDC supply or 100 to 150 VDC for the 125 VDC supply. All Series 90-30 power supplies have DC input capabilities. The following connection information applies to all of them:

Connect the + and - wires from the power source to the top terminals on the terminal board (+ to the top terminal, - to the second terminal). Connect the third terminal from the top to system ground.

+24 VDC Output (All Supplies)

The bottom two terminals are connected to the isolated 24 volt DC output that can be used to supply power to input circuits (within power limitations of the supply).

Warning

If the same DC input power source is used to provide power to two or more power supplies in a Series 90-30 PLC System, ensure that connection polarity is identical at each rack (top terminal + and second terminal -). Do not cross the Positive (+) and Negative (-) lines. A resulting difference in potential can injure personnel or cause damage to equipment. Also, each baseplate must be connected to a common system ground, described earlier in this chapter.

Basic Installation Procedure

Note: Series 90-30 PLCs must be mounted in a protective enclosure. The enclosure should be capable of properly dissipating the heat produced by all of the devices mounted inside it. For details on calculating heat dissipation, refer to Appendix F.

The system design, which includes producing the layout and wiring drawings, should be completed before beginning the installation procedure. This section offers a basic step-by-step approach to installing a Series 90-30 PLC system. Some steps refer to earlier sections of this chapter for additional details. An attempt was made to place the steps in an order that will make the process as efficient as possible. However, due to the wide variance in system designs, this order may not be the most efficient for your system, so you may wish modify this procedure to fit your needs.

1. Gather the schematics, layouts, prints, and other information for the job.

Warning

To avoid the possibility of electrical shock to personnel or damage to your PLC, we recommend that you shut off all power to the system before mounting and wiring the PLC. Also, keep all electronic components away from the area while drilling and tapping to keep metal chips and filings out of these sensitive components.

2. From the layout drawing, determine where the baseplate(s) will be mounted. Lay out the hole locations, either using the dimensions given on your layout drawing or from the "Baseplates" chapter of this manual.
3. Mark the hole locations for the baseplate safety ground wire (see "Baseplate Safety Ground" in this chapter).
4. Mark the hole locations for module shield ground connections (if any). See "Module Shield Ground" (and accompanying sections) in this chapter for instructions.
5. Finish laying (marking hole locations) out the rest of the system. This includes any terminal blocks you will be using. DIN-rail mounted terminal blocks for some of the 32-point I/O modules are manufactured by Weidmuller. DIN-rail mounted GE Fanuc Terminal Block Quick Connect (TBQC) assemblies are optional for some of the 16-point and 32-point discrete I/O modules. If using these TBQCs, refer to Appendix H for data. Also, APM and DSM modules use DIN-rail mounted terminal blocks.

Note

We recommend drilling and tapping all holes before mounting any components. This will avoid getting chips and filings in the components.

6. Drill and tap the marked holes. For baseplate mounting, use 8-32 or 4mm size.
7. Mount the baseplates. Use good quality 8-32 x 1/2 inch or 4 x 12mm size screws. We recommend using star lock washers and flat washers under the screw heads (star lock washer should be located between screw head and flat washer) to ensure a tight baseplate ground connection, and to keep the screws from loosening. Connect each baseplate ground wire as shown in the "Baseplate Safety Ground" section of this chapter.
8. If you have Expansion or Remote racks, determine the correct rack number for each one, then set the rack numbers using the Rack Number Selection dual in-line package (DIP) switch on

the baseplate. Please refer to the “Baseplates” chapter for details on setting these DIP switches. Rack numbers should be assigned by the system programmer because they correspond to system configuration settings and program memory addressing.

9. If you have more than one baseplate (rack), connect the I/O Bus Expansion Cables between the I/O Bus Expansion Connectors, which are located on the right end of the baseplates. The cables are connected in a “daisy-chain” arrangement from one baseplate to the other. This is made possible by the fact that the cables have a dual connector on one end. Therefore, when the cable is plugged into a baseplate connector, the second connector on that end of the cable provides a socket for connecting to the next cable. The data sheet for the I/O Bus Expansion cables (IC693CBL300 etc.) in the “Cables” chapter has sample wiring figures.
10. On the last I/O Bus Expansion Connector, plug in an I/O Bus Expansion Terminator, Catalog Number IC693ACC307 (unless using a cable with built-in terminator resistors, which would either be GE Fanuc cable IC693CBL302, or your own custom-built cable).
11. Install the modules in their correct slots using your system layout drawings. (The label on the side of each module identifies the module type and catalog number.) Refer to the section “Installing Modules” if you are not familiar with how to do this.
12. Connect cables to Option modules. Route cables away from noise-producing wires. See the ”Wire Routing” section of this chapter.
13. Be sure to follow the information in the “Wiring Guidelines” section of this chapter to protect the system from electrical noise. Install the power wires to the Power Supply and I/O modules:
    - **I/O modules with removable terminal boards.** You can wire the terminal boards in-place on the modules or remove them from the modules before wiring. Although removing them may help make wiring easier (a previous section “Working with Removable Terminal Boards” shows how to remove a terminal board), care should be taken to avoid mixing them (each terminal board has the catalog number of the module printed on it, and the hinged cover has a wiring diagram for that module type). If you are using wire duct, routing each module’s wires through the opening in the duct directly under the module will help to keep each terminal board in its correct position.
    - **I/O Modules with terminal blocks.** Some modules use terminal blocks that mount to the enclosure panel. This includes all 32-point modules and, can include other I/O modules if they are fitted with the optional Terminal Block Quick Connect Assembly. Connect the terminal blocks to the connectors on the modules with the provided cables.
14. Connect the signal (switches, sensors, solenoids, etc.) wires to the terminal boards, or terminal blocks/strips. If wiring to terminal boards, these can be removed for ease of wiring, if desired. See the section “Removing a Module’s Terminal Board.”
15. When finished wiring the I/O terminal boards (if used and if you removed them for ease of wiring), re-install them on the modules, being careful to match each one with the correct module.

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GFZ–0085

GE Fanuc Automation

Programmable Control Products

Series 90^{TM}–30
Programmable Controller

Troubleshooting Guide

GE Fanuc Automation

Programmable Control Products

Series 90^{TM}–30
Programmable Controller

Troubleshooting Guide

GFZ–0085 August 1993

Notice

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained in this document does not purport to cover all details or variations in hardware and software, nor to provide for every contingency in connection with installation, operation and maintenance. This document may describe features not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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CIMPLICITY
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Genius
VuMaster
Series Five

Safety Considerations

General Warnings When Troubleshooting

Stand clear of controlled equipment when power is applied. If the problem is intermittent, sudden unexpected machine motion could occur, causing injury. Also reference NFPA 70E Part II for additional guidelines for safety practices.

Never reach into a machine to operate a switch since unexpected motion could occur, causing injury.

Remove all electrical power at the Main Power Disconnect to ensure total power removal.

Always remove power before inserting or removing modules, or before connecting I/O cabling.

Preface

This guide describes a logical sequence for troubleshooting your Series 90–30 programmable controller. It includes the procedure for changing or adding a EPROM or EEPROM to your CPU. The Series 90–30 PLC is a member of the Series 90^{TM} family of programmable logic controllers from GE Fanuc Automation.

Revisions to this Troubleshooting Guide

This is the first release of this Troubleshooting Guide. Included are models CPU 311, 313, 321, 323, 331 and 341.

Related Publications

Series 90^{TM}–30 Programmable Controller Installation Manual (GFK–0356).

Series 90^{TM}–30 and 90–20 PLC Hand–Held Programmer User's Manual (GFK–0402)

Logicmaster^{TM} 90 Series 90–30 and 90–20 Programming Software User's Manual (GFK–0466)

Series 90^{TM}–30/90–20 Programmable Controllers Reference Manual (GFK–0467)

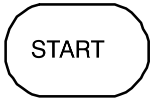
We Welcome Your Comments and Suggestions

At GE Fanuc Automation, we strive to produce quality technical documentation. After you have used this troubleshooting guide, please take a few moments to write us with your comments and suggestions. Our address is: Manager Technical Publications, GE Fanuc Automation. PO Box 8106, Charlottesville, VA 22906

Drake C. Fink

Sr. Staff Systems Engineer

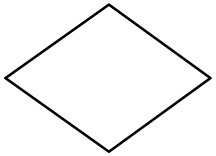
SYMBOLS USED IN THIS GUIDE



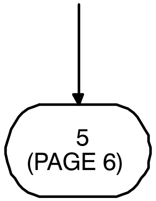
BEGIN AT THIS SYMBOL
ON THE FIRST CHART.

FOLLOW THE PATH WITH THE CORRECT ANSWER IN THE DIRECTION OF THE ARROW

SYMBOLS USED THROUGHOUT THE GUIDE
ARE GEOMETRICALLY CODED

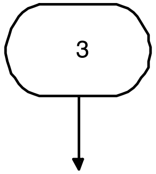


A DIAMOND ASKS A QUESTION



A NUMBERED BUBBLE WITH AN ARROW INTO THE BUBBLE INDICATES THAT THE PROCEDURE IS CONTINUED AT A CORRESPONDINGLY NUMBERED BUBBLE ON THE INDICATED PAGE NUMBER.

A RECTANGLE TELLS
YOU TO DO SOMETHING



A NUMBERED BUBBLE WITH AN ARROW OUT OF THE BUBBLE INDICATES THE START OF A PROCEDURE ON THAT PAGE.I

Adding or Changing the EEPROM in the $90^{TM}-30$

Application programs are normally developed in the CPU's RAM memory and executed from RAM memory. If additional program integrity is desired, or operation of the PLC without a battery is desired, an optional EEPROM or EPROM can be installed in a spare socket (labeled PROGRAM PROM) on the Model 311/313 backplane or in a socket on the model 331/341 CPU module. EEPROMs can be written to and read from. EPROMs can be read when installed in the PLC; however, they must be written to using an external PROM programming device.

Following is the procedure for adding or changing the EEPROM or EPROM. For clarity, the term PROM is used to refer to either an EEPROM or an EPROM.

1. Remove power from the system.
2. If 311/313
   - Remove all modules, including the power supply.
   - Remove the plastic cover.
3. If 331/341:
   - Remove CPU from backplane.
   - Remove front plate and bezel. Unsnap circuit board and remove from case.
4. If the socket is the type which has a screw near the top edge (some versions of 311/331), loosen screw at top of PROM socket (CCW twist;).
5. If present, remove old PROM from socket. Replace with or install new PROM. Orient the PROM so the end with a notch (the top of the prom) is toward the top edge of the backplane. Pin 1 of the prom is the first pin on the left as you move counter–clockwise from the notch. On the 311/331, correct installation orients the notch toward the screw.
6. When present, tighten screw at top of PROM socket (CW twist).
7. If 311/313:
   - Replace the plastic cover.
   - Replace all modules, including the power supply.
8. If 331 CPU:
   - Assure jumper JP1, located at the bottom of the PROM socket, is in the 1–2 position for EPROM and the 3–2 position for EEPROM. This informs the CPU firmware which type of device is present.
9. If 331/341 CPU:
   - Replace circuit board in case.
   - Reinstall front plate and bezel.
   - Replace CPU in backplane.

Changing the EEPROM (continued)

10. Apply power. The PLC follows the flowchart found in the ”Power–Up Sequence” figure in the Power–Up and Power–Down Section of the *Series 90–30/90–20 Programmable Controllers Reference Manual* (GFK–0467) to determine if a program will be loaded from PROM to RAM.

11. For the EEPROM to be used by the CPU, the CPU configuration must be set to use EEPROM as the ”Program Source”. You may use the LM90 Configuration software or the HHP to accomplish this.

12. To store the program in RAM, you may use either the Hand–Held Programmer or Logicmaster 90–30, Rev 3.5 or higher. Refer to the instructions in the *HHP User's Manual* (GFK–0402) for HHP. To use Logicmaster 90–30, follow these instructions:

- Start the LM90–30 Programmer Package
- Activate the Utilities Menu (F9)
- Select the EEPROM function (F10)
- Select the WRITE operation
- Verify the items you want to write to EEPROM are selected.
- Press ENTER to start the operation. Refer to the *Logicmaster 90 Series 90–30 and 90–20 Programming Software User's Manual* (GFK–0466) for more information.

Notes and Precautions

1. **WARNING**: Do not discard the lithium–manganese dioxide battery in fire. Do not attempt to discharge the battery. The battery may burst or burn or release hazardous materials. Dispose of the battery as you would any hazardous material.

2. **CAUTION**: After a power fault, the system will come back on in the mode (*STOP, RUN/ENABLED, RUN/DISABLED)* in which it was operating before power loss, unless the power up configuration specifies a particular mode.

3. Not having a battery installed will not prevent the PLC from running. It will generate a PLC fault on power cycle that prevents the PLC from entering *RUN* mode automatically. Clearing this fault will enable the PLC to be placed in *RUN* mode.

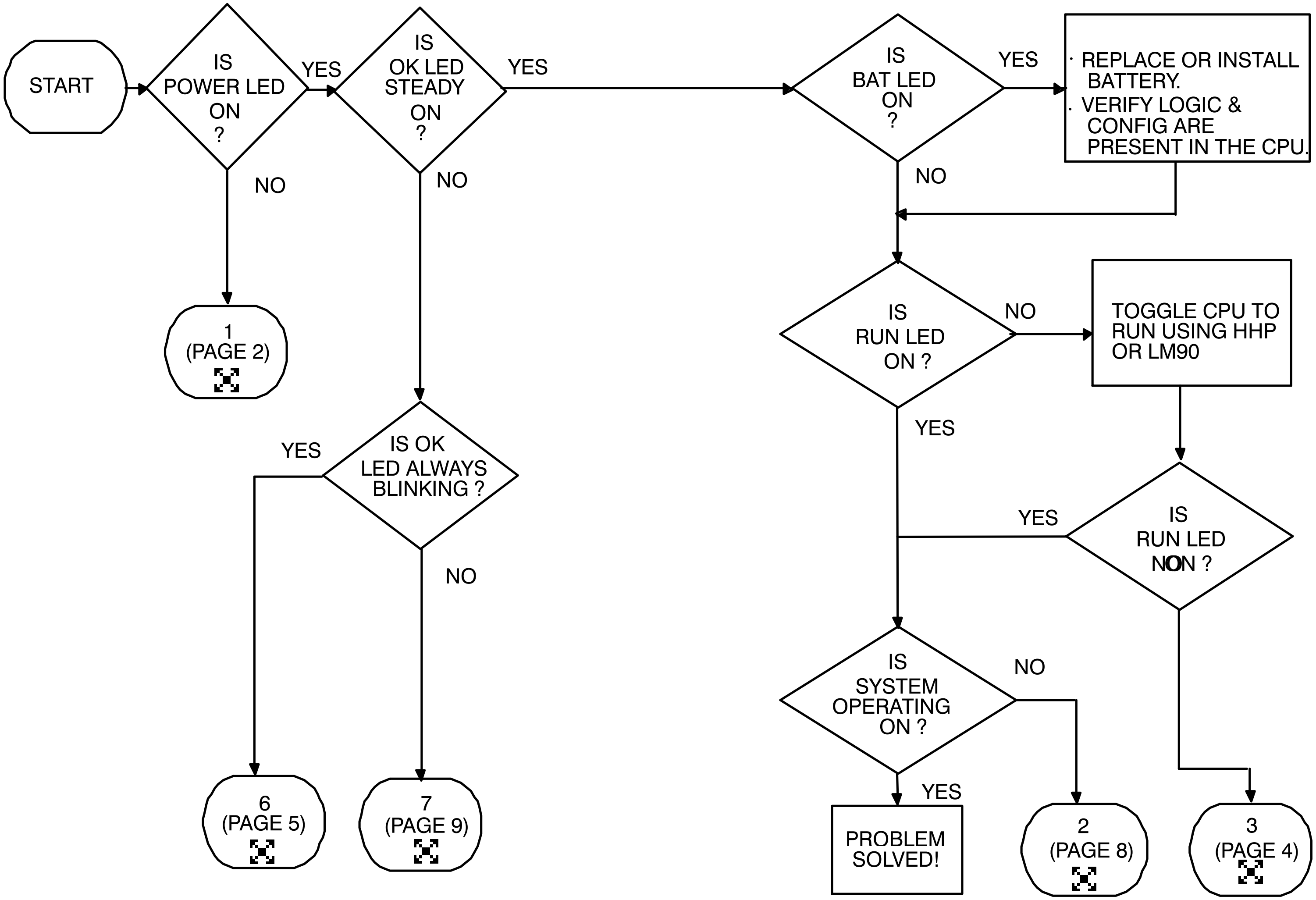
4. To short the ’super cap’ on a 311/321 PLC:

- Remove power from the system.
- Remove all modules, including the power supply.
- Remove the plastic face plate.
- Find component C20 along the left edge of the module. This is the ’super cap’. Short the positive (+) and negative (–) leads of this device.
- Replace the plastic face plate.
- Replace all modules.
- Restore power to the system.

5. Supply (input) voltage tolerances for Series 90–30 power supplies:

IC693PWR321:	100 to 240 VAC 100 to 250 VDC (125 VDC nominal)
IC693PWR322:	18 to 56 VDC, 21 VDC minimum to start 24 VDC OR 48 VDC nominal

6. Total cable length must not exceed 50 feet between a CPU rack and an expansion rack. Length must not exceed 700 feet between a CPU rack and a remote rack. No termination plug is needed on a one–rack system.



PAGE 1

(Refer to the Preface for information on safety considerations, related publications and the symbols used in this guide.)

DIA30AL
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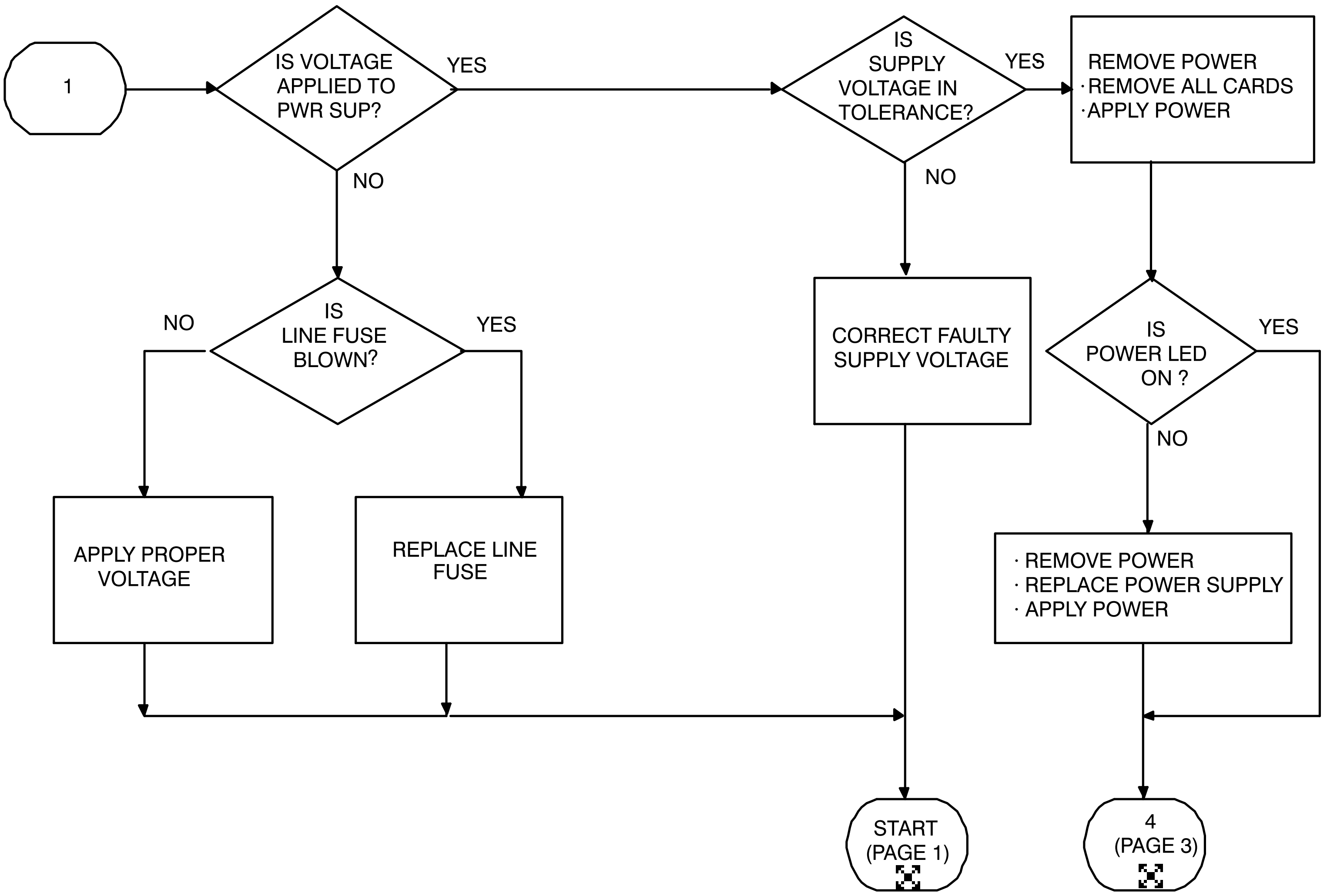

PAGE 2

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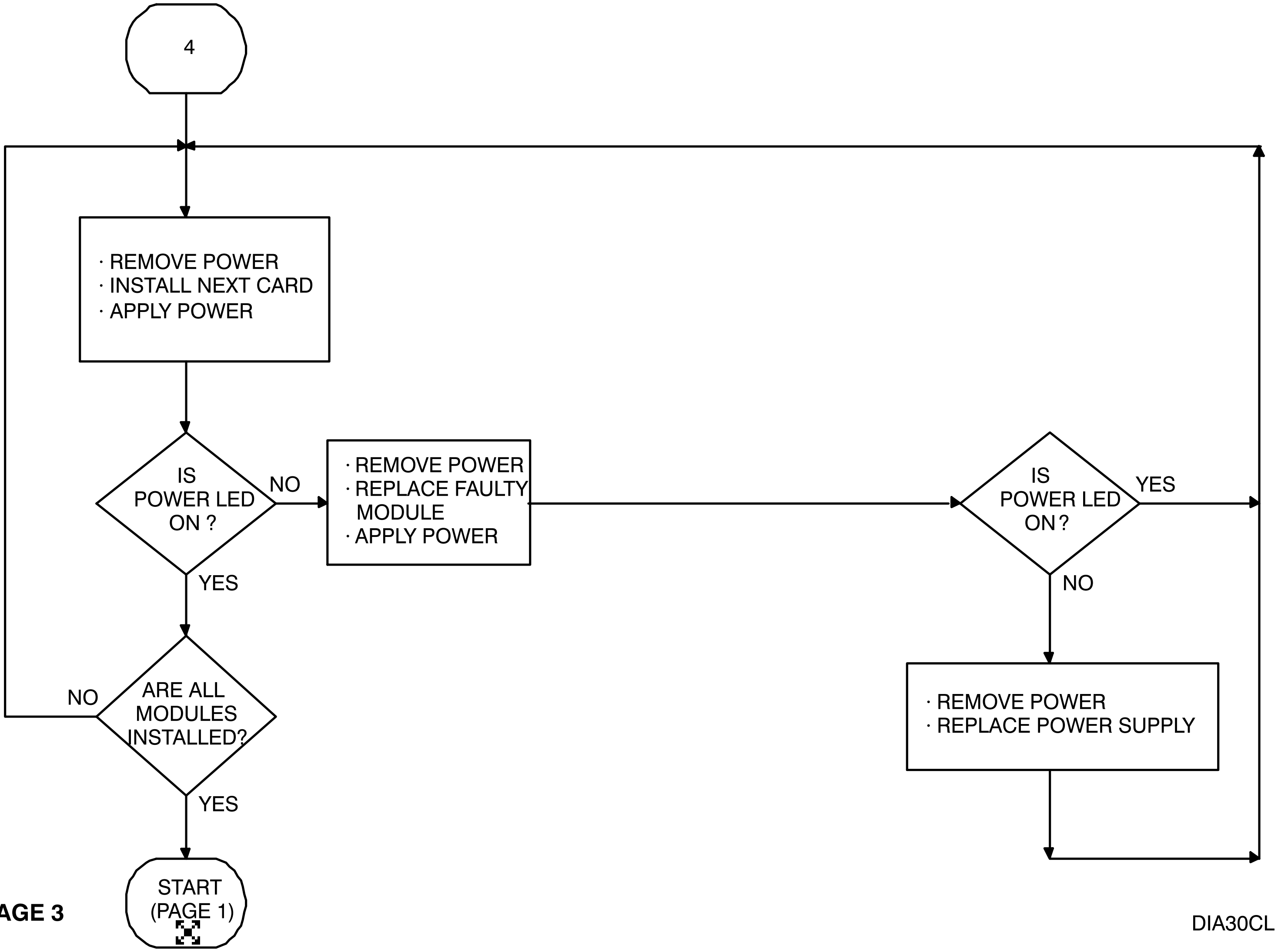
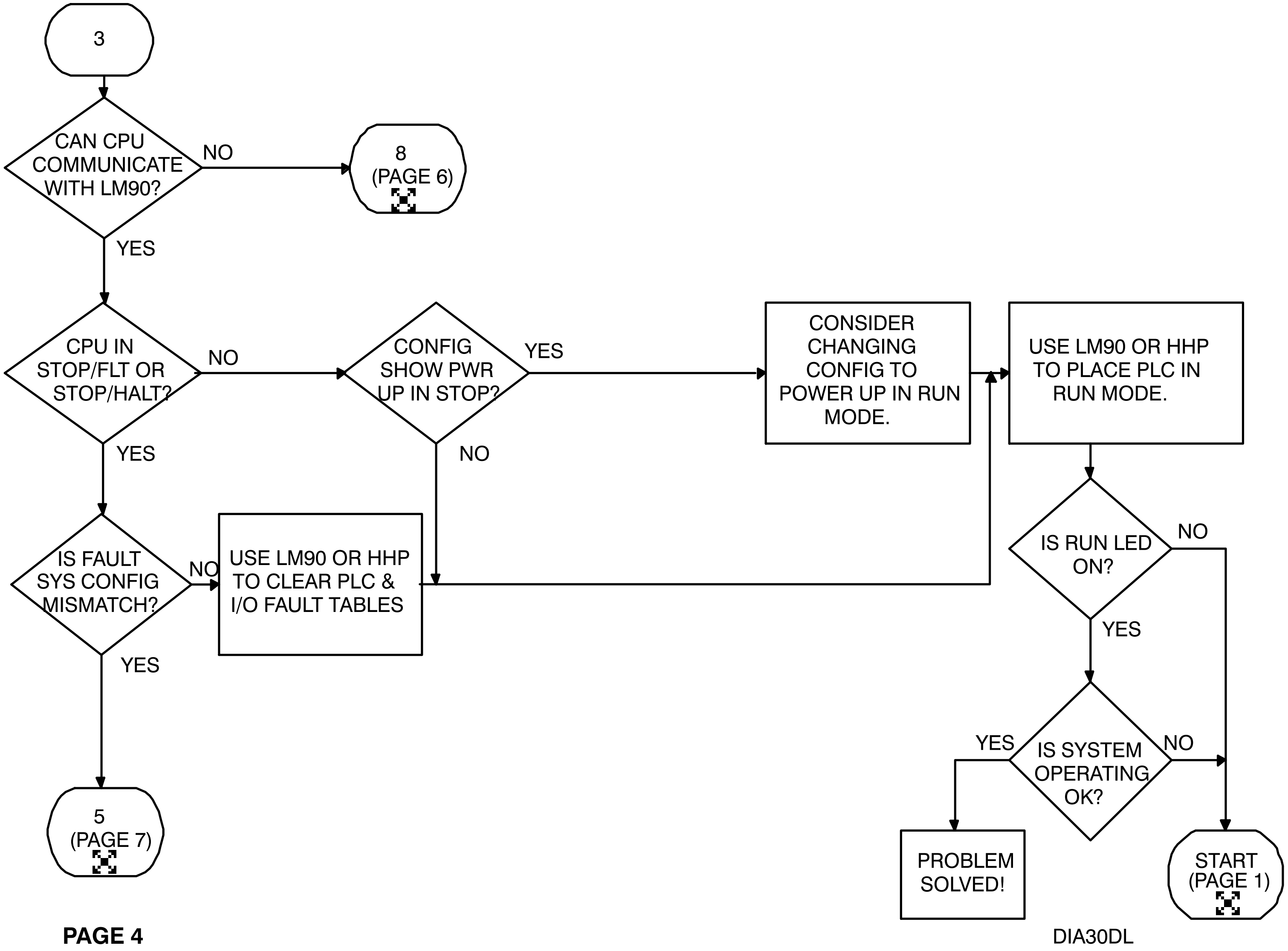
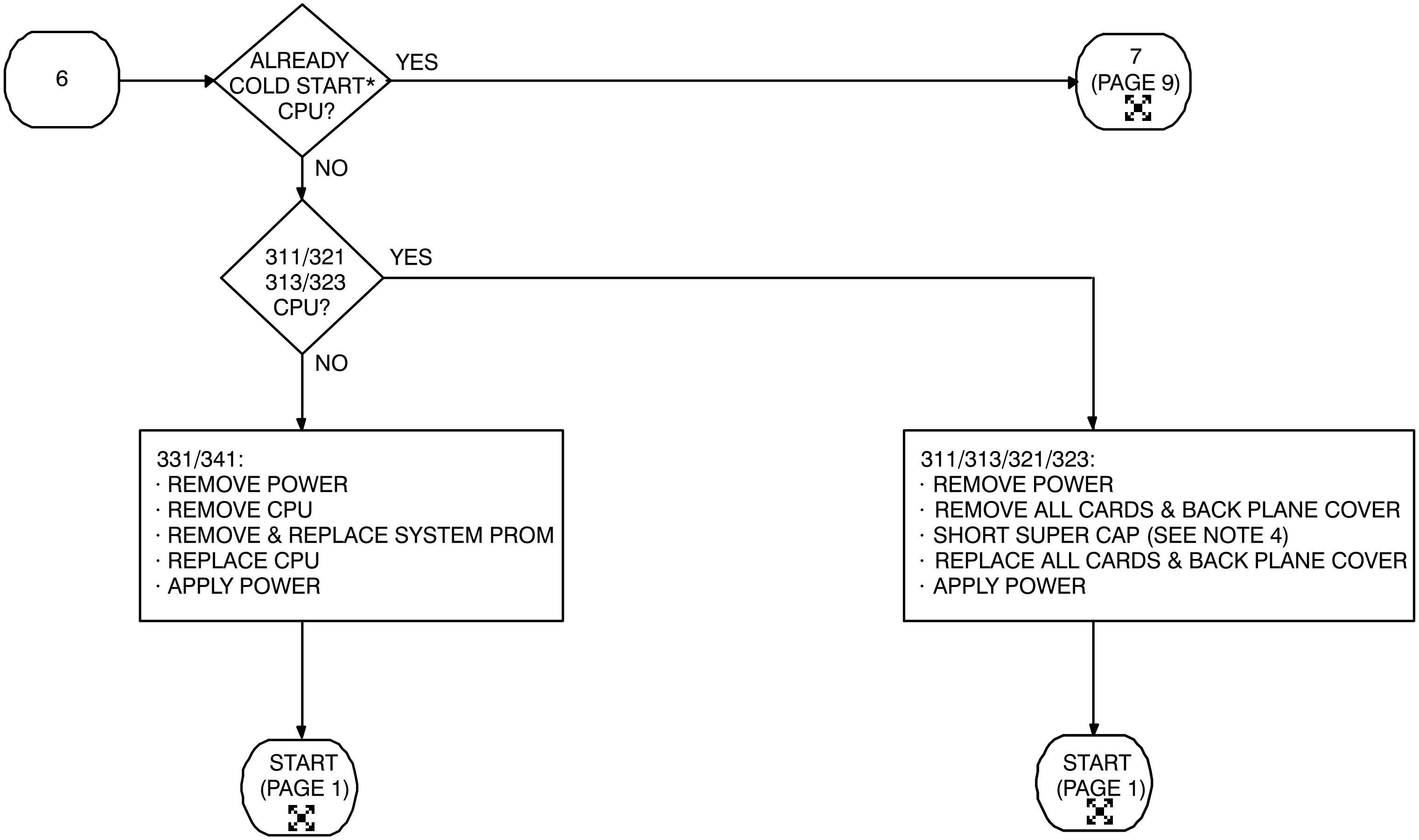


PAGE 3

DIA30CL

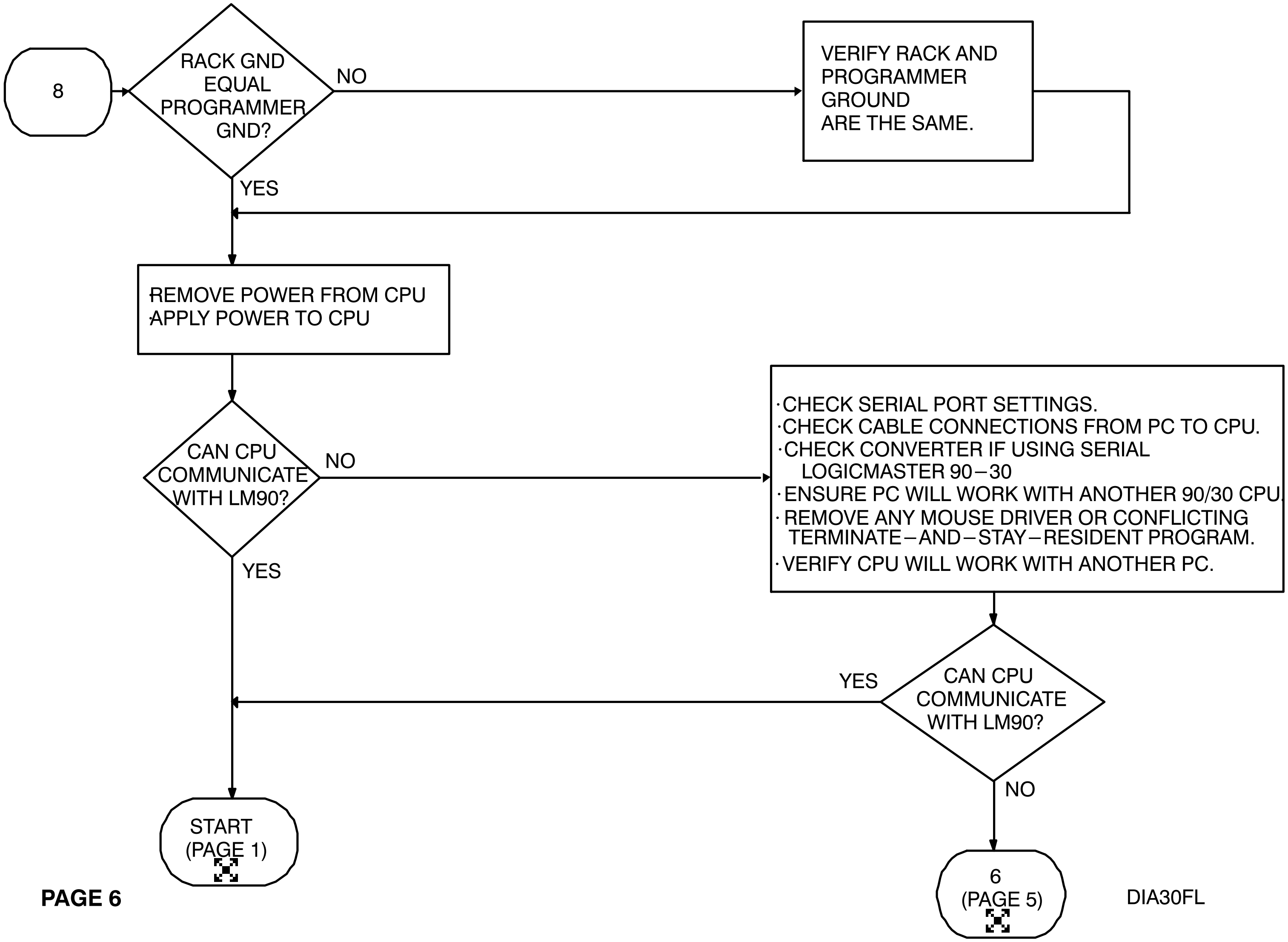

3
CAN CPU COMMUNICATE WITH LM90?
NO
8 (PAGE 6)
YES
CPU IN STOP/FLT OR STOP/HALT?
NO
CONFIG SHOW PWR UP IN STOP?
YES
CONSIDER CHANGING CONFIG TO POWER UP IN RUN MODE.
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
YES
NO
IS FAULT SYS CONFIG MISMATCH?
NO
USE LM90 OR HHP TO CLEAR PLC & I/O FAULT TABLES
IS RUN LED ON?
NO
YES
YES
5 (PAGE 7)
YES
IS SYSTEM OPERATING OK?
NO
PROBLEM SOLVED!
START (PAGE 1)
PAGE 4
DIA30DL



*COLD START DELETES THE CONTENTS OF THE CPU'S MEMORY AND RESTORES COMMUNICATION PARAMETERS (BAUD RATE, PARITY, ETC.) TO THEIR DEFAULT VALUES.

