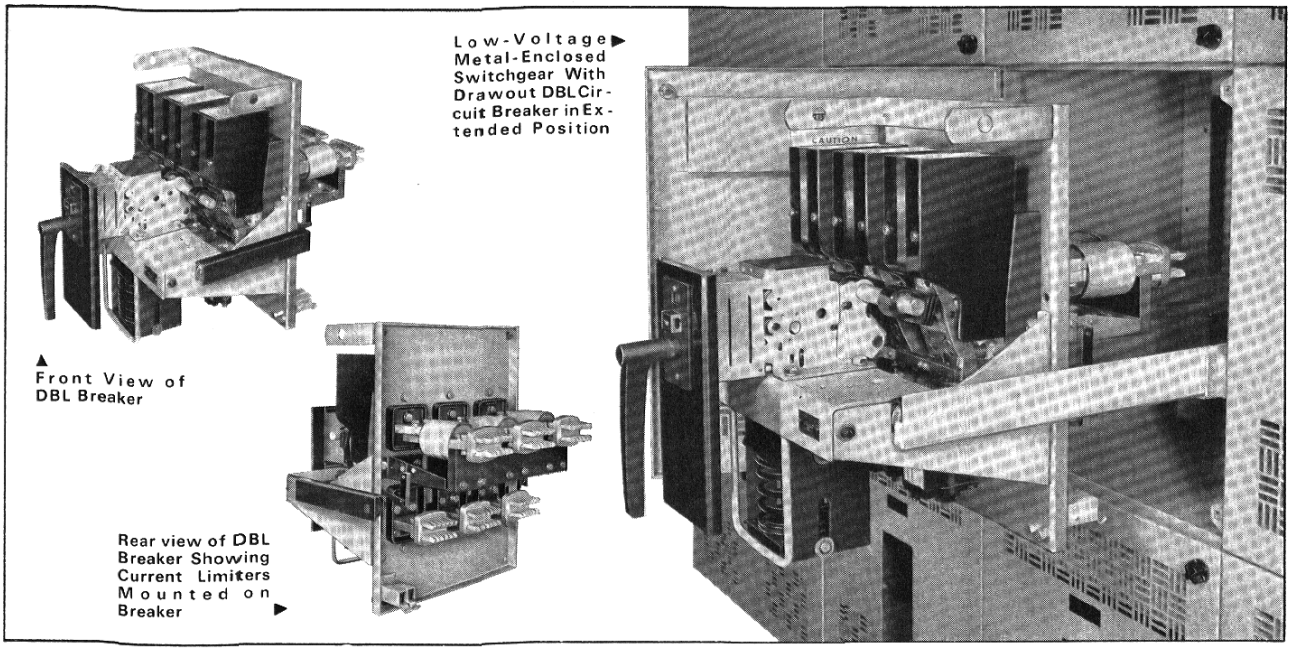
Westinghouse

Low-Voltage Power Circuit Breakers Type DBL Current Limiters

600 Volts A-c
Up to 200,000 Amperes



▲ Front View of DBL Breaker

Rear view of DBL Breaker Showing Current Limiters Mounted on Breaker ▶

Low-Voltage ▶ Metal-Enclosed Switchgear With Drawout DBL Circuit Breaker in Extended Position

Application

The type DBL breakers are combinations of DB breakers and fuses of the current limiting type. DBL breakers are intended for applications needing the overload protection and switching functions of the DB breaker on systems whose available fault current exceeds the interrupting capacity of the DB breakers. By proper choice of DBL breakers, overload protection can be provided, with DB overcurrent trip devices, for relatively small current feeders connected to high short circuit capacity busses. Also, DBL breakers may be used to good advantage when it is desired to protect feeder circuits and load devices from the effects of the first two or three cycles of high fault current, which may occur while the standard DB breaker is interrupting.

Size and Arrangements

The DBL-25 and DBL-50 have the limiter mounted integrally with the drawout unit. The limiter is on the upper terminal and projects horizontally to the rear. The cell structure for the DBL-25 and DBL-50 breaker is just six inches deeper than corresponding cells for standard DB breakers.

The limiters for use with DB-75 and DB-100 breakers are separately mounted on a limiter drawout truck which is placed in the switchgear immediately above associated DB breaker. Bus work is arranged to connect limiters in series ahead of DB-75 or DB-100 breaker.

