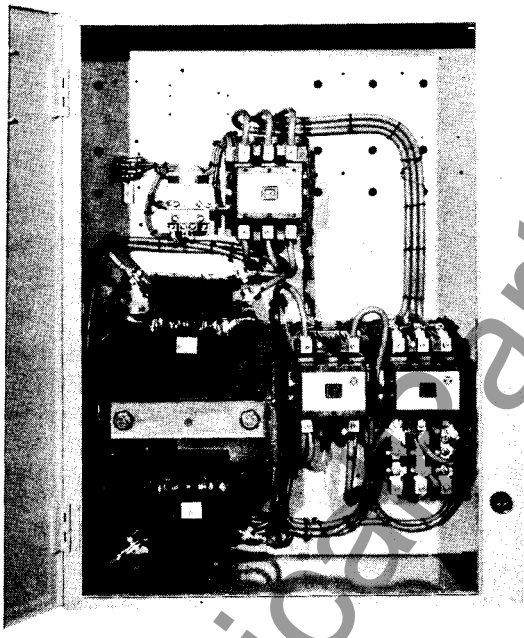
Westinghouse

I.L. 11-600-1B

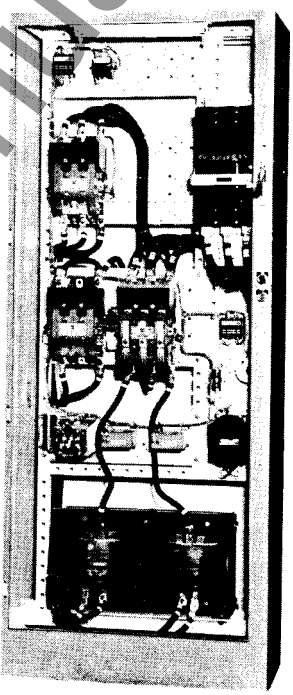
MAGNETIC REDUCED VOLTAGE STARTER

AUTOTRANSFORMER TYPE TIME LIMIT ACCELERATION

GENERAL INFORMATION



TYPICAL - 11-600 - Size 4



TYPICAL - 11-600 - Size 6

MAGNETIC REDUCED VOLTAGE STARTERS to which this leaflet applies are listed with their basic class numbers in table 1 below:

Table No. 1

BASIC CLASS NO.	DESCRIPTION
11-600	Non-Reversing 2-point medium duty cycle
11-603	Class 11-600 with built-in non-fusible De-ion® Disconnect switch
11-604	Class 11-600 with built-in fusible De-ion Disconnect switch
11-606	Class 11-600 with built-in De-ion Circuit Breaker.
11-610	Reversing non-plugging.
11-613	Class 11-610 with built-in non-fusible De-ion Disconnect switch.
11-614	Class 11-610 with built-in fusible De-ion Disconnect switch.
11-616	Class 11-610 with built-in De-ion Circuit Breaker.

This leaflet has been prepared for guidance in installation, adjustment, operation, and maintenance of standard magnetic reduced voltage autotransformer type starters. The standard 3-phase Class 11-600 starter is used as an illustration. The information in this leaflet may also be used to advantage for special and non-standard designs which differ from the standard only in minor electrical or mechanical modifications.

This leaflet, the specific diagram of connections, and the specific device and general instruction leaflets shipped with the starter should all be carefully studied before attempting to install, adjust, operate, or service the equipment and its devices. See reference column of Table No. 5 for list of leaflets giving detailed instructions on the individual devices and general instructions on storage, handling, foundations and supports, installations, erection, unpacking and maintenance.

SUPERSEDES I.L. 11–600–1 A

Table No. 2

MOTOR RATING	STARTING TAPS 25 & 60 Cyc. Approx. Per Cent of Line Voltage	STANDARD DUTY CYCLE TEST†
Up to and including 50 HP	65 - 80	One 15 sec. period out of each 4 minutes for 1 hour, with an inductive load (0.5 pf or less) of 3 times normal full voltage motor full load current connected to the 65% tap.
51 HP up to & incl. 200 HP	50 - 65 - 80	
Over 200 HP	50 - 65 - 80	Three 30 sec. periods separated by 30 sec. intervals, followed by a 60 minute rest period, followed by three 30 second periods, separated by 30 second intervals, with an inductive load (0.5 pf or less) of 3 times normal full voltage motor full load current connected to the 65% tap.