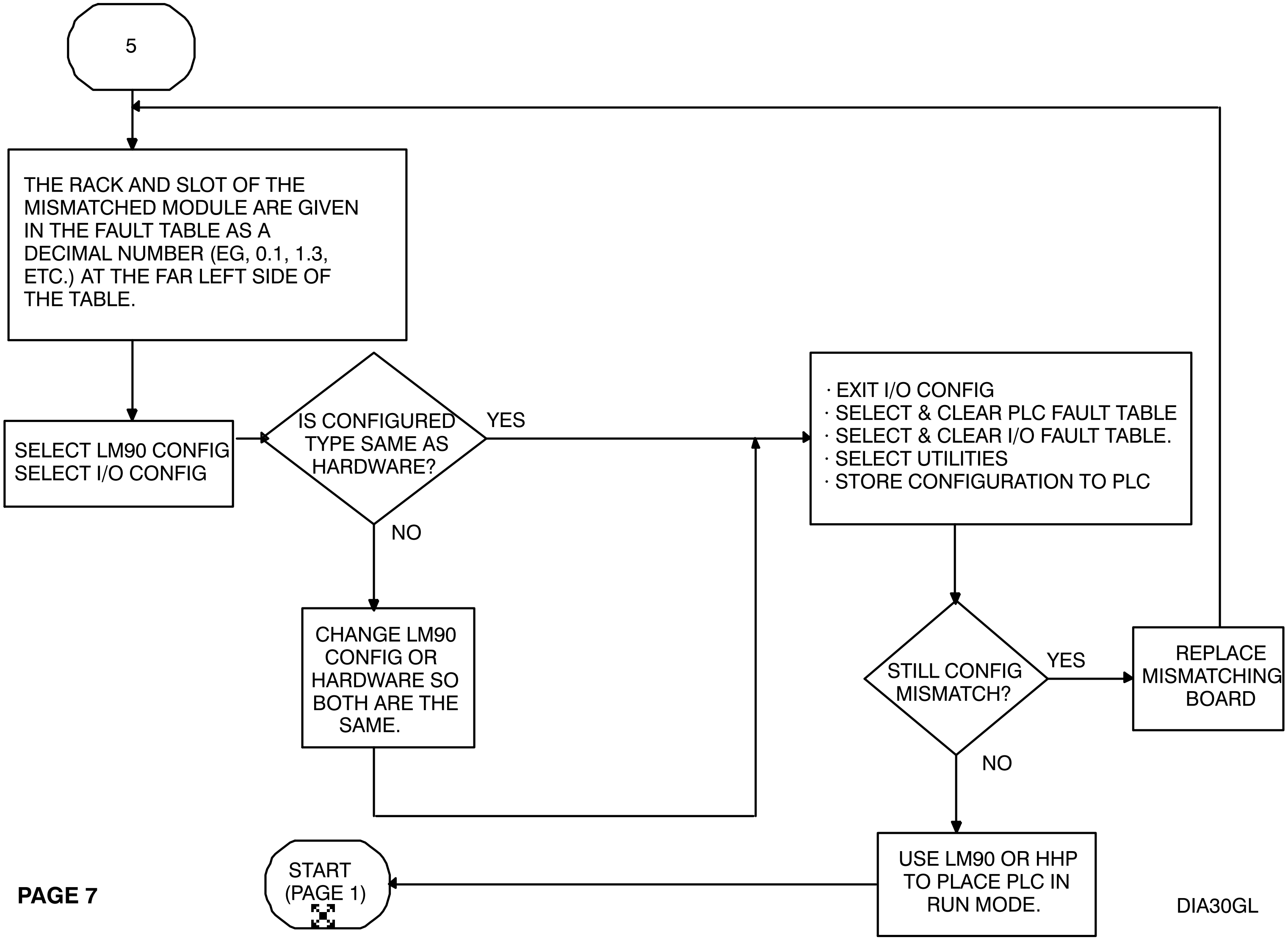
PAGE 5

DIA30EL



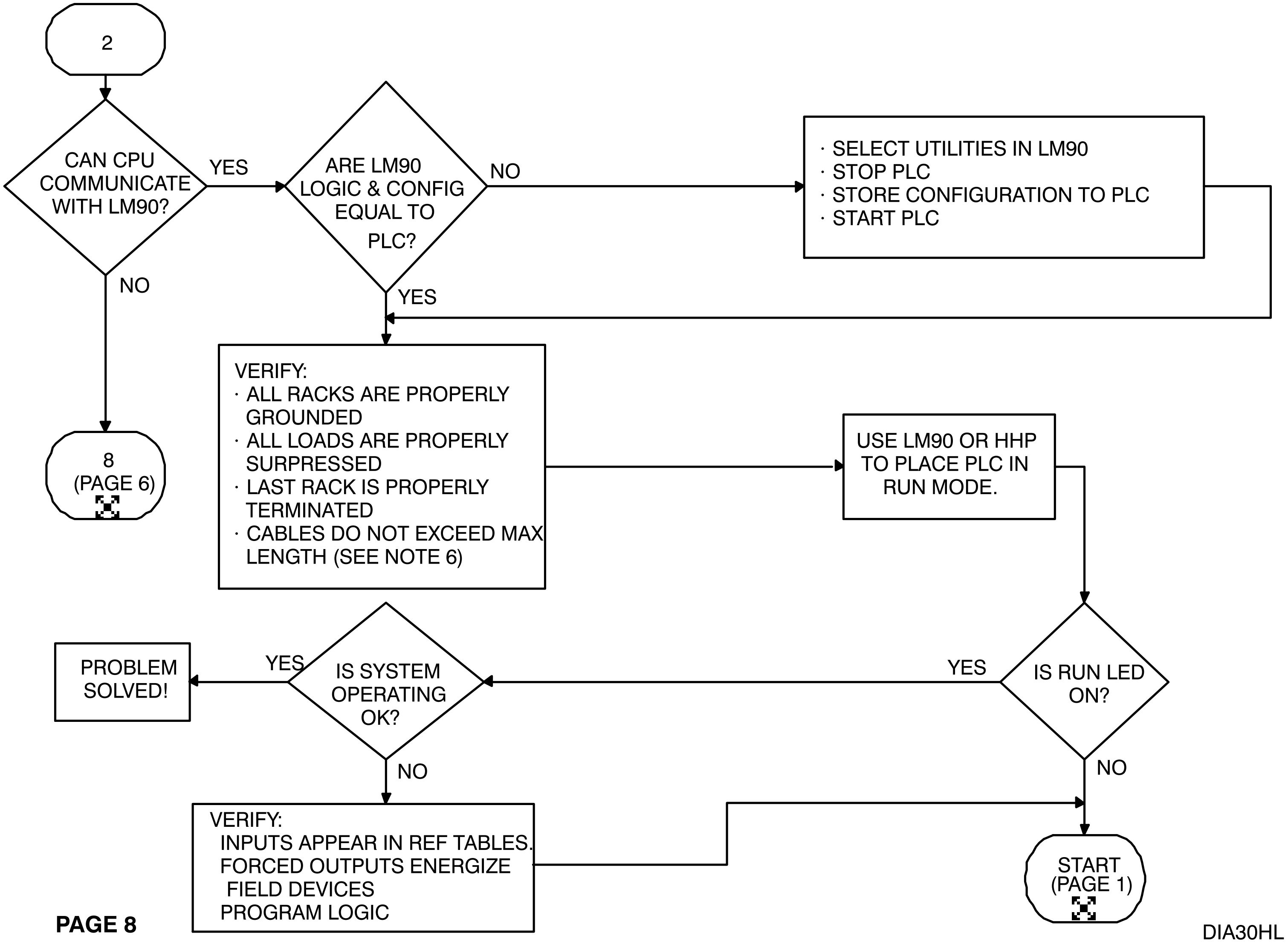
PAGE 6

DIA30FL

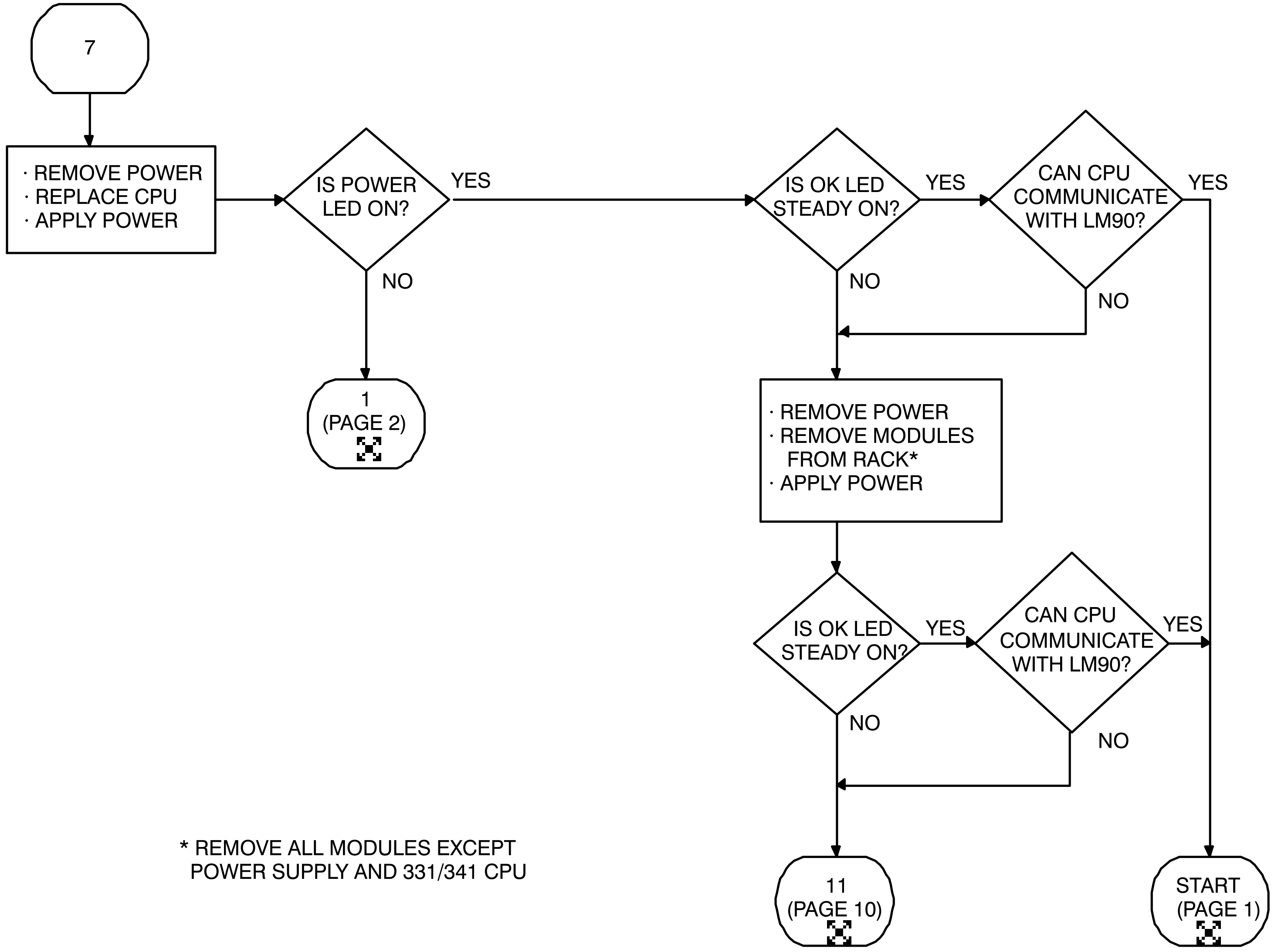


PAGE 7

DIA30GL


2
CAN CPU COMMUNICATE WITH LM90?
YES
NO
ARE LM90 LOGIC & CONFIG EQUAL TO PLC?
NO
YES
· SELECT UTILITIES IN LM90
· STOP PLC
· STORE CONFIGURATION TO PLC
· START PLC
8 (PAGE 6)
VERIFY:
· ALL RACKS ARE PROPERLY GROUNDED
· ALL LOADS ARE PROPERLY SURPRESSED
· LAST RACK IS PROPERLY TERMINATED
· CABLES DO NOT EXCEED MAX LENGTH (SEE NOTE 6)
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
IS RUN LED ON?
YES
NO
IS SYSTEM OPERATING OK?
YES
NO
PROBLEM SOLVED!
VERIFY:
INPUTS APPEAR IN REF TABLES.
FORCED OUTPUTS ENERGIZE FIELD DEVICES
PROGRAM LOGIC
START (PAGE 1)
DIA30HL

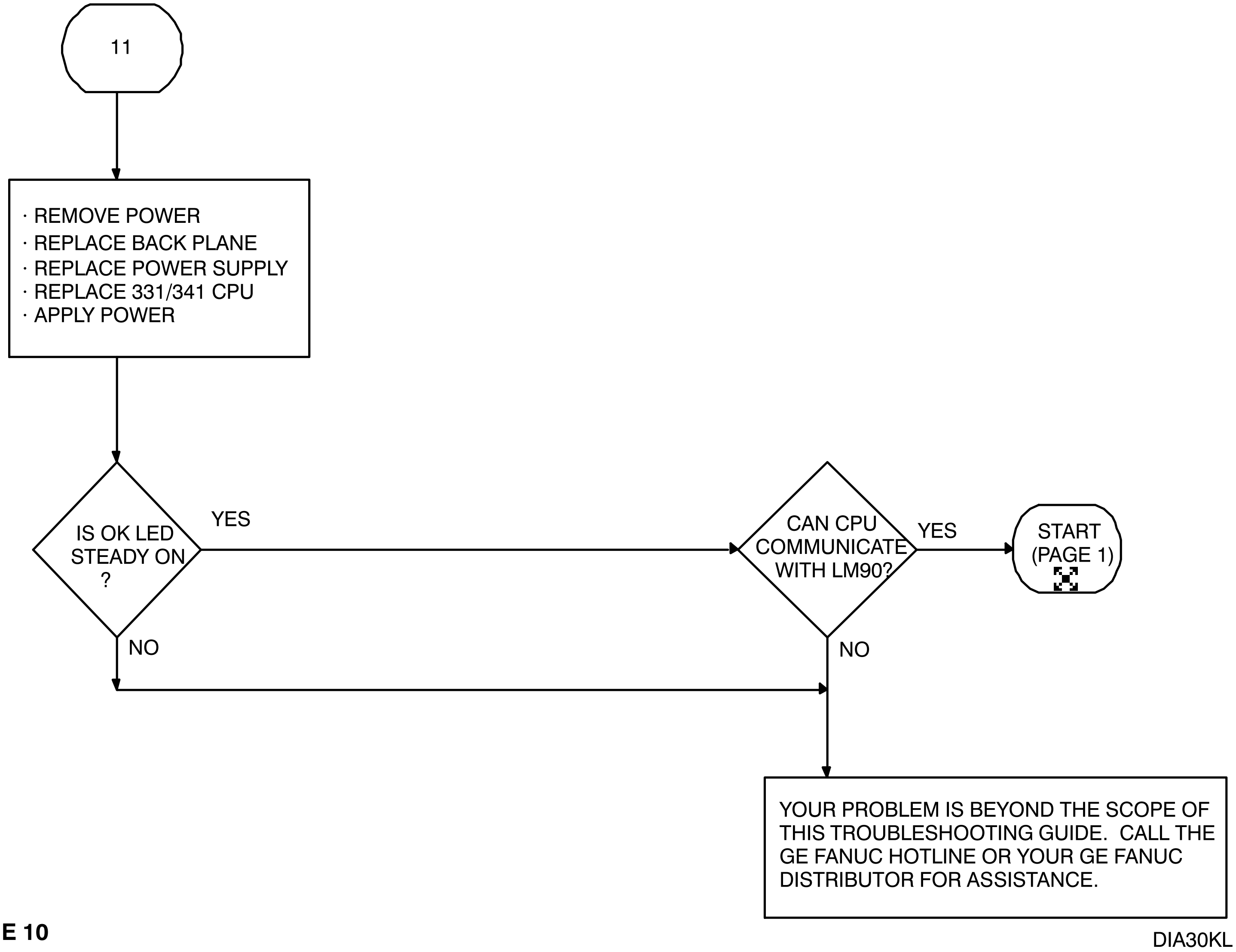
PAGE 8



* REMOVE ALL MODULES EXCEPT
POWER SUPPLY AND 331/341 CPU

PAGE 9

DIA30JL


11
· REMOVE POWER
· REPLACE BACK PLANE
· REPLACE POWER SUPPLY
· REPLACE 331/341 CPU
· APPLY POWER
IS OK LED STEADY ON ?
YES
NO
CAN CPU COMMUNICATE WITH LM90?
YES
NO
START (PAGE 1)
YOUR PROBLEM IS BEYOND THE SCOPE OF THIS TROUBLESHOOTING GUIDE. CALL THE GE FANUC HOTLINE OR YOUR GE FANUC DISTRIBUTOR FOR ASSISTANCE.
DIA30KL

PAGE 10

SP240

Section 6 - Functional Description

SE POWER EQUIPMENT
ESTABLISHED 1981

DIESEL STANDBY GENERATOR

LOCAL CONTROL PANEL

FUNCTIONAL DESCRIPTION

FOR

Brisbane City Council

19th May 2003

ABBREVIATIONS

G1	Generator 1 Diesel

1. GENERAL

1.1. The PLC for the above operation is a GE Fanuc IC693CPU350. This program has been designed for the use on G1. The operation below controls G1.

1.2. A mode selector switch selects how G1 shall operate :

1.2.1. Off

1.2.2. Manual Mode

1.2.3. Test Mode.

1.2.4. Automatic Mode.

2. MANUAL MODE

2.1. To operate G1 in MANUAL Mode.

2.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

2.3. Press the MANUAL START push button to start the generator.

2.4. The generator will begin to crank.

2.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

2.4.2. The generator set is allowed 3 attempts to start.

2.4.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

2.4.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

2.4.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

2.4.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

2.4.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

2.5. To Manual Transfer to Generator in the MANUAL Mode.

- 2.5.1. Start the generator and wait for the generator to run up to speed and voltage and ready to accept load.
- 2.5.2. Press the MANUAL TRANSFER TO GEN push button.
- 2.5.3. The MAINS ATS shall Open.
- 2.5.4. After a 30 second delay the GEN ATS shall Close.
- 2.5.5. If the MAINS ATS fails to Open.
  - 2.5.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.
  - 2.5.5.2. The system shall return back to MAINS ATS operation.
- 2.5.6. If the GEN ATS fails to Close.
  - 2.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.
  - 2.5.6.2. The system shall return back to MAINS ATS operation.

2.6. To Manual Transfer to Mains in the MANUAL Mode.

- 2.6.1. The GENERATOR ATS is Closed.
- 2.6.2. Press the MAN TRANSFER TO MAINS push button.
- 2.6.3. The GEN ATS shall Open.
- 2.6.4. After a 30 second delay the MAINS ATS shall Close.
- 2.6.5. If the GEN ATS fails to Open.
  - 2.6.5.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.
  - 2.6.5.2. The system shall return back to GEN ATS operation.
- 2.6.6. If the MAINS ATS fails to Close.

2.6.6.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

2.6.6.2. The system shall return back to GEN ATS operation.

2.7. To stop the generator in the MANUAL Mode.

2.7.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

2.7.2. If the generator is still GEN ATS operation. The MANUAL TRANSFER TO MAINS is initiated.

2.7.3. When the GEN ATS is Open, the generator will enter the cool down time of 1 second.

2.7.4. After the cool down time, the generator will shut down.

2.7.5. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

3. NON-PERMANENT SITE, MANUAL MODE

3.1. To operate G1 in a Non-Permanent Site Location in MANUAL Mode.

3.2. Connect the generator cables to the site generator CB ensuring the site generator CB is OFF. See BCC procedures.

3.3. A plug with shorting links is required to be installed. It is required to be plugged into the 27 Pin Station Plug.

3.3.1. Pins 11 and 12 are required to be connected. This is to indicate that the Mains ATS is Closed. If they are not connected a MAINS ATS Alarm shall be indicated.

3.4. Select from the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

3.5. Press the MANUAL START push button to start the generator.

3.6. The generator will begin to crank.

3.6.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

3.6.2. The generator set is allowed 3 attempts to start.

3.6.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

3.6.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

3.6.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

3.6.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

3.6.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

3.7. To connect the generator to the site load.

3.7.1. Manually switch over to the generator supply via the site CB’s. See BCC procedures.

3.7.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.8. To disconnect the generator from the site load.

3.8.1. Manually switch over to the mains supply via the site CB's. See BCC procedures.

3.8.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.9. To stop the generator in the MANUAL Mode.

3.9.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

3.9.2. The generator will enter the cool down time of 1 second.

3.9.3. After the cool down time, the generator will shut down.

3.9.4. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

4. TEST OPERATION

4.1. To operate the generator in the TEST Mode.

4.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.

4.3. If the selector is changed to MAN while the generator is operating on TEST, the system shall change to MANUAL TRANSFER TO GEN.

4.4. The generator shall begin to crank.

4.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

4.4.2. The generator is allowed 3 attempts to start.

4.4.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

4.5. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

4.6. The MAINS ATS shall Open.

4.7. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

4.8. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

4.9. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

4.10. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

4.11. If the MAINS ATS fails to Open.

4.11.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.11.2. The system shall shut down and return back to MAINS ATS operation.

4.12. If the GEN ATS fails to Close.

4.12.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.12.2. The system shall shut down and return back to MAINS ATS operation.

4.13. To stop the generator in the TEST Mode.

4.13.1. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO or OFF position.

4.13.2. The GEN ATS shall Open.

4.13.3. After a 30 second delay the MAINS ATS shall Close.

4.13.4. If the GEN ATS fails to Open.

4.13.4.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.13.4.2. The system shall return back to GEN ATS operation.

4.13.5. If the MAINS ATS fails to Close.

4.13.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.13.5.2. The system shall return back to GEN ATS operation.

4.13.6. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

4.13.7. After the cool down time, the generator will shut down.

4.13.8. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

4.13.9. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

5. AUTOMATIC OPERATION

5.1. To operate the generator in the AUTO Mode.

5.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

5.3. The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.

5.4. The Remote Start Command.

5.4.1. The generator shall begin to crank.

5.4.1.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

5.4.1.2. The generator is allowed 3 attempts to start.

5.4.1.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

5.4.2. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

5.4.3. The MAINS ATS shall Open.

5.4.4. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

5.4.5. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

5.4.6. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

5.4.7. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

5.4.8. If the MAINS ATS fails to Open.

5.4.8.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.4.8.2. The system shall shut down and return back to MAINS ATS operation.

5.4.9. If the GEN ATS fails to Close.

5.4.9.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.4.9.2. The system shall shut down and return back to MAINS ATS operation.

5.5. To stop the generator in the AUTO Mode.

5.5.1. The Phase Failure Relay from the clients switch board shall give a Stop Signal for the generators to run.

5.5.2. The Remote Stop Command.

5.5.3. There is a 2 minute proving time for the Phase Failure Relay.

5.5.4. After the 2 minute proving time the GEN ATS shall Open.

5.5.5. After a 30 second delay the MAINS ATS shall Close.

5.5.6. If the GEN ATS fails to Open.

5.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.5.6.2. The system shall return back to GEN ATS operation.

5.5.7. If the MAINS ATS fails to Close.

5.5.7.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.5.7.2. The system shall return back to GEN ATS operation.

5.5.8. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

5.5.9. After the cool down time, the generator will shut down.

5.5.10. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

5.5.11. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

6. FAULT OPERATION

6.1. Emergency Stop Operation.

6.1.1. Operation of the Emergency Stop push button immediately shuts down the generator and Opens the Generator CB. The Emergency Stop is latched, and requires manual resetting to release the Emergency Stop push button.

6.1.2. After the Emergency Stop push button is released, a fault reset will need to be initiated to reset the PLC.

6.2. HIGH HIGH Alarm Operation.

6.2.1. The Generator CB is Opened immediately.

6.2.2. The generator is shut down immediately.

6.2.3. The following alarms will initiate a HIGH HIGH Alarm condition :-

6.2.3.1. Emergency Stop Fault

6.2.3.2. MEN Fault

6.2.3.3. Low Oil Pressure Shutdown Fault, 10 Seconds Startup Delay

6.2.3.4. High Engine Temperature Shutdown Fault, 30 Second Startup Delay

6.2.3.5. Low Radiator Level Fault, 5 Second Delay

6.2.3.6. Over Speed Fault

6.3. HIGH Alarm Operation

6.3.1. The Generator CB is Opened immediately.

6.3.2. Once the generator circuit breaker is opened, the generator will run through its normal cool down time and shut down.

6.3.3. The following alarms will initiate a HIGH Alarm condition:-

6.3.3.1. Generator Under Speed Fault, 5 Second Delay

6.3.3.2. Alternator Under Voltage Fault, 5 Second Delay

6.3.3.3. Alternator Over Voltage Fault, 5 Second Delay

6.3.3.4. Generator CB Tripped Fault

6.3.3.5. Alternator High Temperature Fault, 30 Second Startup Delay

6.4. MEDIUM Alarm Operation.

6.4.1. A Normal Shutdown shall be Initiated.

6.4.2. If the GEN ATS does not Open then the Generator CB is Opened.

6.4.3. The following alarms will initiate a MEDIUM Alarm condition :-

6.4.3.1. Fuel Empty Level Fault, 5 Second Delay

6.4.3.2. Fail To Start Fault, 3 Attempts

6.5. LOW Alarm Operation.

6.5.1. A Warning has occurred on the generator. The generator will not shut down.

6.5.2. The following alarms will initiate a LOW Alarm condition :-

6.5.2.1. Low Oil Pressure Warning Alarm, 10 Seconds Startup Delay

6.5.2.2. High Engine Temperature Warning Alarm, 30 Second Startup Delay

6.5.2.3. Fuel Low Level Alarm, 5 Second Delay

6.5.2.4. Battery Charger AC Supply Failed Alarm, 60 Second Delay

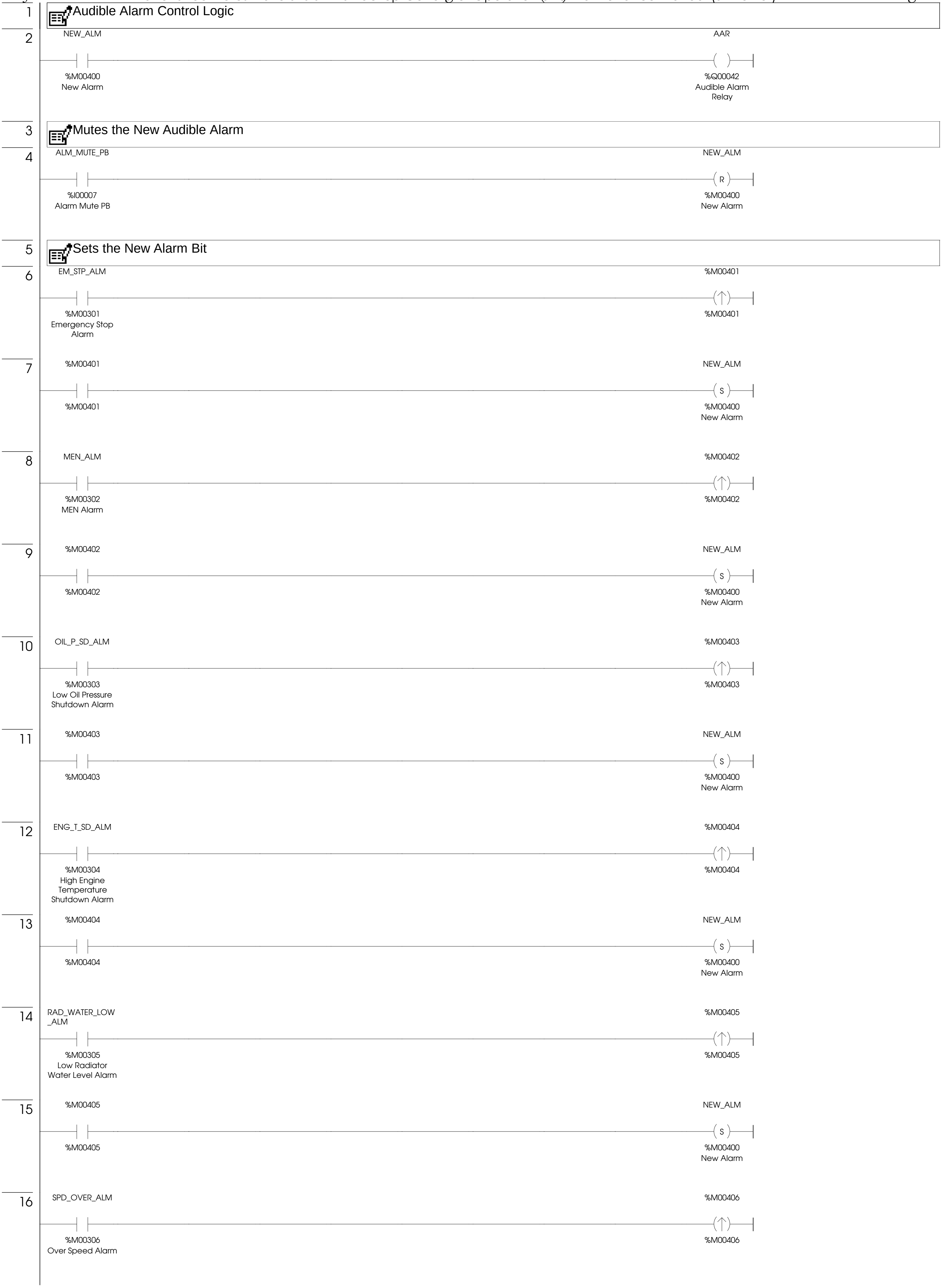
6.5.2.5. Control Battery Low Volts Alarm, 30 Second Delay

6.5.2.6. Start Battery Low Volts Alarm, 60 Second Delay

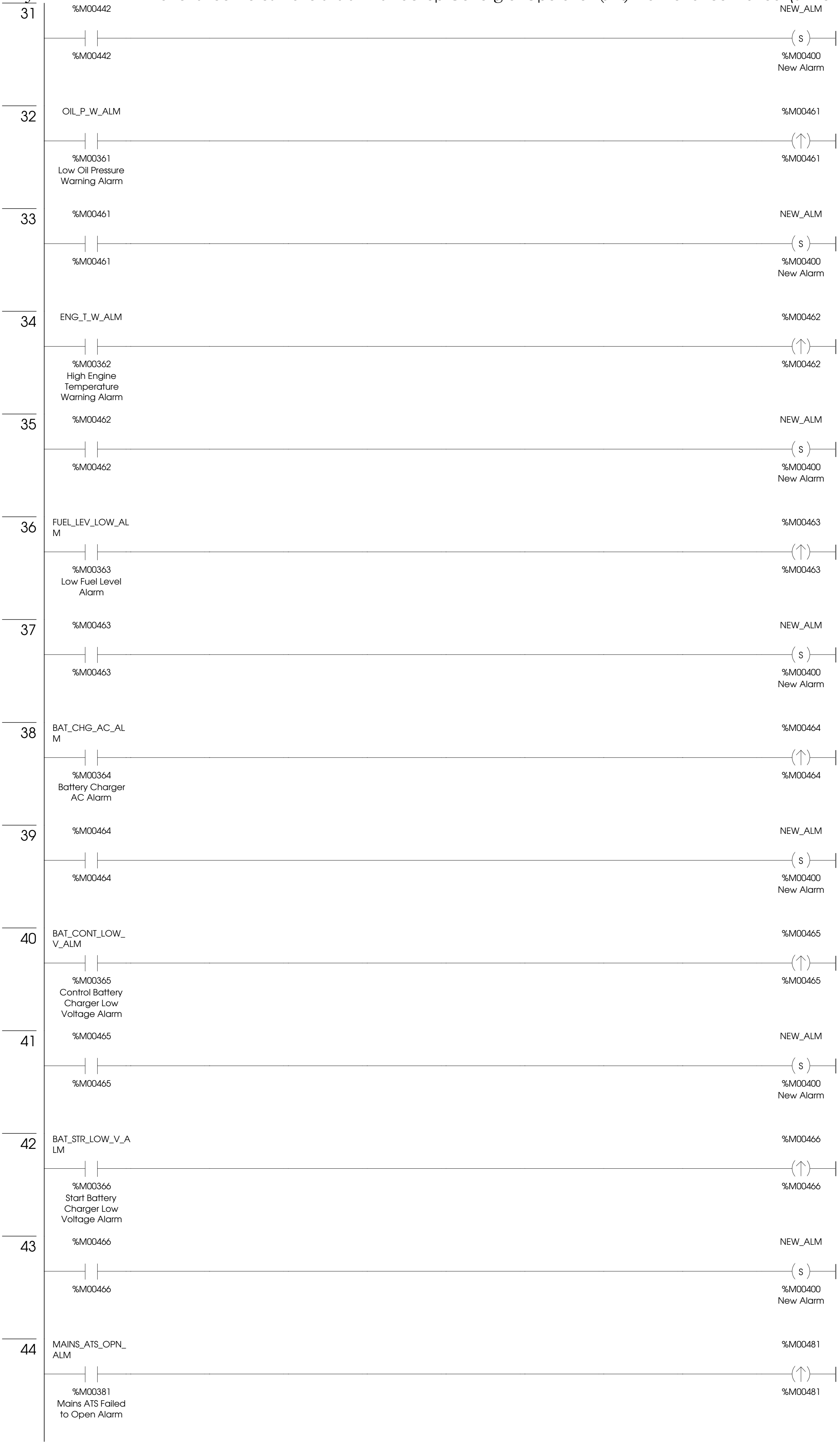
NTB Design

Folder Name.. BCC_4000_2
Nickname... C4000_2
Location.................... C:\Program Files\GE Fanuc Automation\VersaPro
\Project\BCC_4000_2
Created...27-Jun-03, 16:36:03
Modified.. 03-Jul-03, 18:02:02
Description...BCC, Standby Generator, 4000

Block Name:.. AUD_ALM.blk
Description:.. Control Logic for the Audiable Alarm Logic.
Block Type:.. Ladder


1
Audible Alarm Control Logic
2
NEW_ALM
%M00400
New Alarm
AAR
%Q00042
Audible Alarm
Relay
3
Mutes the New Audible Alarm
4
ALM_MUTE_PB
%I00007
Alarm Mute PB
NEW_ALM
R
%M00400
New Alarm
5
Sets the New Alarm Bit
6
EM_STP_ALM
%M00301
Emergency Stop
Alarm
%M00401
%M00401
7
%M00401
%M00401
NEW_ALM
S
%M00400
New Alarm
8
MEN_ALM
%M00302
MEN Alarm
%M00402
%M00402
9
%M00402
%M00402
NEW_ALM
S
%M00400
New Alarm
10
OIL_P_SD_ALM
%M00303
Low Oil Pressure
Shutdown Alarm
%M00403
%M00403
11
%M00403
%M00403
NEW_ALM
S
%M00400
New Alarm
12
ENG_T_SD_ALM
%M00304
High Engine
Temperature
Shutdown Alarm
%M00404
%M00404
13
%M00404
%M00404
NEW_ALM
S
%M00400
New Alarm
14
RAD_WATER_LOW
_ALM
%M00305
Low Radiator
Water Level Alarm
%M00405
%M00405
15
%M00405
%M00405
NEW_ALM
S
%M00400
New Alarm
16
SPD_OVER_ALM
%M00306
Over Speed Alarm
%M00406
%M00406


17
%M00406
NEW_ALM
S
%M00406
%M00400
New Alarm
18
SPD_UNDER_ALM
%M00421
%M00321
Under Speed Alarm
%M00421
19
%M00421
NEW_ALM
S
%M00421
%M00400
New Alarm
20
VOLTS_UNDER_ALM
%M00422
%M00322
Alternator Voltage Under Alarm
%M00422
21
%M00422
NEW_ALM
S
%M00422
%M00400
New Alarm
22
VOLTS_OVER_ALM
%M00423
%M00323
Alternator Voltage Over Alarm
%M00423
23
%M00423
NEW_ALM
S
%M00423
%M00400
New Alarm
24
GEN_CB_TRIP_AL...
%M00424
%M00324
Generator CB Tripped Alarm
%M00424
25
%M00424
NEW_ALM
S
%M00424
%M00400
New Alarm
26
ALT_TEMP_ALM
%M00425
%M00325
Alternator High Temperature Alarm
%M00425
27
%M00425
NEW_ALM
S
%M00425
%M00400
New Alarm
28
FUEL_LEV_EMPTY_ALM
%M00441
%M00341
Fuel Empty Alarm
%M00441
29
%M00441
NEW_ALM
S
%M00441
%M00400
New Alarm
30
FAIL_TO_STR_ALM
%M00442
%M00342
Fail to Start Alarm
%M00442


31
%M00442
%M00442
NEW_ALM
S
%M00400
New Alarm
32
OIL_P_W_ALM
%M00361
Low Oil Pressure Warning Alarm
%M00461
%M00461
33
%M00461
%M00461
NEW_ALM
S
%M00400
New Alarm
34
ENG_T_W_ALM
%M00362
High Engine Temperature Warning Alarm
%M00462
%M00462
35
%M00462
%M00462
NEW_ALM
S
%M00400
New Alarm
36
FUEL_LEV_LOW_ALM
%M00363
Low Fuel Level Alarm
%M00463
%M00463
37
%M00463
%M00463
NEW_ALM
S
%M00400
New Alarm
38
BAT_CHG_AC_ALM
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Battery Charger AC Alarm
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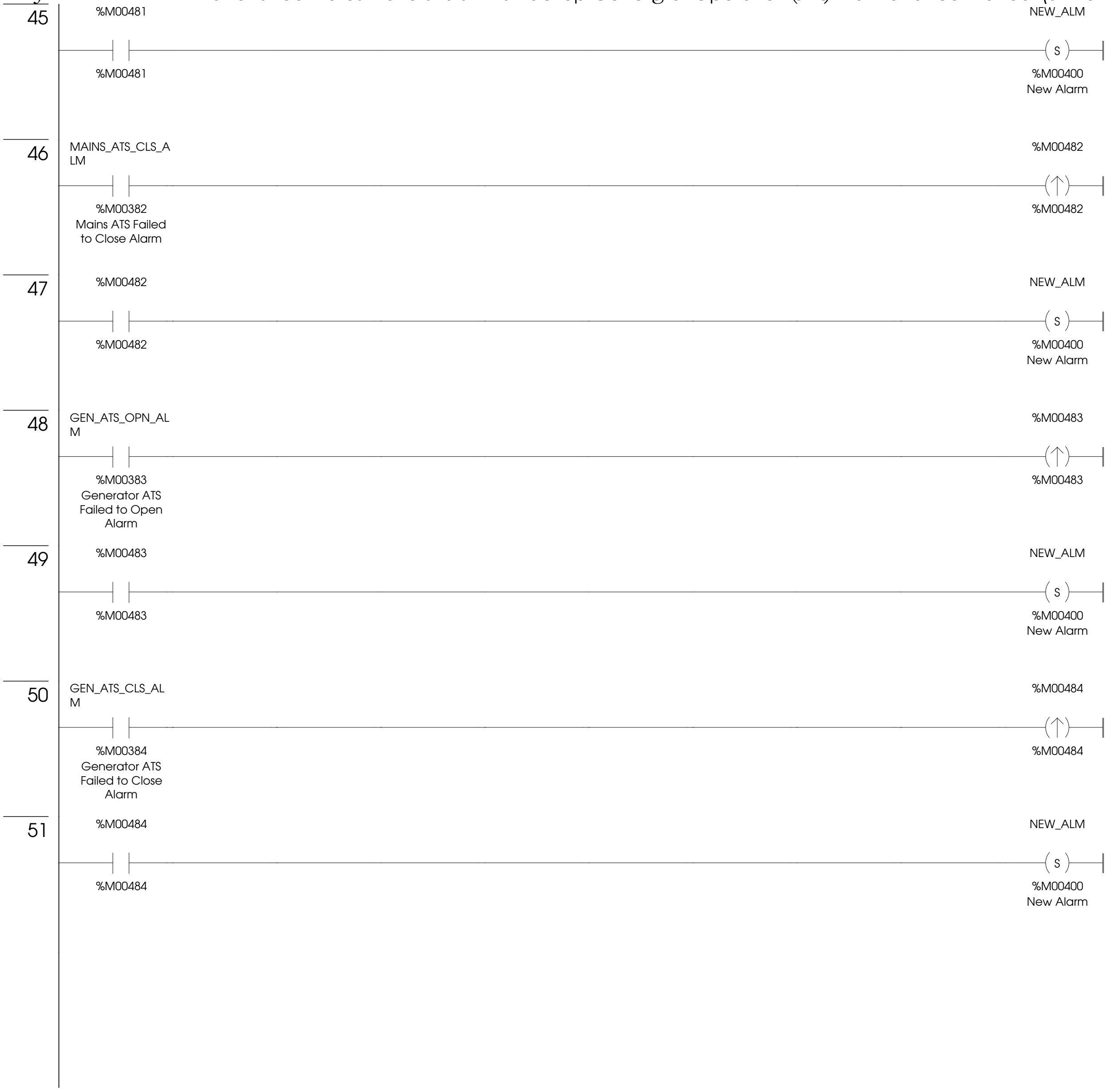
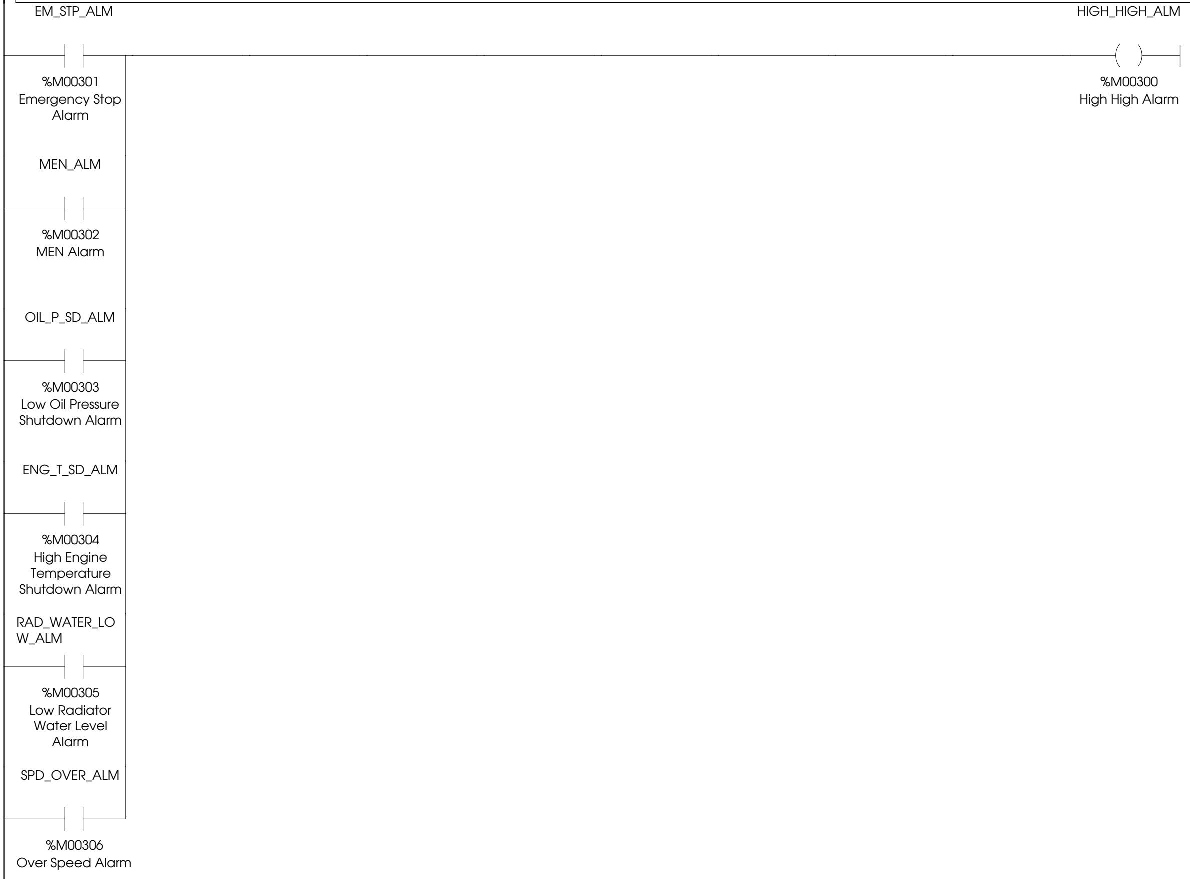
%M00464
39
%M00464
%M00464
NEW_ALM
S
%M00400
New Alarm
40
BAT_CONT_LOW_V_ALM
%M00365
Control Battery Charger Low Voltage Alarm
%M00465
%M00465
41
%M00465
%M00465
NEW_ALM
S
%M00400
New Alarm
42
BAT_STR_LOW_V_ALM
%M00366
Start Battery Charger Low Voltage Alarm
%M00466
%M00466
43
%M00466
%M00466
NEW_ALM
S
%M00400
New Alarm
44
MAINS_ATS_OPN_ALM
%M00381
Mains ATS Failed to Open Alarm
%M00481
%M00481


