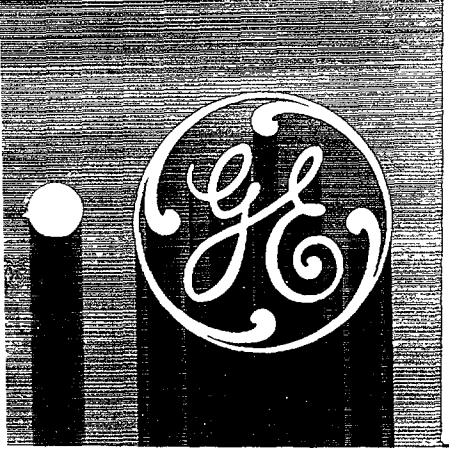


INSTRUCTIONS GEI-90892

FIELD TESTING OF GENERAL ELECTRIC TYPE OVERCURRENT TRIP DEVICES

GENERAL ELECTRIC

CIRCUIT PROTECTIVE DEVICES DEPARTMENT, PLAINVILLE, CT 06062

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

FIELD TESTING OF GENERAL ELECTRIC TYPE OVERCURRENT TRIP DEVICE

GENERAL

Increased interest in breaker maintenance is evident by the increase in field inquiries concerning maintenance procedures. Since the majority of these inquiries concern checking the operation of overcurrent trip devices, the following factory advice is offered as an aid to those involved in that activity.

Before attempting any checks or adjustments, the assigned tester should consult the maintenance manual to familiarize himself with the operating details of the specific breaker involved and the specific overcurrent trip device. He should be certain the power voltage has been removed. Prior to checking the overcurrent trip device, the breaker contacts, mechanism and trip latch should be checked to assure their proper functioning so that the breaker can carry the required current and that the trip shaft is free of high friction loads. The trip latch should be checked for proper trip latch engagement.

Overcurrent Trip Device Checks:

An adequate check to prove the overcurrent trip device functions properly consists of a mechanical check followed by an overcurrent operation.

Mechanical Check:

A careful mechanical check should be made of any magnetic overcurrent trip device to assure a successful tripping operation just before the armature reaches the fully closed air gap condition. This can be done by manually pushing the armature toward the closed air gap position, and determining how much further the armature moves after the breaker has tripped. This check to assure "positive trip" is within the tolerance specified in the breaker maintenance manual is important and can affect the apparent degree of time delay during a subsequent overcurrent timing test. If there is insufficient "positive trip" the armature may "bottom" on the magnet pole face without sufficiently displacing the trip latch. Slightly excessive "positive trip" may cause fast tripping while extremely excessive "positive trip" will allow the trip device armature to be loaded by the latch when the air gap is excessive. When the air gap is excessive, tripping force is at a low level compared to the force at short air gaps and the device may tend to stall or "ride the latch".

The armature of the EC-2, EC-2A, EC-1A and EC-1B of the AK breakers and the oil film (sticky disk) and Grade "B" time of AL-2 type breakers can be manipulated directly while observing the tripping. On the EC-1 device the trip arm is not fastened to the armature. To accurately determine the degree of positive trip on the EC-1, it is necessary to "probe" the armature through the holes provided in the case. A drill rod or short length of stiff wire will serve as a probe. Maintenance manuals for the specific breaker shows the procedure in detail.

While checking positive trip, the armature should be held in the tripped position sufficiently long to assure the time delay escapement is operative as follows:

a. As the armature is pushed to the closed air gap position, devices with instantaneous trip features will allow the instantaneous trip spring to stretch and allow temporary separation of the armature from the time delay dashpot. Maintaining the armature in the closed air gap condition will cause the instantaneous spring to pull the dash pot through its timing stroke. Devices with long delay characteristics will require considerable time to "time out." Failure of the dashpot

to move at all warrants further investigation to see if a bind exists in the dashpot or connecting linkage.. Similarly, lack of any time delay (when the device is so equipped) or a very fast "time out" will generally indicate lack of oil and again further investigation is warranted.

b. When releasing the armature after the device has "timed out" check the armature to be sure it returns to the fully open gap position and rests on the armature open air gap stop. An armature hanging half-way closed indicates a possible bind in the armature pivot or dashpot or possibly the pick-up setting has been reduced so far below the minimum setting that the calibration spring no longer provides resetting torque. Binds in the armature pivot of devices employing oil displacement type dashpots are generally detected by the armature failing to fully reset following a partial "timing out" operation (such as may occur from a motor starting operation). On the next overload the partially closed air gap causes premature tripping. (Generally considered a fail safe condition.)

c. Visually check for missing hardware, clamping devices, evidence of leaking oil, broken cases, cracked breaker trip paddles. On oil film (sticky disc) devices and Grade B timers, the condition of the oil should be observed and changed if necessary. Se maintenance manual for acceptable cleaning methods and type of oil.