† Test Standards for medium duty transformers. (Unless otherwise specified, std, starters are shipped with 65% tap connected).

Transformation of a high motor current to a lower line current by autotransformer turns ratio produces more motor accelerating torque per ampere of accelerating line current than any other common scheme of squirrel cage motor reduced voltage starting. Standard starters provide closed transition from starting to running connection. Use of closed transition starting often reduces peak current and lamp flicker resulting from application of full voltage by the open transition method.

The magnetic medium duty autotransformers supplied on the standard starters have taps and duty cycle test standards per Table No. 2 shown on page 2.

The standard medium duty cycle test is roughly equivalent to a practical duty rating, using general purpose motors of modern design, of approximately one 9 second start every 4 minutes for one hour. A duty in excess of this will produce greater than standard temperature rise and may shorten the life of the transformer unit. If the required duty is appreciably in excess of this medium duty rating, the heavy duty transformer should be used.

If it is desired to apply the standard starter design to duty cycles other than standard, the following generalizations should be considered:

1. For on times less than about 9 seconds, the maximum transformer unit temperature rise will be approximately standard if the total on plus off time is not less than the values given in Table No. 3.

Table No. 3 Equivalent duty cycles to give same transformer temperature rise as standard duty

ON Time seconds	9	6.7	4.5	2.2
Minimum ON plus OFF time minutes	4	3	2	1

2. For on times greater than about 9 seconds the direct ratio relationship of Table No. 3 for equal temperature rise does not apply. Standard starters may be used for accelerating motors where the starting period is approximately 15 sec. and not over six or eight starts are made without allowing the transformer to cool down to the room temperature. Several starts of a longer period, even as long as 30 sec. can be made if the transformer is cold and the starts are not repeated too often.

For starting unloaded MG sets and other loads requiring only relatively low starting torques a light duty autotransformer will often supply adequate starting torque with less exciting and accelerating current than would be obtained with a medium duty autotransformer, and a consequent saving in transformer weight and cost.

For loads requiring more frequent starting or more starting torque or longer accelerating times than can be obtained with the standard medium duty autotransformer, heavy duty autotransformers must be used.

Table No. 4 below gives tap voltages and duty cycle tests for light and heavy duty transformers.

Unless otherwise specified, starters with light duty transformers are shipped with 45% tap connected.

Table No. 4 Special Transformer Test Standards

	STARTING TAPS 25 & 60 Cyc. Approx. Per Cent of Line Voltage	DUTY CYCLE
LIGHT DUTY	30 - 37.5 - 45	Three 30 sec. periods separated by 30 sec. intervals, followed by a 60 minute rest period, followed by three 30 sec. periods, separated by 30 sec. intervals, with an inductive load (0.5 pf or less) of 1.75 times normal full voltage motor full load current connected to the 37.5 percent tap.
HEAVY DUTY	Taps are determined by application	Five one-minute periods separated by one-minute intervals, followed by a 2-hr. rest period, followed by five more 1-minute periods separated by 1-minute intervals, with the mid-taps connected to the motor (rotor blocked) or to an equivalent inductive load.

DESCRIPTION and INSTALLATION

The standard basic three-phase starter, sizes 2, 3, 4, and 5, includes two 3-pole starting contactors plus a 3-pole running contactor, with mechanical interlock and suitable electrical interlocking to prevent start and run contactors closing at the same time. Suitable interposing relays to handle the contactor coil currents when required, a set of overload relays, a timing relay, an autotransformer, and necessary connection, wiring, and terminal details, are standard. The starting contactors apply reduced voltage to the motor through the autotransformer when the pilot device first operates to start the motor and timing relay. After the time set on the timing relay has elapsed, the timing relay drops out the initial starting contactor and the 3-pole running contactor then applies full voltage to the motor. Starters size 6, 7, 8, and 9, include the same basic devices as above except interposing relays, to handle the coil inrush currents, will be provided.

