



power
circuit
breakers

general characteristics and ratings

technical
data

33-060

.75 to 345 kv • indoor and outdoor

page 1

In order to assist in the proper selection and application of circuit breakers, standardized ratings are listed with respect to:

1. Maximum voltage at which the breaker may be operated.
2. Insulation level withstand test values.
3. Maximum continuous current with respect to a definite temperature rise.
4. Maximum rms current which the breaker will carry for any time, however small, up to a time of one second.
5. Maximum rms current which the breaker will carry for four seconds.
6. Interrupting ratings.
7. Time from energizing trip coil with normal voltage until circuit is interrupted at 25 percent to 100 percent of interrupting rating.

In choosing a breaker for a particular circuit so that satisfactory service may be expected, it naturally follows that the limitations imposed by a given breaker rating must not be exceeded in any respect, otherwise excessive maintenance or other unsatisfactory manifestations will be experienced.

The standard current ratings of Westinghouse circuit breakers are based on the maximum rms amperes at 60 cycles that the breakers will carry continuously under usual service conditions without exceeding the heating limits specified in the Standardization Rules of the NEMA and A.I.E.E., provided the connections to the breakers do not exceed these limits and all contact surfaces are kept clean and in proper adjustment.

The standard voltage ratings of Westinghouse power circuit breakers range from 750 to 345,000 volts.

The interrupting ratings and breaker characteristics as published by the Westinghouse Electric Corporation are based upon NEMA Standards.

small oil circuit breakers • with CO-2-minute—CO duty cycle

| type | voltage ratings | | | insulation withstand test 60 cycle rms kv | current rating: amperes | | | interrupting ratings® | | |
|---------|-----------------|-------------------------|----------------------------------|---|------------------------------|------------|----------|-------------------------|---------------------------|--------------------|
| | rated kv | maximum design kv | min. kv for rated int. mva | | contin- uous 60 cycles | short time | | 3-phase rated mva | amperes at rated kv | maximum amperes |
| | | | | | | momentary | 4-second | | | |
| indoor | | | | | | | | | | |
| I | 4.16 | 4.76 | 1.5 | 19 | 60 | | 2000 | 2 | 250 | 800 |
| F-10 | 2.5 | 2.5 | 1.5 | 15 | 5-60 | 50* | 25* | 10 | 2400 | 3800 |
| F-10 | 2.5 | 2.5 | 1.5 | 15 | 5-300 | 50* | 25* | 10 | 2400 | 3800 |
| F-11 | 2.5 | 2.5 | 2.3 | 15 | 400 | 6500 | 3800 | 15 | 3500 | 3800 |
| MF | 2.5 | 2.5 | 2.3 | 15 | 400 | 6500 | 3800 | 15 | 3500 | 3800 |
| MF | 4.16 | 4.76 | 2.3 | 19 | 600 | 10000 | 6300 | 25 | 3500 | 6300 |
| outdoor | | | | | | | | | | |
| FO-11 | 4.16 | 4.76 | .75 | 19 | 200 | 50* | 25* | 4.5 | 600 | 4000 |
| FO-11 | 4.16 | 4.76 | .75 | 19 | 400 | 50* | 25* | 4.5 | 600 | 4000 |
| F-1W.P. | 4.16 | 4.76 | .75 | 19 | 5-200 | 50* | 25* | 9 | 1200 | 8000 |
| F-1W.P. | .75 | .75 | .75 | 4 | 300 | 50* | 25* | 6.5 | 5000 | 8000 |
| subway | | | | | | | | | | |
| FS-11 | 7.2 | 7.5 | .75 | 26 | 200 | 7000 | 4000 | 5 | 400 | 4000 |
| FS-11 | 7.2 | 7.5 | .75 | 26 | 400 | 7000 | 4000 | 5 | 400 | 4000 |

* Times coil rating.

® Interrupting Ratings. In these tables are listed the rms total amperes which the breakers are rated to interrupt under the conditions imposed by two unit operations with a two-minute interval. Each unit operation consists of a closing of the circuit breaker followed immediately by its opening without purposely delayed action. To obtain the ampere interrupting rating of a breaker for use on a system of less than rated voltage the following formula should be used:

$$\text{Amperes at system voltage} = \text{Amperes at rated voltage} \times \frac{\text{rated voltage}}{\text{system voltage}}$$

If the value so calculated exceeds that given in the column headed "Maximum Rating", the maximum rating must be used as the interrupting rating of the breaker. In no case should a breaker be used to interrupt currents greater than the maximum interrupting rating listed.