Overcurrent Check:

If desired, an overcurrent test can be made to assure the breaker will trip on overcurrent. The purpose of overcurrent testing of trip devices in the field should be to determine if the breaker will perform as required for that circuit to which it is applied. Since the trip device exhibits its lowest trip force levels when encountering low levels of overcurrent, an indication of adequate trip device performance can generally be assured by making an overcurrent check at approximately 150 to 300 percent of coil rating as shown in Table I. On dual magnetic trip devices, the armature and pivot pin is common to both the long time delay feature and the instantaneous trip. If the force generated across the air gap is sufficient to attract the armature for slight overcurrents in the long time region, tripping on short circuit by the same armature is assured. As the armature times toward the closed air gap position, the force across the air gap increases high enough to stretch the instantaneous spring and exercise the instantaneous trip parts. Similarly, the short time armature on selective trip devices is on the same pivot as the long time armature and the iron structure is comparable. Therefore, checking the long time delay feature affords reasonable assurance of all features successfully performing their trip functions. The long time delay pick-up should be set at 100% current.

Overcurrent Test Equipment:

In addition to being capable of producing current levels approximately 300% of trip coil rating, the current must be reasonably sinusoidal. Since overcurrent trip devices are designed to saturate slightly above continuous rating to avoid destructive forces at short circuit levels of overcurrent, the devices represent a non-linear impedance at current levels recommended for time delay testing. If the trip device represents the predominant impedance in the test circuit, a non-sinusoidal current wave shape results. To maintain a reasonably sinusoidal wave shape of current, air core reactance should be inserted in the series circuit. The air core reactance must represent the predominant reactive (and linear) impedance to minimize the effect of the trip device impedance. Insertion of this additional impedance in turn requires an increase in test voltage. The minimum external impedance requirement varies for each coil size. The smaller the rating of the trip coil, the higher becomes its impedance, the more external impedance is required, hence the higher the required source voltage. Rather than specify the external impedance required for each coil rating, it is more convenient to indicate the open circuit voltage required for various coil ratings. The

external impedance can then be inserted as required to control the test current. Figure 1 shows these open circuit voltage requirements for various coils. This voltage can be quickly checked after the current has been set by measuring the voltage with the breaker open and the test set "on" at the level required to produce 300% continuous current.

Test Procedure:

1. With a test set meeting the minimum requirements outlined above and connected securely to the upper and lower studs of one pole of the breaker, set the long time pick-up setting on the trip device to 100%. The relative position of the adjustable time setting of EC-2 type devices should be noted. It is important that time adjusting screw is not forced to the limit of its travel; otherwise binding of the time delay linkage may result.

2. Close the breaker and adjust the current to the degree of over-current listed in Table I for the particular O. C. trip device.

3. Shut off the test set to allow the device to re-set.

4. Re-apply the power and record the trip time in the appropriate test log book.

If repeat tests are attempted, it will be necessary to allow a sufficient cooling time between tests so as not to exceed the thermal capacity of the circuit breaker.

The magnets of some overcurrent trip devices are oriented in such a direction that the flux across the air gap of the device of one pole effects the pick-up of the devices on adjacent poles. Generally, these breakers have correction factors applied to their single phase calibration currents to assure adequate performance when applied on 3 phase circuits. These correction factors should be similarly applied when field checking. Notes on Table I indicate the correction factors to be applied. Test data should be compared with acceptable or specified limits so that discrepancies can be verified immediately.

On completion of the overcurrent trip device test, it is important to carefully reassemble any accessories that were removed to facilitate the overcurrent trip device test or adjustments. Any adjustments to those accessories should be made as directed by the maintenance manual. Careless reassembly of accessories may result in subsequent serious damage to the breakers and the circuits they protect.