Interrupting Ability and Scope

The type DB circuit breaker will handle any normal overload currents on a time delay basis and will trip instantaneously at the currents listed in table 1A. For faults above 1500% (Assuming the minimum coordinating fuse is used) of the coil rating, the limiter becomes a faster interrupter than the DB breaker and will give protection to the breaker up to 200,000 amperes maximum.

Built-in Trigger Fuses

The limiters used with the DBL-25 and DBL-50 breakers include "built-in" trigger fuses which operate to trip the breaker open should any one limiter blow, this protects against single phase operation. These trigger fuses indicate which phase has been opened and they also keep the circuit breaker "trip free" until the faulted fuses has been replaced.

Safety Feature

DBL-25 and DBL-50 limiters form an integral part of the breaker and are inaccessible until the breaker is completely withdrawn from the compartment. The breaker cannot be withdrawn until it has been tripped open. This positive safety feature prevents contact with the limiters unless the circuit breaker is open and breaker and limiters are completely isolated.

Higher Rated DBL's in Series With DB-75 and DB-100 Breakers

For steady state loads above 1600 amperes and when the short circuit capacity of the system exceeds the interrupting rating of the type DB-75 or DB-100 breakers, higher current rating limiters may be put in series with the standard DB-75 or DB-100 breakers.

Standard drawout features are obtained by mounting the limiters on a separate drawout truck located in a compartment which is placed above the DB-75 or DB-100 drawout breaker compartment. The fuse truck is interlocked with the breaker to insure the breaker is open before the fuse truck can be withdrawn.

These separate current limiters include trigger fuses and a micro-switch for each pole. When a main current limiter operates to clear a fault, the trigger fuse operates the micro-switch, which in turn trips the circuit breaker through its shunt trip coil, eliminating single phase operation.

Ratings

The type DBL-25 breaker is available with trip coil ratings of 40, 50, 70, 90, 100, 125, 150, 200, 225, 250, 300, 350, 400, 500, and 600 amperes.

The type DBL-50 breaker is available with trip coil ratings of 600, 800, 1000, 1200, and 1600 amperes.

Maximum fuse ratings are listed in table 1, part B.

Minimum fuse ratings are listed in table 1, part A.

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Table 1: Fuse Ratings

Part A:
Minimum Fuse Rating in Amperes (For Coordination With Breaker Trip Element)

Frame Size	Coil Rating Amperes	Instantaneous Pickup Amperes	Long Delay Element Setting Minimum	Curve	Maximum
DBL-25 ③	300	600	200	405410	300
		1200	300	405410	400
		1500	500	351056	500
		2400	800	351056	1000
		3000	800	351056	1000
		3600	1000	405123	1000
	400	800	300	405410	300
		1600	500	405410	600
		2000	600	351056	600
		3200	1000	351056	1000
		4000	1200	351056	1200
		4800	1200	405123	1600
	500	1000	300	405410	400
		2000	600	405410	800
		2500	800	351056	800
		4000	1000	351056	1200
		5000	1600	351056	1600
		6000	1600	405123	2000
	600	1200	400	405410	500
		2400	800	405410	800
		3000	1000	351056	1000
		4800	1200	351056	1600
		6000	1600	351056	2000
		7200	2000	405123	2000
DBL-50 ③	800	1600	600	375475	600
		3200	800	375475	1000
		4000	1200	351057	1200
		6400	2000	351057	2500
		8000	2500	351057	2500
		9600	3000	388530	3000
	1000	2000	600	375475	800
		4000	1000	375475	1200
		5000	1600	351057	1600
		8000	2500	351057	3000
		10000	3000	351057	3000
	1200	2400	800	375475	1000
		4800	1000	375475	1600
		6000	2000	351057	2000
		9600	3000	351057	3000
	1600	3200	1000	375475	1200
		6400	1600	375475	2000
		8000	2500	351057	3000
		12800	3000	351057	④
DBL-75	2000	10000	3000	351058	3000
		15000	4000	351058	④
	3000	10000	3000	351058	3000
		15000	4000	351058	④
DBL-100	4000	10000	3000	351058	3000
		16000	4000	351058	5000
		20000	6000	351058	6000

③ Lower rating trip coils are available when desired.
④ Will not coordinate fuse may open before breaker.