February, 1958

supersedes performance data 33-110 dated March, 1954
mailed to: E/275-261/AD; C26-3X, Y, Z, a



power circuit breaker ratings

| type | voltage ratings | | | insulation level | | current ratings: amperes | | | interrupting ratings | | | |
|------------|-----------------|----------------------------------|-------------------------------------|------------------------------|------------------------------|---------------------------------------|----------------|-------------|-------------------------|---------------------------------------|------------------------------|-----------------------------|
| | rated kv (1) | maxi- mum design kv (1) | min. kv for rated int. mva | withstand test | | contin- uous 60 cycles (3-a) | short time | | 3-phase rated mva | amperes at rated voltage (4) | maxi- mum am- peres | time in cycles (5) |
| | | | | low fre- quency rms-kv | impulse crest kv (2-a) | | momen- tary | 4 second | | | | |
| indoor oil | | | | | | | | | | | | |
| F-122 | 4.16 | 4.76 | 2.3 | 19 | 60 | 600 | 10000 | 6300 | 25* | 3500* | 6300* | 8 |
| F-124-A | 4.16 | 4.76 | 2.3 | 19 | 60 | 1200 | 20000 | 12500 | 50 | 7000 | 12500 | 8 |
| F-124-A | 7.2 | 8.25 | 2.3 | 26 | 75 | 600 | 20000 | 12500 | 50 | 4000 | 12500 | 8 |
| F-100 | 7.2 | 8.25 | 2.3 | 26 | 75 | 600 | 40000 | 25000 | 100 | 8000 | 25000 | 8 |
| F-100 | 7.2 | 8.25 | 2.3 | 26 | 75 | 1200 | 40000 | 25000 | 100 | 8000 | 25000 | 8 |
| F-100 | 7.2 | 8.25 | 2.3 | 26 | 75 | 2000 | 40000 | 25000 | 100 | 8000 | 25000 | 8 |
| B-20-B | 13.8 | 15.0 | 4.0 | 36 | 95 | 600 | 35000 | 22000 | 150 | 6300 | 22000 | 8 |
| B-20-B | 13.8 | 15.0 | 4.0 | 36 | 95 | 1200 | 35000 | 22000 | 150 | 6300 | 22000 | 8 |
| B-22-B | 13.8 | 15.0 | 4.0 | 36 | 95 | 1200 | 60000 | 36000 | 250 | 10600 | 36000 | 8 |
| B-28-B | 13.8 | 15.0 | 6.6 | 36 | 95 | 1200 | 70000 | 44000 | 500 | 21000 | 44000 | 8 |
| B-28-B | 13.8 | 15.0 | 6.6 | 36 | 95 | 2000 | 70000 | 44000 | 500 | 21000 | 44000 | 8 |
| O-111-A | 14.4 | 15.5 | 6.6 | 50 | 110 | 1200 | 70000 | 44000 | 500 | 20000 | 44000 | 8 |
| O-22-B | 14.4 | 15.5 | 12 | 50 | 110 | 1200 | 77000 | 48000 | 1000 | 40000 | 48000 | 8 |
| O-22-B | 14.4 | 15.5 | 12 | 50 | 110 | 3000 | 77000 | 48000 | 1000 | 40000 | 48000 | 8 |
| O-44-C | 14.4 | 15.5 | 12 | 50 | 110 | 2000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| O-44-C | 14.4 | 15.5 | 12 | 50 | 110 | 4000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| O-44-C | 34.5 | 38 | 23 | 80 | 200 | 1200 | 61000 | 38000 | 1500 | 25000 | 38000 | 8 |
| O-44-C | 34.5 | 38 | 23 | 80 | 200 | 3000 | 61000 | 38000 | 1500 | 25000 | 38000 | 8 |