Test Results:

The trip time measured for the trip device at the recommended overcurrent condition should be compared with the factory trip curve for new devices. In view of the wide variation in the parameters responsible for the apparent degree of time delay from a trip device, tripping times will often exceed the band width shown on the characteristic curves. These variations can be caused by variations in the current wave produced by test equipment, wide deviations in ambient temperature or high oil temperature caused by repetitive testing. Field adjustments, if necessary, should be confined within the adjustable range designed into the device for field adjustments. Replacement parts (other than cases or clamping hardware) are not generally available for overcurrent devices. When replacement devices are required, complete nameplate information extracted from the overcurrent trip device and the involved breaker should accompany the order.

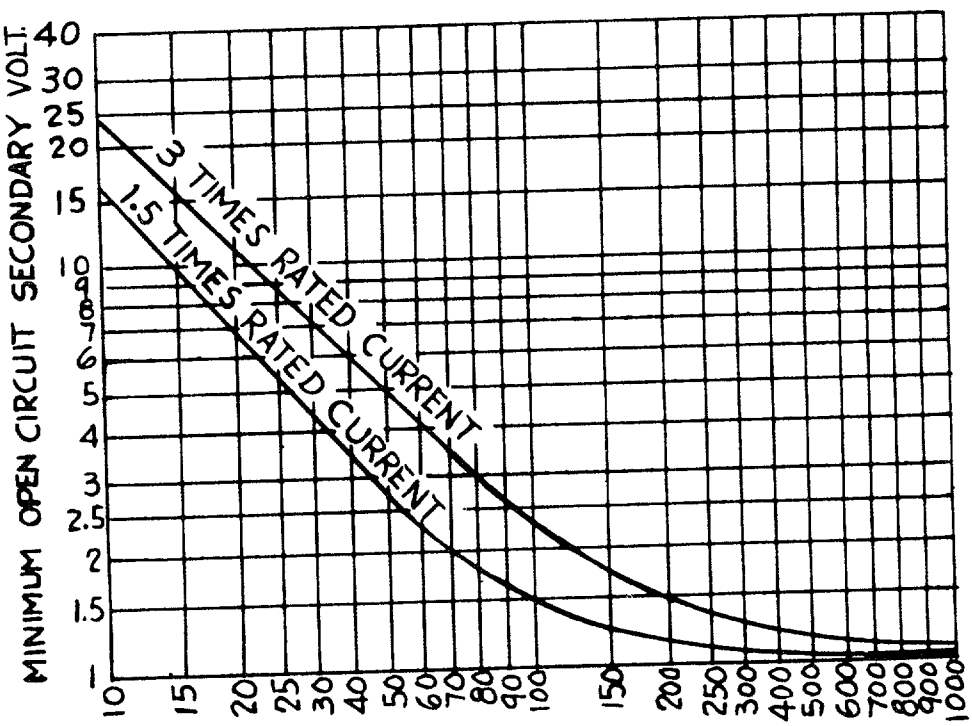
TABLE I

Breaker Type	Type Overcurrent Trip Device	Test Current in Percent of L.T.D. Pick-up *
AL-2	Oil film (sticky disc)	150
	Grade B	150
AK-15/25/50	EC-1	150
AK-15/25/50	EC-2, EC-2A (inst. 4X)	150
AK-15/25/50	EC-2, EC-2A (inst. 6X or higher)	300
AK-1-75-100	EC-1	150 **
AK-2-75-100	EC-1A, EC-1B	150 ***

* Pick-up set at 100% of trip device rating.

** Characteristics having XX suffixes should have 147% correction factored into current. Correction factors for YY characteristics are 160% on left and right poles and 187% on center poles.

*** Correction factors of 93 and 107% for left and right poles respective must be factored into test currents.



AMPERE RATING OF TRIP DEVICES

FIG-1

GENERAL ELECTRIC INSTALLATION AND SERVICE ENGINEERING OFFICES

FIELD SERVICE OFFICE CODE KEY
- * Mechanical & Nuclear Service
- † Electrical & Electronic Service
- ‡ Marine Service
- x Transportation

FOR YOUR LASTING SATISFACTION . . . with the performance and availability of your General Electric equipment, GE provides this nationwide network of field service offices, serving utility, industrial, transportation and marine users. Qualified field engineers provide installation, start-up, employee training, engineering maintenance and other services, throughout the productive life of the equipment. For full information, call your nearest Installation & Service Engineering office

ALABAMA
- † Birmingham 35205 — 2151 Highland Ave
- * † ‡ Mobile 36609 . — 1111 S. Beltline Highway

ALASKA
- † Anchorage 99501 — 115 Whitney Rd

ARIZONA
- * † Phoenix 85012 — 3550 N Central Ave
- † Tucson 85716 — 151 S Tucson Blvd

ARKANSAS
- † North Little Rock 72119 . — 120 Main St.