45
%M00481
NEW_ALM
S
%M00481
%M00400
New Alarm
46
MAINS_ATS_CLS_ALM
%M00482
%M00382
Mains ATS Failed to Close Alarm
%M00482
47
%M00482
NEW_ALM
S
%M00482
%M00400
New Alarm
48
GEN_ATS_OPN_ALM
%M00483
%M00383
Generator ATS Failed to Open Alarm
%M00483
49
%M00483
NEW_ALM
S
%M00483
%M00400
New Alarm
50
GEN_ATS_CLS_ALM
%M00484
%M00384
Generator ATS Failed to Close Alarm
%M00484
51
%M00484
NEW_ALM
S
%M00484
%M00400
New Alarm

Block Name:..ALARM.blk
Description:..Control Logic for the Generator Alarms.
Block Type:..Ladder

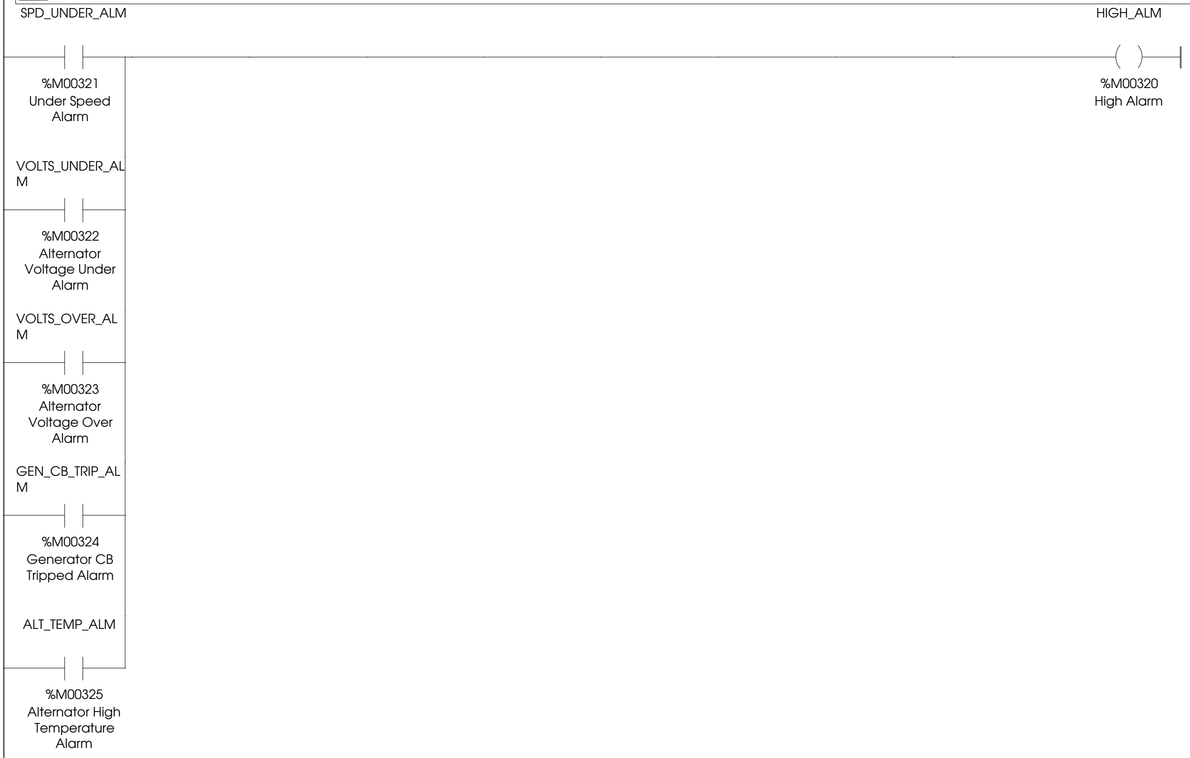
1 Generator High High Alarms

2



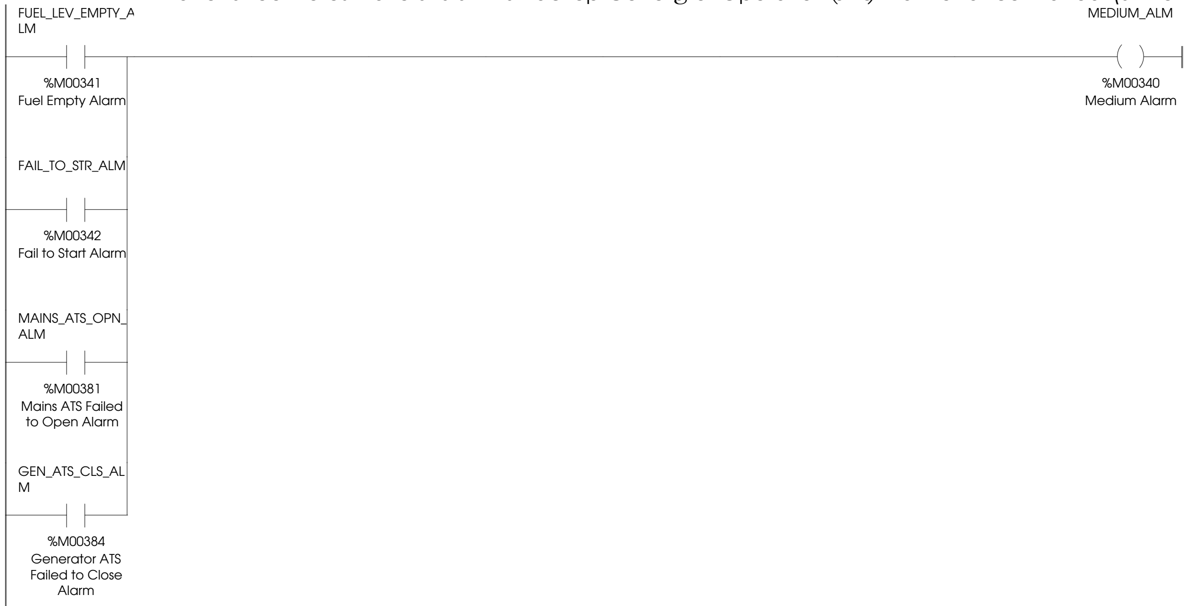
3 Generator High Alarms

4



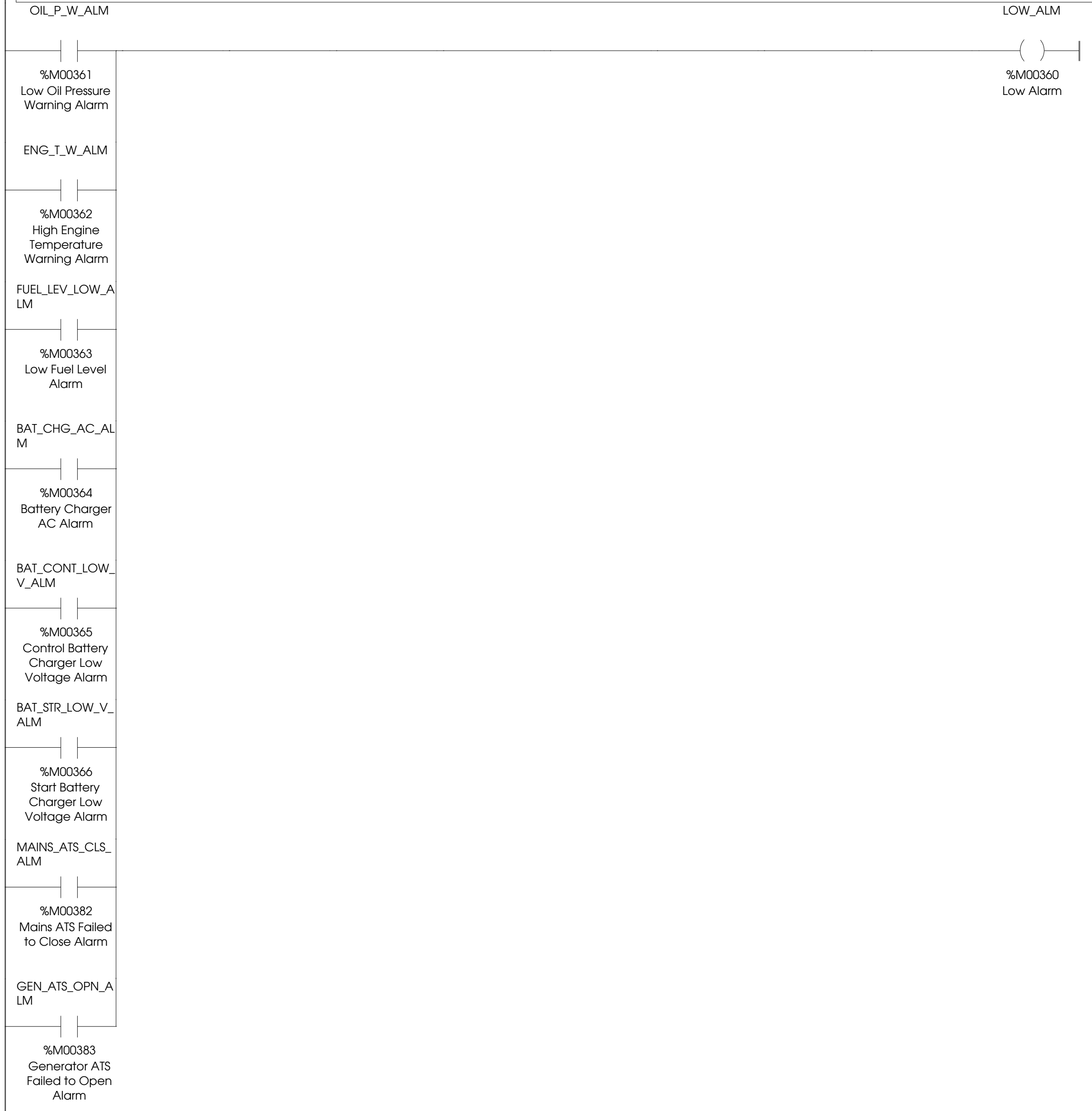
5 Generator Medium Alarms

6

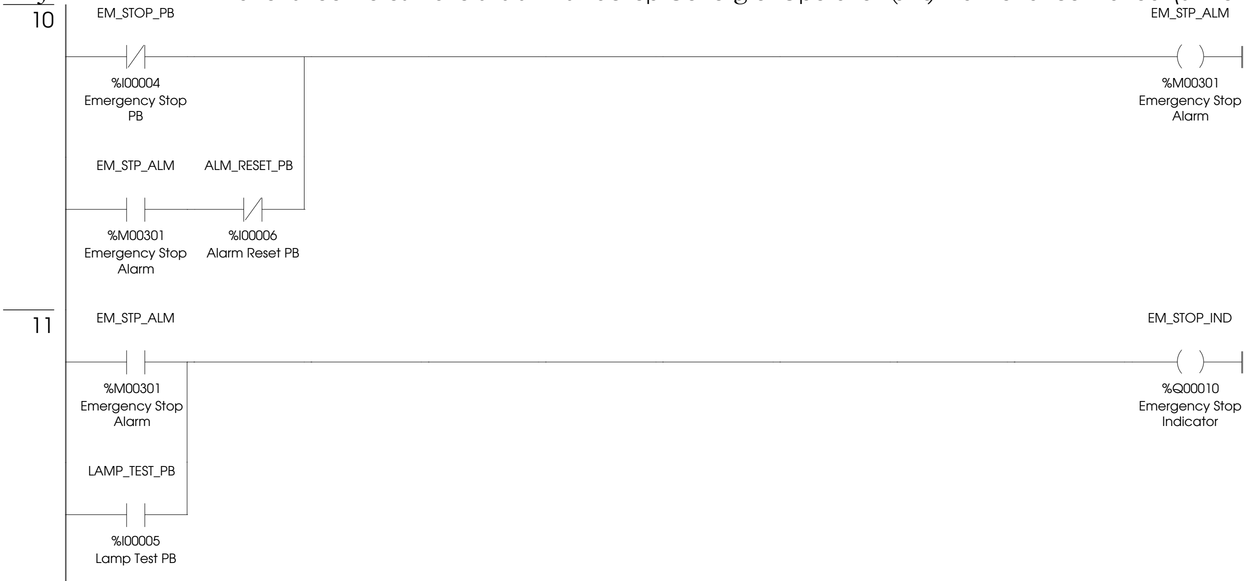


7 Generator Low Alarms

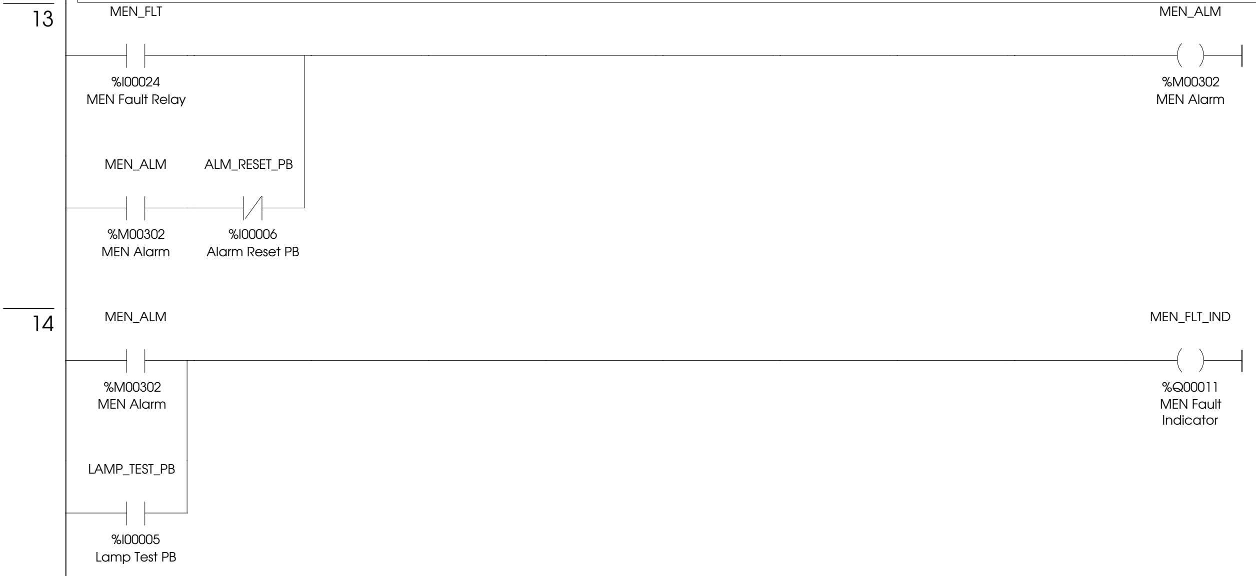
8



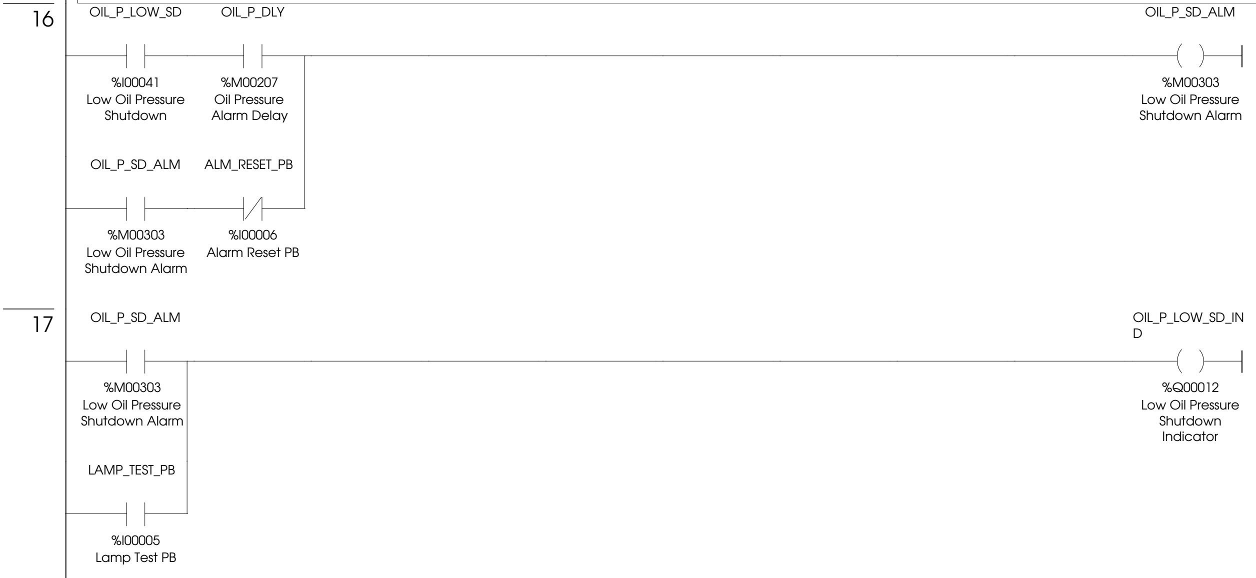
9 Generator Emergency Stop Alarm



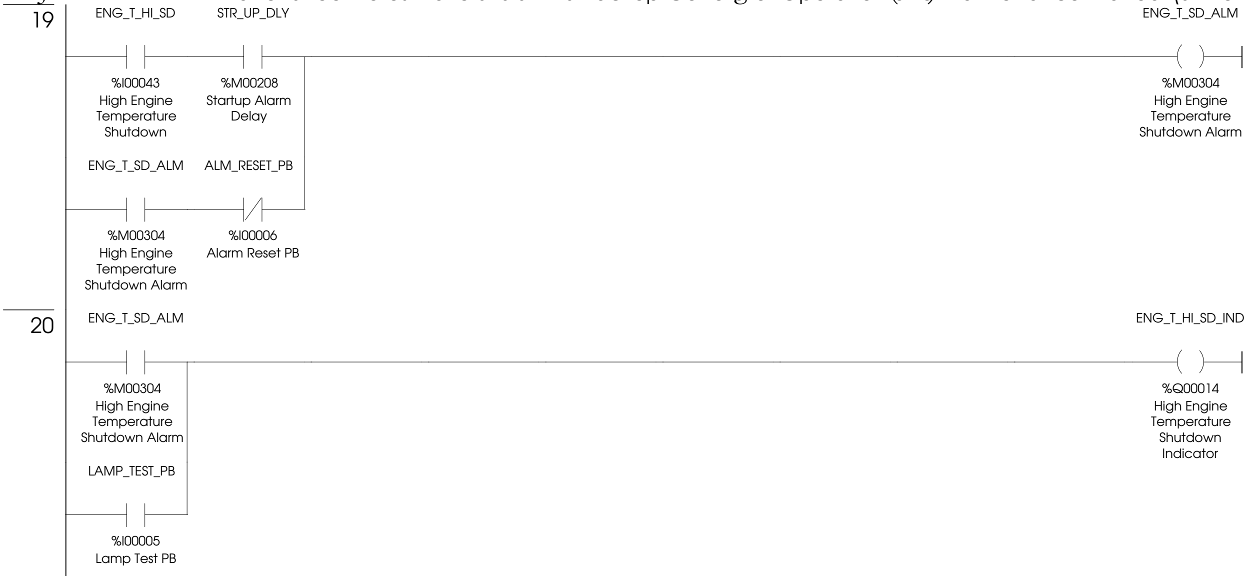
12 Generator MEN Alarm



15 Generator Low Oil Pressure Shut Down Alarm

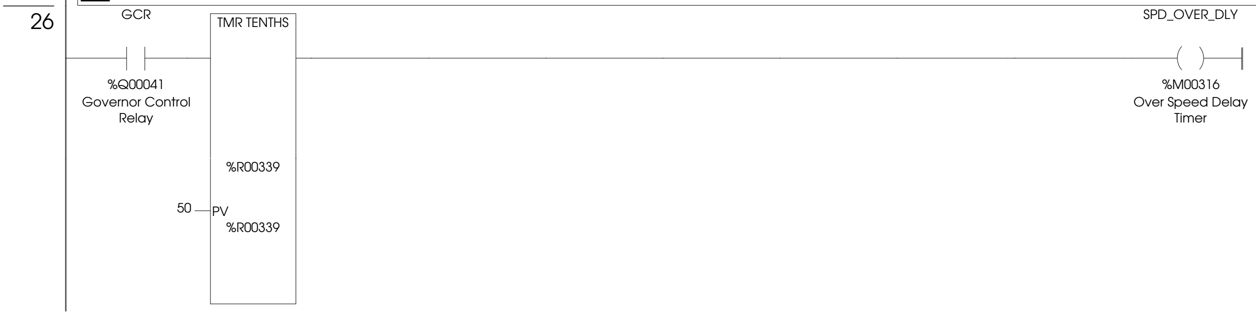


18 Generator High Engine Temperature Shut Down Alarm

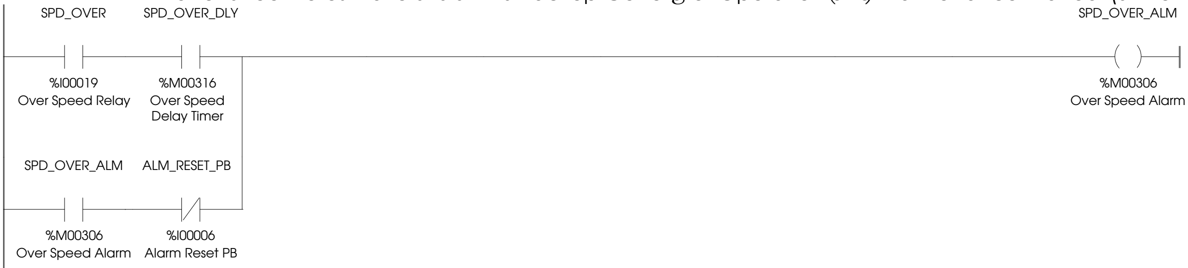


21 Generator Low Radiator Water Level Alarm

25 Generator Over Speed Alarm



27



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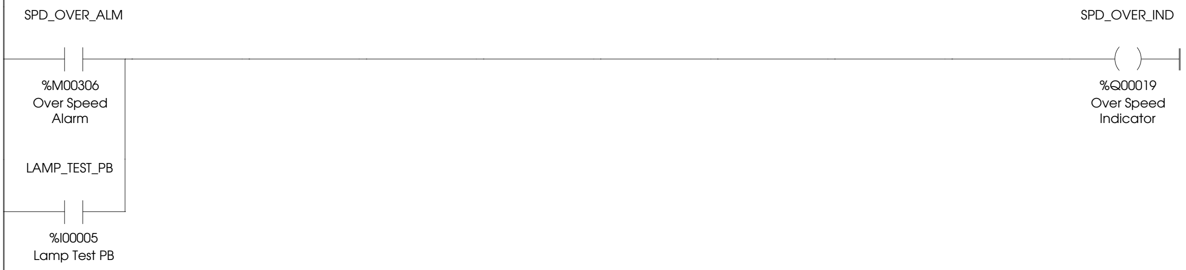
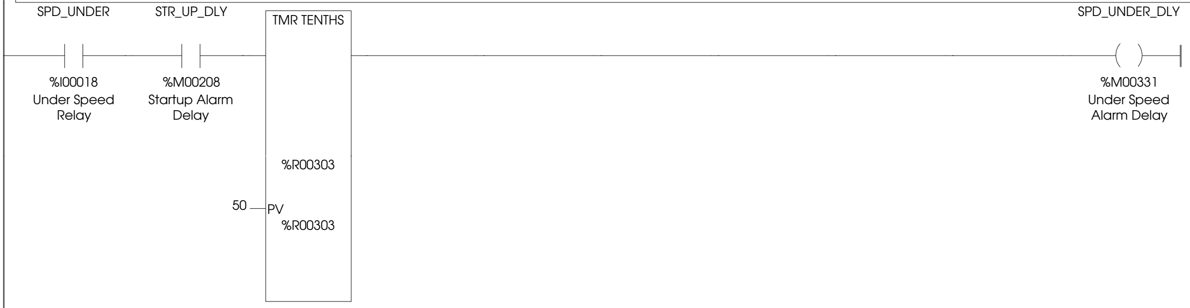


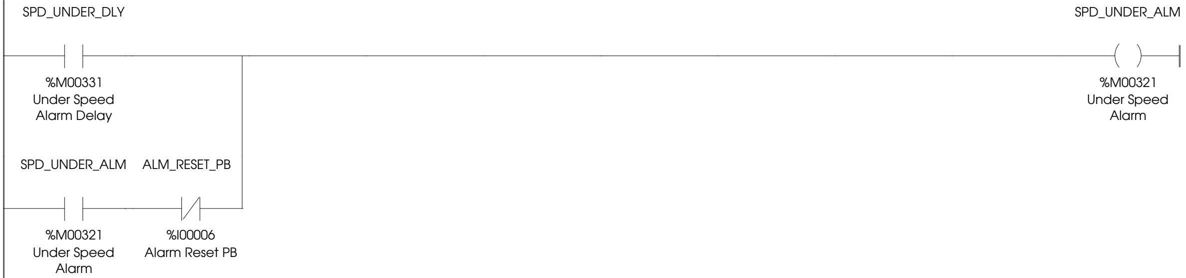
29

Generator Under Speed Alarm

30



31

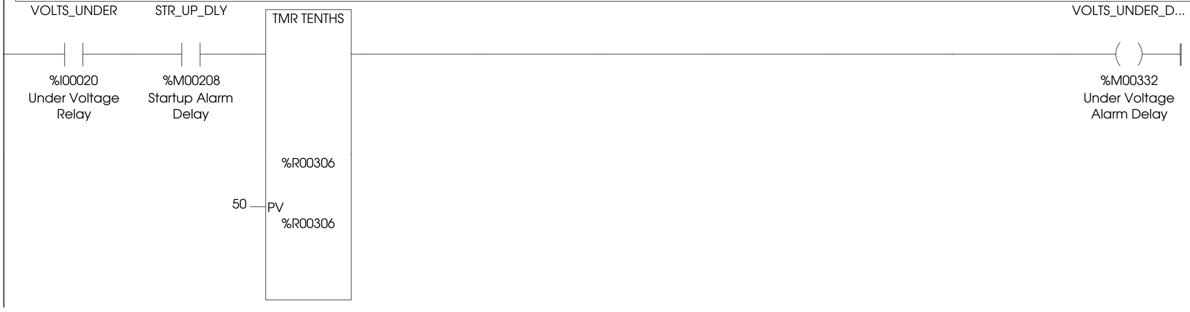


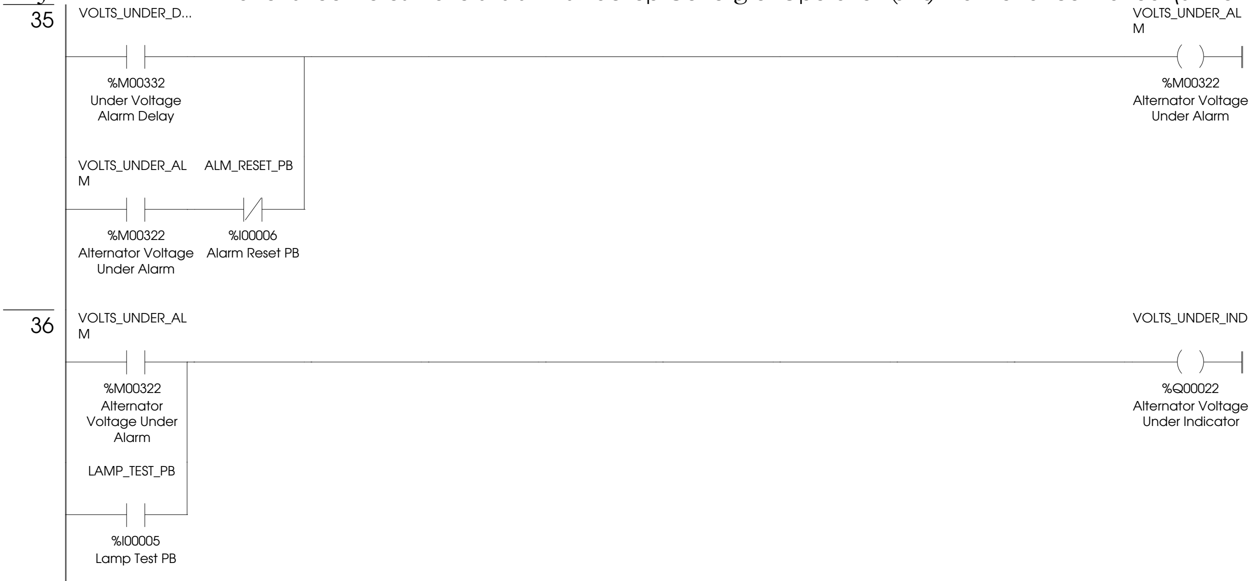
32

33

Generator Under Voltage Alarm

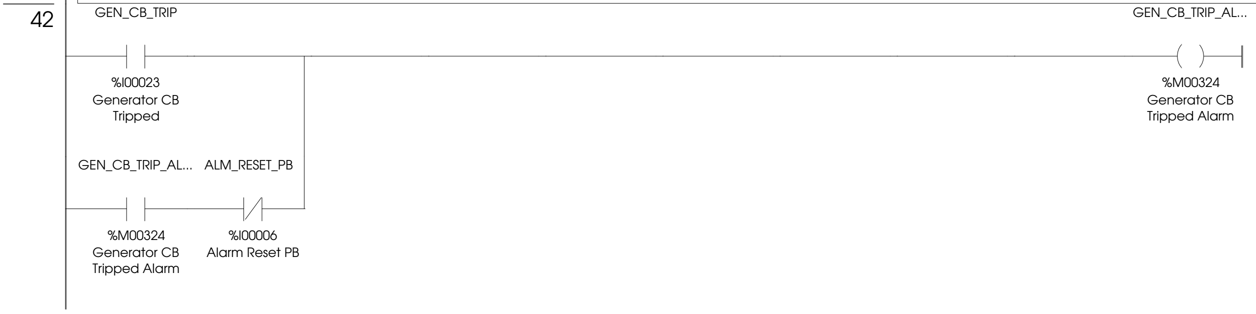
34



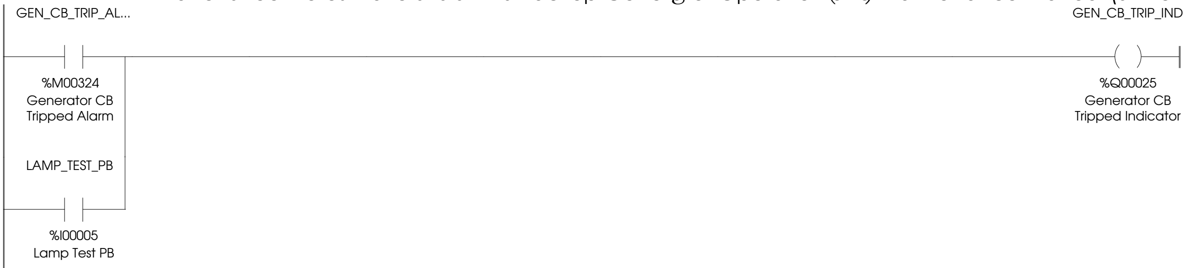


37 Generator Over Voltage Alarm

41 Generator CB Tripped Alarm



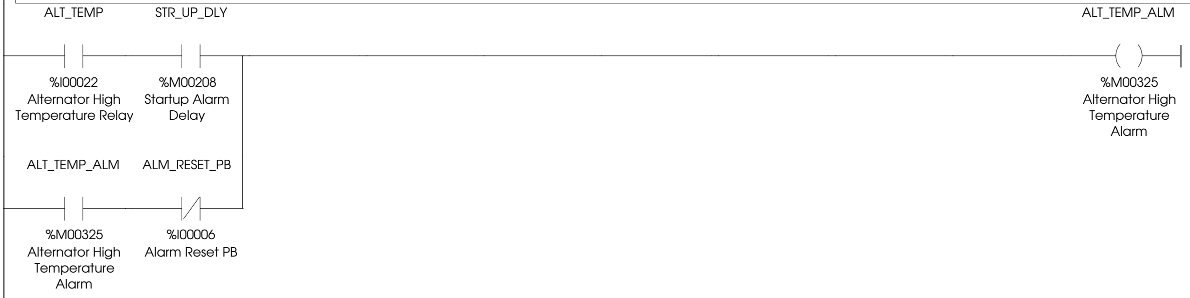
43



44

Generator High Alternator Temperature Alarm

45

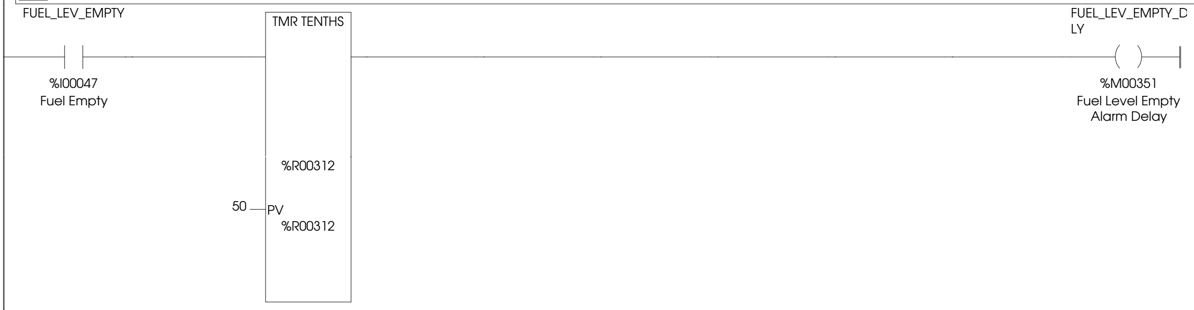


46

47

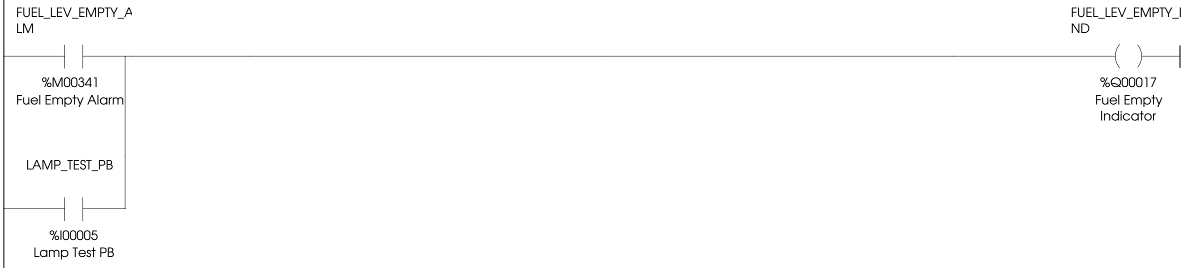
Generator Fuel Level Empty Alarm

48



49

50

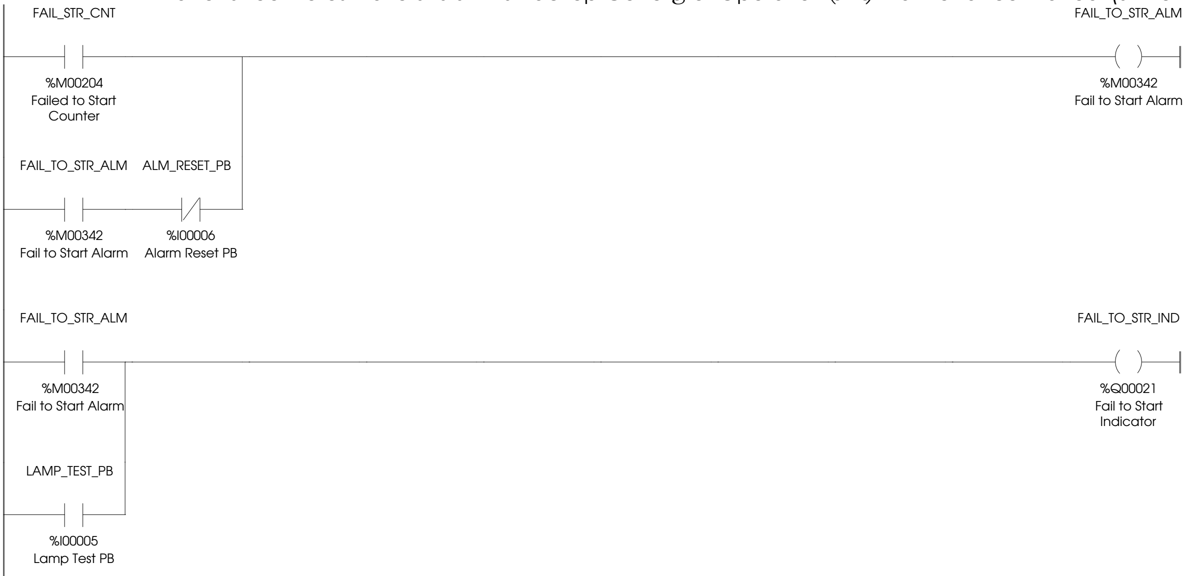


51

Generator Fail To Start Alarm

52

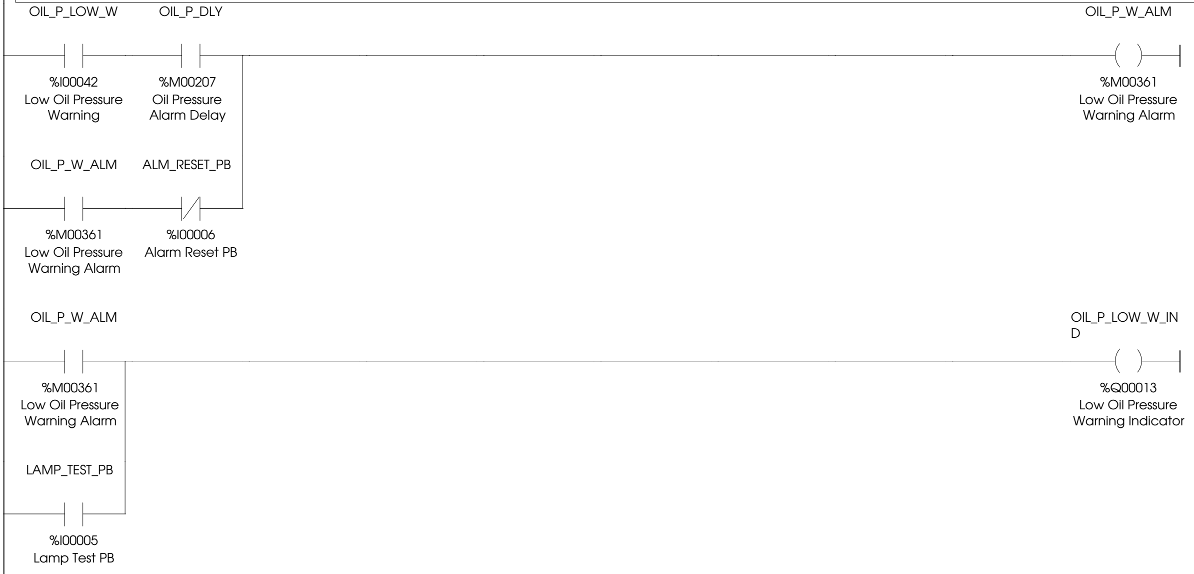
53



54 Generator Low Oil Pressure Warning Alarm

55

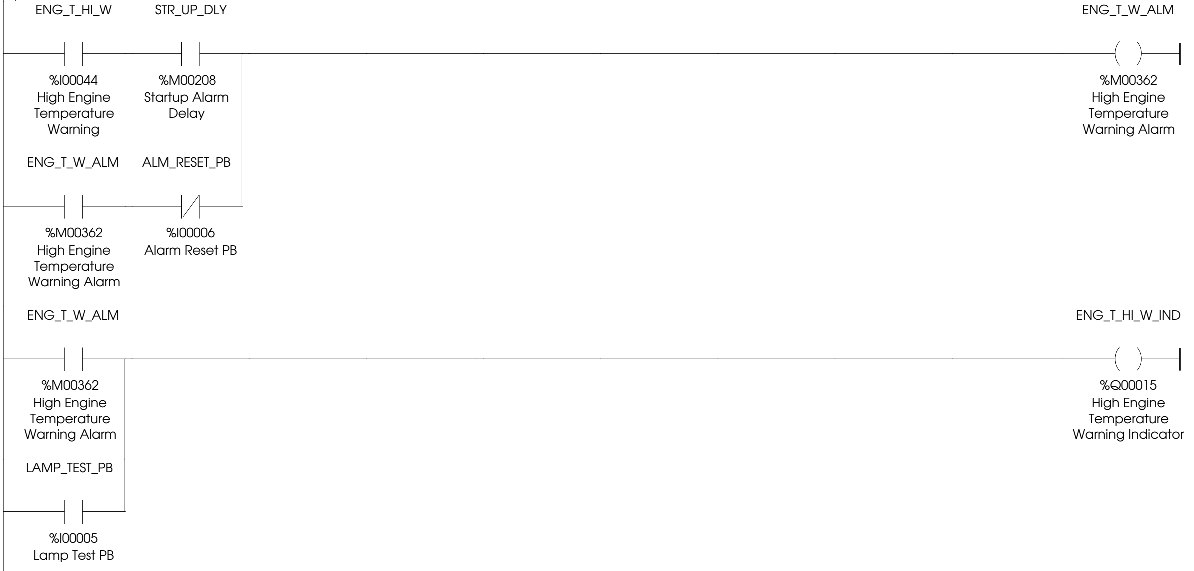
56



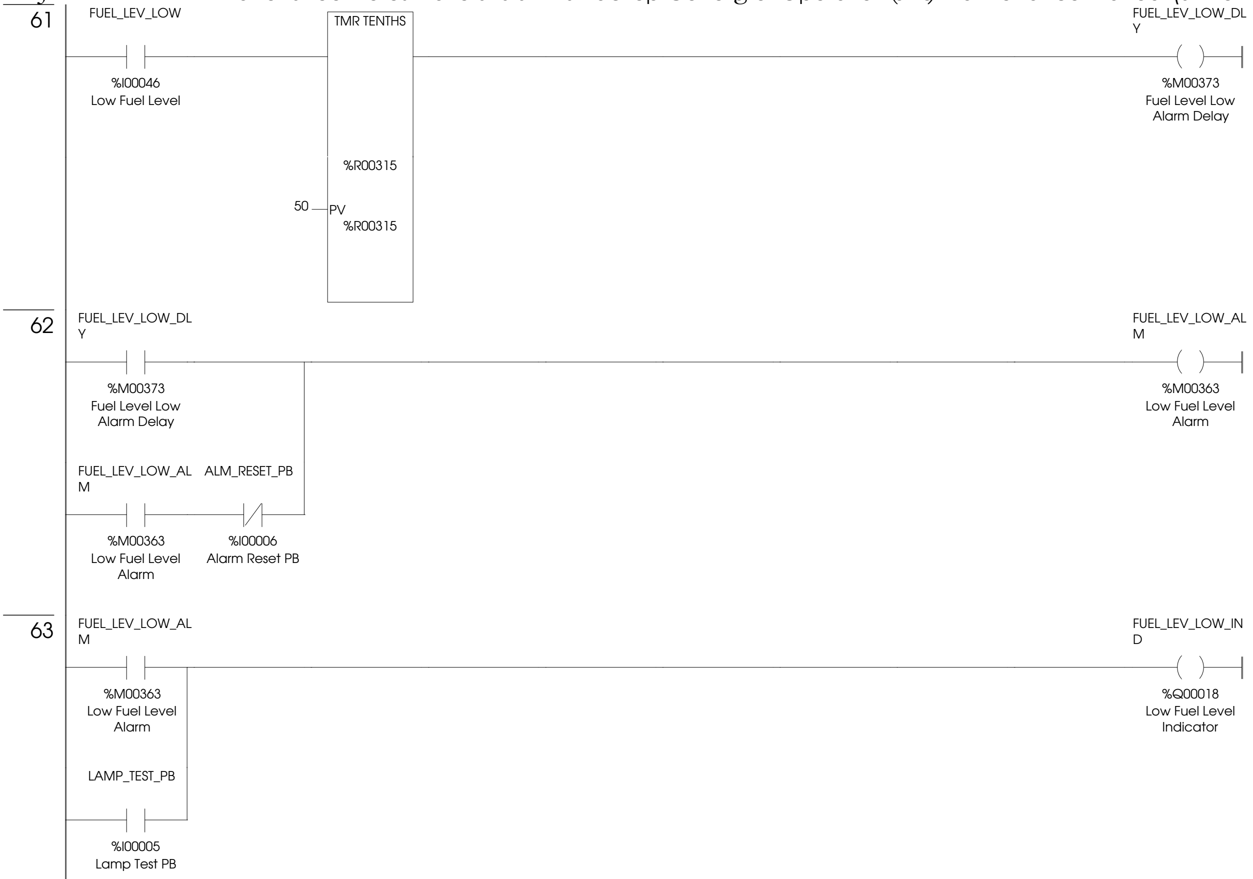
57 Generator High Engine Temperature Warning Alarm