indoor oilless - type CA compressed air circuit breakers

| | | | | | | | | | | | | |
|--------------------|------|------|----|-----|-----|------|--------|--------|------|--------|--------|---|
| 150 CAF 500 | 14.4 | 15.5 | 12 | 50 | 110 | 2000 | 40000 | 24000 | 500 | 20000 | 24000 | 8 |
| 150 CA 1000 | 14.4 | 15.5 | 12 | 50 | 110 | 1200 | 77000 | 48000 | 1000 | 40000 | 48000 | 8 |
| 150 CA 1000 | 14.4 | 15.5 | 12 | 50 | 110 | 3000 | 77000 | 48000 | 1000 | 40000 | 48000 | 8 |
| 150 CA 1500 | 14.4 | 15.5 | 12 | 50 | 110 | 2000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| 150 CA 1500 | 14.4 | 15.5 | 12 | 50 | 110 | 4000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| 150 CA 2500 | 14.4 | 15.5 | 12 | 50 | 110 | 5000 | 190000 | 120000 | 2500 | 100000 | 120000 | 8 |
| 345 CAF 500 | 34.5 | 38 | 23 | 80 | 200 | 1200 | 18000 | 12600 | 500 | 8400 | 12600 | 8 |
| 345 CA 1500 | 34.5 | 38 | 23 | 80 | 200 | 1200 | 61000 | 38000 | 1500 | 25000 | 38000 | 8 |
| 345 CA 1500 | 34.5 | 38 | 23 | 80 | 200 | 3000 | 61000 | 38000 | 1500 | 25000 | 38000 | 8 |
| 345 CA 2500 | 34.5 | 38 | 24 | 80 | 200 | 3000 | 96000 | 60000 | 2500 | 42000 | 60000 | 8 |
| 690 CA 3500 | 69 | 72.5 | 66 | 160 | 350 | 2000 | 49000 | 31000 | 3500 | 29000 | 31000 | 8 |
| 690 CA 5000 | 69 | 72.5 | 66 | 160 | 350 | 2000 | 70000 | 44000 | 5000 | 42000 | 44000 | 8 |

notes:

A. These ratings are based on the recommendations of the EEI-AEIC-NEMA Joint Committee on Power Circuit Breakers.

B. These interrupting ratings are for 60-cycle systems. Applications on 25-cycle systems should receive special consideration.

The following items refer to the corresponding numbers in the table:

(1) Voltage ratings based on recommendations of EEI-NEMA Joint Committee on Preferred Voltage Ratings for A-C Systems and Equipment.

(2-a) 1.5 x 40 ms positive or negative. All impulse values are phase-to-phase and phase-to-ground and across the open contacts. 14.4 breakers and 34.5-kv breakers, when used at lower voltages or on grounded neutral systems where

adequate surge or over-voltage protection is provided, may have the impulse tests specified at 95 kv or 150 kv respectively. Such applications should be given special consideration.

(2-b) 1.5 x 40 ms positive or negative wave. All impulse values are phase-to-phase, and phase-to-ground and across the open contacts.

(3) The 25-cycle continuous current ratings in amperes are given herewith following the respective 60-cycle ratings:

a. 600-700; 1200-1400; 2000-2250; 3000-3500; 4000-4500; 5000-5500.

b. 600-700; 800-900; 1200-1400; 2000-2250; 3000-3500; 4000-4500.

▲ F-122 interrupting rating is based on CO-2 minute-CO duty cycle.