CALIFORNIA
- * † ‡ Los Angeles 90054 . . . . — 212 N Vignes St.
- † Palo Alto 94303 — 960 San Antonio Rd.
- † Sacramento 95808 — 2407 J St.
- † San Diego 92103 . — 2560 First Ave.
- * ‡ San Francisco 94119 — 55 Hawthorne St.
- * Vernon 90058 . . . — 3035 E 46th St

COLORADO
- * † Denver 80206. . — 201 University Blvd.

CONNECTICUT
- * † Meriden 06450 . . . . — 1 Prestige Dr.

FLORIDA
- † ‡ Jacksonville 32203 . . . . — 4040 Woodcock Dr.
- † ‡ Miami 33134 . . . . — 4100 W Flagler St.
- * † ‡ Tampa 33609 . . . . . — 2106 S. Lois Ave.

GEORGIA
- * † ‡ Atlanta 30309 . . . . . — 1860 Peachtree Rd., NW
- † ‡ Savannah 31405 . . . . — 5002 Paulsen St.

HAWAII
- * † ‡ Honolulu 96813 . . . . . — 440 Coral St.

ILLINOIS
- * † ‡ x Chicago 60680 . . — 840 S Canal St.

INDIANA
- † Evansville 47705 . — 2709 Washington Ave
- † Fort Wayne 46807 — 3608 S Calhoun St.
- * † Indianapolis 46207 . . — 3750 N Meridian St.

IOWA
- † Davenport 52805 — P.O Box 630, 1039 State St., Bettendorf

KENTUCKY
- † Louisville 40218 . . — 2300 Meadow Dr

LOUISIANA
- † Baton Rouge 70806 . — 8312 Florida Blvd
- * † ‡ New Orleans 70125 — 4747 Earhart Blvd
- * † ′ Shreveport 71104 — 2640 Centenary Blvd
- † Monroe 71201 — 1028 North 6th St

MARYLAND
- * † ‡ Baltimore 21201 . . . . — 1 N Charles St.

MASSACHUSETTS
- * † ‡ Wellesley 02181 . . . — 1 Washington St

MICHIGAN
- * † ‡ Detroit 48202 . . . . — 700 Antoinette St.
- † Jackson 49201 . . . — 210 W Franklin St.
- † Saginaw 48607 — 1008 Second National Bank Bldg

MINNESOTA
- † ‡ Duluth 55802 . — 300 W. Superior St.
- * † ‡ Minneapolis 55416 — 1500 Lilac Drive So

MISSOURI
- * † Kansas City 64199. . . . . — 911 Main St.
- * † St Louis 63101 . . . . . — 1015 Locust St.

MONTANA
- † Butte 59701 . . . . . — 103 N. Wyoming St

NEBRASKA
- * † Omaha 68102 . . . . . — 409 S. 17th St

NEW JERSEY
- * † Millburn 07041 . . . . . — 25 E. Willow St

NEW YORK
- † ‡ Albany 12205 . . — 15 Computer Drive, West
- * † ‡ Buffalo 14205 . . . — 625 Delaware Ave.
- * † ‡ x New York 10022 . . . — 641 Lexington Ave.
- * Rochester 14604 . . . . — 89 East Ave
- * † ‡ Syracuse 13208 . . . . — 3532 James St.

NORTH CAROLINA
- * † ‡ Charlotte 28207 . . . — 141 Providence Rd
- * Wilmington — Reigelwood 28456 . . . . . — P O Box 186

OHIO
- * † Cincinnati 45206. . . . — 2621 Victory Pkwy
- * † ‡ Cleveland 44104 — 1000 Lakeside Ave.
- † Columbus 43229 — 1110 Morse Rd.
- † ‡ Toledo 43606 . . . . — 3125 Douglas Rd
- † Youngstown 44507 — 272 Indianola Ave.

OKLAHOMA
- * † Oklahoma City 73106. — 2000 Classen Blvd.
- † Tulsa 74105 — P O Box 7646, Southside Sta.