Part B:
Maximum Fuse Rating in Amperes (Dependent on Peak Let-Through Current of the Fuse)

Frame Size	System Voltage	Total Available Short Circuit Current 100,000 Amp	150,000 Amp	200,000 Amp
DBL-25	240	2000	2000	1600⑤
	480-600	2000	1600⑤	1200④
DBL-50	240	3000	3000	2500⑤
	480-600	3000	2500⑤	2000⑤
DBL-75	240-600	4000	4000	4000
DBL-100	240-600	6000	6000	6000

⑤ Note: The size fuse listed is recommended as safe and satisfactory for all operating conditions. The next size larger fuse i.e., 1600 amp where 1200 amp appears in table and 2000 amp where 1600 amp appears, etc., may be used if:

a. The breaker has a larger breaker between it and the power source, i.e., a DBL-25 feeder with a DBL-50 main breaker,
or
b. Breaker is electrically operated, and inspected and maintained after every fault operation.

Table 2: Application of Fused Low Voltage Power Circuit Breakers to Full Voltage Motor Starting and Running Duty of 3 Phase 60 Cycle 40°C Rise Motors

Cont. Curr. Rating of Fused Breaker Amperes	Motor Full Load Current Amperes Minimum	Maximum	Maximum Permissible Motor Locked Rotor Curr. at 60 Cycles, Amps①	Rating of Current Limiting Fuse② Amperes	Horsepower Rating of 3 Phase Alternating Current Motors: Induction Motors 220V	440V	550V	100 Per Cent Power Factor Synchronous Motors 220V	440V	550V	80 Per Cent Power Factor Synchronous Motors 220V	440V	550V
125	80	109	1000	400	40	75	100	50	100	125	40	75	100
150	96	131	1200	600	50	100	125	60	...	150	...	...	...
175	112	152	1400	600	60	...	150	...	125	...	50	100	125
200	128	174	1600	600	...	125	...	75	150	200	60	125	150
225	144	196	1800	800	75	150	200	...	...	...	...	...	...
250	160	218	2000	800	...	...	...	100	200	250	75	150	200
300	192	261	2400	1000	100	200	250	...	...	300	...	...	...
350	224	304	2800	1200	...	250	300	125	250	350	100	200	250
400	256	348	3200	1200	125	...	350	...	300	400	125	250	300
500	320	435	4000	1600	150	300, 350	400, 450	...	350, 400	450, 500	...	300	350, 400
600	384	522	4800	2000	200	400	500	...	450	600	...	350	450
800	512	696	6400	2000	250	450, 500	600, 700	...	500, 600	700,800	...	400, 500	500, 600

① Locked rotor currents are based upon motors having NEC code letters A through F, inclusive. If the locked rotor current exceeds this value, select the fused breaker having the next higher continuous current rating, provided there is a calibration point on the breaker which does not exceed 140 per cent of the motor full load current.
② Based on the use of direct acting trip device with instantaneous element. Where information is available, the fuse rating shall be selected to suit the particular application based on: (a) motor current; (b) direct acting trip characteristics; (c) fuse time melting characteristics; (d) system coordination requirements. When the instantaneous element is omitted from the direct acting trip device, these fuse ratings shall comply with the National Electric Code requirements for motor branch circuit overcurrent protection.

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Limiter Coordination

Curve number 1 shows a typical type DBL breaker overcurrent trip attachment with long time delay and instantaneous characteristics. Line A represents the maximum limiter rating from table 1, part B that should be used with that particular DBL breaker. Note that excellent coordination is secured with the DB breaker and the use of larger limiter ratings would not adequately protect the breaker on high currents.