58

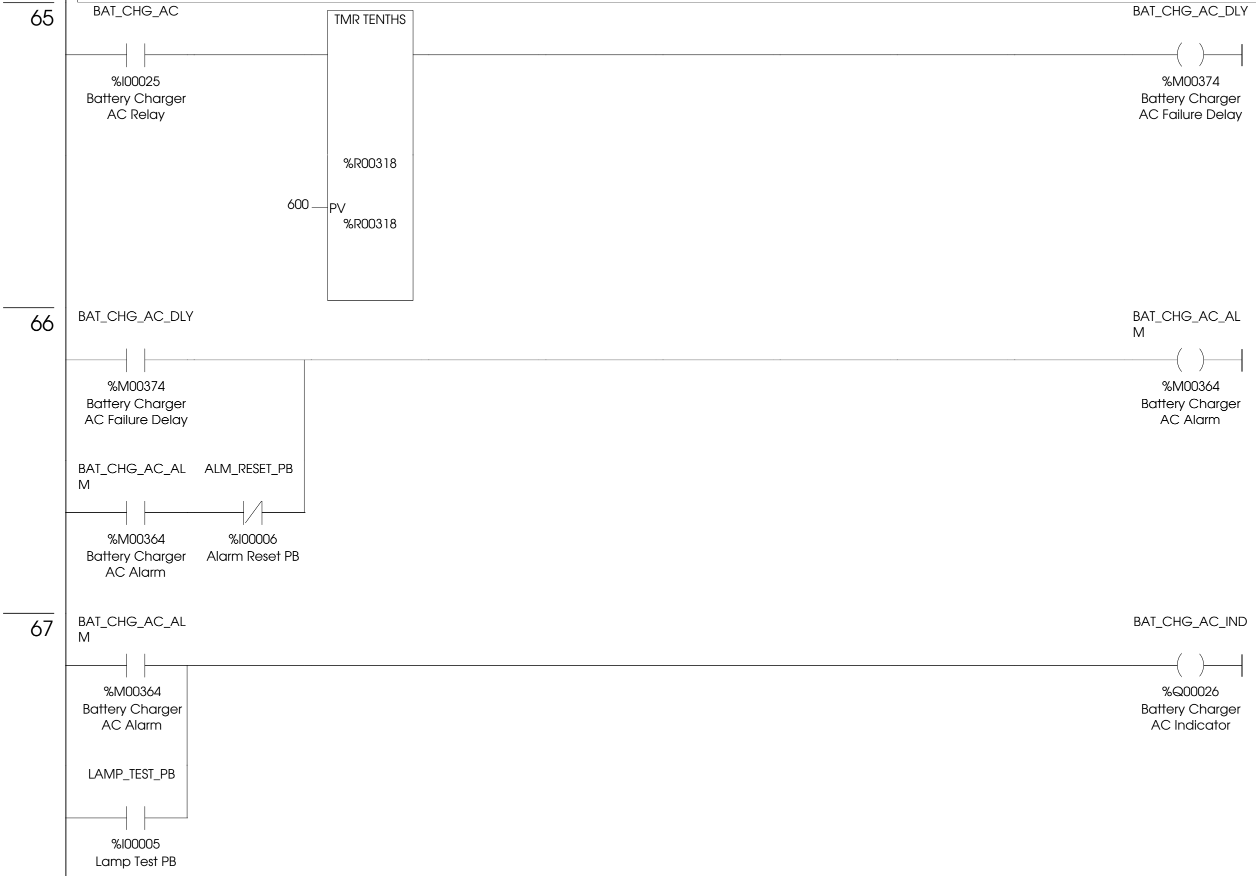
59



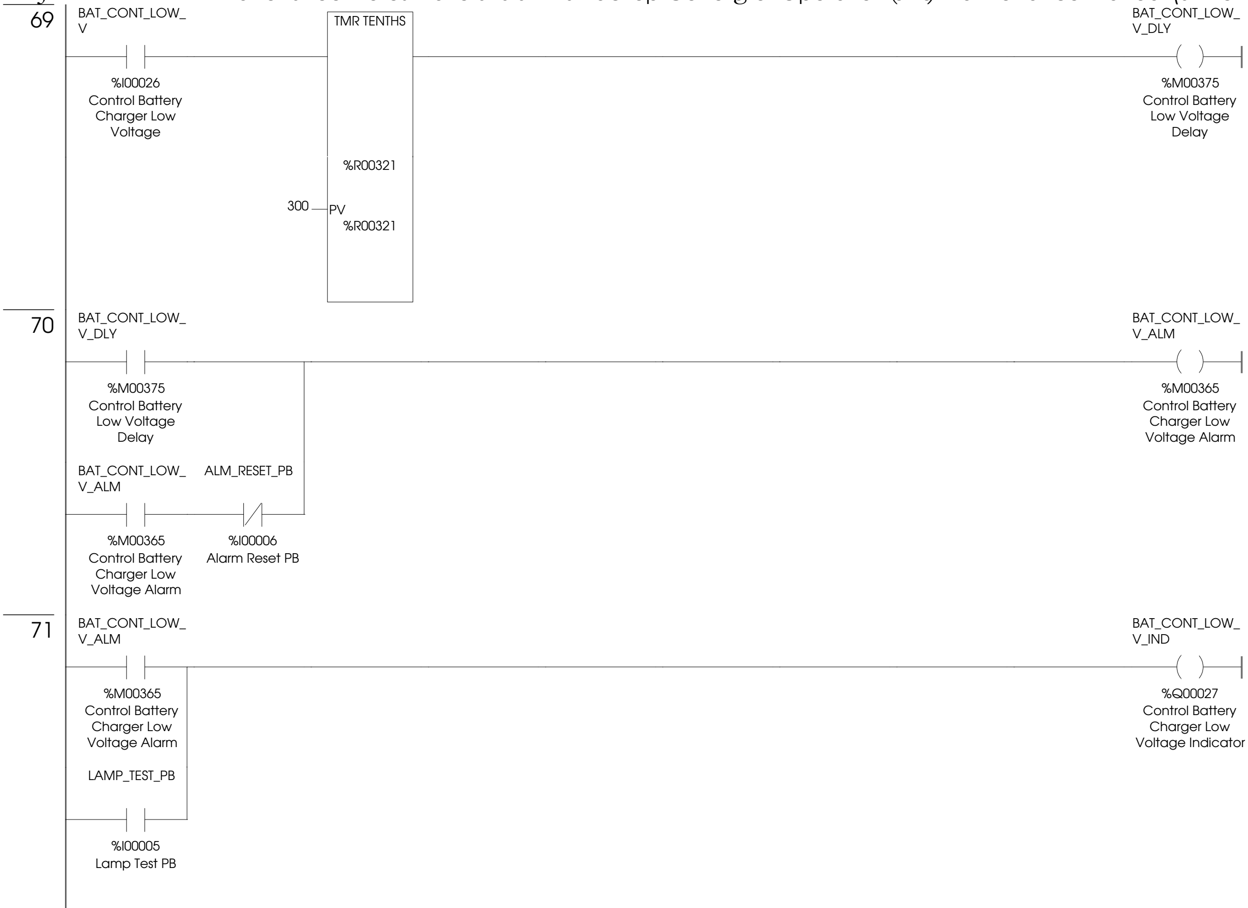
60 Generator Fuel Level Low Alarm



64 Generator Battery Charger AC Fail Alarm

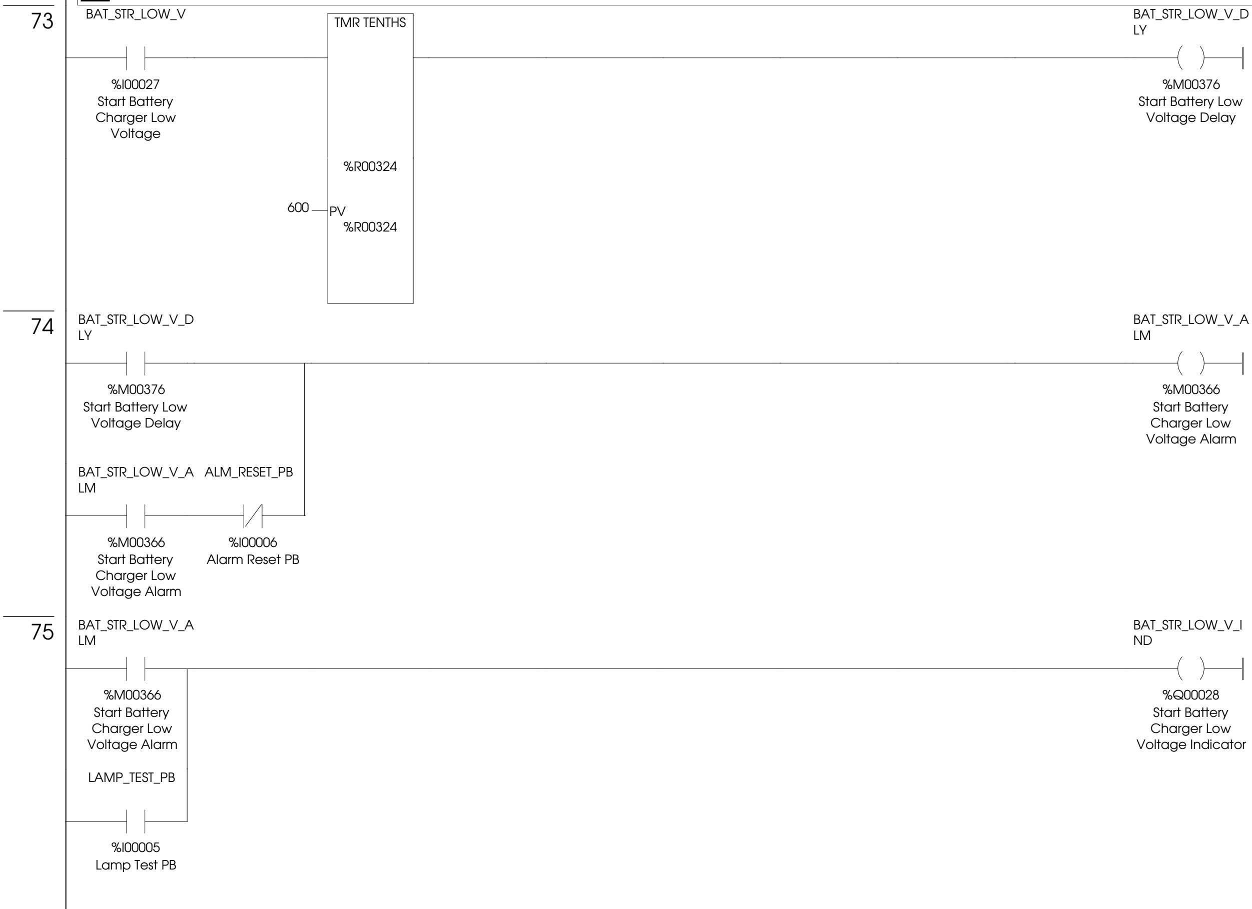


68 Generator Control Battery Low Voltage Alarm



72

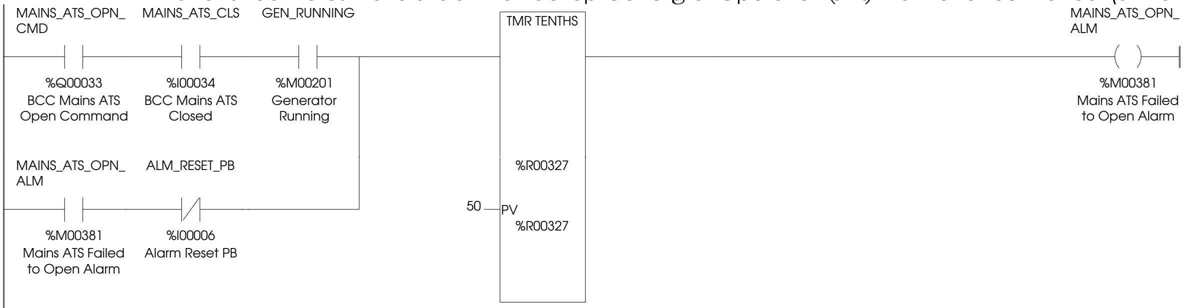
Generator Start Battery Low Voltage Alarm



76

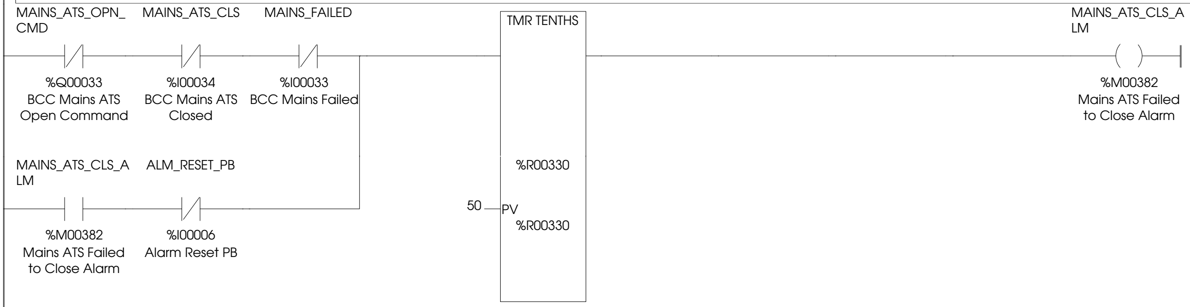
Mains ATS Fail to Open Alarm

77



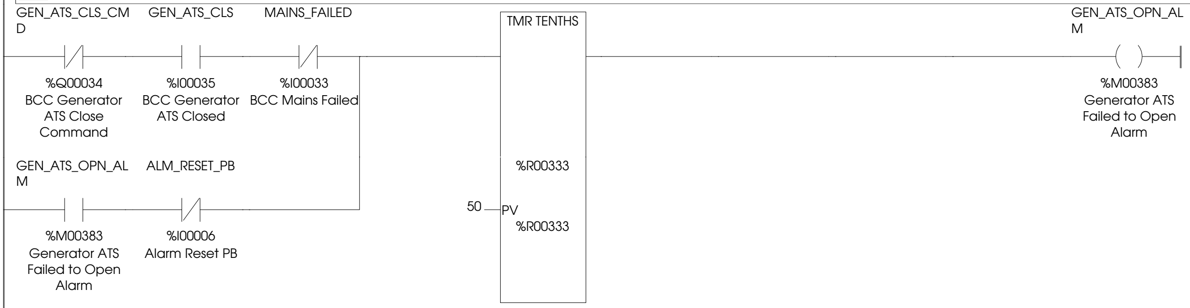
78 Mains ATS Fail to Close Alarm

79



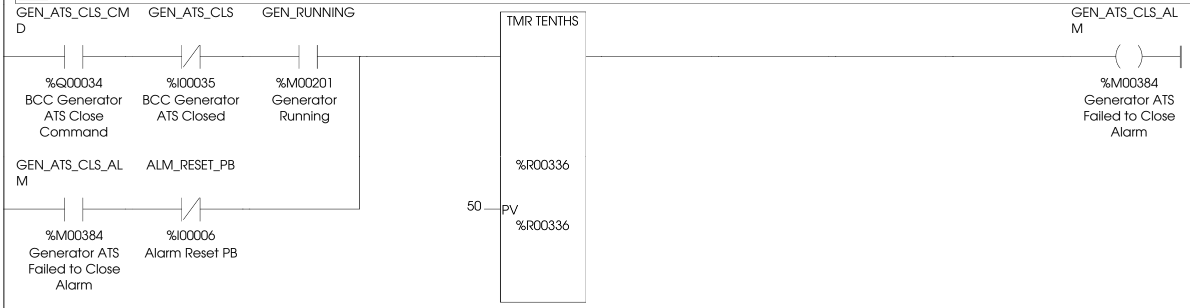
80 Generator ATS Fail to Open Alarm

81



82 Generator ATS Fail to Close Alarm

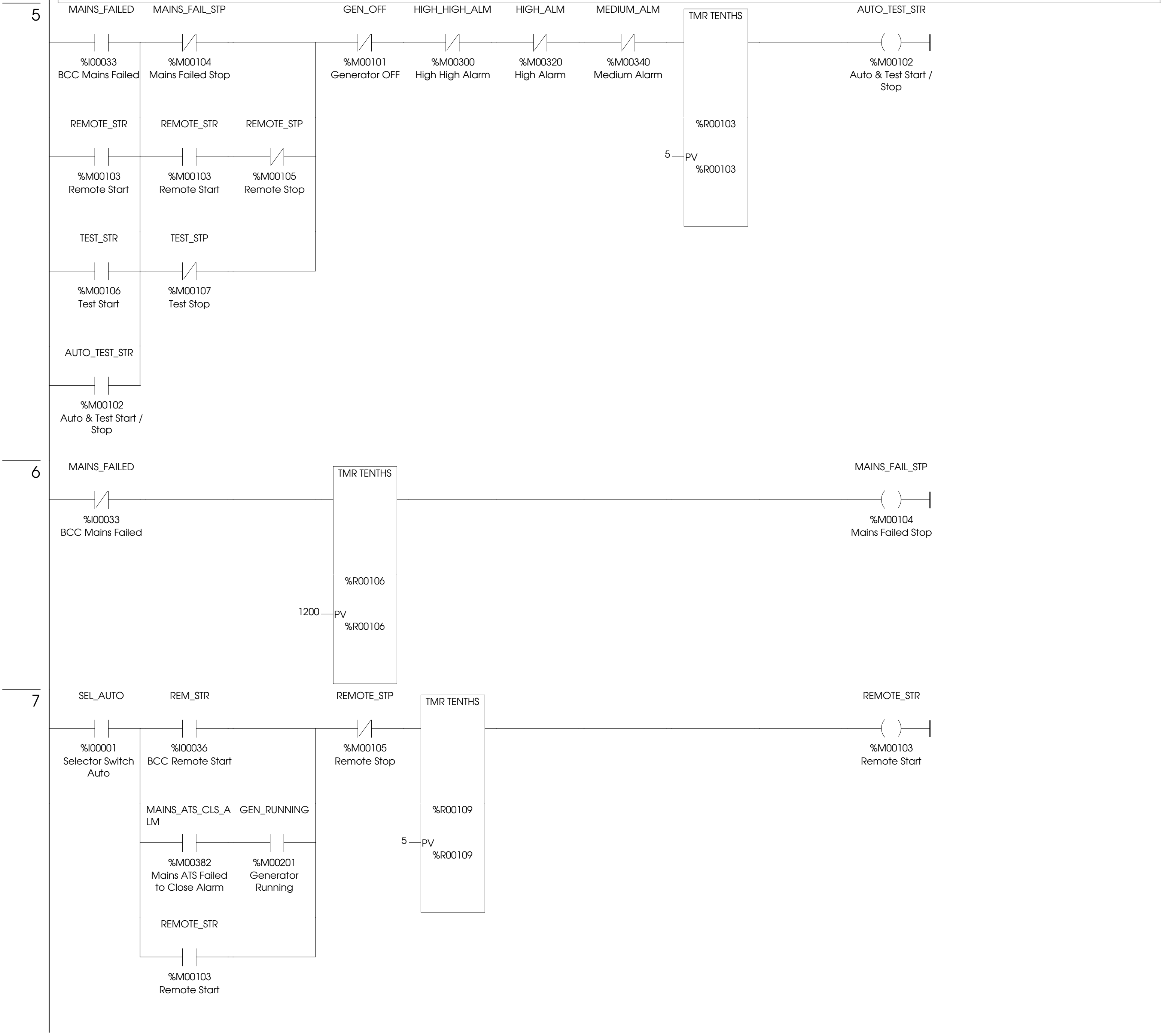
83

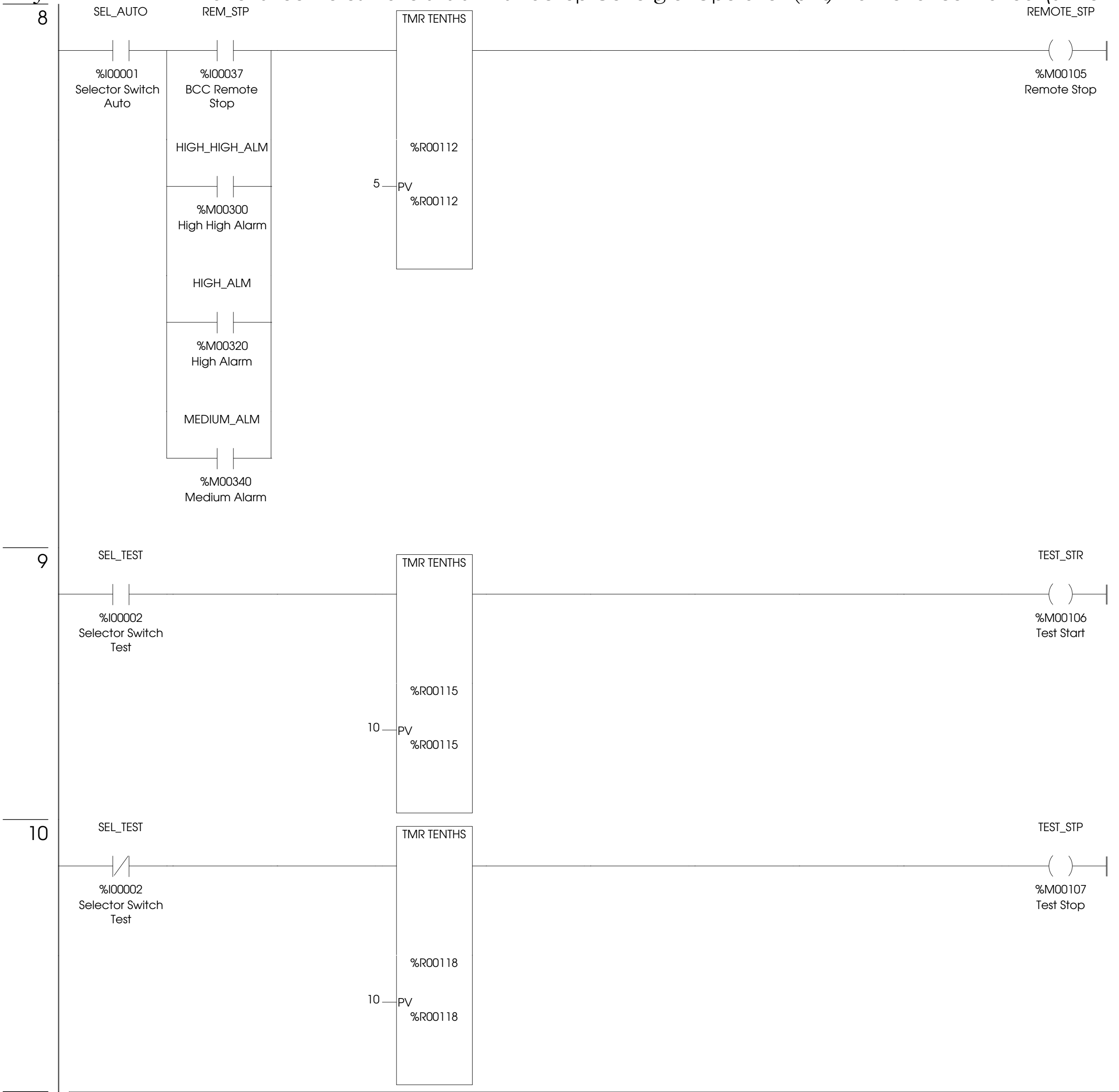


Block Name:..SEQ.blk
Description:..Control Logic for the Generator Operation Sequences.
Block Type:..Ladder

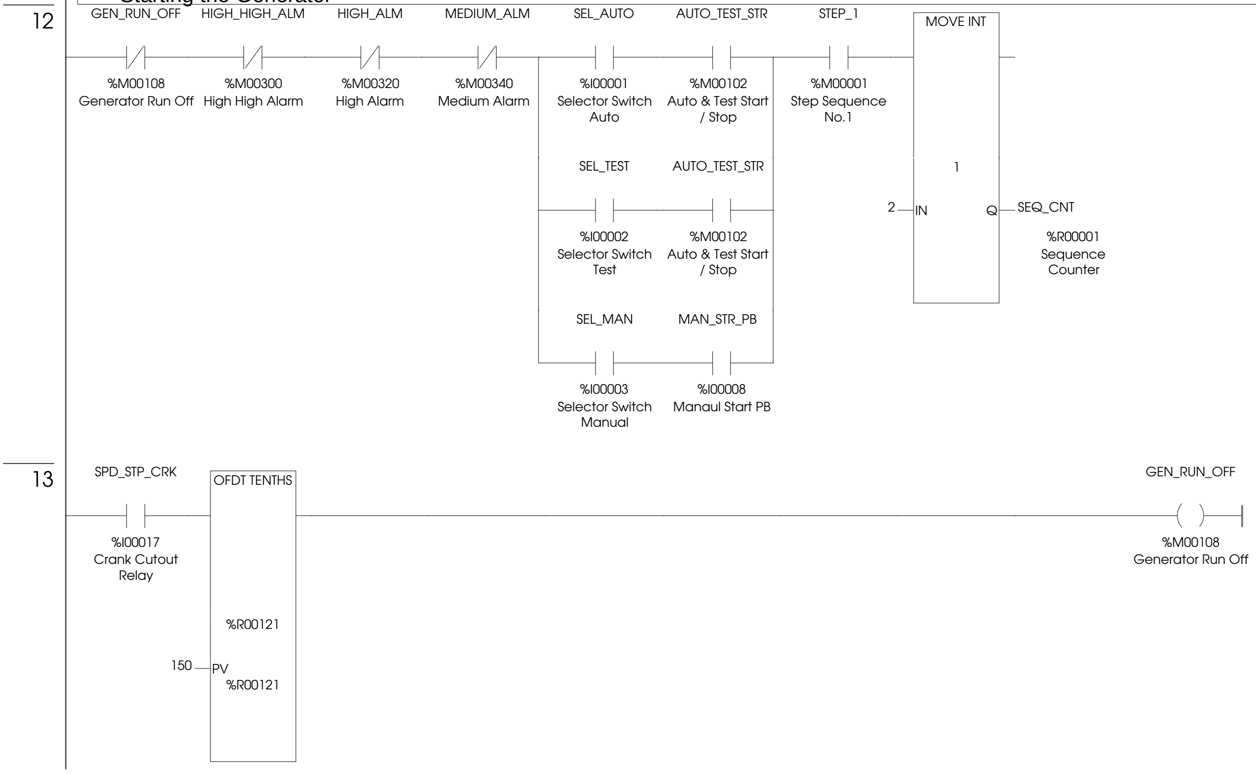
1 Generator OFF State

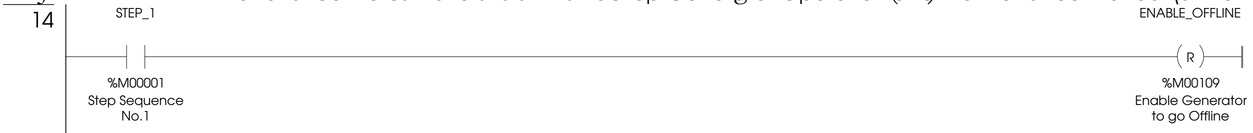
4 Generator Automatic Start and Stop Logic





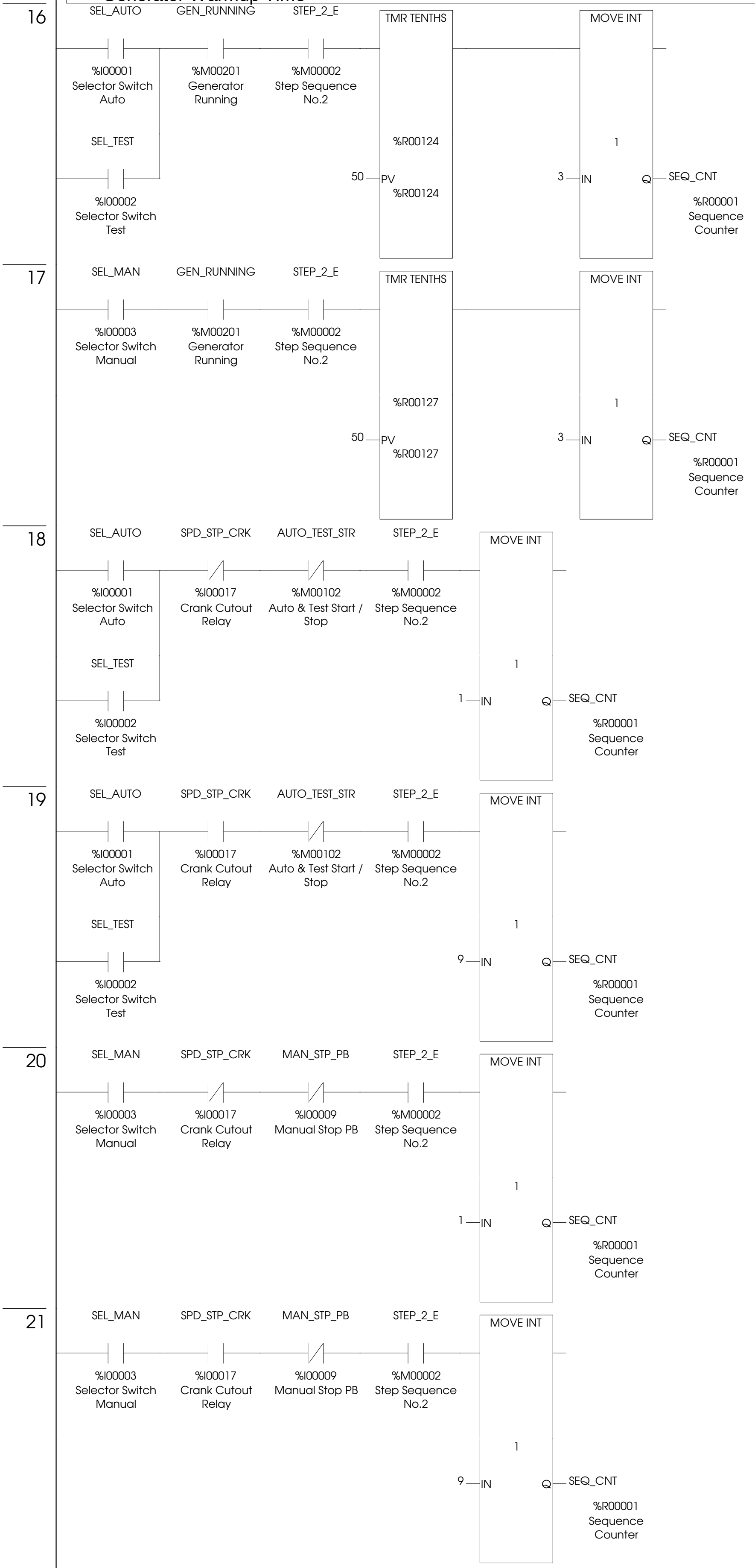
11 Generator Sequence 1 -- 2
Starting the Generator





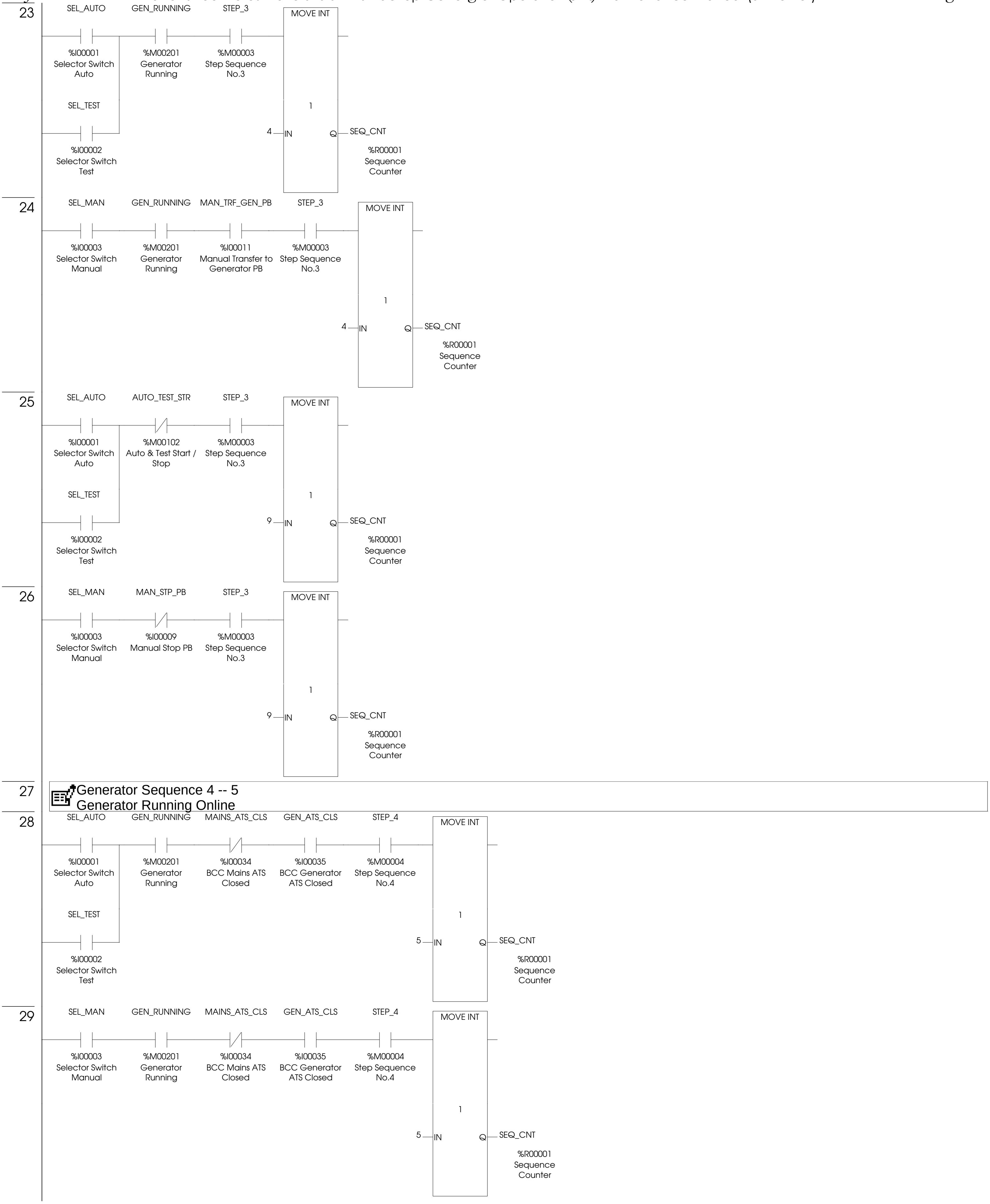
15

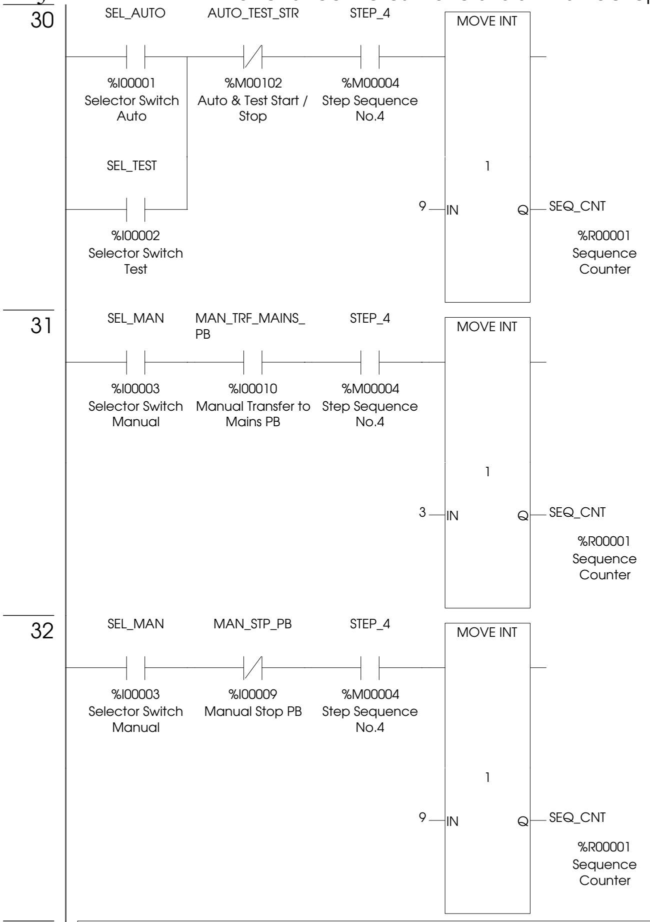
Generator Sequence 2 -- 3
Generator Running at Rated Speed
Generator Warmup Time