general characteristics and ratings

technical
data

33-060

.75 to 345 kv • indoor and outdoor

page 3

| type | voltage ratings | | | insulation level | | current ratings: amperes | | | interrupting ratings | | | |
|----------------|-----------------|----------------------------------|-------------------------------------|------------------------------|------------------------------|---------------------------------------|----------------|-------------|-------------------------|---------------------------------------|------------------------------|-----------------------------|
| | rated kv (1) | maxi- mum design kv (1) | min. kv for rated int. mva | withstand test | | contin- uous 60 cycles (3-b) | short time | | 3-phase rated mva | amperes at rated voltage (4) | maxi- mum am- peres | time in cycles (5) |
| | | | | low fre- quency rms-kv | impulse crest kv (2-b) | | momen- tary | 4 second | | | | |
| outdoor oil | | | | | | | | | | | | |
| F022B | 7.2 | 8.25 | 2.3 | 26 | 75 | 600 | 20000 | 12500 | 50 | 4000 | 12500 | 8 |
| 144 G 100 | 14.4 | 15.5 | 3.85 | 50 | 110 | 600 | 24000 | 15000 | 100 | 4000 | 15000 | 5 |
| 144 G 250 | 14.4 | 15.5 | 5.8 | 50 | 110 | 600 | 40000 | 25000 | 250 | 10000 | 25000 | 5 |
| 144 G 250 | 14.4 | 15.5 | 5.8 | 50 | 110 | 1200 | 40000 | 25000 | 250 | 10000 | 25000 | 5 |
| 144 G 1000 | 14.4 | 15.5 | 12 | 50 | 110 | 1200 | 77000 | 48000 | 1000 | 40000 | 48000 | 8 |
| 144 G 1500 | 14.4 | 15.5 | 12 | 50 | 110 | 3000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| 144 G 1500 | 14.4 | 15.5 | 12 | 50 | 110 | 4000 | 115000 | 72000 | 1500 | 60000 | 72000 | 8 |
| 230 G 250 | 23 | 25.8 | 12 | 60 | 150 | 600 | 19000 | 12000 | 250 | 6300 | 12000 | 5 |
| 230 G 500 | 23 | 25.8 | 12 | 60 | 150 | 1200 | 38000 | 24000 | 500 | 12600 | 24000 | 8 |
| 345 G 500 | 34.5 | 38 | 23 | 80 | 200 | 1200 | 20000 | 12600 | 500 | 8400 | 12600 | 8 |
| 345 G 1000 | 34.5 | 38 | 23 | 80 | 200 | 1200 | 40000 | 25000 | 1000 | 17000 | 25000 | 8 |
| 345 G 1500 | 34.5 | 38 | 23 | 80 | 200 | 1200 | 61000 | 38000 | 1500 | 25000 | 38000 | 8 |
| 345 G 2500 | 34.5 | 38 | 24 | 80 | 200 | 2000 | 96000 | 60000 | 2500 | 42000 | 60000 | 8 |
| 460 G 500 | 46 | 48.3 | 40 | 105 | 250 | 1200 | 12000 | 7200 | 500 | 6300 | 7200 | 8 |
| 460 G 1500 | 46 | 48.3 | 40 | 105 | 250 | 1200 | 35000 | 22000 | 1500 | 19000 | 22000 | 8 |
| 690 G 1000 | 69 | 72.5 | 60 | 160 | 350 | 1200 | 16000 | 9600 | 1000 | 8400 | 9600 | 5 |
| 690 G 1500 | 69 | 72.5 | 60 | 160 | 350 | 1200 | 23000 | 14500 | 1500 | 12600 | 14500 | 5 |
| 690 G 2500 | 69 | 72.5 | 60 | 160 | 350 | 1200 | 38000 | 24000 | 2500 | 21000 | 24000 | 5 |
| GO 5 A | 69 | 72.5 | 60 | 160 | 350 | 1200 | 38000 | 24000 | 2500 | 21000 | 24000 | 5 |
| GM 6 A | 69 | 72.5 | 66 | 160 | 350 | 2000 | 49000 | 31000 | 3500 | 29000 | 31000 | 5 |
| GM 6 | 69 | 72.5 | 66 | 160 | 350 | 2000 | 49000 | 31000 | 3500 | 29000 | 31000 | 5 |
| 690 GM 5000 | 69 | 72.5 | 66 | 160 | 350 | 2000 | 70000 | 44000 | 5000 | 42000 | 44000 | 5 |
| GM 3 | 115 | 121 | 105 | 260 | 550 | 800 | 13500 | 8300 | 1500 | 7500 | 8300 | 5 |
| GM 6 | 115 | 121 | 110 | 260 | 550 | 1200 | 39000 | 26000 | 5000 | 25000 | 26000 | 3 |
| 1150 GM 10000+ | 115 | 121 | 110 | 260 | 550 | 1600 | 78000 | 52000 | 10000 | 50000 | 52000 | 3 |
| GM 5 | 138 | 145 | 120 | 310 | 650 | 1200 | 36000 | 24000 | 5000 | 21000 | 24000 | 3 |
| GM 7 | 138 | 145 | 132 | 310 | 650 | 1600 | 66000 | 44000 | 10000 | 42000 | 44000 | 3 |
| 1380 GM 15000 | 138 | 145 | 132 | 310 | 650 | 2000 | 99000 | 66000 | 15000 | 63000 | 66000 | 3 |
| GM 5 | 161 | 169 | 150 | 365 | 750 | 1200 | 29000 | 19300 | 5000 | 18000 | 19300 | 3 |
| GM 7 | 161 | 169 | 154 | 365 | 750 | 1600 | 57000 | 38000 | 10000 | 36000 | 38000 | 3 |
| 1610 GM 15000 | 161 | 169 | 154 | 365 | 750 | 1600 | 84000 | 56000 | 15000 | 54000 | 56000 | 3 |
| 2300 GW 5000 | 230(6) | 242(6) | 220(6) | 425(6) | 900(6) | 1200 | 19500 | 13000 | 5000 | 12500 | 13000 | 3 |
| 2300 GW 10000 | 230(6) | 242(6) | 220(6) | 425(6) | 900(6) | 1600 | 39000 | 26000 | 10000 | 25000 | 26000 | 3 |
| 2300 GW 15000 | 230(6) | 242(6) | 220(6) | 425(6) | 900(6) | 1600 | 58500 | 39000 | 15000 | 37500 | 39000 | 3 |
| 3450 GW 25000 | 345(6) | 362(6) | 330(6) | 555(6) | 1300(6) | 1600 | 66000 | 44000 | 25000 | 42000 | 44000 | 3 |