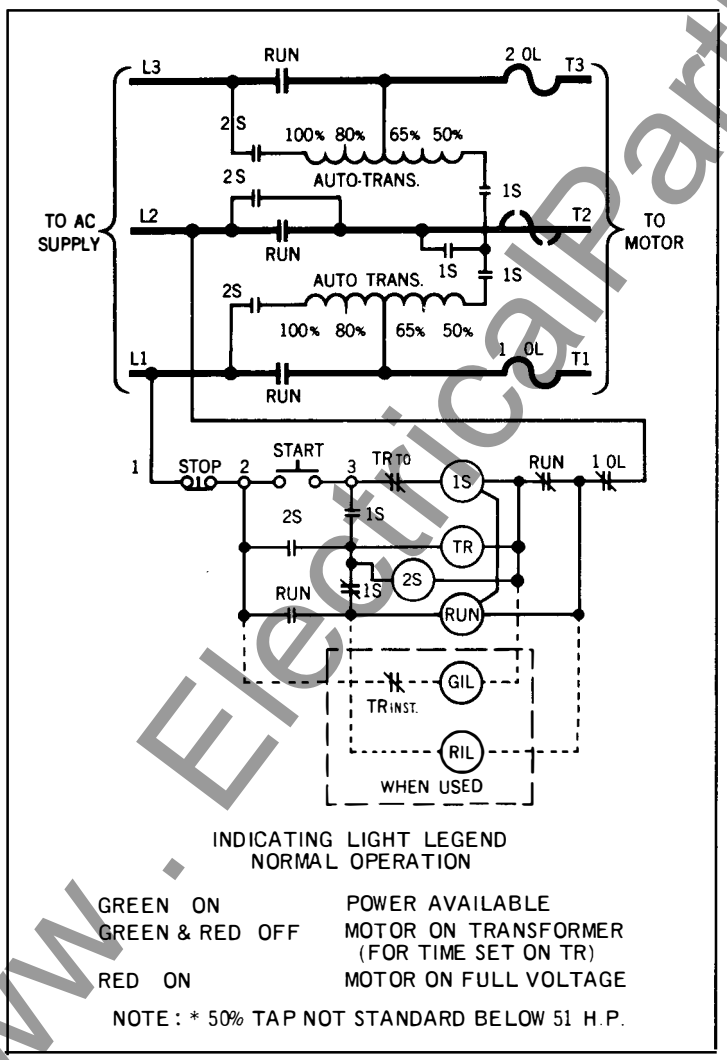


FIG. 1. Typical Elementary Diagram

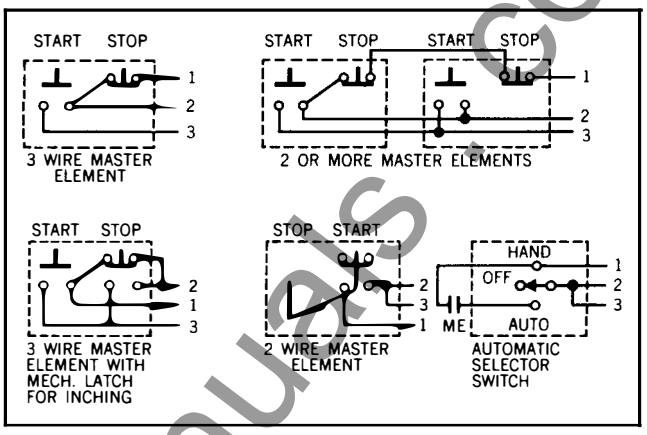


FIG. 2. Optional Master Element Schemes

These starters use separate 3-pole and 2-pole contactors for starting. The 2-pole contactor closes the autotransformer winding connections to the T2 line so subsequent immediate closing of the 3-pole starting contactor applies reduced voltage to the motor through the autotransformer. The 2-pole contactor is mechanically and electrically interlocked with the 3-pole running contactor to prevent both contactors closing at the same time. When the time set on the timing relay has elapsed, the timing relay drops out the 2-pole contactor. The motor remains energized through part of the autotransformer winding during the short transition period until the running contactor closes and applies full voltage to the motor.

Interposing relays are not supplied on the standard size 2, 3, 4, and 5 starters. See Fig. ① for typical elementary diagram. Fig. ② shows some optional master element (pilot device) schemes.

The inching scheme shown in Fig. 2 is a simple low cost scheme that should be applied with caution as it is not a foolproof inching arrangement. Should foolproof inching be required for safety or other operational considerations, do not use this scheme. Starters with inching relays are recommended for foolproof inching.