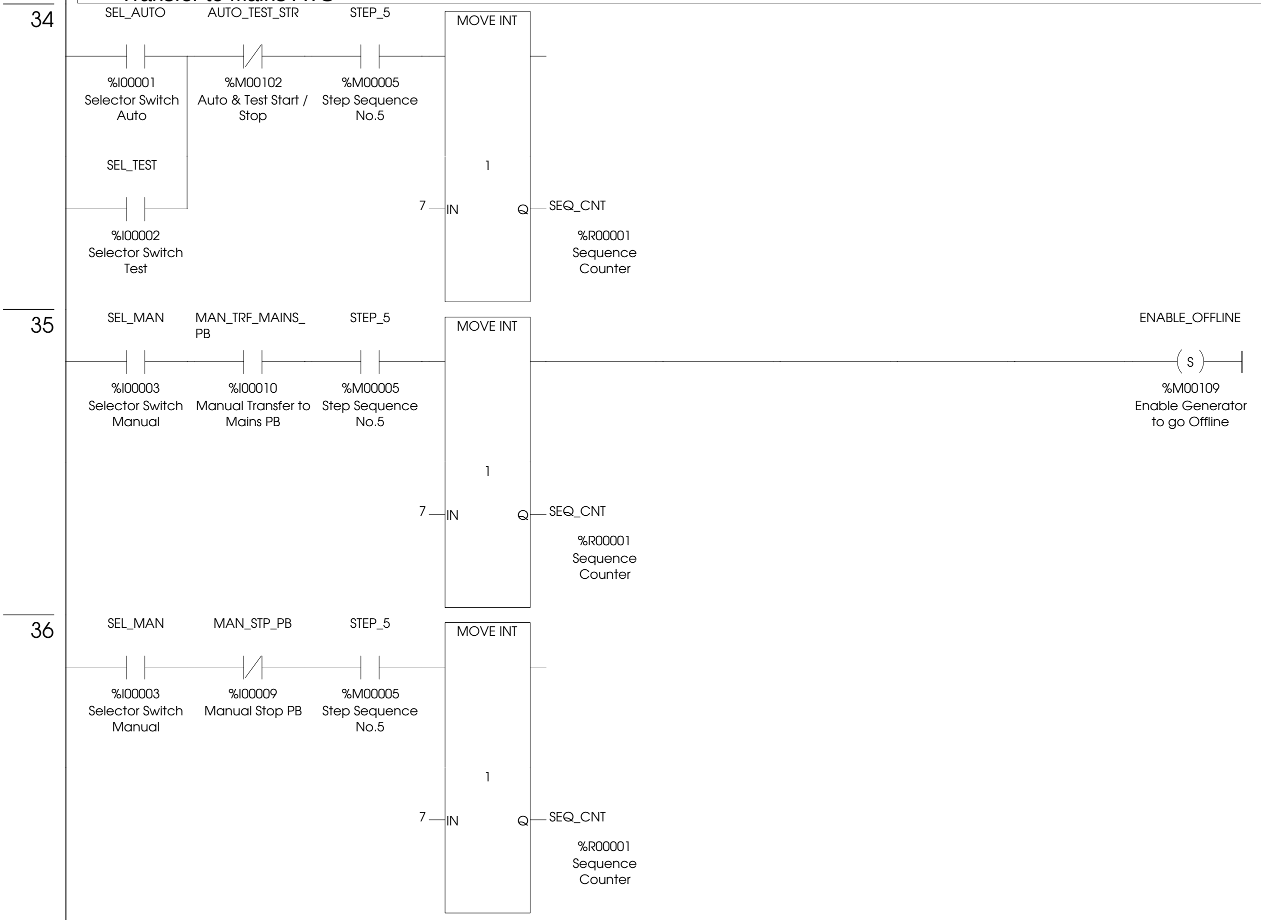
22

Generator Sequence 3 -- 4
Generator Running at Rated Speed
Transfer to Generator ATS

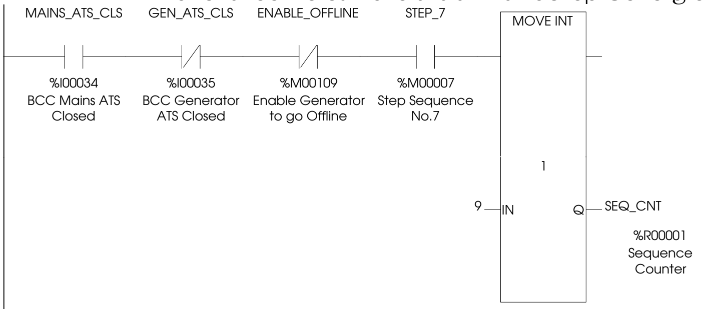

23
SEL_AUTO
GEN_RUNNING
STEP_3
MOVE INT
%I00001 Selector Switch Auto
%M00201 Generator Running
%M00003 Step Sequence No.3
SEL_TEST
1
4 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
24
SEL_MAN
GEN_RUNNING
MAN_TRF_GEN_PB
STEP_3
MOVE INT
%I00003 Selector Switch Manual
%M00201 Generator Running
%I00011 Manual Transfer to Generator PB
%M00003 Step Sequence No.3
1
4 IN Q SEQ_CNT
%R00001 Sequence Counter
25
SEL_AUTO
AUTO_TEST_STR
STEP_3
MOVE INT
%I00001 Selector Switch Auto
%M00102 Auto & Test Start / Stop
%M00003 Step Sequence No.3
SEL_TEST
1
9 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
26
SEL_MAN
MAN_STP_PB
STEP_3
MOVE INT
%I00003 Selector Switch Manual
%I00009 Manual Stop PB
%M00003 Step Sequence No.3
1
9 IN Q SEQ_CNT
%R00001 Sequence Counter
27
Generator Sequence 4 -- 5
Generator Running Online
28
SEL_AUTO
GEN_RUNNING
MAINS_ATS_CLS
GEN_ATS_CLS
STEP_4
MOVE INT
%I00001 Selector Switch Auto
%M00201 Generator Running
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00004 Step Sequence No.4
SEL_TEST
1
5 IN Q SEQ_CNT
%I00002 Selector Switch Test
%R00001 Sequence Counter
29
SEL_MAN
GEN_RUNNING
MAINS_ATS_CLS
GEN_ATS_CLS
STEP_4
MOVE INT
%I00003 Selector Switch Manual
%M00201 Generator Running
%I00034 BCC Mains ATS Closed
%I00035 BCC Generator ATS Closed
%M00004 Step Sequence No.4
1
5 IN Q SEQ_CNT
%R00001 Sequence Counter



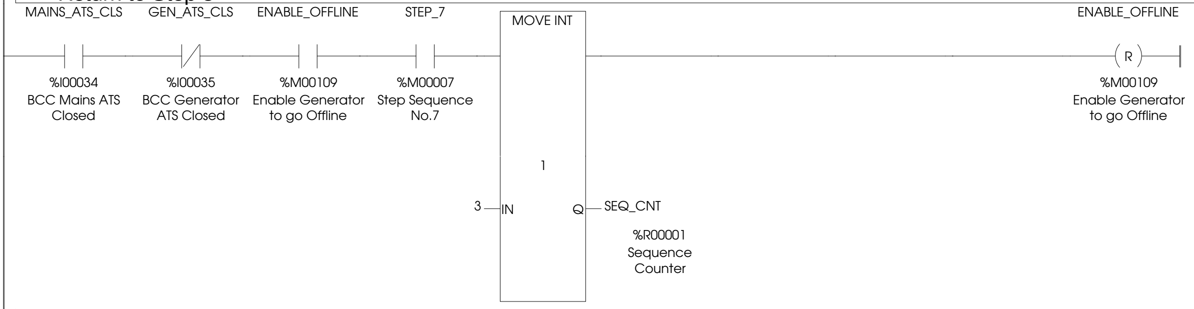
33
Generator Sequence 5 -- 7
Generator Running Online
Transfer to Mains ATS



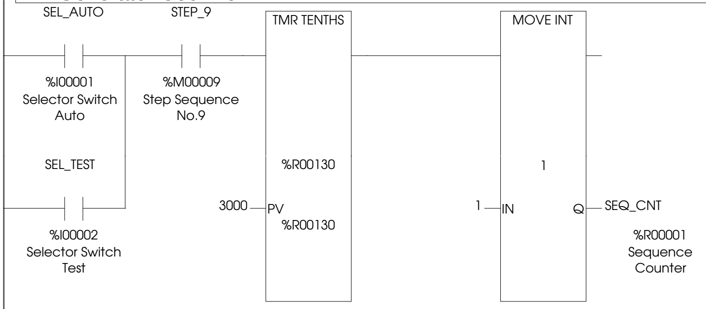
37
Generator Sequence 7 -- 9
Generator Running
Mains ATS Closed

38


39
Generator Sequence 7 -- 3
Generator Running
Mains ATS Closed
Return to Step 3

40


41
Generator Sequence 9 -- 1
Generator Cool Down

42


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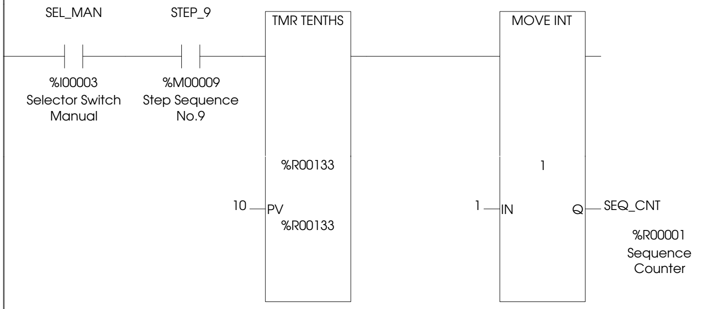
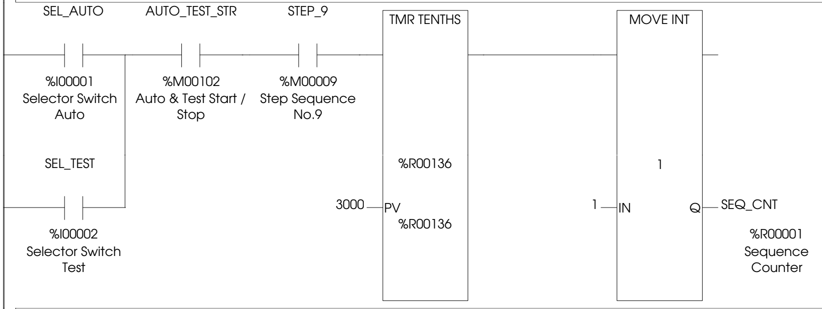
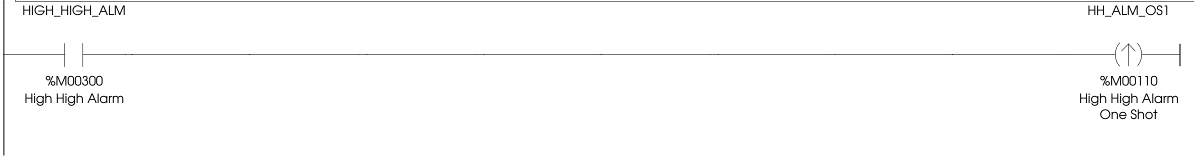
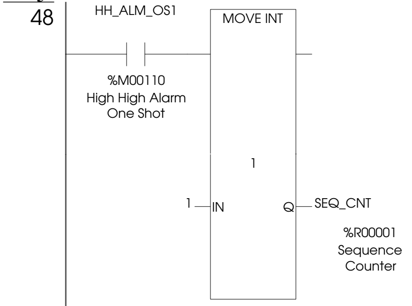


44
Generator Sequence 9 -- 2
Generator Restart

45


46
Generator High High Alarm
Generator Shut Down

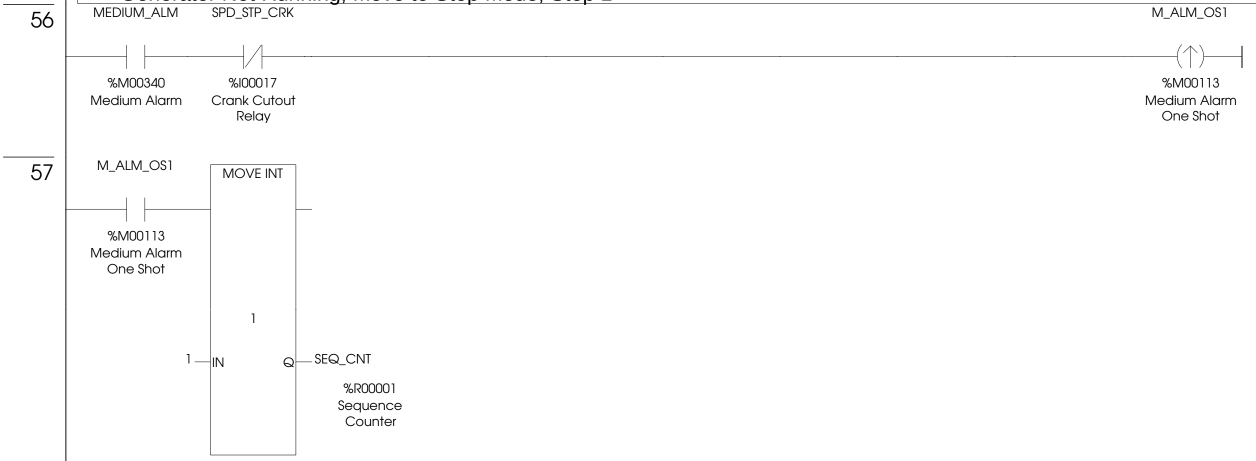
47




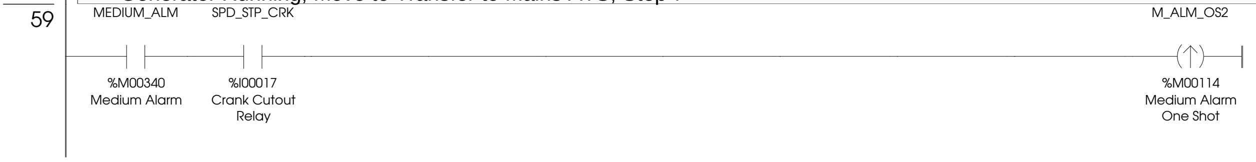
49 **Generator High Alarm**
Generator Not Running, Move to Stop Mode, Step 1

52 **Generator High Alarm**
Generator Running, Move to Cool Down Mode, Step 9

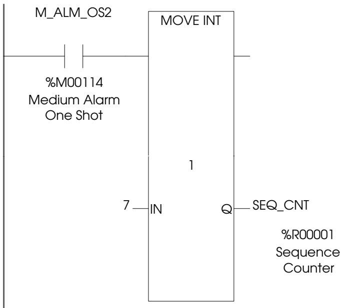
55 **Generator Medium Alarm**
Generator Not Running, Move to Stop Mode, Step 1



58 **Generator Medium Alarm**
Generator Running, Move to Transfer to Mains ATS, Step 7



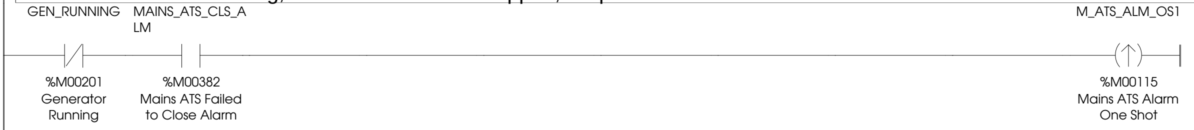
60



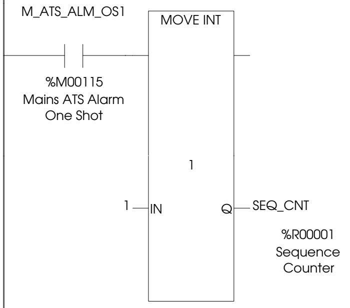
61

Mains ATS FAil To Close Alarm
Generator Not Running, Move to Generator Stopped, Step 1

62



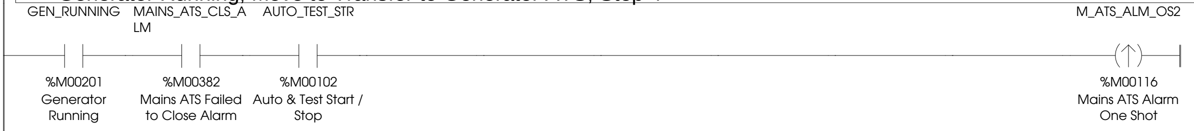
63



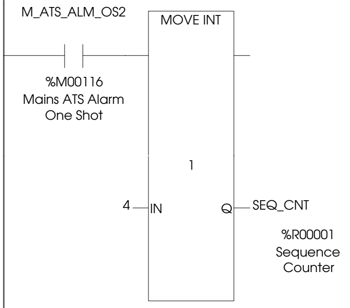
64

Mains ATS Fail To Close Alarm
Generator Running, Move to Transfer to Generator ATS, Step 4

65



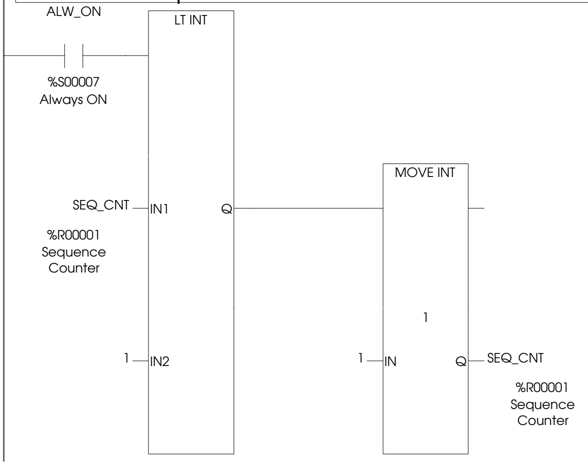
66

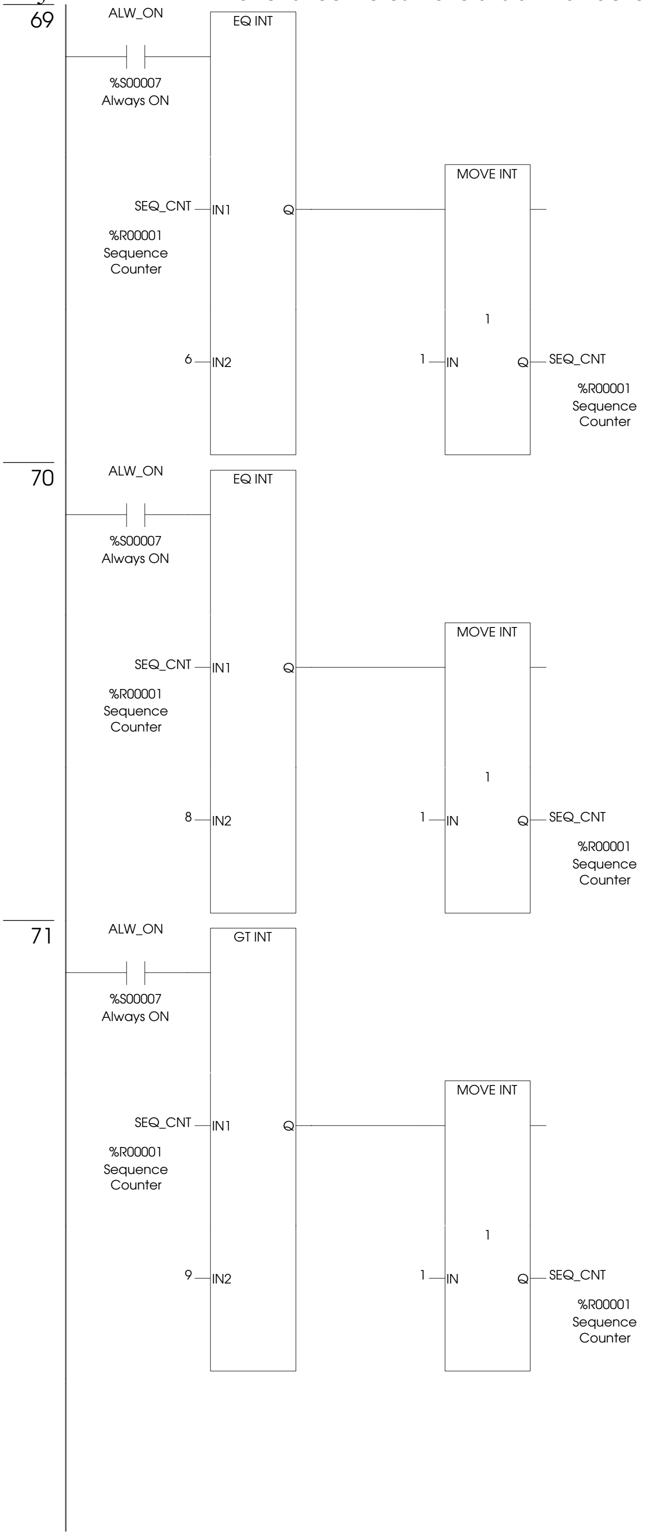


67

Generator Sequence Counter is Out of Range.
Reset to Step 1

68

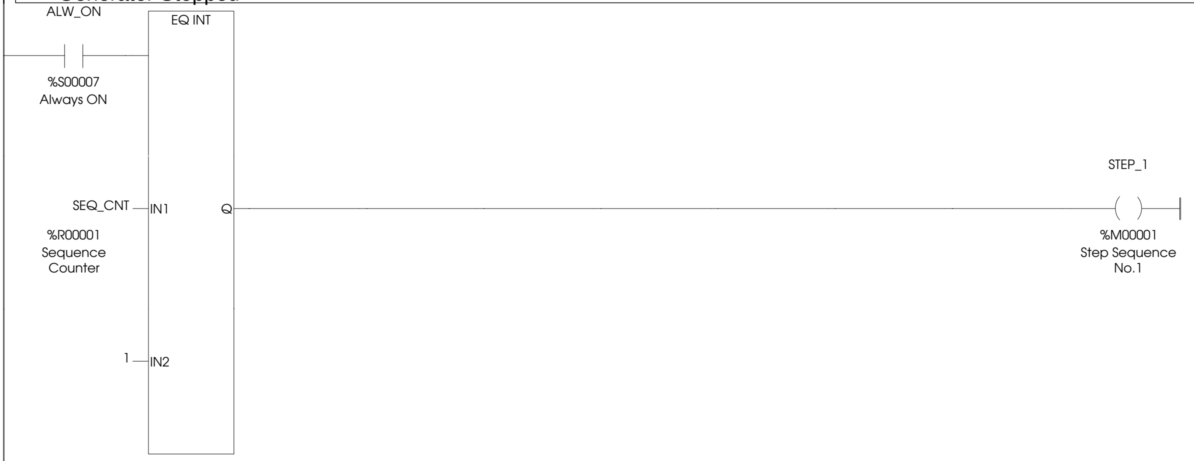



69
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
6
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
70
ALW_ON
%S00007
Always ON
EQ INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
8
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter
71
ALW_ON
%S00007
Always ON
GT INT
SEQ_CNT
IN1
Q
%R00001
Sequence
Counter
9
IN2
MOVE INT
1
1
IN
Q
SEQ_CNT
%R00001
Sequence
Counter

Block Name:... MAIN.blk
Description:... Control Logic for the Generator Sequence Steps.
Block Type:..Ladder

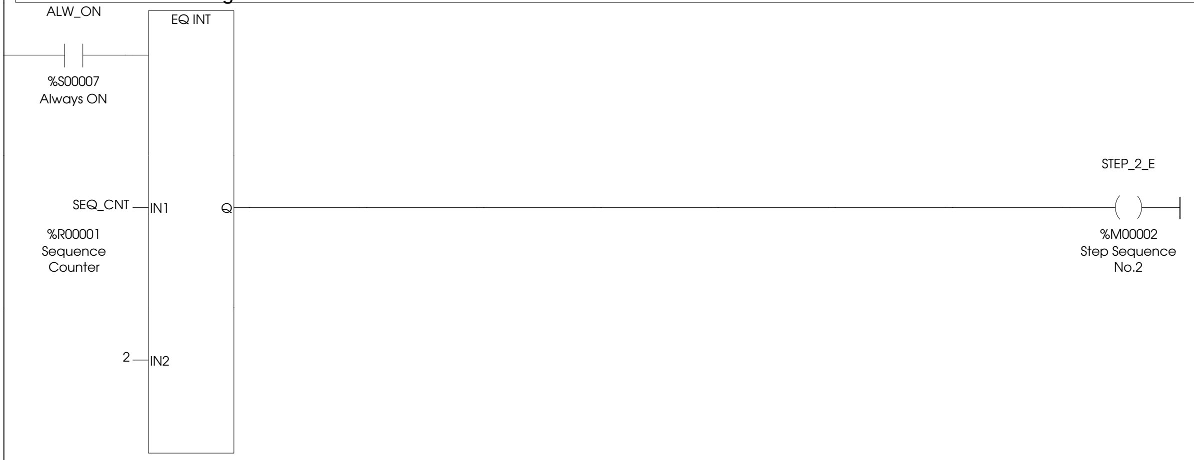
1 Generator Sequence No.1
Generator Stopped

2

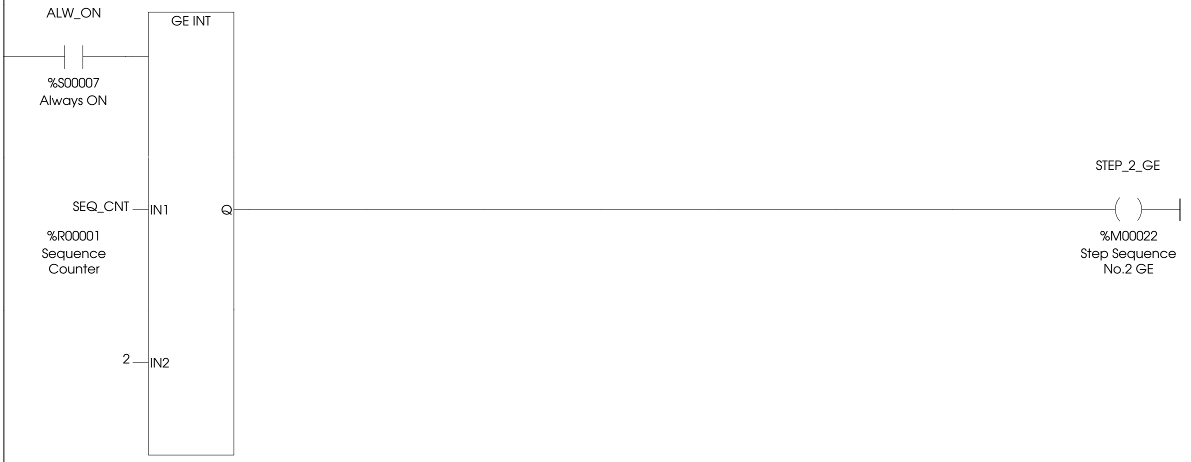


3 Generator Sequence No.2
Generator Starting

4

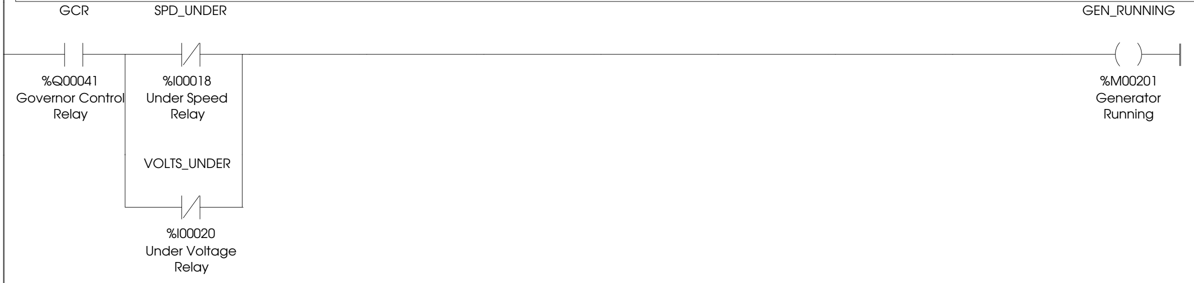


5



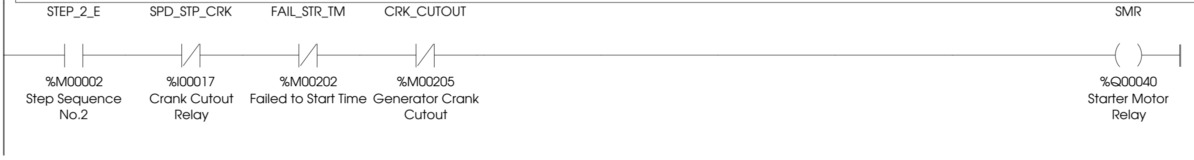
6 Generator Running Logic

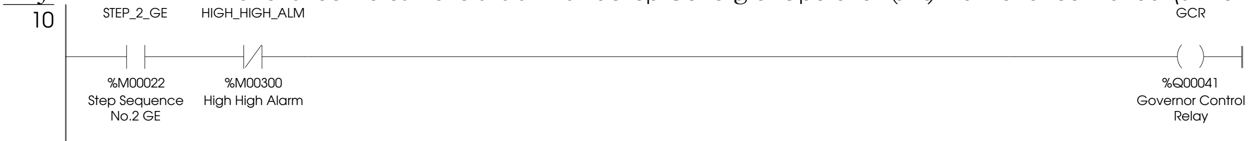
7



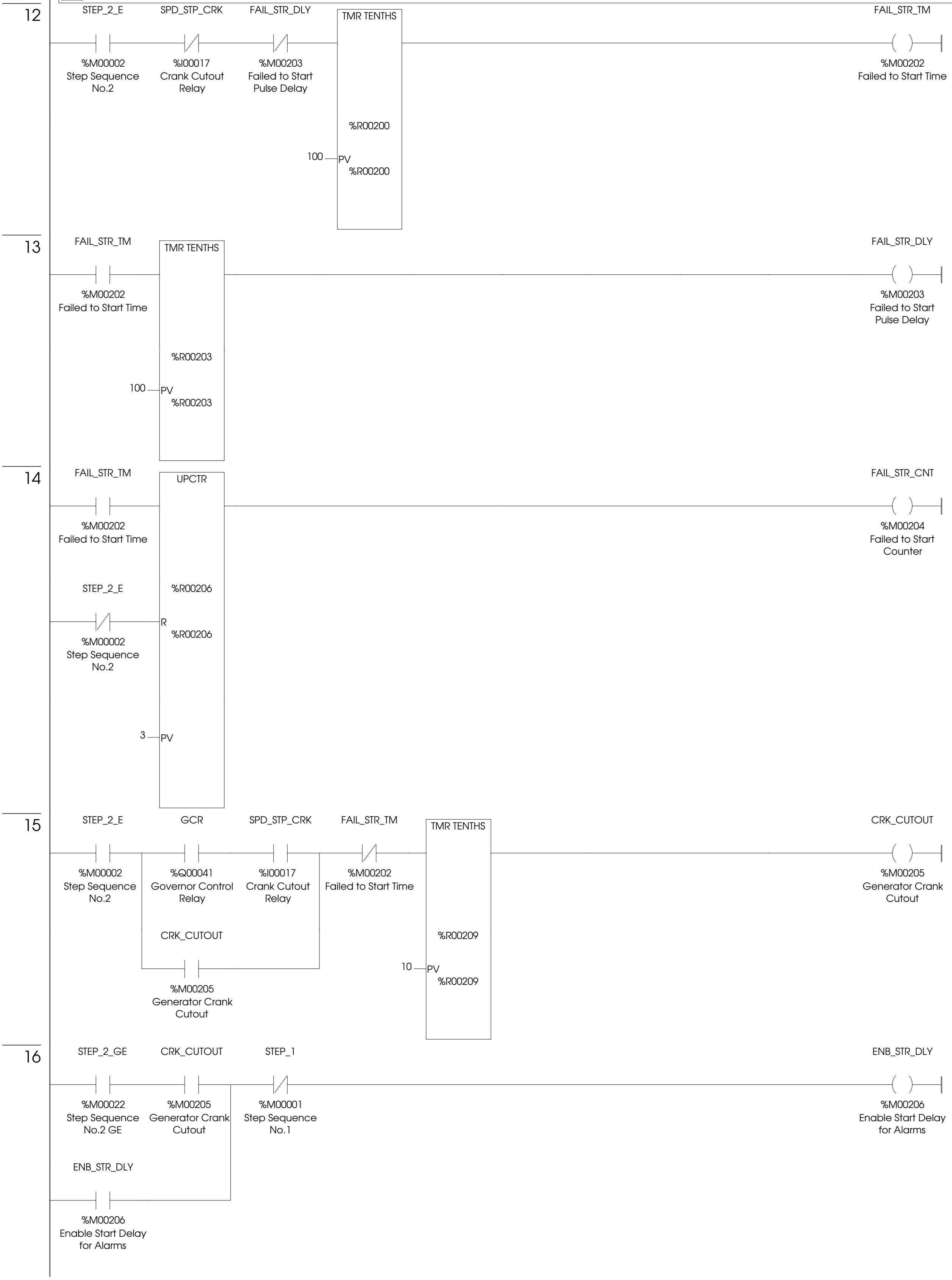
8 Generator Starter Motor and Governor Logic