outdoor oilless • type CA compressed air circuit breakers

| | | | | | | | | | | | | |
|----------------------|-----|-----|-----|--------|--------|------|-------|-------|-------|-------|-------|---|
| 1380 CA 10000 | 138 | 145 | 132 | 310(7) | 650(6) | 1600 | 66000 | 44000 | 10000 | 42000 | 44000 | 3 |
|----------------------|-----|-----|-----|--------|--------|------|-------|-------|-------|-------|-------|---|

- (4) To obtain the rated interrupting current of a breaker at an operating voltage other than the rated voltage of the circuit breaker, the following formula should be used:

Amperes at operating voltage

$$= \text{amperes at rated voltage} \times \frac{\text{rated voltage}}{\text{operating voltage}}$$

For calculated values use the nearest 100-ampere step.

If the value so calculated exceeds that of the rated maximum interrupting current, then the latter rating must be used as the interrupting rating of the breaker.

- (5) The rated interrupting time of the breakers listed in this table shall be not more than the number of cycles given in column headed "Time in Cycles". Time shall be measured at 60 cycles per second.

- (6) The GW type breakers are intended for applications only on systems effectively grounded as defined by AIEE-32. When protected by lightning arresters, the arresters shall have a maximum permissible line-to-ground rating of 196 kv and 264 kv for the 230 kv and 345 kv breaker ratings respectively.

- (7) These ratings apply only when pressure in tanks is 200 psi gauge or above.

+ This rating has not been standardized by EEE-AEIC-NEMA Joint Committee.



reclosing duty cycle factors

for breakers listed on pages 2 and 3
(except type F-122)

NEMA SG-6-90 breaker rating factors for reclosing service (rev.)

A. The interrupting ratings of power circuit breakers may be reduced for operating duty cycles other than the standard, CO+15 sec.+CO (See SG6-40, par. B) to enable them to meet the standard of interrupting performance. (See SG6-40, par. C.)

note: Such factors do not apply to highly repetitive duty at or near the continuous rating of the breaker.

B. For purposes of this section, the following duty cycles shall be considered as representing the *usual duty cycles for reclosing service*:

reclosing duty cycle I—0+15 sec.**+CO+15 sec.**+CO+15 sec.**+CO

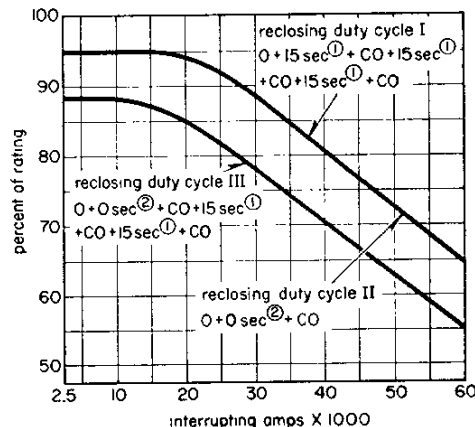
reclosing duty cycle II—0+0 sec.**+CO

reclosing duty cycle III—0+0 sec.**+CO+15 sec.**+CO+15 sec.**+CO

* Zero seconds shall be interpreted to mean no intentional time delay.
** 15 seconds or longer.