OREGON
- † Eugene 97401 . . . . . — 1170 Pearl St.
- * † ‡ Portland 97210. . . . . — 2929 NW 29th Ave.

PENNSYLVANIA
- * Allentown 18102 . . . — 1444 Hamilton St.
- * † ‡ Philadelphia 19102 . . — 3 Penn Center Plaza
- * † Pittsburgh 15222 . . — 300 6th Avenue Bldg

SOUTH CAROLINA
- † ‡ Columbia 29204 . . — 2700 Middleburg Dr.
- † Greenville 29607 . — 41 No Pleasantburg Dr.

TENNESSEE
- * † Chattanooga 37411 . . . . . — 5800 Bldg, Eastgate Center
- † Memphis 38130. . . — 3385 Airways Blvd.

TEXAS
- * † Amarillo 79101 . . . . . — 303 Polk St.
- * † ‡ Beaumont 77704 . . . . — 1385 Calder Ave.
- * ‡ Corpus Christi 78401 . — 205 N. Chaparral St.
- * † Dallas 75222 . . — 8101 Stemmons Freeway
- * † El Paso 79945 . . . . . — 215 N. Stanton
- † Fort Worth 76102 . . . — 408 W. Seventh St.
- * † ‡ Houston 77027 . . . — 4219 Richmond Ave
- † San Antonio 78204. . . — 434 S. Main St.

UTAH
- † Salt Lake City 84111 . — 431 S. Third East St

VIRGINIA
- * ‡ Newport News 23601 . . — 311 Main St.
- † ‡ Richmond 23230 — 1508 Willow Lawn Dr.
- † Roanoke 24015 . . . — 2018 Colonial Ave.

WASHINGTON
- * † ‡ Seattle 98188 — 112 Andover Park East, Tukwila
- † Spokane 99202 — E 1805 Trent Ave

WEST VIRGINIA
- * † Charleston 25328 . — 306 MacCorkle Ave , SE

WISCONSIN
- * Appleton 54911 — 3003 West College Dr.
- † ‡ Milwaukee 53202 — 615 E Michigan St

GENERAL ELECTRIC SERVICE SHOPS

WHEN YOU NEED SERVICE These GE Service Shops will repair, recondition, and rebuild your electric apparatus The facilities are available day and night, seven days a week, for work in the shops or on your premises Latest factory methods and genuine GE renewal parts are used to maintain performance of your equipment For full information about these services, contact your nearest service shop or sales office

ALABAMA
- • * Birmingham 35211 — 1500 Mims Ave , S. W.
- • Mobile 36609 . — 721 Lakeside Dr

ARIZONA
- • (Phoenix) Glendale 85019 — 4911 W Colter St
- • Phoenix 85019 — 3840 W Clarendon St
- • Tucson 85713. — 2942 So. Palo Verde Ave

CALIFORNIA
- • Los Angeles 90301 . — 6900 Stanford Ave
- • (Los Angeles) Anaheim 92805 . . . . — 3601 E. LaPalma Ave
- • (Los Angeles) Inglewood 90301 . . . . — 228 W Florence Ave
- • Sacramento 95814. . — 99 North 17th St.
- • * (San Francisco) Oakland 94608 . . . . . — 1650 34th St.

COLORADO
- • * Denver 80205 . . . . — 3353 Larimer St

CONNECTICUT
- • * (Southington) Plantsville 06479 . . . . . — 370 Atwater St

FLORIDA
- • * Jacksonville 32203 . . . — 2020 W Beaver St.
- • (Miami) Hialeah 33010. . — 1062 East 28th St
- • * Tampa 33601 . . . . — 19th & Grant Sts.

GEORGIA
- • (Atlanta) Chamblee 30341 . . . . — 5035 Peachtree Industrial-Blvd.
- * Atlanta . . — 2379 John Glenn Dr.

ILLINOIS
- • * Chicago 60638 . . . — 6045 S. Nottingham Ave.

INDIANA
- • Evansville 47711 . . — 401 N. Congress Ave.
- • Ft. Wayne 46803 . . . — 1731 Edsall Ave
- • Hammond 46320 . . . . — 1138 164th Place
- • * Indianapolis 46222 . — 1740 W Vermont St

IOWA
- • (Davenport) Bettendorf 52722 . — 1025 State St.