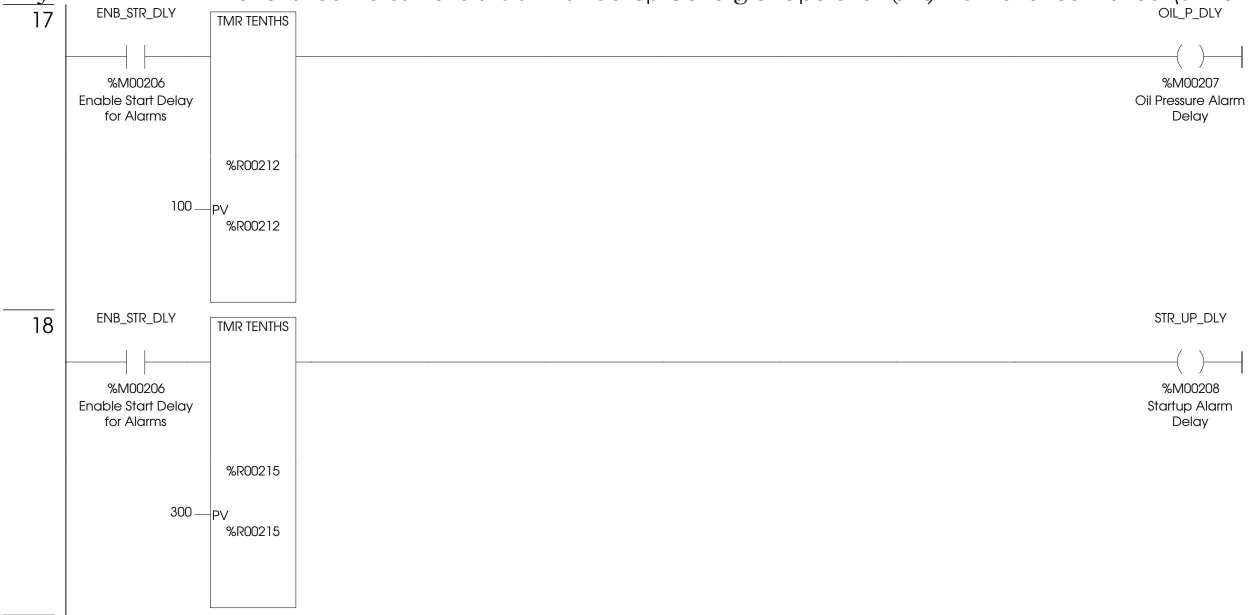
9



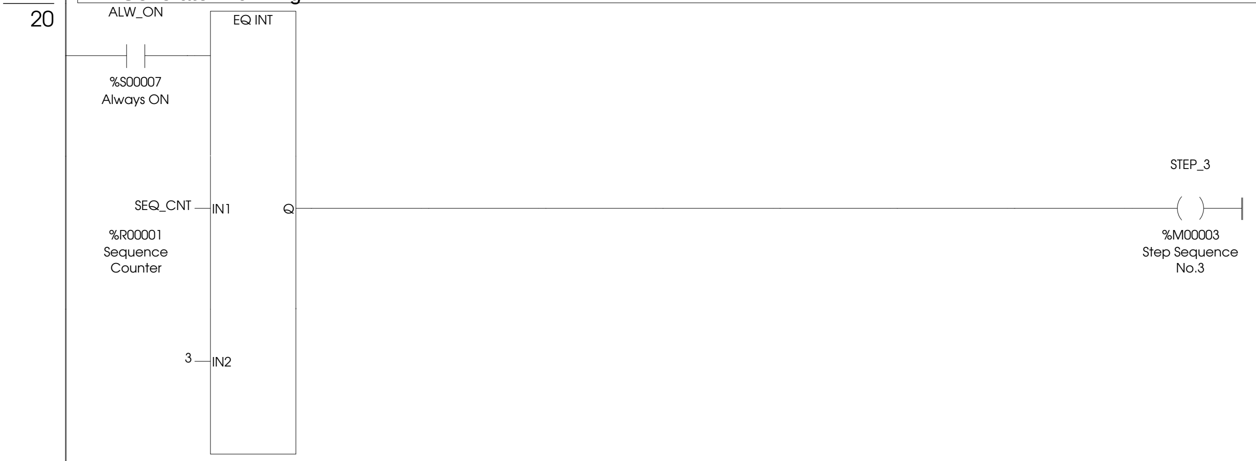


11 Generator Fail To Start Timers and Counters

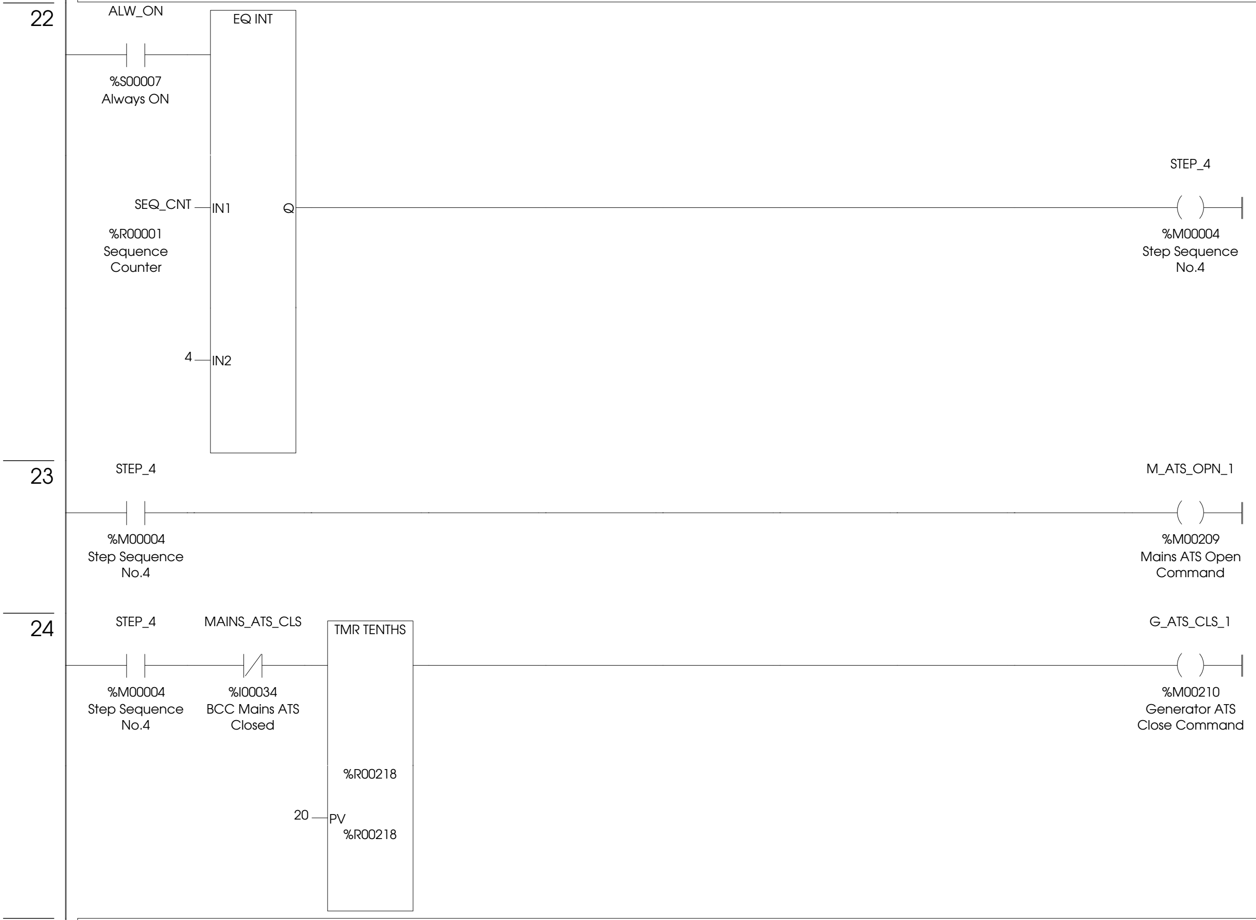




19 Generator Sequence No.3
Generator Running

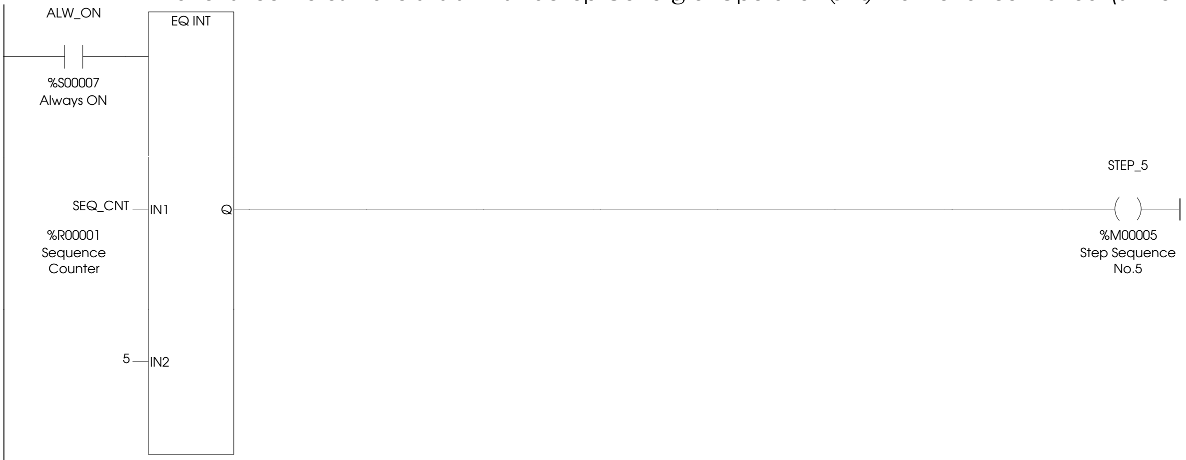


21 Generator Sequence No.4
Transfer to Generator ATS



25 Generator Sequence No.5
Generator Running Online

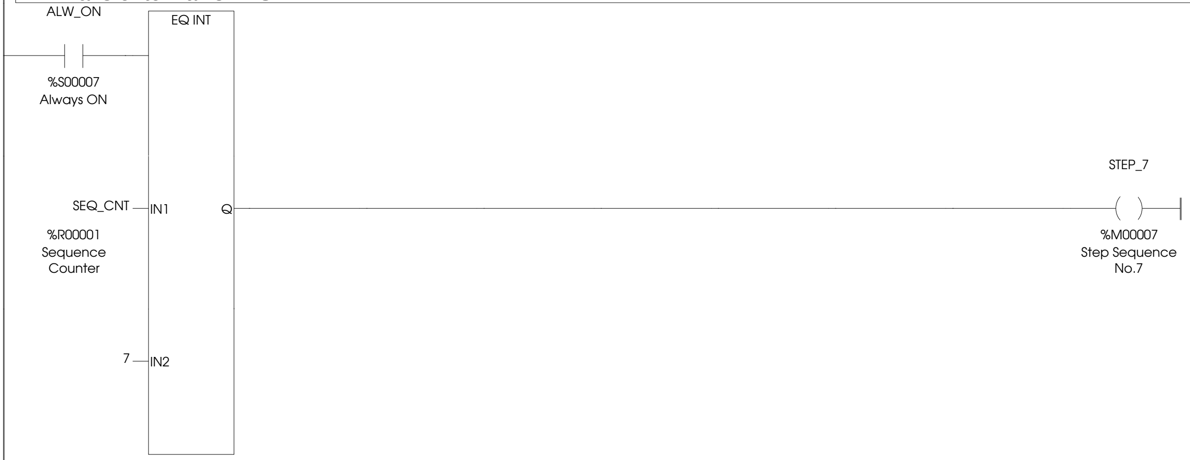
26



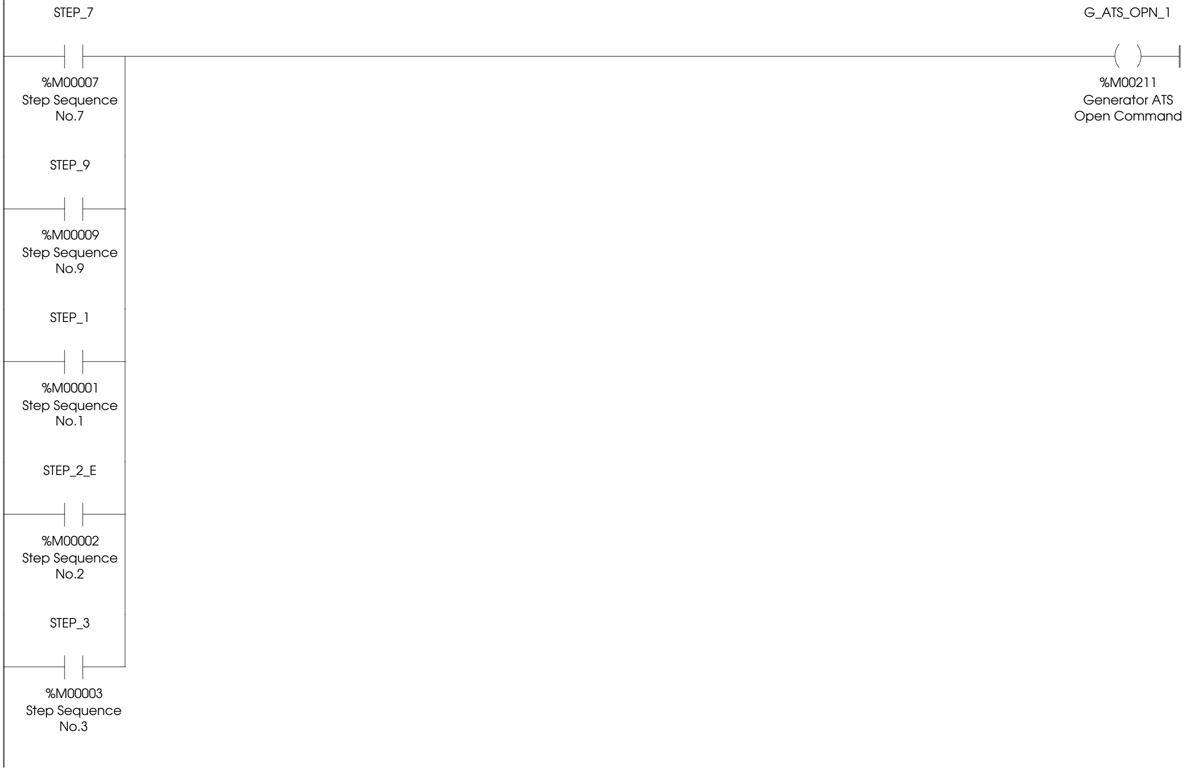
27

Generator Sequence No.7
Transfer to Mains ATS

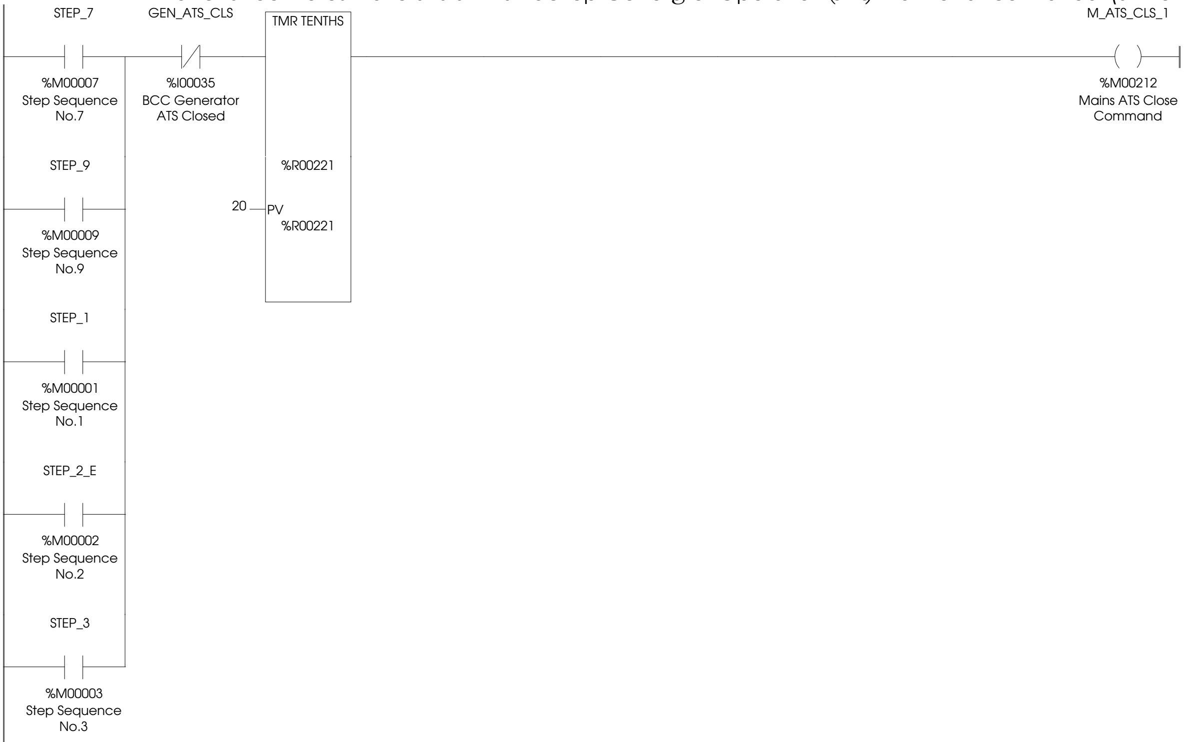
28



29



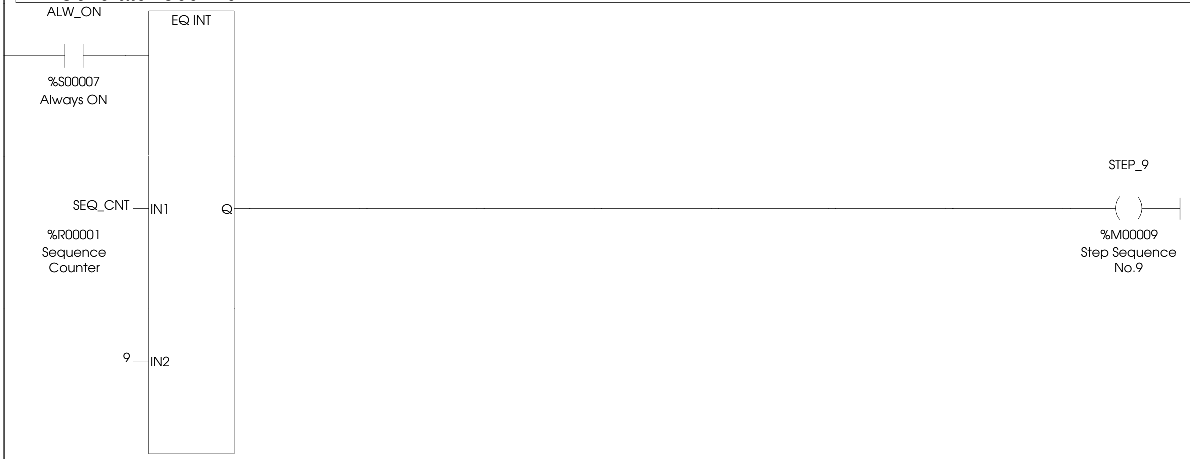
30



31

Generator Sequence No.9
Generator Offline
Generator Cool Down

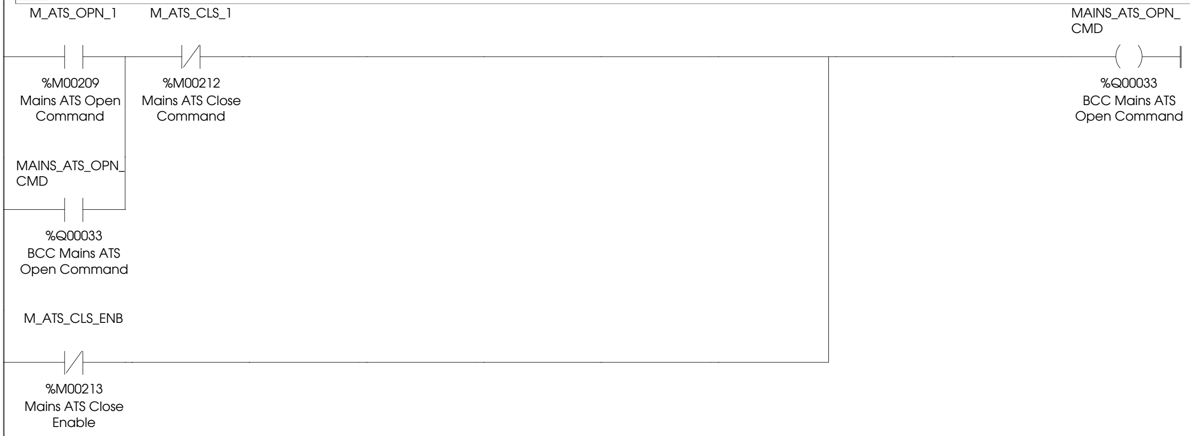
32



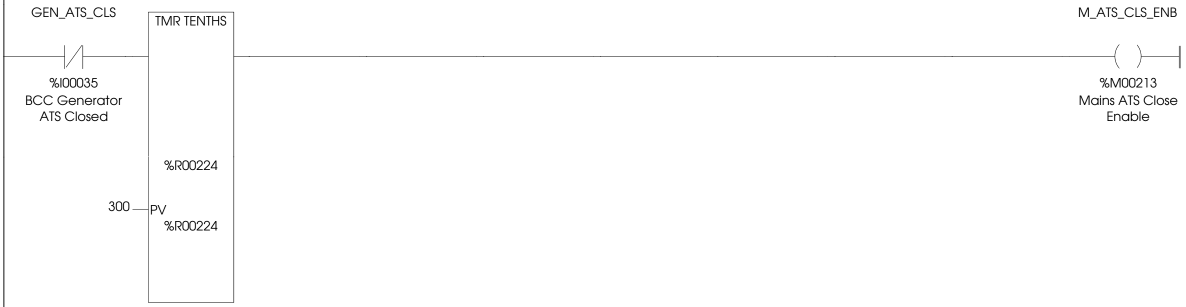
33

Mains ATS Control Logic

34

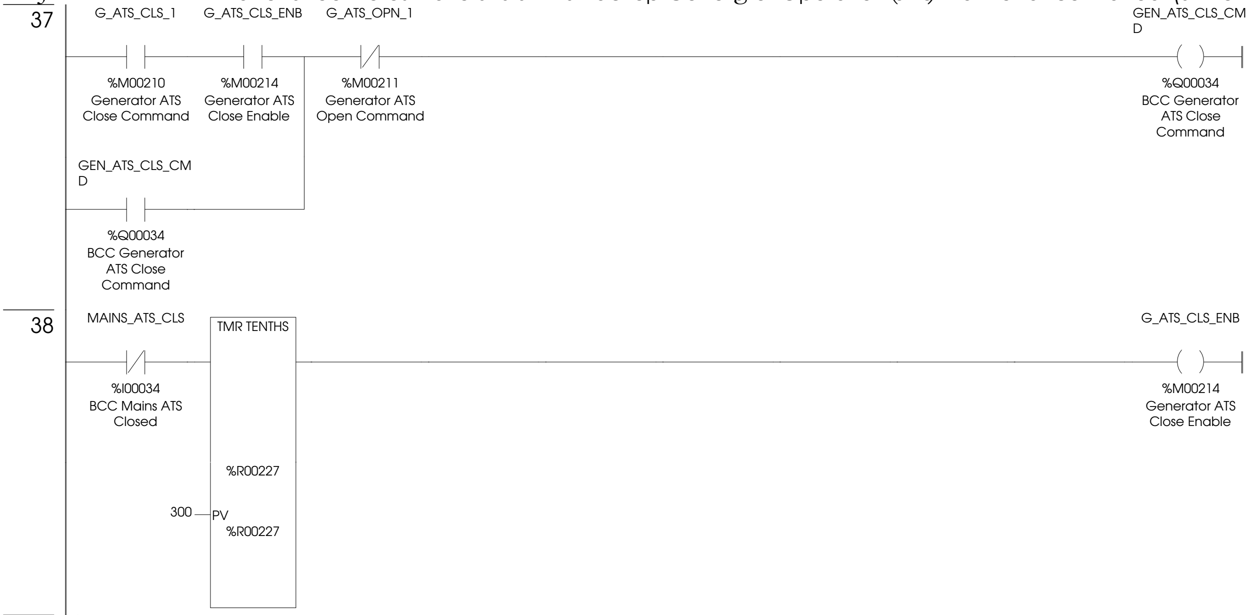


35



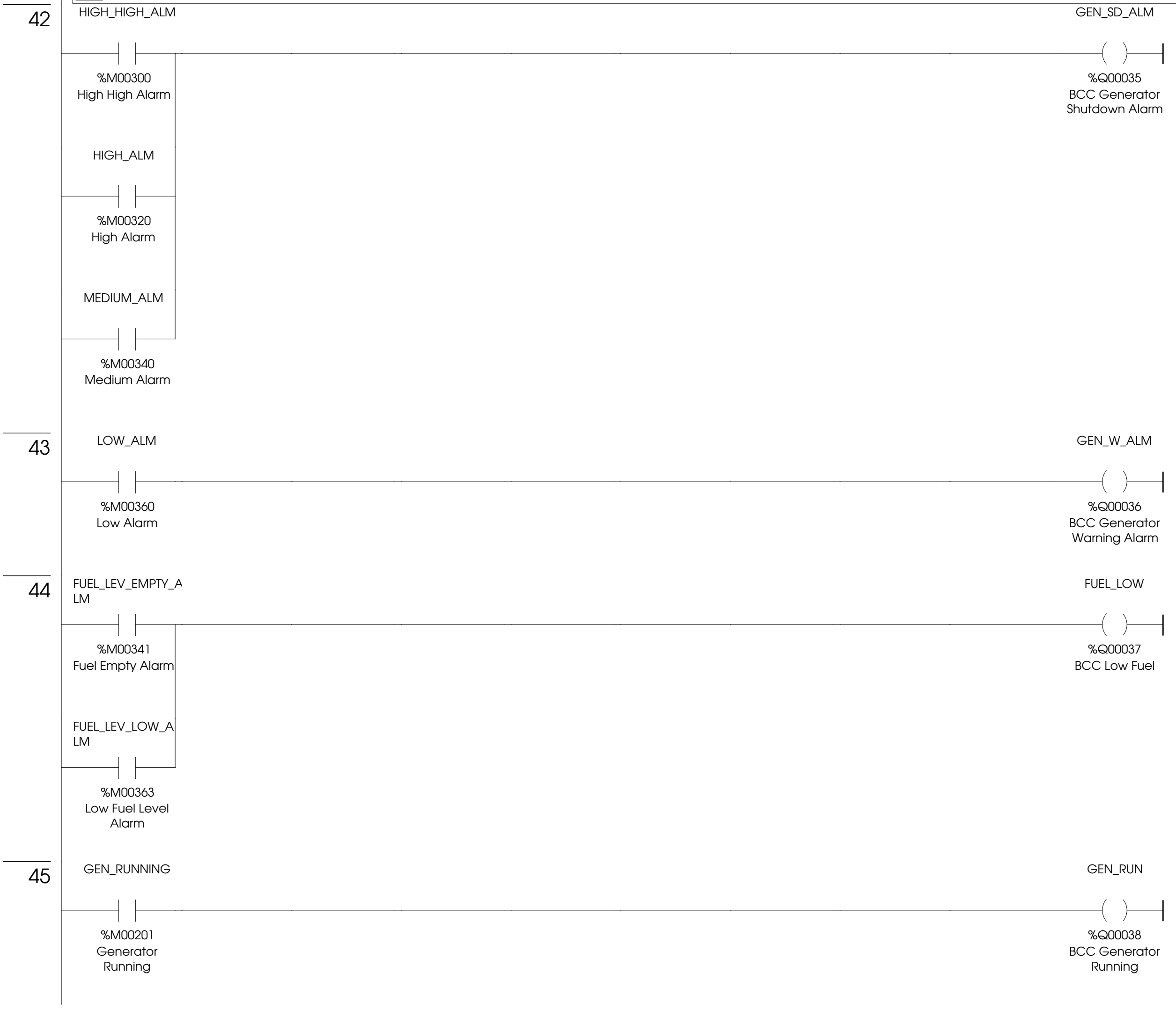
36

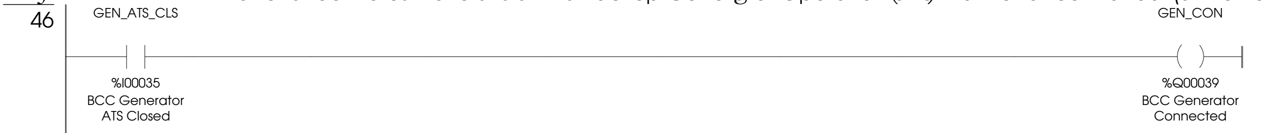
Generator ATS Control Logic



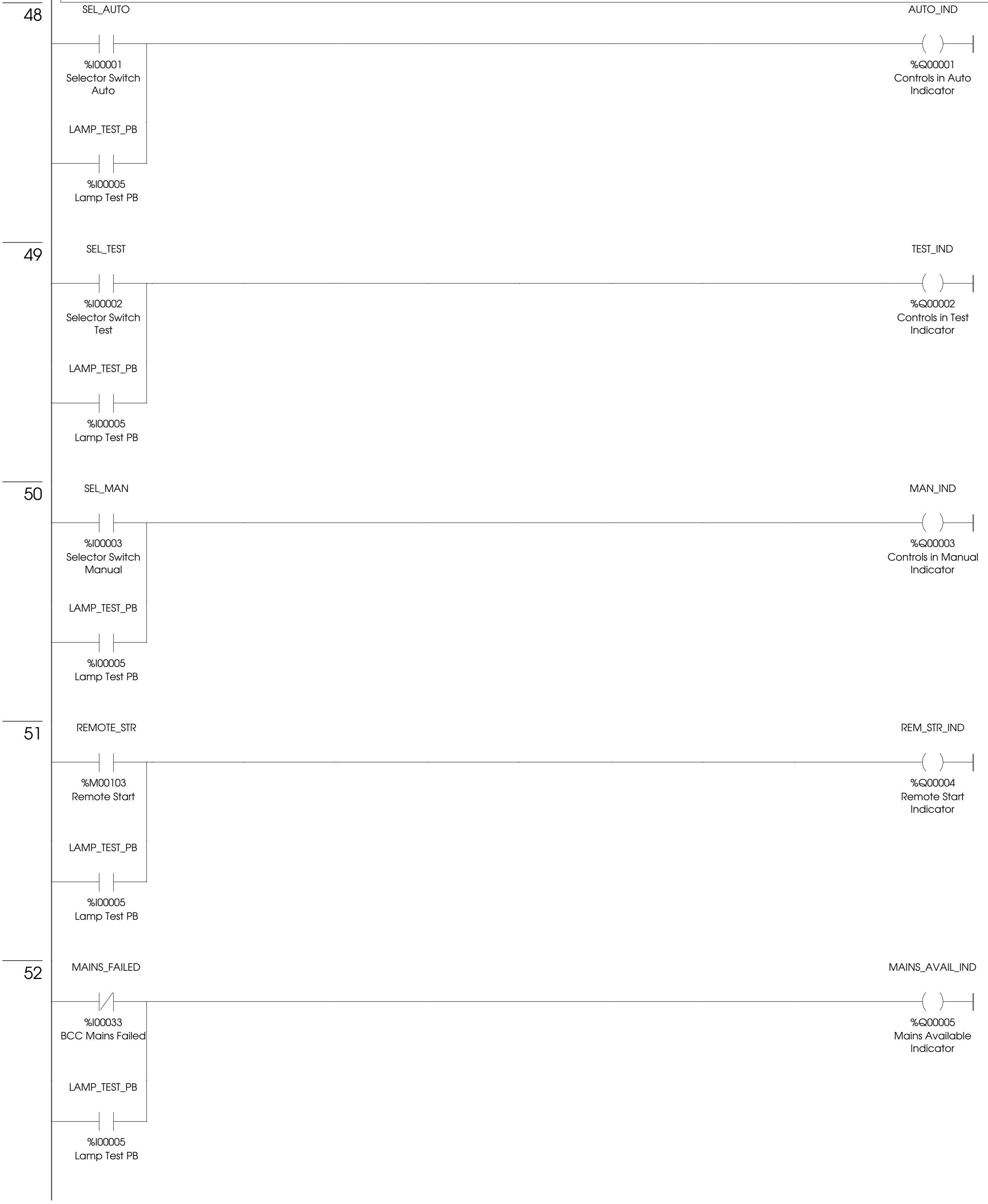
39 Generator CB Shunt Trip Control Logic

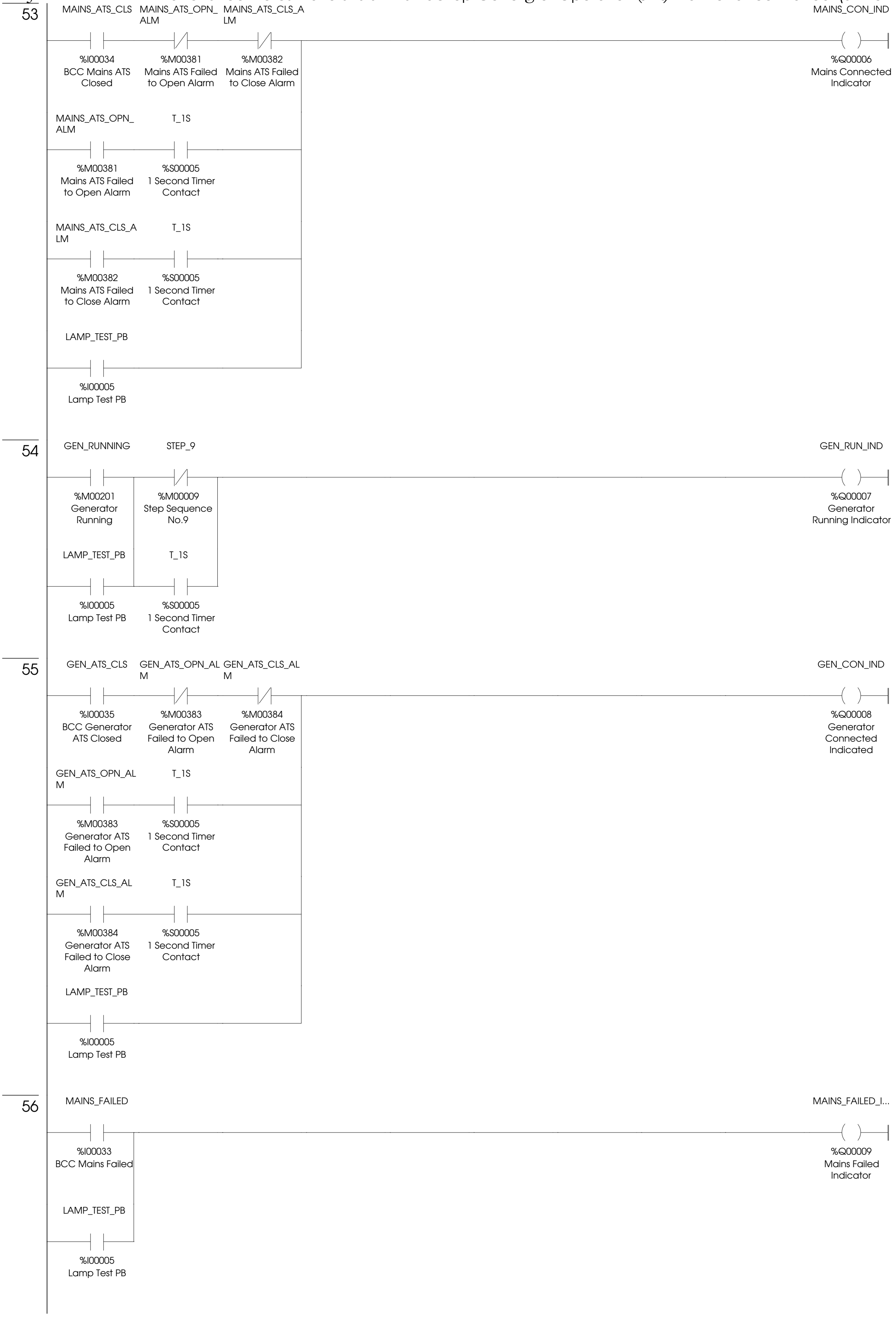
41 BCC Interface Relay Outputs

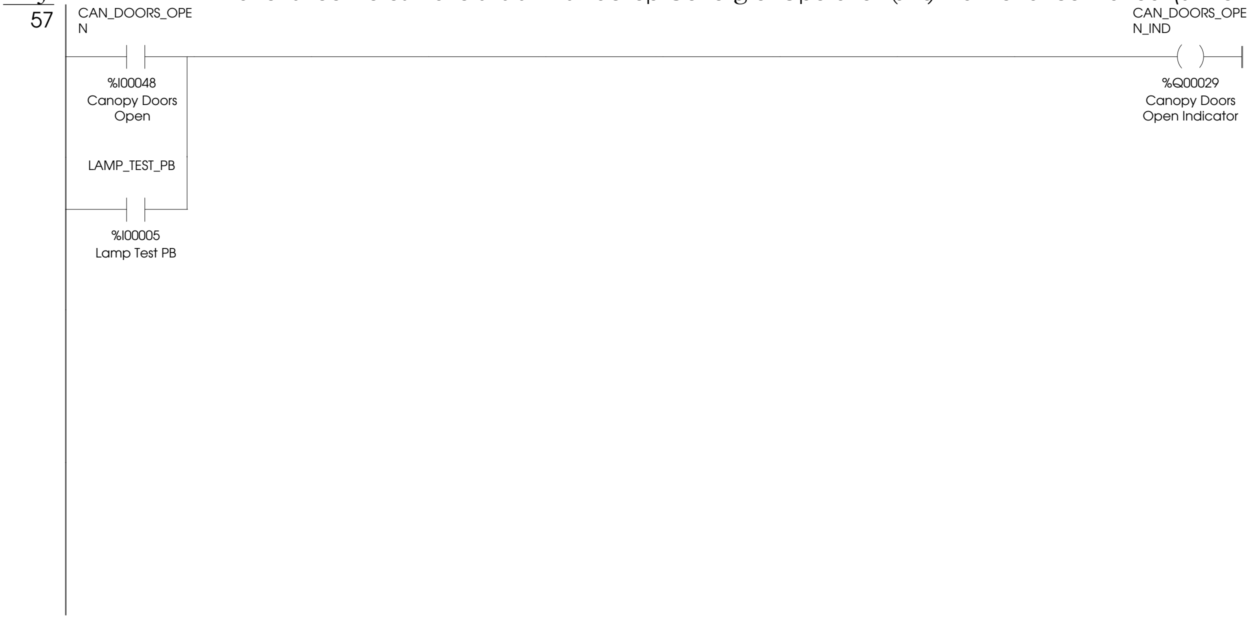




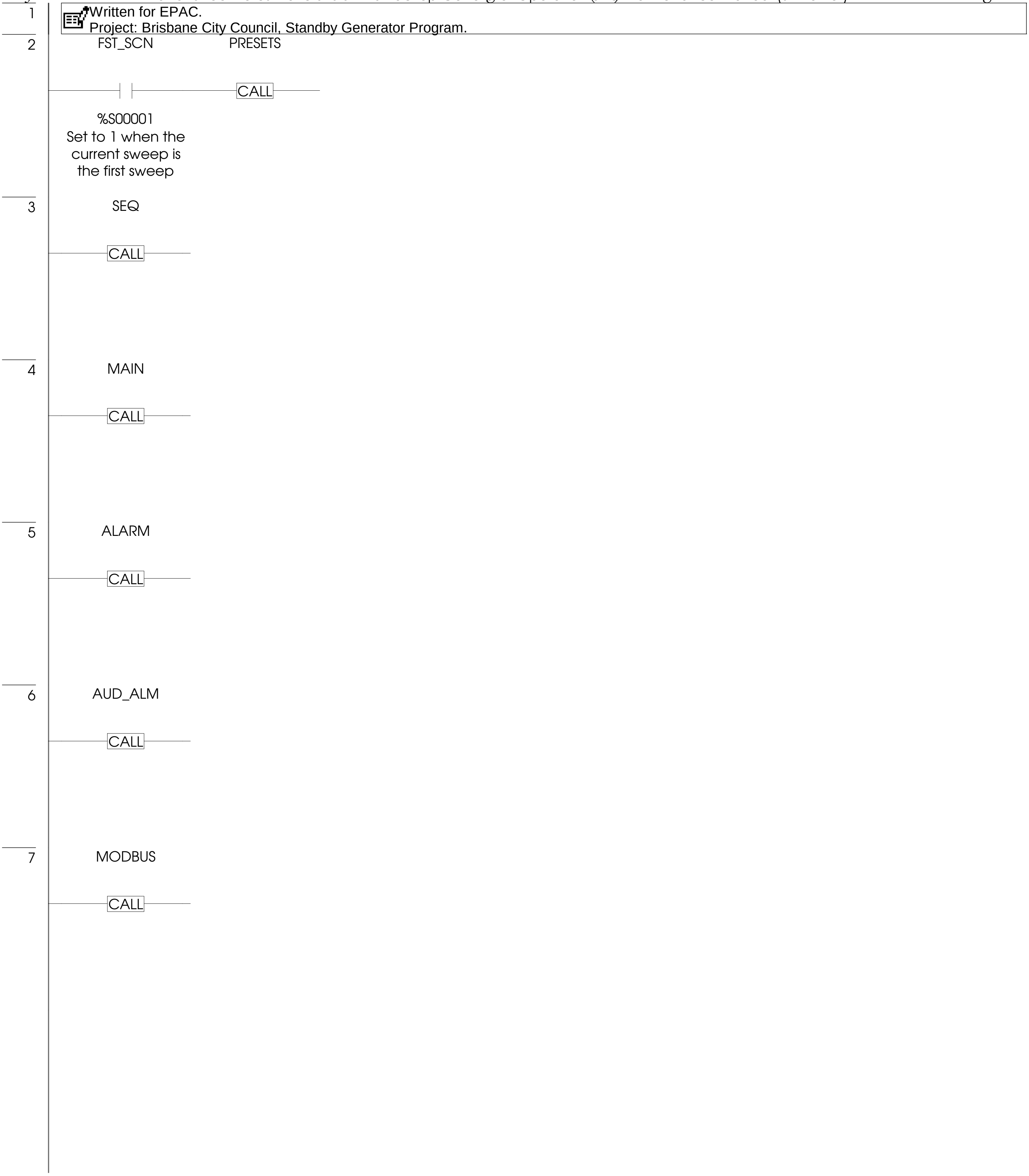
47 Local Control Panel Indicators




53
MAINS_ATS_CLS
%I00034
BCC Mains ATS Closed
MAINS_ATS_OPN_ALM
%M00381
Mains ATS Failed to Open Alarm
MAINS_ATS_CLS_ALM
%M00382
Mains ATS Failed to Close Alarm
MAINS_CON_IND
%Q00006
Mains Connected Indicator
MAINS_ATS_OPN_ALM
%M00381
Mains ATS Failed to Open Alarm
T_1S
%S00005
1 Second Timer Contact
MAINS_ATS_CLS_ALM
%M00382
Mains ATS Failed to Close Alarm
T_1S
%S00005
1 Second Timer Contact
LAMP_TEST_PB
%I00005
Lamp Test PB
54
GEN_RUNNING
%M00201
Generator Running
STEP_9
%M00009
Step Sequence No.9
GEN_RUN_IND
%Q00007
Generator Running Indicator
LAMP_TEST_PB
%I00005
Lamp Test PB
T_1S
%S00005
1 Second Timer Contact
55
GEN_ATS_CLS
%I00035
BCC Generator ATS Closed
GEN_ATS_OPN_ALM
%M00383
Generator ATS Failed to Open Alarm
GEN_ATS_CLS_ALM
%M00384
Generator ATS Failed to Close Alarm
GEN_CON_IND
%Q00008
Generator Connected Indicated
GEN_ATS_OPN_ALM
%M00383
Generator ATS Failed to Open Alarm
T_1S
%S00005
1 Second Timer Contact
GEN_ATS_CLS_ALM
%M00384
Generator ATS Failed to Close Alarm
T_1S
%S00005
1 Second Timer Contact
LAMP_TEST_PB
%I00005
Lamp Test PB
56
MAINS_FAILED
%I00033
BCC Mains Failed
MAINS_FAILED_I...
%Q00009
Mains Failed Indicator
LAMP_TEST_PB
%I00005
Lamp Test PB


57
CAN_DOORS_OPEN
%I00048
Canopy Doors Open
LAMP_TEST_PB
%I00005
Lamp Test PB
CAN_DOORS_OPEN_IND
%Q00029
Canopy Doors Open Indicator

Block Name:... _MAIN.blk
Description:...Control Logic for the Call for Sub Routines.
Block Type:..Ladder

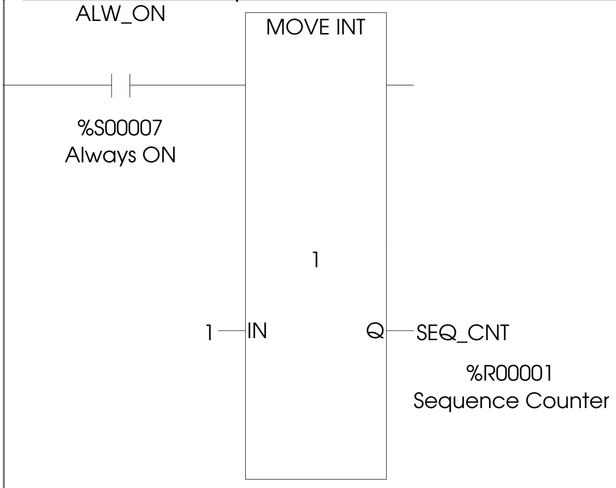


Written for EPAC.
Project: Brisbane City Council, Standby Generator Program.