Inching operation using the scheme of Fig. ② will depend upon whether latch depresses stop button fully or only partially. (Both arrangements are in use and available). Should the latch only depress the stop button partially, then the stop and start button must both be depressed for inching intervals longer than the setting of the timing relay. This is necessary to enable the starter to transfer to run at the end of the starting time. Damage to autotransformer may occur if the rated duty cycle on time is exceeded without adequate cooling time.

Table No. 5 Application, Heater Selection and Instruction Literature Guide

APPLICATION					HEATER SELECTION		REFERENCE	
3-PHASE, 60-CYCLE 2-POLE, APPROXIMATE MAXIMUM MOTOR HORSEPOWER* AT VOLTAGE			CONTACTOR & RELAY ENCLOSED 8-HOUR RATING*	STANDARD STARTER NEMA 1 ENCLOSED	SELECT OL RELAY HEATERS FROM	FACTORY SETTING TIMING RELAY	INSTRUCTION LITERATURE†	
220	380	440/550	Amps.	Class	Instructions	Seconds	Individual Device Instructions	Common Device Instructions
15	25	25	45	11-600S2	I.L. 13193	5	A/200 Contactor I.L. 13158 A/200 OL Relay I.L. 13193	Agastat Timer SR15-X Mech. Interlock I.L. 13189
30	50	50	90	11-600S3	I.L. 13299	7	A/200 Contactor I.L. 13239 Block Overload I.L. 13299	Elect. Interlock I.L. 13134
50	75	100	135	11-600S4	I.L. 13299	7	A/200 Contactor I.L. 13239 Block Overload I.L. 13299	
100	150	200	270	11-600S5	I.L. 13193	8	GCA Contactor I.L. 15825–14 CT/O.L. I.L. 15827–20 Elec. Interlock I.L. 15829–8 Elec. Interlock I.L. 13134 Mech. Interlock I.L. 15829–10	Agastat Timer SR–15–X A/200 OL Relay I.L. 13193
200	350	400	540	11-600S6	I.L. 13193	8	GCA Contactor I.L. 15825–15 Elec. Interlock I.L. 15829–2A GPA Contactor I.L. 15825–10 Elec. Interlock I.L. 15829–8 Mech. Interlock I.L. 15829–10	
300	500	600	810	11-600S7	I.L. 13193	8	GP8 GPD Cont. I.L. 15825–6B L63-Elect. Int. I.L. 15829–4 GPD Contactor I.L. 15825–9 L60 Elect. Int. I.L. 15829–2A	
450	800	900	1210	11-600S8	I.L. 13193	10	GPD Contactor I.L. 15825–9 L63 Elect. Int. I.L. 15829–4	

* Application must always be such that contactor and relay continuous currents will not exceed 8-hour enclosed rating.

† For general instructions covering unpacking, handling, storing, installation and maintenance, see I.L. 1477-D, I.L. 4330, I.L. 7000-2, I.L. 4332, I.L. 7000-1 and MB 1781-G.

Should the latch depress the stop button fully, then inch operations using start button only will be normal with starter transfer to run occurring automatically at the end of the starting period.

Combined inching and starting duty must not exceed rated duty if full autotransformer life is to be obtained.

Short-Circuit Protection. Unless the starter is provided with built-in line fuses or circuit breaker, the customer should protect the starter against short circuits by one of the following methods:

1. Fuses rated at not more than 4 times rated motor current.
2. Time limit circuit breaker set at not more than four times rated motor current.

Overload Protection. Overload during either starting or running will stop the motor. Before putting the starter in service check the overload heater marking against the heater table per Table No. 5.

If overload relay has optional reset feature, select type of reset action desired and adjust relay accordingly. For details on mounting heaters and optional reset adjustment see specific relay leaflet (Ref. column Table No. 5).

Connections. See specific controller and motor diagrams for connection details. Typical elementary diagram is shown in Fig. ①. When making connections insert the bared cable or wire end into the connector so it is squeezed between the back of the tang and the collar when the fastener is tightened.

Electrical Interlocks. Additional electrical interlocks for customer sequence interlocking may often be added. See specific device leaflet and specific controller diagram for details. Note that mechanical interlocking sometimes restricts the addition of electrical interlocks on the size 7, 8, and 9 starters.