KENTUCKY
- • Louisville 40209 . . — 3900 Crittenden Drive

LOUISIANA
- • Baton Rouge 70814 — 10955 North Dual St
- • * New Orleans 70114 — 1115 DeArmas St

MARYLAND
- • * Baltimore 21230 — 920 E Fort Ave.

MASSACHUSETTS
- • * Δ (Boston) Medford 02155 — 3960 Mystic Valley Pkwy

MICHIGAN
- • * Δ (Detroit) Riverview — 18075 Krause Ave.
- • Flint 48505 . . — 1506 E Carpenter Rd

MINNESOTA
- • Duluth 55807 — 50th Ave W & St.Louis Bay
- • * Minneapolis 55430 — 2025 49th Ave , N.

MISSOURI
- • * Kansas City 64120 — 3525 Gardner Ave.
- • * St Louis 63110 — 1115 East Rd.

NEW JERSEY
- • New Brunswick 08902 . — 3 Lawrence St

NEW MEXICO
- • Albuquerque 87109 — 4420 McLeod Rd NE

NEW YORK
- • Albany 12205 . . . . — 1097 Central Ave.
- • * (Buffalo) Tonawanda 14150 — 175 Milens Rd
- • (Long Island) Old Bethpage 11804 . . . — 183 Bethpage-Sweet Hollow Rd.
- • (New York City) North Bergen, N. J 07012 . . . . — 6001 Tonnelle Ave.
- • (New York City) Clifton, N J 07012 . . . . . — 9 Brighton Rd
- • Δ Schenectady 12305 . . . — 1 River Rd.
- • Syracuse 13208 — 1015 E Hiawatha Blvd

NORTH CAROLINA
- • * Charlotte 28208 . . — 2328 Thrift Rd.

OHIO
- • Akron (Canton) 44720 . . . — 7900 Whipple Ave. N. W.
- • * Cincinnati 45202 . . . . — 444 West 3rd St.
- • * Δ Cleveland 44125 . . . . — 4477 East 49th St.
- • Columbus 43229 . . . — 6660 Huntley Rd.
- • * Toledo 43605 . . . — 405 Dearborn Ave.
- • Youngstown 44507 . — 272 E Indianola Ave

OKLAHOMA
- • Tulsa 74145 . — 5220 S 100th East Ave

OREGON
- • Eugene 97402 . . . . — 570 Wilson St.
- • * Portland 97210 — 2727 NW 29th Ave.

PENNSYLVANIA
- • Allentown 18103 . — 668 E Highland St.
- • (Delaware Valley) Cherry Hill, N J, 08034 . . . . — 1790 E. Marlton Pike
- • Johnstown 15802 . . — 841 Oak St
- • Philadelphia 19124 — 1040 East Erie Ave.
- • * (Pittsburgh) West Mifflin 15122 . — 4930 Buttermilk Hollow Rd.
- • York 17403 . . . — 54 N Harrison St.

SOUTH CAROLINA
- • (Charleston) No. Charleston 29401 . . — 2490 Debonair St

TENNESSEE
- • Knoxville 37914 . — 2621 Governor John Sevier Hwy.
- • Memphis 38107 — 708 North Main St.

TEXAS
- • Beaumont 77705 . . . — 1490 W. Cardinal Dr
- • Corpus Christi 78401 . . . . — 115 Waco St
- • * Dallas 75235 . . . . — 3202 Manor Way
- • Houston 77036 . — 5534 Harvey Wilson Dr.
- • Houston 77036 . — 6916 Harwin Dr.
- • Midland 79701 . . . — 704 S. Johnston St.

UTAH
- • * Salt Lake City 84110 . — 301 S. 7th West St

VIRGINIA
- • * Richmond 23224 . . — 1403 Ingram Ave.
- • Roanoke 24013 . . . — 1004 River Ave., SE

WASHINGTON
- • * Seattle 98134 . . . — 3422 First Ave., South
- • Spokane 99211 . . — E. 4323 Mission St.

WEST VIRGINIA
- • * Charleston 25328 . — 306 MacCorkle Ave., SE

WISCONSIN
- • (Appleton) Menasha 54910 — 1725 Racine St.
- • Milwaukee 53207 — 235 W Oklahoma Ave.

• Electrical/Mechanical Service Shop * Instrumentation Shop Δ Special Manufacturing Shop