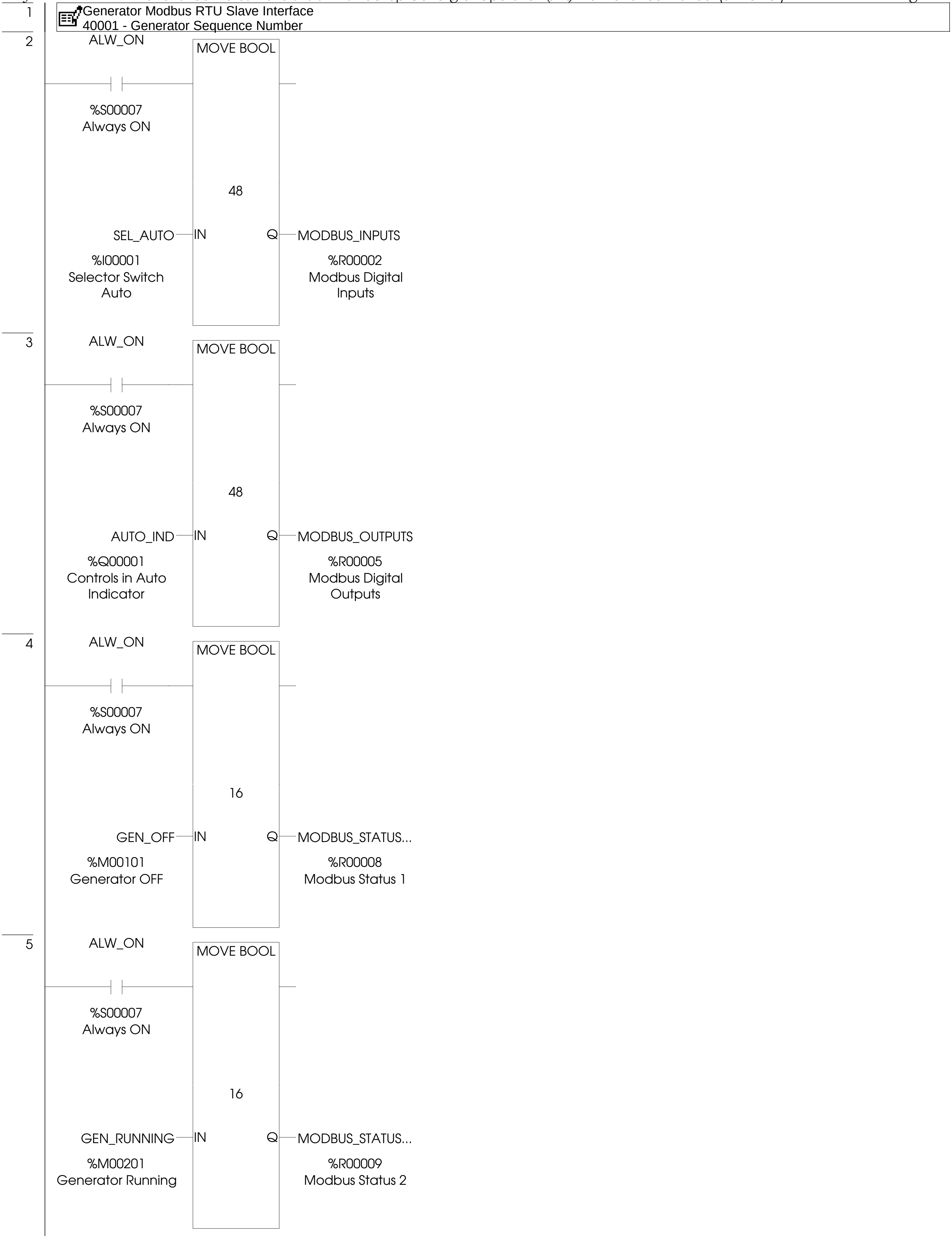
Block Name:..PRESETS.blk
Description:..Control Logic Generator Presets.
Block Type:...Ladder

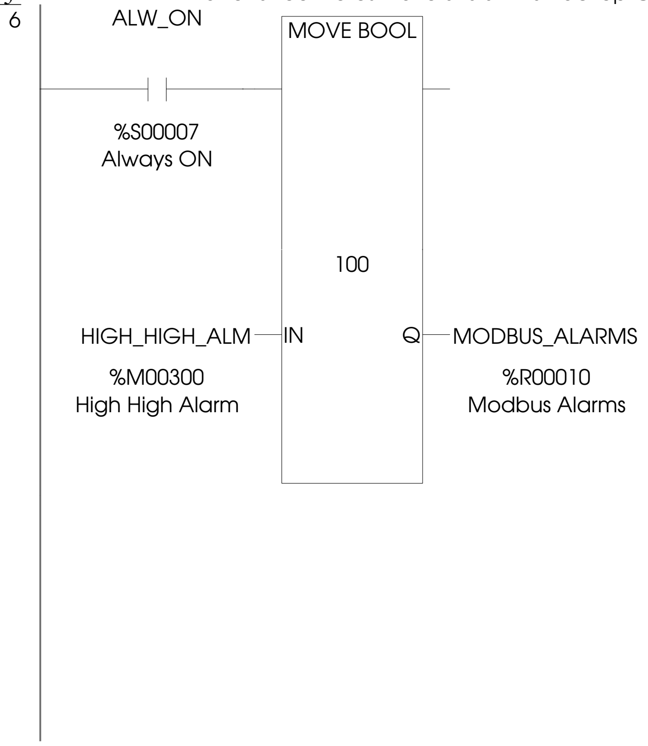
1 Presets Routine
Move 1 to the Sequence Counter

2



Block Name:...MODBUS.blk
Description:.................................... Control Logic for the Modbus RTU Communications Data.
Block Type:..Ladder


1
Generator Modbus RTU Slave Interface
40001 - Generator Sequence Number
2
ALW_ON
%S00007
Always ON
MOVE BOOL
48
SEL_AUTO
%I00001
Selector Switch Auto
IN
Q
MODBUS_INPUTS
%R00002
Modbus Digital Inputs
3
ALW_ON
%S00007
Always ON
MOVE BOOL
48
AUTO_IND
%Q00001
Controls in Auto Indicator
IN
Q
MODBUS_OUTPUTS
%R00005
Modbus Digital Outputs
4
ALW_ON
%S00007
Always ON
MOVE BOOL
16
GEN_OFF
%M00101
Generator OFF
IN
Q
MODBUS_STATUS...
%R00008
Modbus Status 1
5
ALW_ON
%S00007
Always ON
MOVE BOOL
16
GEN_RUNNING
%M00201
Generator Running
IN
Q
MODBUS_STATUS...
%R00009
Modbus Status 2


6
ALW_ON
%S00007
Always ON
MOVE BOOL
100
HIGH_HIGH_ALM
%M00300
High High Alarm
IN
Q
MODBUS_ALARMS
%R00010
Modbus Alarms

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
SEL_AUTO	BIT	1	%I00001	Selector Switch Auto		Global	R		
SEL_TEST	BIT	1	%I00002	Selector Switch Test		Global	R		
SEL_MAN	BIT	1	%I00003	Selector Switch Manual		Global	R		
EM_STOP_PB	BIT	1	%I00004	Emergency Stop PB		Global	R		
LAMP_TEST_PB	BIT	1	%I00005	Lamp Test PB		Global	R		
ALM_RESET_PB	BIT	1	%I00006	Alarm Reset PB		Global	R		
ALM_MUTE_PB	BIT	1	%I00007	Alarm Mute PB		Global	R		
MAN_STR_PB	BIT	1	%I00008	Manaul Start PB		Global	R		
MAN_STP_PB	BIT	1	%I00009	Manual Stop PB		Global	R		
MAN_TRF_MAINS_PB	BIT	1	%I00010	Manual Transfer to Mains PB		Global	R		
MAN_TRF_GEN_PB	BIT	1	%I00011	Manual Transfer to Generator PB		Global	R		
SPD_STP_CRK	BIT	1	%I00017	Crank Cutout Relay		Global	R		
SPD_UNDER	BIT	1	%I00018	Under Speed Relay		Global	R		
SPD_OVER	BIT	1	%I00019	Over Speed Relay		Global	R		
VOLTS_UNDER	BIT	1	%I00020	Under Voltage Relay		Global	R		
VOLTS_OVER	BIT	1	%I00021	Over Voltage Relay		Global	R		
ALT_TEMP	BIT	1	%I00022	Alternator High Temperature Relay		Global	R		
GEN_CB_TRIP	BIT	1	%I00023	Generator CB Tripped		Global	R		
MEN_FLT	BIT	1	%I00024	MEN Fault Relay		Global	R		
BAT_CHG_AC	BIT	1	%I00025	Battery Charger AC Relay		Global	R		
BAT_CONT_LOW_V	BIT	1	%I00026	Control Battery Charger Low Voltage		Global	R		
BAT_STR_LOW_V	BIT	1	%I00027	Start Battery Charger Low Voltage		Global	R		
MAINS_FAILED	BIT	1	%I00033	BCC Mains Failed		Global	R		
MAINS_ATS_CLS	BIT	1	%I00034	BCC Mains ATS Closed		Global	R		
GEN_ATS_CLS	BIT	1	%I00035	BCC Generator ATS Closed		Global	R		
REM_STR	BIT	1	%I00036	BCC Remote Start		Global	R		
REM_STP	BIT	1	%I00037	BCC Remote Stop		Global	R		
OIL_P_LOW_SD	BIT	1	%I00041	Low Oil Pressure Shutdown		Global	R		
OIL_P_LOW_W	BIT	1	%I00042	Low Oil Pressure Warning		Global	R		
ENG_T_HI_SD	BIT	1	%I00043	High Engine Temperature Shutdown		Global	R		
ENG_T_HI_W	BIT	1	%I00044	High Engine Temperature Warning		Global	R		
RAD_WATER_LOW	BIT	1	%I00045	Low Radiator Water Level		Global	R		
FUEL_LEV_LOW	BIT	1	%I00046	Low Fuel Level		Global	R		
FUEL_LEV_EMPTY	BIT	1	%I00047	Fuel Empty		Global	R		
CAN_DOORS_OPEN	BIT	1	%I00048	Canopy Doors Open		Global	R		
STEP_1	BIT	1	%M00001	Step Sequence No.1		Global			
STEP_2_E	BIT	1	%M00002	Step Sequence No.2		Global			
STEP_3	BIT	1	%M00003	Step Sequence No.3		Global			
STEP_4	BIT	1	%M00004	Step Sequence No.4		Global			
STEP_5	BIT	1	%M00005	Step Sequence No.5		Global			
STEP_6	BIT	1	%M00006	Step Sequence No.6		Global			
STEP_7	BIT	1	%M00007	Step Sequence No.7		Global			
STEP_8	BIT	1	%M00008	Step Sequence No.8		Global			
STEP_9	BIT	1	%M00009	Step Sequence No.9		Global			
STEP_2_GE	BIT	1	%M00022	Step Sequence No.2 GE		Global			
GEN_OFF	BIT	1	%M00101	Generator OFF		Global			
AUTO_TEST_STR	BIT	1	%M00102	Auto _Test Start / Stop		Global			
REMOTE_STR	BIT	1	%M00103	Remote Start		Global			
MAINS_FAIL_STP	BIT	1	%M00104	Mains Failed Stop		Global			
REMOTE_STP	BIT	1	%M00105	Remote Stop		Global			
TEST_STR	BIT	1	%M00106	Test Start		Global			
TEST_STP	BIT	1	%M00107	Test Stop		Global			
GEN_RUN_OFF	BIT	1	%M00108	Generator Run Off		Global			
ENABLE_OFFLINE	BIT	1	%M00109	Enable Generator to go Offline		Global			
HH_ALM_OS1	BIT	1	%M00110	High High Alarm One Shot		Global			
H_ALM_OS1	BIT	1	%M00111	High Alarm One Shot		Global			
H_ALM_OS2	BIT	1	%M00112	High Alarm One Shot		Global			
M_ALM_OS1	BIT	1	%M00113	Medium Alarm One Shot		Global			
M_ALM_OS2	BIT	1	%M00114	Medium Alarm One Shot		Global			
M_ATS_ALM_OS1	BIT	1	%M00115	Mains ATS Alarm One Shot		Global			
M_ATS_ALM_OS2	BIT	1	%M00116	Mains ATS Alarm One Shot		Global			
GEN_RUNNING	BIT	1	%M00201	Generator Running		Global			
FAIL_STR_TM	BIT	1	%M00202	Failed to Start Time		Global			
FAIL_STR_DLY	BIT	1	%M00203	Failed to Start Pulse Delay		Global			
FAIL_STR_CNT	BIT	1	%M00204	Failed to Start Counter		Global			
CRK_CUTOUT	BIT	1	%M00205	Generator Crank Cutout		Global			
ENB_STR_DLY	BIT	1	%M00206	Enable Start Delay for Alarms		Global			
OIL_P_DLY	BIT	1	%M00207	Oil Pressure Alarm Delay		Global			
STR_UP_DLY	BIT	1	%M00208	Startup Alarm Delay		Global			

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
M_ATS_OPN_1	BIT	1	%M00209	Mains ATS Open Command		Global			
G_ATS_CLS_1	BIT	1	%M00210	Generator ATS Close Command		Global			
G_ATS_OPN_1	BIT	1	%M00211	Generator ATS Open Command		Global			
M_ATS_CLS_1	BIT	1	%M00212	Mains ATS Close Command		Global			
M_ATS_CLS_ENB	BIT	1	%M00213	Mains ATS Close Enable		Global			
G_ATS_CLS_ENB	BIT	1	%M00214	Generator ATS Close Enable		Global			
HIGH_HIGH_ALM	BIT	1	%M00300	High High Alarm		Global			
EM_STP_ALM	BIT	1	%M00301	Emergency Stop Alarm		Global			
MEN_ALM	BIT	1	%M00302	MEN Alarm		Global			
OIL_P_SD_ALM	BIT	1	%M00303	Low Oil Pressure Shutdown Alarm		Global			
ENG_T_SD_ALM	BIT	1	%M00304	High Engine Temperature Shutdown Alarm		Global			
RAD_WATER_LOW_ALM	BIT	1	%M00305	Low Radiator Water Level Alarm		Global			
SPD_OVER_ALM	BIT	1	%M00306	Over Speed Alarm		Global			
RAD_WATER_LOW_DLY	BIT	1	%M00315	Radiator Water Level Low Delay		Global			
SPD_OVER_DLY	BIT	1	%M00316	Over Speed Delay Timer		Global	R		
HIGH_ALM	BIT	1	%M00320	High Alarm		Global			
SPD_UNDER_ALM	BIT	1	%M00321	Under Speed Alarm		Global			
VOLTS_UNDER_ALM	BIT	1	%M00322	Alternator Voltage Under Alarm		Global			
VOLTS_OVER_ALM	BIT	1	%M00323	Alternator Voltage Over Alarm		Global			
GEN_CB_TRIP_ALM	BIT	1	%M00324	Generator CB Tripped Alarm		Global			
ALT_TEMP_ALM	BIT	1	%M00325	Alternator High Temperature Alarm		Global			
SPD_UNDER_DLY	BIT	1	%M00331	Under Speed Alarm Delay		Global			
VOLTS_UNDER_DLY	BIT	1	%M00332	Under Voltage Alarm Delay		Global			
VOLTS_OVER_DLY	BIT	1	%M00333	Over Voltage Alarm Delay		Global			
MEDIUM_ALM	BIT	1	%M00340	Medium Alarm		Global			
FUEL_LEV_EMPTY_ALM	BIT	1	%M00341	Fuel Empty Alarm		Global			
FAIL_TO_STR_ALM	BIT	1	%M00342	Fail to Start Alarm		Global			
FUEL_LEV_EMPTY_DLY	BIT	1	%M00351	Fuel Level Empty Alarm Delay		Global			
LOW_ALM	BIT	1	%M00360	Low Alarm		Global			
OIL_P_W_ALM	BIT	1	%M00361	Low Oil Pressure Warning Alarm		Global			
ENG_T_W_ALM	BIT	1	%M00362	High Engine Temperature Warning Alarm		Global			
FUEL_LEV_LOW_ALM	BIT	1	%M00363	Low Fuel Level Alarm		Global			
BAT_CHG_AC_ALM	BIT	1	%M00364	Battery Charger AC Alarm		Global			
BAT_CONT_LOW_V_ALM	BIT	1	%M00365	Control Battery Charger Low Voltage Alarm		Global			
BAT_STR_LOW_V_ALM	BIT	1	%M00366	Start Battery Charger Low Voltage Alarm		Global			
FUEL_LEV_LOW_DLY	BIT	1	%M00373	Fuel Level Low Alarm Delay		Global	R		
BAT_CHG_AC_DLY	BIT	1	%M00374	Battery Charger AC Failure Delay		Global	R		
BAT_CONT_LOW_V_DLY	BIT	1	%M00375	Control Battery Low Voltage Delay		Global	R		
BAT_STR_LOW_V_DLY	BIT	1	%M00376	Start Battery Low Voltage Delay		Global	R		
MAINS_ATS_OPN_ALM	BIT	1	%M00381	Mains ATS Failed to Open Alarm		Global			
MAINS_ATS_CLS_ALM	BIT	1	%M00382	Mains ATS Failed to Close Alarm		Global			
GEN_ATS_OPN_ALM	BIT	1	%M00383	Generator ATS Failed to Open Alarm		Global			
GEN_ATS_CLS_ALM	BIT	1	%M00384	Generator ATS Failed to Close Alarm		Global			
NEW_ALM	BIT	1	%M00400	New Alarm		Global	R		
%M00401	BIT	1	%M00401	**No Description**		Global	R		
%M00402	BIT	1	%M00402	**No Description**		Global	R		
%M00403	BIT	1	%M00403	**No Description**		Global	R		
%M00404	BIT	1	%M00404	**No Description**		Global	R		
%M00405	BIT	1	%M00405	**No Description**		Global	R		
%M00406	BIT	1	%M00406	**No Description**		Global	R		
%M00421	BIT	1	%M00421	**No Description**		Global	R		
%M00422	BIT	1	%M00422	**No Description**		Global	R		
%M00423	BIT	1	%M00423	**No Description**		Global	R		
%M00424	BIT	1	%M00424	**No Description**		Global	R		
%M00425	BIT	1	%M00425	**No Description**		Global	R		

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
%M00441	BIT	1	%M00441	**No Description**		Global	R		
%M00442	BIT	1	%M00442	**No Description**		Global	R		
%M00461	BIT	1	%M00461	**No Description**		Global	R		
%M00462	BIT	1	%M00462	**No Description**		Global	R		
%M00463	BIT	1	%M00463	**No Description**		Global	R		
%M00464	BIT	1	%M00464	**No Description**		Global	R		
%M00465	BIT	1	%M00465	**No Description**		Global	R		
%M00466	BIT	1	%M00466	**No Description**		Global	R		
%M00481	BIT	1	%M00481	**No Description**		Global	R		
%M00482	BIT	1	%M00482	**No Description**		Global	R		
%M00483	BIT	1	%M00483	**No Description**		Global	R		
%M00484	BIT	1	%M00484	**No Description**		Global	R		
AUTO_IND	BIT	1	%Q00001	Controls in Auto Indicator		Global			
TEST_IND	BIT	1	%Q00002	Controls in Test Indicator		Global			
MAN_IND	BIT	1	%Q00003	Controls in Manual Indicator		Global			
REM_STR_IND	BIT	1	%Q00004	Remote Start Indicator		Global			
MAINS_AVAIL_IND	BIT	1	%Q00005	Mains Available Indicator		Global			
MAINS_CON_IND	BIT	1	%Q00006	Mains Connected Indicator		Global			
GEN_RUN_IND	BIT	1	%Q00007	Generator Running Indicator		Global			
GEN_CON_IND	BIT	1	%Q00008	Generator Connected Indicated		Global			
MAINS_FAILED_IND	BIT	1	%Q00009	Mains Failed Indicator		Global			
EM_STOP_IND	BIT	1	%Q00010	Emergency Stop Indicator		Global			
MEN_FLT_IND	BIT	1	%Q00011	MEN Fault Indicator		Global			
OIL_P_LOW_SD_IND	BIT	1	%Q00012	Low Oil Pressure Shutdown Indicator		Global			
OIL_P_LOW_W_IND	BIT	1	%Q00013	Low Oil Pressure Warning Indicator		Global			
ENG_T_HI_SD_IND	BIT	1	%Q00014	High Engine Temperature Shutdown Indicator		Global			
ENG_T_HI_W_IND	BIT	1	%Q00015	High Engine Temperature Warning Indicator		Global			
RAD_WATER_LOW_IND	BIT	1	%Q00016	Low Radiator Water Level Indicator		Global			
FUEL_LEV_EMPTY_IND	BIT	1	%Q00017	Fuel Empty Indicator		Global			
FUEL_LEV_LOW_IND	BIT	1	%Q00018	Low Fuel Level Indicator		Global			
SPD_OVER_IND	BIT	1	%Q00019	Over Speed Indicator		Global			
SPD_UNDER_IND	BIT	1	%Q00020	Under Speed Indicator		Global			
FAIL_TO_STR_IND	BIT	1	%Q00021	Fail to Start Indicator		Global			
VOLTS_UNDER_IND	BIT	1	%Q00022	Alternator Voltage Under Indicator		Global			
VOLTS_OVER_IND	BIT	1	%Q00023	Alternator Voltage Over Indicator		Global			
ALT_TEMP_IND	BIT	1	%Q00024	Alternator High Temperature Indicator		Global			
GEN_CB_TRIP_IND	BIT	1	%Q00025	Generator CB Tripped Indicator		Global			
BAT_CHG_AC_IND	BIT	1	%Q00026	Battery Charger AC Indicator		Global			
BAT_CONT_LOW_V_IND	BIT	1	%Q00027	Control Battery Charger Low Voltage Indicator		Global			
BAT_STR_LOW_V_IND	BIT	1	%Q00028	Start Battery Charger Low Voltage Indicator		Global			
CAN_DOORS_OPEN_IND	BIT	1	%Q00029	Canopy Doors Open Indicator		Global			
MAINS_ATS_OPN_CMD	BIT	1	%Q00033	BCC Mains ATS Open Command		Global			
GEN_ATS_CLS_CMD	BIT	1	%Q00034	BCC Generator ATS Close Command		Global			
GEN_SD_ALM	BIT	1	%Q00035	BCC Generator Shutdown Alarm		Global			
GEN_W_ALM	BIT	1	%Q00036	BCC Generator Warning Alarm		Global			
FUEL_LOW	BIT	1	%Q00037	BCC Low Fuel		Global			
GEN_RUN	BIT	1	%Q00038	BCC Generator Running		Global			
GEN_CON	BIT	1	%Q00039	BCC Generator Connected		Global			
SMR	BIT	1	%Q00040	Starter Motor Relay		Global			
GCR	BIT	1	%Q00041	Governor Control Relay		Global			
AAR	BIT	1	%Q00042	Audible Alarm Relay		Global			
SDAR	BIT	1	%Q00043	Generator Shunt Trip Relay		Global			
SEQ_CNT	WORD	1	%R00001	Sequence Counter		Global	R		
MODBUS_INPUTS	WORD	1	%R00002	Modbus Digital Inputs		Global	R		
MODBUS_OUTPUTS	WORD	1	%R00005	Modbus Digital Outputs		Global	R		
MODBUS_STATUS_1	WORD	1	%R00008	Modbus Status 1		Global	R		
MODBUS_STATUS_2	WORD	1	%R00009	Modbus Status 2		Global	R		
MODBUS_ALARMS	WORD	1	%R00010	Modbus Alarms		Global	R		
%R00100	WORD	3	%R00100	**No Description**		Global	R		
%R00103	WORD	3	%R00103	**No Description**		Global	R		

GLOBAL VARIABLES

Name	Type	Len	Address	Description	Stored Val	Scope	Ret	Ovr	Ext
%R00106	WORD	3	%R00106	**No Description**		Global	R		
%R00109	WORD	3	%R00109	**No Description**		Global	R		
%R00112	WORD	3	%R00112	**No Description**		Global	R		
%R00115	WORD	3	%R00115	**No Description**		Global	R		
%R00118	WORD	3	%R00118	**No Description**		Global	R		
%R00121	WORD	3	%R00121	**No Description**		Global	R		
%R00124	WORD	3	%R00124	**No Description**		Global	R		
%R00127	WORD	3	%R00127	**No Description**		Global	R		
%R00130	WORD	3	%R00130	**No Description**		Global	R		
%R00200	WORD	3	%R00200	**No Description**		Global	R		
%R00203	WORD	3	%R00203	**No Description**		Global	R		
%R00206	WORD	3	%R00206	**No Description**		Global	R		
%R00209	WORD	3	%R00209	**No Description**		Global	R		
%R00212	WORD	3	%R00212	**No Description**		Global	R		
%R00215	WORD	3	%R00215	**No Description**		Global	R		
%R00218	WORD	3	%R00218	**No Description**		Global	R		
%R00221	WORD	3	%R00221	**No Description**		Global	R		
%R00224	WORD	3	%R00224	**No Description**		Global	R		
%R00227	WORD	3	%R00227	**No Description**		Global	R		
%R00230	WORD	3	%R00230	**No Description**		Global	R		
%R00300	WORD	3	%R00300	**No Description**		Global	R		
%R00303	WORD	3	%R00303	**No Description**		Global	R		
%R00306	WORD	3	%R00306	**No Description**		Global	R		
%R00309	WORD	3	%R00309	**No Description**		Global	R		
%R00312	WORD	3	%R00312	**No Description**		Global	R		
%R00315	WORD	3	%R00315	**No Description**		Global	R		
%R00318	WORD	3	%R00318	**No Description**		Global	R		
%R00321	WORD	3	%R00321	**No Description**		Global	R		
%R00324	WORD	3	%R00324	**No Description**		Global	R		
%R00327	WORD	3	%R00327	**No Description**		Global	R		
%R00330	WORD	3	%R00330	**No Description**		Global	R		
%R00333	WORD	3	%R00333	**No Description**		Global	R		
%R00336	WORD	3	%R00336	**No Description**		Global	R		
%R00339	WORD	3	%R00339	**No Description**		Global	R		
FST_SCN	BIT	1	%S00001	Set to 1 when the current sweep is the first sweep		Global	R		
LST_SCAN	BIT	1	%S00002	Reset from 1 to 0 when the current sweep is the last sweep		Global	R		
T_10MS	BIT	1	%S00003	0.01 Second Timer Contact		Global	R		
T_100MS	BIT	1	%S00004	0.1 Second Timer Contact		Global	R		
T_1S	BIT	1	%S00005	1 Second Timer Contact		Global	R		
T_1M	BIT	1	%S00006	1 Minute Timer Contact		Global	R		
ALW_ON	BIT	1	%S00007	Always ON		Global	R		
ALW_OFF	BIT	1	%S00008	Always OFF		Global	R		
PLC_BAT	BIT	1	%S00014	Set to indicate a bad battery in the CPU		Global	R		
%R00133	WORD	3	%R00133	**No Description**		Global	R		
%R00136	WORD	3	%R00136	**No Description**		Global	R		

GLOBAL SUMMARY OF HIGHEST USED REFERENCE ADDRESSES

MEMORY AREA	ADDRESS
Analog Input (%AI)	None Used
Analog Output (%AQ)	None Used
Input (%I)	%I00048
Output (%Q)	%Q00048
Internal Memory (%M)	%M00484
Register (%R)	%R00341
Genius Global (%G)	None Used
Genius Global (%GA)	None Used
Genius Global (%GB)	None Used
Genius Global (%GC)	None Used
Genius Global (%GD)	None Used
Genius Global (%GE)	None Used
Temporary (%T)	None Used
System (%S)	%S00007
System (%SA)	None Used
System (%SB)	None Used
System (%SC)	None Used
Program (%P)	None Used

Table of Contents

PROJECTS – ENGINEERING

Sewerage System Performance Improvements
Backup Diesel Generators for Pump Stations

FUNCTIONAL SITE TESTS FOR GENERATOR, AUTOMATIC TRANSFER SWITCH, AND RTU

Prepared by	:	Alan Mooney Telephone - 07 3403 3356 Facsimile - 07 3403 0205
Document ID	:	Genset Functional Tests
Date of Issue	:	**June 2003**
Revision	:	**Rev 1**

Actions are shown in RED

1 MANUAL MODE FUNCTIONAL TESTS

1.1 Manual Mode Start

Turn the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.
Press the MANUAL START push button to start the generator.
The generator set is allowed 3 attempts to start.
If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.
Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.
Once the generator is running there is a 30 second warm up time before it is ready to accept load.
RESULTS: PASS/FAIL_____________NOTES_________________________________

1.2 Stopping the generator in the Manual Mode.

Press the MANUAL STOP push button.
If the generator is still GEN ATS operation. The MANUAL TRANSFER TO MAINS is initiated.
When the GEN ATS is Open, the generator will enter the cool down time of 1 second.
After the cool down time, the generator will shut down.
RESULTS: PASS/FAIL_____________NOTES_________________________________

2 TEST MODE FUNCTIONAL TESTS

2.1 Test Mode Start – and test of Manual Mode interruption

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.
The generator shall begin to crank.
Change the selector MAN while the generator is operating on TEST: to test that the system shall change to MANUAL TRANSFER TO GEN.
Press the MANUAL STOP push button.
RESULTS: PASS/FAIL_____________NOTES_________________________________

2.2 Continue Test

Select TEST operation again by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.
The generator shall begin to crank.
Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.
Once the generator is running there is a 30 second warm up time before it is ready to accept load.
After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close
RESULTS: PASS/FAIL_____________NOTES_________________________________

2.3 Stopping Generator In The Test Mode - To Test Mains Failure /Genset Restart During Shutdown

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO or OFF position.

The GEN ATS shall Open and the MAINS ATS shall Close

When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

During this time turn off the Mains to the site

When Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

RESULTS: PASS/FAIL_____________NOTES_________________________________

2.4 Stopping generator in the Test Mode.

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO or OFF position.

The GEN ATS shall Open and the MAINS ATS shall Close

After the cool down time of 5 minutes, the generator will shut down.

RESULTS: PASS/FAIL_____________NOTES_________________________________

2.5 Test Mode Selected with genset unavailable (fault or GEN CB off).

Make GENSET unavailable

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.

Observe results – Genset discussion of preferred results (unit should not start?)

RESULTS: PASS/FAIL_____________NOTES_________________________________

3 AUTOMATIC MODE FUNCTIONAL TESTS

3.1 Automatic Start

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

Turn off the Mains to the switchboard.

The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.

Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

Once the generator is running there is a 30 second warm up time before it is ready to accept load.

After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close.

RESULTS: PASS/FAIL_____________NOTES_________________________________

3.2 Stopping the generator in the Auto Mode –and testing genset restart for mains failure during cool-down.

Turn on the Mains to the switchboard
The Phase Failure Relay from the clients switch board shall give a Stop Signal for the generator
There is a 2 minute proving time for the Phase Failure Relay.
After the 2 minute proving time the GEN ATS shall Open and the MAINS ATS shall Close
When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

During this time turn off the Mains to the site
When Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.3 Stopping the generator in the Auto Mode - continued.

Turn on the Mains to the switchboard
The Phase Failure Relay from the clients switch board shall give a Stop Signal for the generator
There is a 2 minute proving time for the Phase Failure Relay.
After the 2 minute proving time the GEN ATS shall Open and the MAINS ATS shall Close
When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.
After the cool down time, the generator will shut down.
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.4 Automatic ATS Transfer To Genset- Mains ATS Failure

Disable MAINS ATS CB
Restart the generator in Auto by turning off the Mains
The MAINS ATS will fail to Open: After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.
The system shall then return back to MAINS ATS operation.
Stop the generator using the Stop button
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.5 Automatic ATS Transfer - Gen ATS Failure

Re-enable the MAINS ATS CB
Disable GEN ATS CB
Restart the generator in Auto by turning off the Mains
The GEN ATS will fail to Close: After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.
The system shall return back to MAINS ATS operation.
Stop the generator using the Stop button
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.6 Automatic ATS Transfer To Mains - Gen ATS Failure

Disable GEN ATS CB
Restart the generator in Auto by turning off the Mains
The GEN ATS will fail to Open.
After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.
The system shall return back to GEN ATS operation.
Stop the generator using the Stop button
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.7 Automatic ATS Transfer To Mains - Mains ATS Failure

Re-enable the GEN ATS CB
Disable MAINS ATS CB
Restart the generator in Auto by turning off the Mains
The MAINS ATS will fail to Close.
After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.
The system shall return back to GEN ATS operation.
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.8 Running in Auto and umbilical looses connection.

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.
Turn off the Mains to the switchboard.
The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.
Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.
Once the generator is running there is a 30 second warm up time before it is ready to accept load.
After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close.
Remove umbilical plug
Observe results – Genset discussion of preferred results (ATS returns to MAINS?)
RESULTS: PASS/FAIL_____________NOTES_________________________________

3.9 Running in Auto and genset trips or faults.

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.
Turn off the Mains to the switchboard.
The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.
Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.
Once the generator is running there is a 30 second warm up time before it is ready to accept load.
After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close.
Cause Genset trip or fault
Observe results – Genset discussion of preferred results (ATS returns to MAINS?)
RESULTS: PASS/FAIL_____________NOTES_________________________________

4 REMOTE START/STOP TESTS

4.1 Remote start command.

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

Initiate a Remote Start Command from the BW Control Room

Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

Once the generator is running there is a 30 second warm up time before it is ready to accept load.

After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close.

RESULTS: PASS/FAIL_____________NOTES_________________________________

4.2 Remote stop command.

Initiate a Remote Start Command from the BW Control Room

The GEN ATS shall Open and the MAINS ATS shall Close

When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

After the cool down time, the generator will shut down.

RESULTS: PASS/FAIL_____________NOTES_________________________________

4.3 Remote Start with genset unavailable.

Make GENSET unavailable

Initiate a Remote Start Command from the BW Control Room

Observe results – Genset discussion of preferred results (unit should not transfer to MAINS?)

RESULTS: PASS/FAIL_____________NOTES_________________________________

4.4 Remote Stop with when running with MAINS not available unavailable.

Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

Turn off the Mains to the switchboard.

The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.

Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

Once the generator is running there is a 30 second warm up time before it is ready to accept load.

After the warm up time has expired, the MAINS ATS shall Open and the GEN ATS shall Close.

Initiate a Remote Start Command from the BW Control Room

Observe results – Genset discussion of preferred results (unit should not transfer to MAINS?)

RESULTS: PASS/FAIL_____________NOTES_________________________________

5 SPECIFIC PROBLEM CHECKS (Variations to Functional Spec)

5.1 RTU IO and IDTS Alarms

The assumption is that all RTU IO and alarms have been proven by NCS.

5.2 From discussions on Indooroopilly Rd:

If the Genset ATS trips when genset is running - will ATS switch back to Mains?
If the Genset ATS trips when genset is running (medium alarm) - will ATS switch back to Mains?

If the Genset on-board CB trips when genset is running - will ATS switch back to Mains?

If the Mains ATS trips when genset is not running - will the genset start?
Eg Monitor the Mains ATS and allow the Gen ATS to take load when the Mains ATS is tripped. The problem is that genset start is initiated by PFR **above** the ATS.

If Mains trips amd no genset start is initiated (?) and then Remote Start signal is sent will unit start and then transfer to GENSET

Does a Remote start "reset" the tripped ATS CB or provide a "work-around"?

5.3 From M&E:

The remote start (from control room) was sent with the Generator C/B in the off / tripped position.
The generator started and the ATS Switched to generator supply.
The generator continued to run with out supplying the site (C/B was off) and failed to transfer back to the available Energex supply with out a remote stop signal.

5.4 From Contract:

Performance guarantee of not less than 0.8pu at alternator terminals during startup - measure volts drop on start-up of load.

6 FAULTS - TO BE TESTED WHERE REQUIRED

6.1 HIGH HIGH Alarm Operation.

The Generator CB is Opened immediately.
The generator is shut down immediately.

The following alarms will initiate a HIGH HIGH Alarm condition :-
Emergency Stop Fault
MEN Fault
Low Oil Pressure Shutdown Fault, 10 Seconds Startup Delay
High Engine Temperature Shutdown Fault, 30 second Startup Delay
Low Radiator Level Fault, 5 Second Delay
Over Speed Fault

6.2 HIGH Alarm Operation

The Generator CB is Opened immediately.
Once the generator circuit breaker is opened, the generator will run through its normal cool down time and shut down.

The following alarms will initiate a HIGH Alarm condition:-
Generator Under Speed Fault, 5 Second Delay
Alternator Under Voltage Fault, 5 Second Delay
Alternator Over Voltage Fault, 5 Second Delay
Generator CB Tripped Fault
Alternator High Temperature Fault, 30 Second Startup Delay

6.3 MEDIUM Alarm Operation.

A Normal Shutdown shall be Initiated.
If the GEN ATS does not Open then the Generator CB is Opened.

The following alarms will initiate a MEDIUM Alarm condition :-
Fuel Empty Level Fault, 5 Second Delay
Fail To Start Fault, 3 Attempts

6.4 LOW Alarm Operation.

A Warning has occurred on the generator. The generator will not shut down for this level of alarm.

The following alarms will initiate a LOW Alarm condition :-
Low Oil Pressure Warning Alarm, 10 Seconds Startup Delay
High Engine Temperature Warning Alarm, 30 Second Startup Delay
Fuel Low Level Alarm, 5 Second Delay
Battery Charger AC Supply Failed Alarm, 60 Second Delay
Control Battery Low Volts Alarm, 30 Second Delay
Start Battery Low Volts Alarm, 60 Second Delay

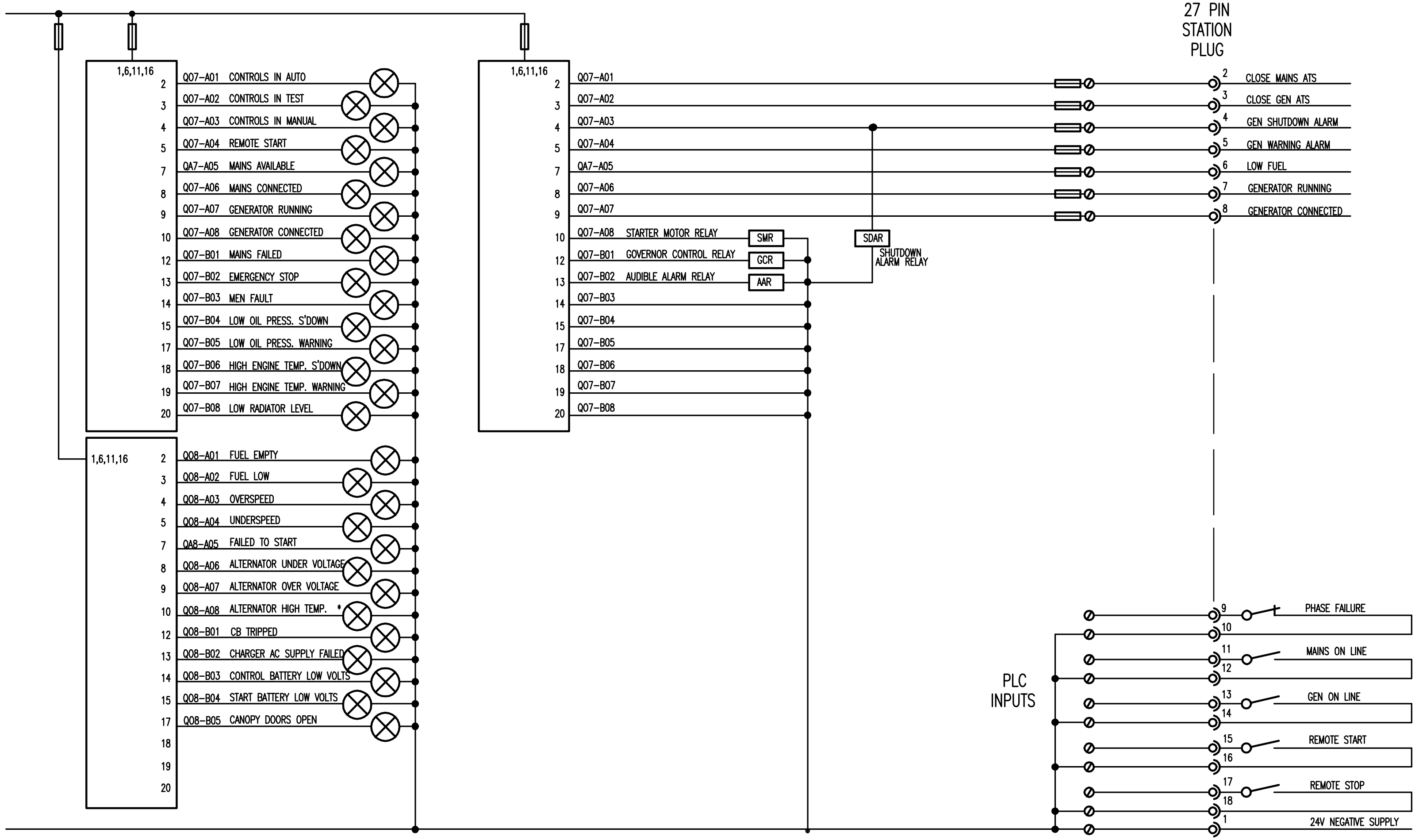
AT A LATER DATE??