TESTS and ADJUSTMENTS

Make a careful check of the controller with all motor leads disconnected to insure that the equipment is in good operating condition. In particular, check the following:

a. Does controller go through complete sequence properly?

b. Does the timing relay operate properly to de-energize the start contactor after a definite preset time? Factory setting for this relay will be found in Table No. 5.

c. Does the pushbutton station (or other master switch) operate to control the equipment as expected?

After tests as above, make temporary motor connections and make further tests and adjustments as follows:

d. Check direction of rotation of motor and correct if necessary.

e. Observe motor acceleration time and adjust timing relay setting to apply full voltage as soon as the motor rate of acceleration becomes noticeably reduced. If the starting load on the motor is variable, this adjustment should be made with the larger values of load. Some compromise setting may be desirable if the larger values of load seldom occur. It may be necessary to change the autotransformer tap if the load and motor characteristics are such that the factory tap setting is not optimim. Use of a higher percent voltage tap will produce more acceleration torque, but will require more line current. The lowest tap setting which will give a reasonable acceleration time is optimum for most ordinary applications. See specific device leaflet for adjustment instructions for timing relay.

Caution: Do not exceed autotransformer duty rating while adjusting timing relay and transformer taps. Autotransformer damage or burnout may occur due to failure to allow adequate autotransformer cooling time while testing.

f. Observe overload relay operation. Relay should not trip starter off at rated motor load.

After above tests and adjustments are completed, motor leads may be permanently connected and insulated if necessary.

MAINTENANCE

In operating, servicing and adjusting the equipment, the attendant should consult the diagram and the general and specific device instruction leaflets and particularly remember the following points:

1. **Warning. All circuits should be de-energized and disconnecting devices locked open when working on equipment.**

2. The equipment should be kept clean at all times.

3. Periodic inspection should be made of all equipment to insure that all apparatus is kept in working condition.

4. Contacts becoming badly worn should be replaced before they cause failure. Proper spring pressure should be maintained at all times.

5. Insulating oil (used in oil switches, hazardous location, and circuit breaker type starters) should be periodically checked and reconditioned or changed when necessary. See I.B. 44-820-1 for detailed instructions on care of insulating oils.

6. Do not oil contactor bearings.

7. Do not use emery paper around electrical apparatus. Sandpaper or file only when necessary and use care to avoid embedding metal particles in insulating materials.

8. Keep all connections tight; particular attention should be given to thermal overload relay heater connections to keep them clean and tight.

In Case of Trouble.

a. If control fuses blow check carefully for shorted or damaged coils or wires; repair equipment and replace fuse.

b. If motor fails to accelerate properly

1. Check AC line for low voltage or single phase condition.
2. Check load and motor for overload, excessive friction or blocking.
3. Check load at starting. Is it too great for motor torque? If necessary, increase starting voltage by changing autotransformer taps.

c. If overload Relay Trips

1. Check AC line for low voltage or single phase condition.

2. Check motor and load for overload, excessive friction, or blocking.

3. Check condition of heater connections. Clean and tighten if necessary.

4. Check ambient temperature at relay when relay trips. Overload relays have ± 15% adjustment for any particular heater rating and they are shipped on 100% setting. To provide best protection set as near motor full load as practical and yet not produce nuisance tripping. Heaters may have been selected for a lower ambient than actually exists. See heater table and overload relay instruction leaflet (Table 5 Reference).

5. Inspect carefully relay, control, motor and load for any abnormal condition. Correct such condition.

6. Reset relay and attempt new start, observing carefully operation of equipment, motor and load. If accelerating time is quite long, higher torque or HP motor may be required.

d. If starter fails to go through starting sequence completely, check interlock contacts, connections, and operation of devices. Check, particularly, the controller diagram for any interlock sequence information such as note Φ Fig. ① and see that the proper sequence is being obtained.

If any major repairs become necessary, we recommend that the nearest Westinghouse Sales Office be asked for their recommendations.

Each equipment is designed and supplied for a particular voltage, frequency, horsepower, and number of phases as marked on nameplate, based on standard general purpose motors of standard modern design. Before applying starter on other voltage, frequency, motor type, or horsepower rating, the nearest Westinghouse Sales Office should be consulted.

Westinghouse Electric Corporation
General Control Division
Asheville, N. C. 28813

Printed in U.S.A.
8-70