C. The breaker rating factors for the usual reclosing duty cycles are obtained by reference to figure 1. This gives the percentage rating factor for the duty cycle in question at the rated interrupting current at the circuit voltage of the system to which the breaker will be applied.

figure 1



① ~ 15 seconds or longer.

② ~ Zero seconds shall be interpreted to mean no intentional time delay

D. The breaker interrupting rating at the specified reclosing duty cycle is obtained by multiplying the rated interrupting amperes by the rating factor.

Example: Determine the interrupting rating of a 34.5 kv, 1000 mva breaker used at 23 kv on reclosing duty cycle I.

1. Breaker interrupting rating on standard duty cycle:
17,000 amperes at 34.5 kv
25,000 amperes at 23 kv
2. Figure 1 gives a rating factor of 91.5% at 25,000 amperes for reclosing duty cycle I.
3. Breaker interrupting rating on duty cycle I at 23 kv = rating factor, 91.5% x 25,000 amperes = 22,900 amperes.

E. *breaker rating factors for other than the usual reclosing duty cycles*

1. The standard for the number of operations is two (2). Additional operations increase the duty on the contacts

and therefore a rating is applied to enable circuit breakers to meet standards of interrupting performance. (See SG6-40, par. C.)

(a) *for three operations*—Use mean factor between 2 and 4 operations (standard and duty cycle I).

Example: 0+15 sec.+CO+15 sec.+CO
% Factor = 97 for 20,000 amperes

(b) *for five operations*—Use factor obtained by reducing that for 4 operations (duty cycle I) by difference between 2 and 4 operations.

Example: 0+15 sec.+CO+15 sec.+CO+15 sec.+CO+15 sec.+CO
% Factor = 94—6 = 88 for 20,000 amperes

2. The standard for the interval between operations is 15 seconds. Reducing this interval increases the interrupting duty and therefore a rating factor is applied to enable breaker to meet standards of interrupting performance. (See SG6-40 par. C.)

(a) *for two operations*—Reduce 100% factor for 15 seconds by an amount equal to proportionate part of the reduction for zero interval as determined by the ratio of the times.

Example: 0+5 sec.+CO
% Factor = 100— $\frac{2}{5}(100-94)$ = 96 for 20,000 amperes

(b) *for four operations*—Multiply the factor for duty cycle I by the appropriate factor determined under paragraph 2 (a) for each interval less than standard.

Example: 0+5 sec.+CO+5 sec.+CO+5 sec.+CO
% Factor = 94 x 96 x 96 x 96 = 83 for 20,000 amperes

(c) *for three or five operations*—Use combination of rule 1 and rule 2 (a) applied for each interval.

Example: 0+5 sec.+CO+5 sec.+CO
% Factor = 97 x 96 x 96 = 89 for 20,000 amperes

3. The usual instantaneous reclosing cycles are duty cycles II and III. Variations are in the number of operations.

(a) *for three operations*—Use mean between factors for duty cycles II and III.

Example: 0+0 sec.+CO+15 sec.+CO
% Factor = $\frac{94+85}{2}$ = 89.5 for 20,000 amperes

(b) *for five operations*—Use factor by reducing that for 4 operations (duty cycle III) by difference between 2 and 4 operations.

Example: 0+0 sec.+CO+15 sec.+CO+15 sec.+CO+15 sec.+CO
% Factor = 85—(94—85) = 76 for 20,000 amperes

for breakers listed on page 1 (and type F-122)

| duty cycles | interrupting rating in percentage of standard ratings |
|-------------------------------------|---|
| CO—2 min.—CO | 100 |
| CO—2 min.—CO—2 min.—CO | 70 |
| CO—30 sec.—CO—30 sec.—CO—30 sec.—CO | 60 |
| CO—15 sec.—CO | 60 |
| CO—0 sec.—CO—0 sec.—CO—0 sec.—CO | 25 |
| CO—0 sec.—CO—30 sec.—CO—75 sec.—CO | 30 |
| CO—15 sec.—CO—30 sec.—CO—75 sec.—CO | 40 |
| CO—60 sec.—CO—60 sec.—CO | 70 |

+ '0 sec.' shall be interpreted to mean no intentional time delay.