3. NON-PERMANENT SITE, MANUAL MODE

3.1. To operate G1 in a Non-Permanent Site Location in MANUAL Mode.
3.2. Connect the generator cables to the site generator CB ensuring the site generator CB is OFF. See BCC procedures.
3.3. A plug with shorting links is required to be installed. It is required to be plugged into the 27 Pin Station Plug.
3.3.1. Pins 11 and 12 are required to be connected. This is to indicate that the Mains ATS is Closed. If they are not connected a MAINS ATS Alarm shall be indicated.
3.4. Select from the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.
3.5. Press the MANUAL START push button to start the generator.
3.6. The generator will begin to crank.
3.6.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.
3.6.2. The generator set is allowed 3 attempts to start.
3.6.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.
3.6.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.
3.6.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.
3.6.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.
3.6.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.
3.7. To connect the generator to the site load.
3.7.1. Manually switch over to the generator supply via the site CB's. See BCC procedures.
3.7.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.
3.8. To disconnect the generator from the site load.
3.8.1. Manually switch over to the mains supply via the site CB's. See BCC procedures.
3.8.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.
3.9. To stop the generator in the MANUAL Mode.
3.9.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.
3.9.2. The generator will enter the cool down time of 1 second.
3.9.3. After the cool down time, the generator will shut down.
3.9.4. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

SP240

Section 7 - Drawings



Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment
0	1.8.03				AS BUILT

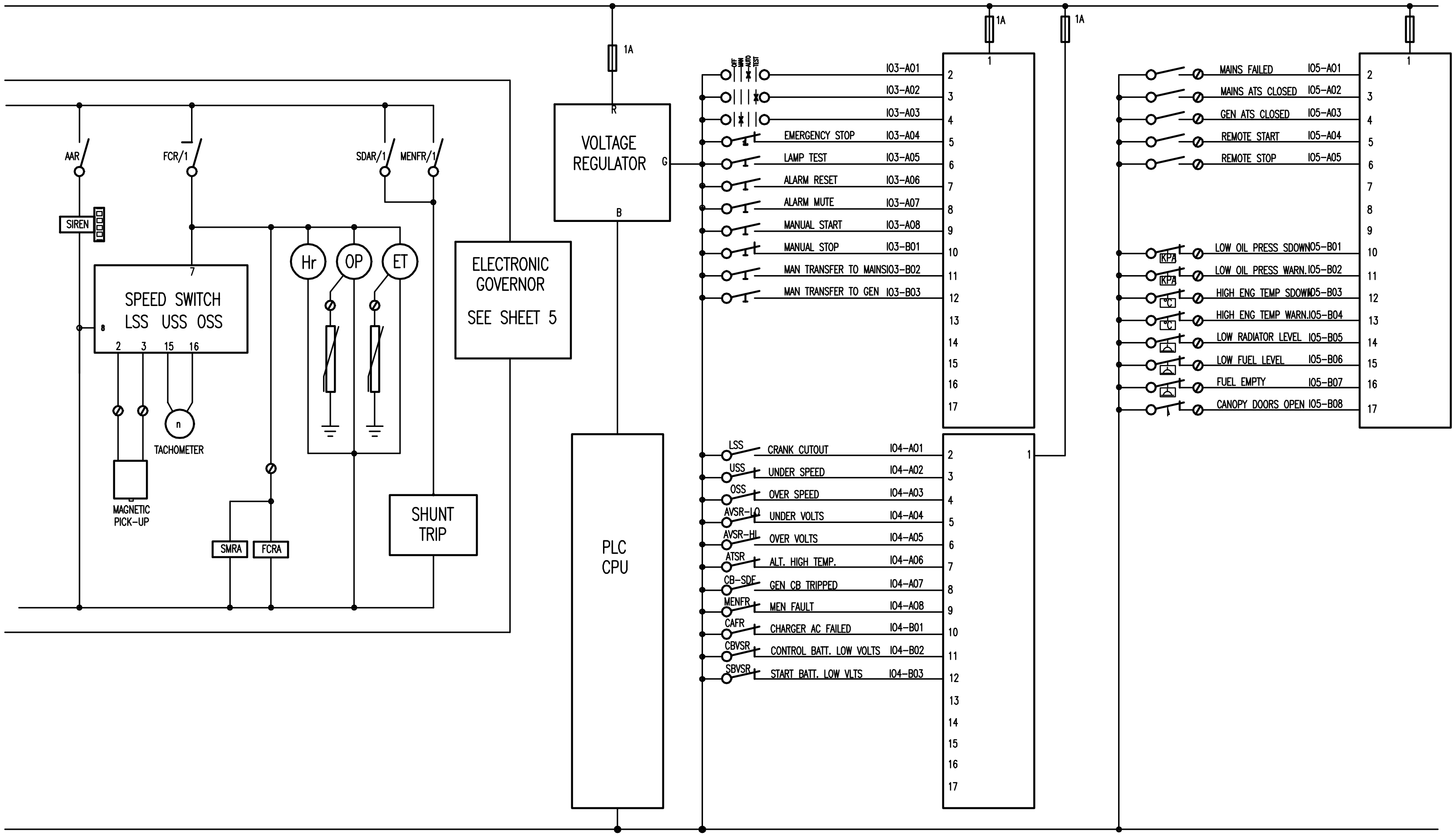
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
Facsimile: (07) 3390 4631

Client: BCC BRISBANE WATER
Project: PUMP STATION BACKUP GENSET

Drafter	Draft Check	Reviewed Project Manager	Approved Project Director
HJR / RSL			
Designed	Design Review	JP	JP

Title: ELECTRICAL SCHEMATIC

Scale	No in set	SE Ref No.	SE Job No	S.E. Drawing No.	AMDT
1:1	5	14291		14291-603	0
Engineer's Ref. No		Client Ref No.			



0	1.8.03				AS BUILT
Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment

POWER EQUIPMENT
Division of Southside Engineering
47 PROPRIETARY ST.
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BRISBANE, QLD. 4173
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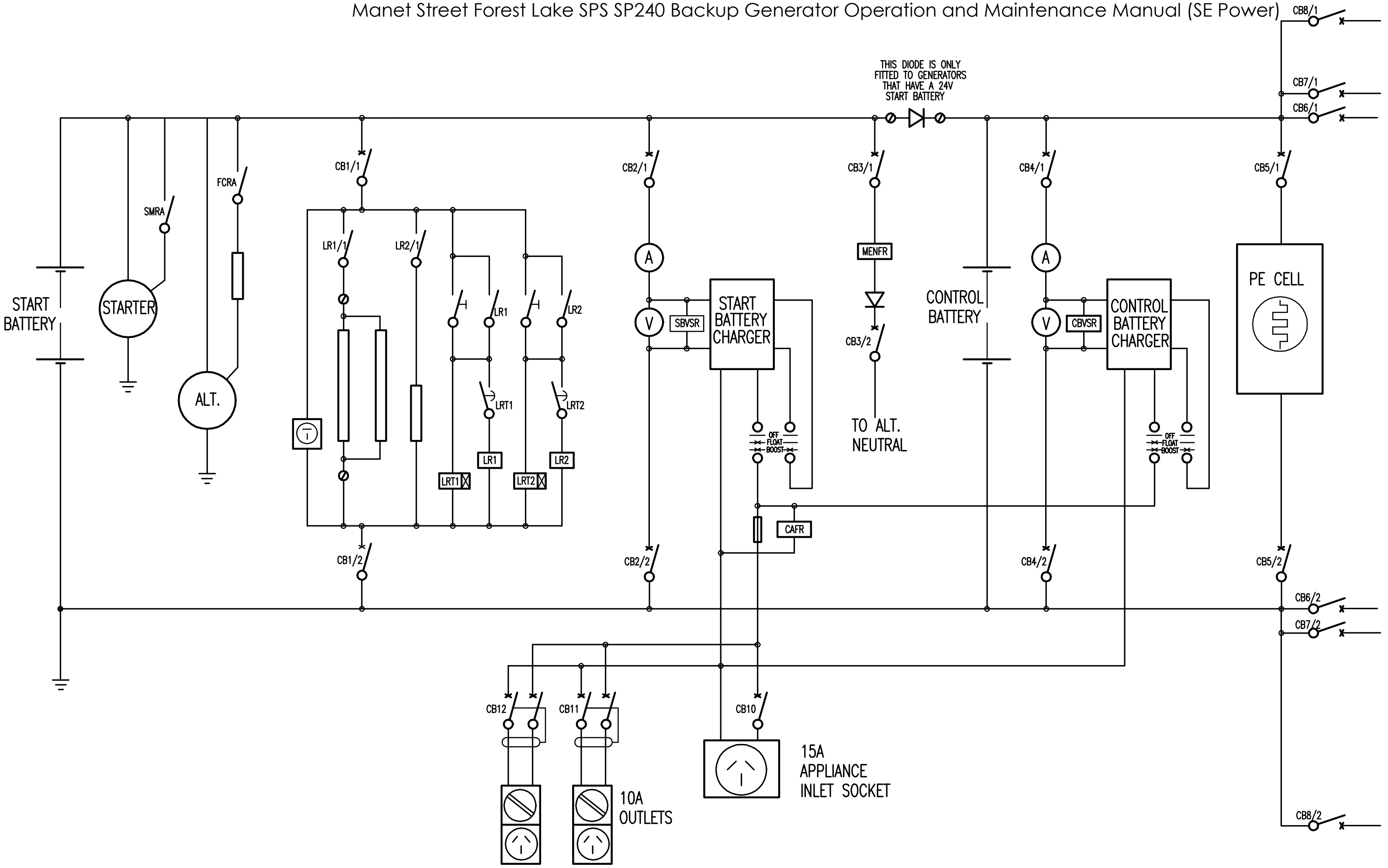
Client
BCC BRISBANE WATER

Project
PUMP STATION BACKUP GENSET

Drafter HJR / RSL	Draft Check	Reviewed Project Manager JP	Approved Project Director JP
Designed HJR	Design Review		

Title
ELECTRICAL SCHEMATIC

Scale 1:1	No in set 5	SE Ref No. 14291	SE Job No	S.E. Drawing No. 14291-602	AMDT 0
Engineer's Ref. No		Client Ref No.			



Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment
0	1.8.03				AS BUILT

POWER EQUIPMENT

Division of Southside Engineering
47 PROPRIETARY ST.
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Designed HJR	Design Review	JP	JP

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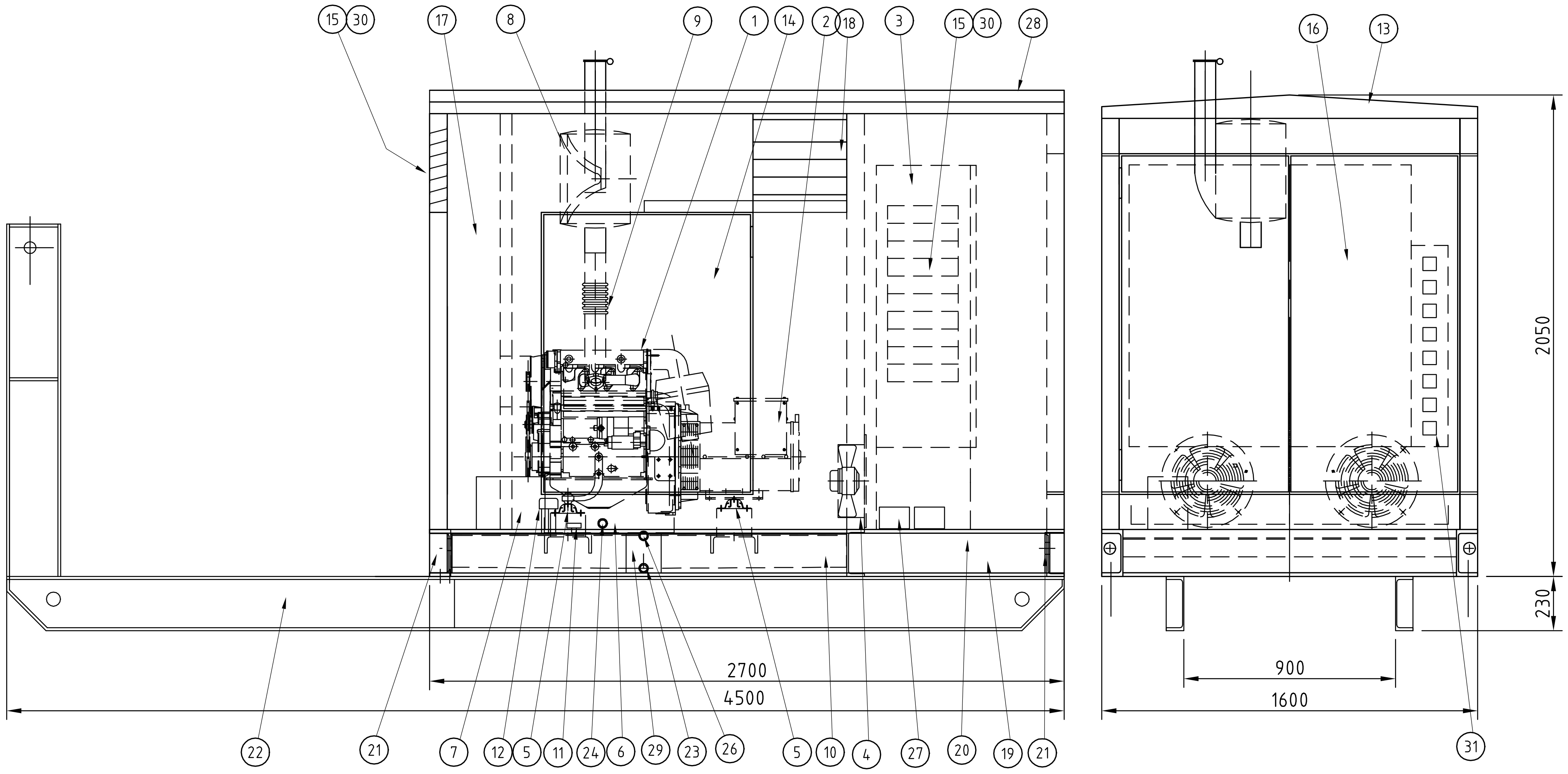
Scale	No in set	SE Ref No.	SE Job No	S.E. Drawing No.	AMDT
1:1	5	14291		14291-601	0
Engineer's Ref. No		Client Ref No.			



LEGEND	
ITEM	DESCRIPTION
1	ENGINE DEUTZ F3L1011
2a	ALTERNATOR STAMFORD BC184F
2b	ALTERNATOR STAMFORD BC184G
3	CONTROL SWITCHBOARD
4	VENTILATION FAN (2)
5	A/V MOUNTS (4 OFF)
6	ENGINE DRIP TRAY
7	STARTING BATTERY (382)
8	EXHAUST SILENCER (COWL TS30PR)
9	EXHAUST PIPE FLEXIBLE Ø75
10	FUEL TANK BASE FRAME 300 L
11	FUEL GAUGE (MECHANICAL)
12	FUEL FILL POINT (INSIDE ENCLOSURE)
13	ACOUSTIC ENCLOSURE (70dbA @ 7m)
14	SIDE ACCESS DOORS (2 OFF)
15	AIR INLET GRILL
16	SWITCHBOARD ACCESS DOOR
17	PLENUM CHAMBER
18	AIR OUTLET GRILL
19	CABLE ENTRY ZONE
20	ANCHOR POINT
21	LIFTING POINTS
22	TRANSPORT SKID
23	FUEL TANK DRAIN (LOCKABLE)
24	OIL DRAIN (LOCKABLE)
26	CATCHMENT TRAY DRAIN
27	CONTROL BATTERIES (2x12 VOLT)
28	BATTERY CHARGING SOLAR PANEL
29	DRAIN POINT LOCKABLE COVER
30	INSECT SCREEN
31	OUTPUT & CONTROL SOCKETS T.B.A.

NOTE
ENCLOSURE COLOUR : MIST GREEN
BASE TANK COLOUR : MIST GREEN
SKID BASE COLOUR : MIST GREEN

APPROVED FOR CONSTRUCTION

SP100 MUSGRAVE ROAD (USING ITEM 2a)
SP240 MANET STREET (USING ITEM 2b)

0	2.6.03				ISSUE FOR CONSTRUCTION
A	2.5.03				APPROVAL ISSUE
Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment

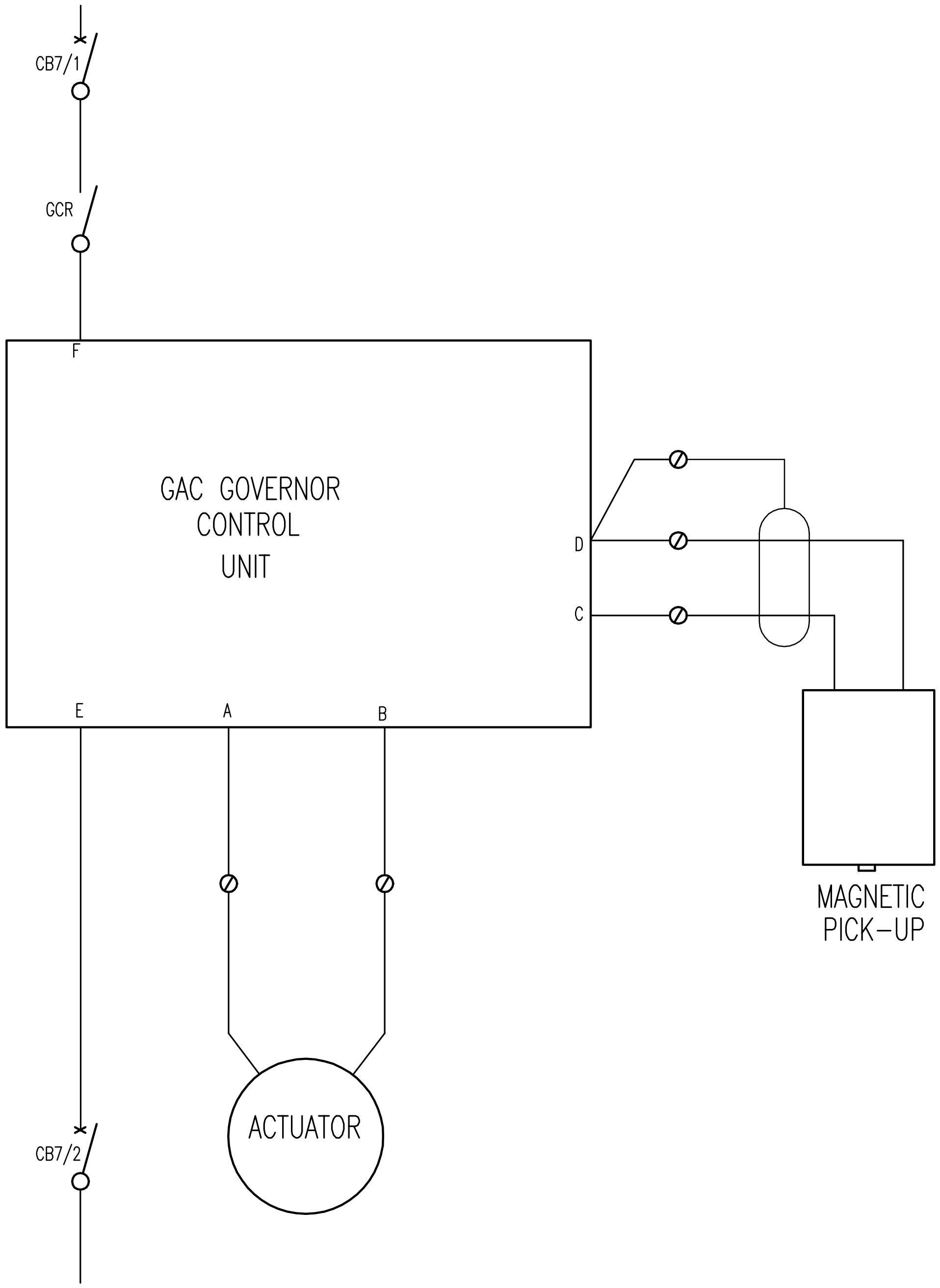
S.E. POWER EQUIPMENT
Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
Facsimile: (07) 3390 4631

Client BRISBANE WATER
Project SEWAGE PUMP STATION BACKUP GENSET

Drafter RSL	Draft Check	Reviewed Project Manager	Approved Project Director
Designed RSL	Design Review		

Title SP100, SP240 ARRANGEMENT

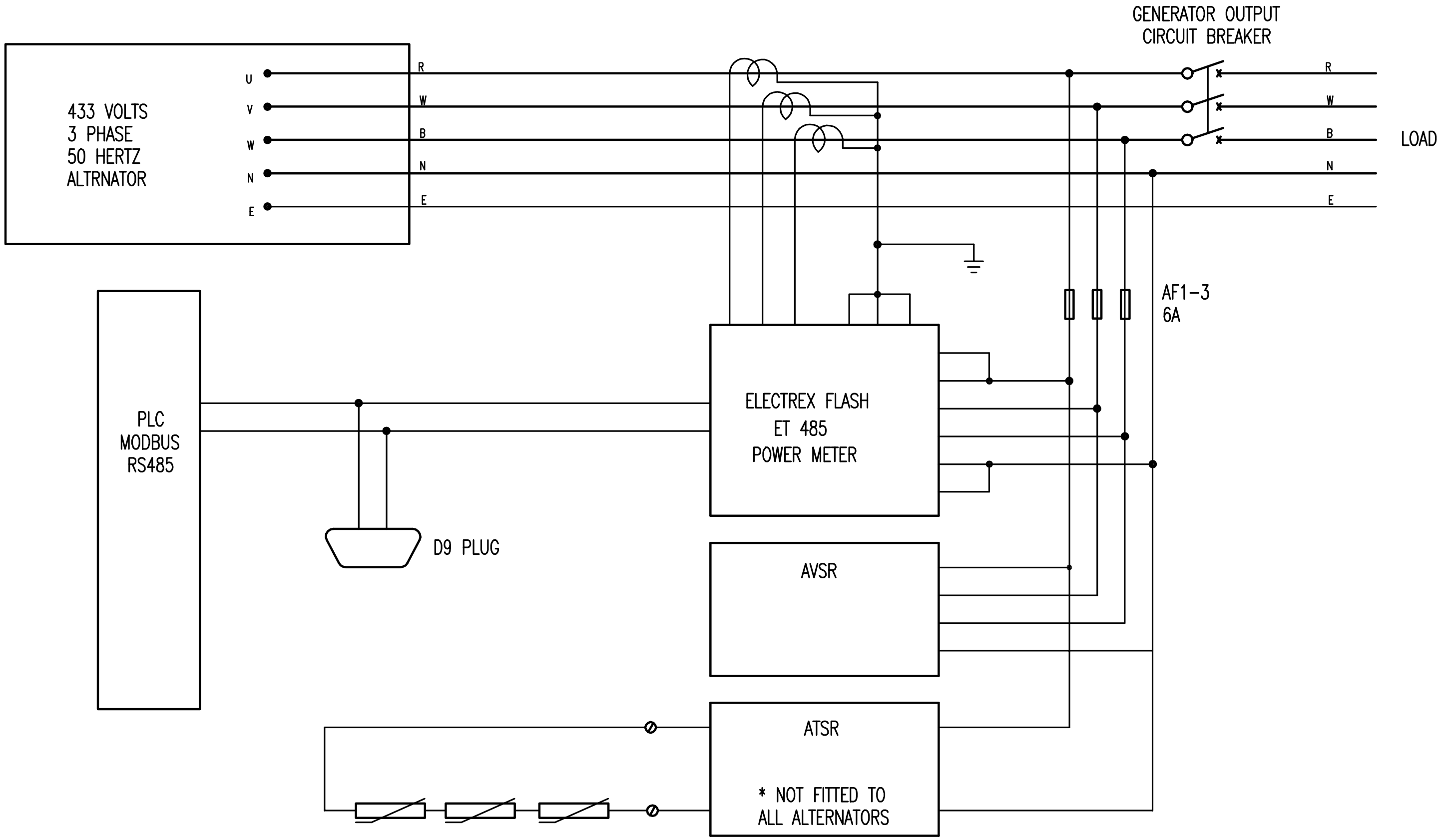
Scale 1:20	No in set 1	SE Ref No. 14291	SE Job No	S.E. Drawing No.	AMDT
Engineer's Ref. No		Client Ref No. 30140-02/03		14291-005	0



0 1.8.03 AS BUILT

EQUIPMENT DATA SHEET	REV No: 0	PROJECT No: 14291-605		DATE: 1.08.03
TITLE: BCC BRISBANE WATER PUMP STATION BACKUP GENSET GAC GOVERNOR CONTROLS		REF:	PREPARED BY: HJR / RSL	CHECKED BY:
		APPROVED FOR ISSUE JP		SCALE: 1:1

POWER EQUIPMENT



0	1.8.03				AS BUILT
Rev.	Date	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	Amendment

POWER EQUIPMENT

Division of Southside Engineering
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
Facsimile: (07) 3390 4631

Client
BCC BRISBANE WATER

Project
PUMP STATION BACKUP GENSET

Drafter HJR / RSL	Draft Check	Reviewed Project Manager JP	Approved Project Director JP
Designed HJR	Design Review		

Title
ELECTRICAL SCHEMATIC

Scale 1:1	No in set 5	SE Ref No. 14291	SE Job No	S.E. Drawing No. 14291-604	AMDT 0
Engineer's Ref. No		Client Ref No.			

SP240

Section 8 - Test Reports

SE Power Equipment
47 Proprietary Street, Tingalpa, Qld 4173
Telephone: (07) 3890 1744
PO Box 3306 Tingalpa B.C. Qld 4173

DIESEL GENERATOR SET
CONTROL FUNCTION TEST REPORT

SEP 009/B

CLIENT: BRISBANE WATER SP240

DATE: 28·06·03

SERIAL NO: 0306014

JOB NO: 14291

ENGINE TYPE: F3L1011f

ENG. SERIAL NO: 00772383

ALTERNATOR TYPE: BCI184G

ALT. SERIAL NO: X03B070401

GENSET CONTROL FUNCTIONS	FUNCTION	LAMP	REMARKS
Engine High Temp. Alarm	WARN.	✓	
Engine High Temp. Shutdown	S'DOWN	✓	
Low Water Level Alarm	N/A	–	AIR COOLED
CB Tripped/Alt., Overload	S'DOWN	✓	
Low Oil Pressure Alarm	WARN.	✓	
Low Oil Pressure Shutdown	S'DOWN	✓	
Emergency Stop	S'DOWN	✓	
Start Fail Alarm	LOCK-OUT	✓	
Genset Running	INDICATION	✓	
MEN Fault	S'DOWN	✓	
Starter Motor Relay	FUNCTION O.K.	✓	
Fuel Low	WARN.	✓	
Fuel Empty	S'DOWN	✓	
Engine Gauges	FUNCT. O.K.	✓	
Status Lamps/Controls	" "	✓	
Underspeed Shutdown	S'DOWN	✓	
Overspeed Shutdown	"	✓	
Remote Start/Stop	FUNCT. O.K.	✓	
Lamp Test	" "	✓	
Alarm Shudown	" "	✓	
Alt Undervolts	S'DOWN	✓	
Alt Overvolts	"	✓	
Charger AC Failed	WARN.	✓	
Control Batt. Low Volts	"	✓	
Start Batt. Low volts	"	✓	
Canopy doors Open	"	✓	
Audible Alarm/Mute	FUNCT. O.K.	✓	
Remote ATS Controls	" "	✓	
Alternator High Temperature	N/A	–	NOT FITTED.

CUSTOMER TESTING OFFICER:

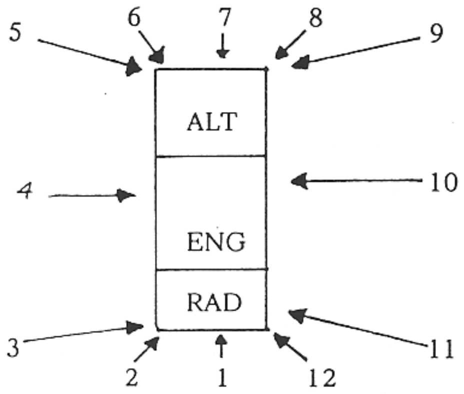
TESTING OFFICER: J. ROTH

~~GAS~~ GENERATOR SET SOUND PRESSURE LEVEL TEST REPORT

SEP 0023/ D

47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

CLIENT: BRISBANE WATER SP240
DATE: 02·07·03
SERIAL NO: 0306014
JOB NO: 14291
ENGINE TYPE: F3L1011f
ENG. SERIAL NO: X03B070401
ALTERNATOR TYPE: BCI184G
ALT. SERIAL NO: 00772383
SOUND LEVEL INSTRUMENT: RION NL-04



Position Layout

Remarks:

Distance: 7 m
Height: 1·5 m

POSITION	SOUND LEVEL dB(A)	LOAD %				
		25	50	75	100	110
①		62·5	63·4	65·3	68·1	68·2
2						
3						
④		62·5	64·5	66·1	67·1	67·1
5						
6						
⑦		62·5	64·6	66·4	67·8	67·9
8						
9						
⑩		61·9	66·0	66·3	67·4	67·6
11						
12						
Average		62·35	64·62	66·02	67·6	67·7

QUALITY ASSURANCE OFFICER:
CUSTOMER TESTING OFFICER:
TESTING OFFICER: D. COOPER
WITNESS TESTING OFFICER:

SE POWER EQUIPMENT
47 Proprietary Street
Tingalpa Qld 4173
PH: (07) 3890 1744

SEP0084

TRANSIENT LOAD RESPONSE TEST SHEET

Transient response for load changes: Load PF 0.8

% Change Electrical kW	0-25	0-50	0-75	0-100	100-0	75-0	50-0	25-0
Change in Electrical kW	2·99kw	6·2kw	9,5kw	12·5kw	12·5kw	9·5kw	6·2kw	2·99kw
% Change HZ	0	0	0	0	0	0	0	0
% Change Volts	0	0	0	0	0	0	0	0
Recovery secs	3 Se	3 Sec	3 Se	4 Se	3 Se	3 Sec	3 Sec	3 Sec.

CLIENT : BRISBANE WATER SP240

04.07.03

EQ. S/N : 0306014

ENGINE : DEUTZ F3L1011f - S/N: 00772383

ALTERNATOR : STAMFORD BCI184G - S/N: X03B070401

GOVERNOR : G.A.C.

SE POWER EQUIPMENT
47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

DIESEL GENERATOR SET LOAD TEST REPORT

SEP 0064/D

CLIENT: BRISBANE WATER SP240

DATE: 03·07·03

SERIAL NO: 0306014

JOB NO/CONTRACT NO: 14291

ENGINE TYPE: F3L1011f

ENG. SERIAL NO: 00772328

ALTERNATOR TYPE: BCI184G

ALT. SERIAL NO: X03B070401

GOVERNOR TYPE: G.A.C. ELECTRONIC

STARTER MOTOR: DEUTZ

OVERSPEED TYPE: PLC

UNDERSPEED TYPE: PLC

SHUTDOWN SOLENOID: G.A.C.

HIGH OIL ~~WATER~~: DEUTZ

LOW OIL PRESSURE SHUTDOWN: HOBBS

A: 17

KW: 12·8 KWE

TECHNICAN: M. SALT

INSPECTOR:

TIME	0:05	0:20	1:00	1:30	2:00	2:30	3:00	3:15	3:20	
OIL PRESSURE	350	350	350	340	330	330	330	330	345	
OIL TEMPERATURE	90	100	105	105	105	105	105	105	100	
JACKET WATER TEMPERATURE	N/A	–	–	–	–	–	–	–	–	
AMPS	0	12	17	17	18·7	18·7	18·7	8	0	
VOLTS	415/240	✓	✓	✓	✓	✓	✓	✓	✓	
AMBIENT TEMPERATURE	19	19	19	20	20	20	20	20	20	
HZ	50	50	50	50	50	50	50	50	50	
KW	0	9.5	12	12	14	14	14	6.5	0	
LOAD%	0	75%	100%	100%	110%	110%	110%	50%	0	

REMARKS

47 Proprietary Street
Tingalpa Q 4173
BRISBANE AUSTRALIA

SE POWER EQUIPMENT

SEP 0013

FINAL INSPECTION CHECKLIST

This form is to be completely filled out before any generating set leaves the factory.

It is to be signed by the person doing the inspection and by their immediate supervisor. In the case of a non-standard job it must also be signed by the Special Projects Manager or the Engineering Manager.

A copy of this form is to be sent out with the plant concerned.

Please neatly tick in the boxes provided where applicable and note any comments in the space provided.

MODEL: SP240 SERIAL NO: 0306014 ENGINE NO: 00772383

JOB NO: 14291 DATE: 04.07.03 CUSTOMER: BRISBANE WATER SP240

===

BASE

(1) All welds continuous, neat and clean. ☑
(2) All bolts tightened. ☑
(3) Bearers completely secured. ☑
(4) No sharp corners. ☑

RADIATOR

(1) Radiator correctly mounted. N/A ☐
(2) All pipework included and secure. ☐
(3) Drain plug in place. ☐
(4) Water removed from radiator. ☐
(5) Clamps on hoses tight. ☐

ENGINE

(1) Fan is correctly mounted. ☑
(2) All guards in place and secure. ☑
(3) Wiring loom is correct to drawing, securely fixed and marked and is terminated in an appropriate terminal box. ☑
(4) Battery leads attached and secure and long enough for termination to battery. ☑
(5) Air cleaner is properly mounted. ☑
(6) Magnetic pickup is fitted and set to correct depth. ☑
(7) Exhaust pipe and silencer (where required) are fitted correctly. ☑
(8) Dip stick in place. ☑
(9) Oil removed from engine. ☐ -
(10) All fuel and oil unions completely tightened. ☑
(11) All ordered options are fitted and function correctly. ☑
(12) All parts secure, no damage. ☑
(13) All earths less than 0.1 ohms. ☐ -
(14) Cables and hoses secure for transport. ☑

CONTROL SYSTEM (where applicable)

(1) Control functions as ordered. ☑
(2) Control is mounted correctly. ☑
(3) All leads, terminals, fuses, printed circuit boards and switchgear are completely secure and marked correctly. ☑
(4) Dust seals are fitted around doors. ☑
(5) Doors hinged correctly. ☑
(6) All earths less than 0.1 ohms. ☐ -
(7) Red Danger labels in cubicle. ☑

CONTROL SYSTEM (cont)

(8) Perspex shield secure, clean and no sharp corners. –
(9) Cables correct, no damage. ✓
(10) Locks and keys satisfactory. –

ALTERNATOR

(1) Alternator is correctly mounted. ✓
(2) Alternator leads are correctly mounted inside terminal box and marked correctly. ✓
(3) A.V.R. is mounted, connected properly and set to correct setting. ✓
(4) Coupling and adaptor are properly fastened between engine and alternator with correct size and tensile grade bolts. ✓
(5) All options ordered are fitted and function properly. ✓
(6) Alternator is correctly wired for the appropriate voltage as per either Order or Bills of Material. ✓
(7) Earth stud fitted. ✓

FINISH

(1) Plant is painted to correct colour. ✓
(2) All blemishes in finish, especially paint runs, are completely removed. ✓

GENERAL INSPECTION

(1) Genset is manufactured to correct engine/alternator/radiator/bases configuration as specified on Bill of Materials. ✓
(2) All documents are in a sealed plastic bag and secured inside alternator terminal box. X
    a) Engine Handbook X
    b) Alternator Handbook X
    c) Warranty Card +
    d) Packing List X
    e) Test Sheet X
(3) No Oil/No Water label is attached to positive battery lead. X
(4) All labels are straight and in correct location. ✓

SIGNED: D. COOPER INSPECTOR

________________ QUALITY ASSURANCE

COMMENTS:

SP240

Section 9 - IDTS Test

BRISBANE WATER

Network Control Systems

IDTS POINT COMMISSIONING SHEET AND GENERATOR SUPPLY OPERATIONAL CHECKS

Pump Station Generator Connection Project (STTX- I910)

DATE: 13/5/04

Site Name:

NOTE: *Some (or all) of the Generator associated IDTS points may be Scan Inhibited in the IDTS system. Remove the Scan Inhibit from these points before proceeding with these tests*

IDTS Point : Generator Offsite

Action	**Observation**	**Result**
Connect the Control interface lead to the station	Confirm that GENERATOR OFFSITE alarm return to normal is received by IDTS	√ **Yes**
Disconnect the Control interface lead to the station	Confirm that GENERATOR OFFSITE alarm is received by IDTS	√ **Yes**
Reconnect the Control interface lead to the station		√ **Yes**

IDTS Point : Security Door_limit_switch

Action	**Observation**	**Result**
Open a canopy door on the Generator	Confirm that SECURITY DOOR_LIMIT_SWITCH alarm is received by IDTS	√ **Yes**
Close the canopy door	Confirm that SECURITY DOOR_LIMIT_SWITCH alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Low_fuel

Action	**Observation**	**Result**
Make the Generator low fuel warning alarm active	Confirm that GENERATOR LOW_FUEL alarm is received by IDTS	√ **Yes**
Deactivate the Generator low fuel warning alarm	Confirm that GENERATOR LOW_FUEL alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Warning

Action	**Observation**	**Result**
Make the Generator warning alarm active (except by low fuel)	Confirm that GENERATOR WARNING alarm is received by IDTS	√ **Yes**
Deactivate the Generator warning alarm	Confirm that GENERATOR WARNING alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Common_fault

Action	**Observation**	**Result**
Make the Generator common fault alarm active	Confirm that GENERATOR COMMON_FAULT alarm is received by IDTS	√ **Yes**
Deactivate the Generator common fault alarm	Confirm that GENERATOR COMMON_FAULT alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Automatic

Action	**Observation**	**Result**
Turn the generator to local mode	Confirm that GENERATOR AUTOMATIC alarm is received by IDTS	√ **Yes**
Return the generator to automatic mode	Confirm that GENERATOR AUTOMATIC alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator CB_tripped

Action	**Observation**	**Result**
Trip the Generator circuit breaker	Confirm that GENERATOR CB_TRIPPED alarm is received by IDTS	√ **Yes**
Reset the Generator circuit breaker	Confirm that GENERATOR CB_TRIPPED alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Running

Action	**Observation**	**Result**
Start the Generator (off line only)	Confirm that GENERATOR RUNNING alarm is received by IDTS	√ **Yes**
Stop the Generator	Confirm that GENERATOR RUNNING alarm return to normal is received by IDTS	√ **Yes**

IDTS Control Points : Generator Remote_run_request
& Generator Remote_stop_request

Action	**Observation**	**Result**
Confirm the Generator is available to run, but not running		√ **Yes**
Set the IDTS control point GENERATOR REMOTE_RUN_REQUEST and send to the site	Confirm that the Generator starts and runs off-line	√ **Yes**
	Confirm that GENERATOR RUNNING alarm is received by IDTS	√ **Yes**
Set the IDTS control point GENERATOR REMOTE_STOP_REQUEST and send to the site	Confirm that the Generator stops	√ **Yes**
	Confirm that GENERATOR RUNNING alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Power_supply Energex_power

Action	**Observation**	**Result**
Turn the generator to local mode		√ **Yes**
Fail the Energex power	Confirm that POWER_SUPPLY ENERGEX POWER alarm is received by IDTS	√ **Yes**
Restore the Energex power	Confirm that POWER_SUPPLY ENERGEX POWER alarm return to normal is received by IDTS	√ **Yes**

IDTS Point : Generator Connected, and

Generator supply operational checks

NOTE: The purpose of these operational checks is;

- *to confirm Generator is capable of starting all available pumps on site "simultaneously" (each pump start separated only by the RTU / PLC minimum pump start separation time), and running all pumps continuously for at least one minute.*
- *to confirm the pumps are interlocked under Generator supply (where required)*
- *to confirm the code changes have not interfered with the operation of the Surcharge Imminent probe.*

Action	**Observation**	**Result**
Ensure the Generator is in Automatic mode		**√ Yes**
Ensure the pumps are selected for local mode		**√ Yes**
Ensure there is enough sewage in the well for the pumps to run continuously for one minute		**√ Yes**
Fail the Energex power to the Generator	Confirm that the Generator starts and supplies power to the station	**√ Yes**
	Confirm that GENERATOR CONNECTED alarm is received by IDTS	**√ Yes**
Press all pumps local start buttons together	Confirm that all pumps (available under Generator supply) start	**√ Yes**
Sites: Billan St, Musgrave Rd, Centenary Hwy / Kooringal Dr, Manet St, Sanananda St and Sinnamon Rd.	Confirm the RTU will run a maximum of one pump under generator supply.	**√ Yes**
Site: Creek Rd / Oldfield Rd	Confirm the RTU will run a maximum of two pumps under generator supply.	**N/A**
Restore Energex power and record the time taken for the Generator controller to return the station power to Energex supply	Time for station power to return to Energex supply	**120 Secs**
	Confirm that GENERATOR CONNECTED alarm return to normal is received by IDTS	**√ Yes**
Record time taken for the Generator to stop after station power to returns to Energex supply	Time for Generator to stop after station power to returns to Energex supply	**300 Secs**

Pump Automatic operation, and
Surcharge Imminent operation under Generator supply

Action	**Observation**	**Result**
Fail the Energex power to the Generator	Confirm that the Generator starts and supplies power to the station	√ **Yes**
Ensure the pumps are selected for remote mode	Fixed speed pump sites: Confirm that the duty pump lowers the well to the Duty A stop level and stops	√ **Yes**
	Variable speed pump sites: Confirm that the duty pump operates on variable speed control satisfactorily	√ **Yes**
Ensure the well level is below the Duty A start level using pump local control as required		√ **Yes**
Ensure the pumps are selected for remote mode and are stopped		√ **Yes**
Activate the surcharge imminent probe for at least 10 sec	Confirm that WET_WELL SURCHARGE_IMMINENT alarm is received by IDTS	√ **Yes**
	Confirm that all pumps (available under Generator supply) start	√ **Yes**
Ensure the well does not fall below the Duty A stop level by selecting local mode for the pumps as required		√ **Yes**
Return the surcharge imminent probe to normal	Confirm that WET_WELL SURCHARGE_IMMINENT alarm return to normal is received by IDTS	√ **Yes**
Restore Energex power indication to the Generator and allow the Generator controller to return the station power to Energex supply		√ **Yes**

Commissioning Notes:

IDTS Points and Generator Supply

Operational Checks commissioned by …