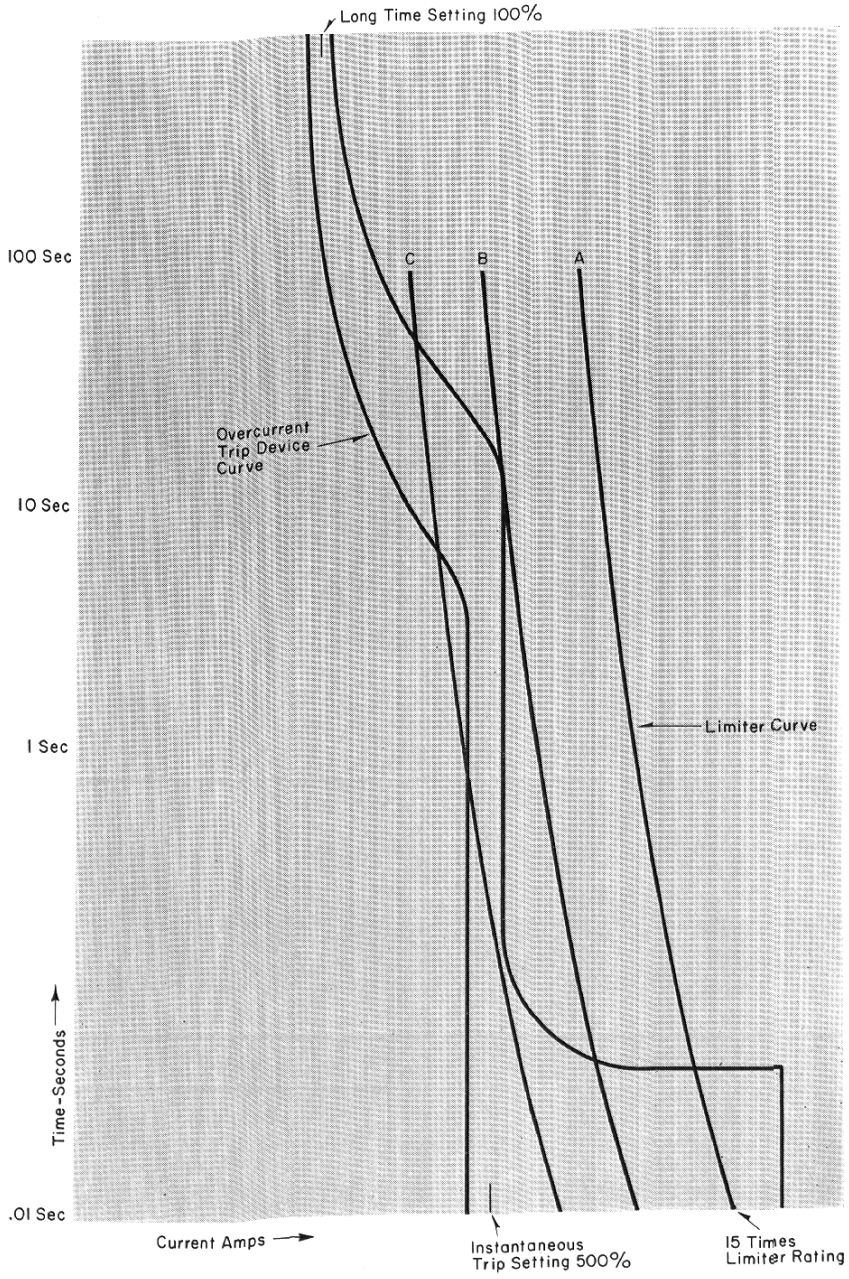
Line B represents the recommended minimum limiter rating from table 1, part A. As can be seen, this curve provides good coordination with the DB breaker. In addition, this limiter would permit less peak amperes to flow than curve A and would thereby provide better protection to secondary distribution apparatus such as bus ducts, motor starters, AB breakers, etc.

Line C represents a limiter that is smaller than the recommended rating. This limiter would permit less peak amperes to flow than either curves B or A and, therefore, would provide better protection to secondary distribution apparatus. However, this limiter would not coordinate with the DB breaker and heavy overloads would cause the limiter to blow instead of tripping of the breaker or both breaker and limiter may go at the same time. This is usually not to the customer's advantage and is not recommended.

Curve number 2 represents a 60 ampere type DBL-50 breaker which has the time delay set at 20 seconds, the long delay pickup set at 100% and the instantaneous trip set at 500%. Note that excellent coordination is secured with all limiters rated 800 amperes to 3000 amperes. However, the dotted line curve represents what happens when the long delay is increased to 30 seconds and the instantaneous trip is increased to 1000%. Note that coordination between breaker and limiter is lost when the lower rated limiters are used. In this case, the 2000 ampere rating would be recommended.

Curve number 3 shows the current limiting effect of the limiters used with type DB breakers. Curve number 4 shows the melting time characteristics of the limiters. Curve number 5 illustrates the operating characteristics of current limiters used with type DB breakers.

Curve 1: Typical DBL Breaker Coordination Curves



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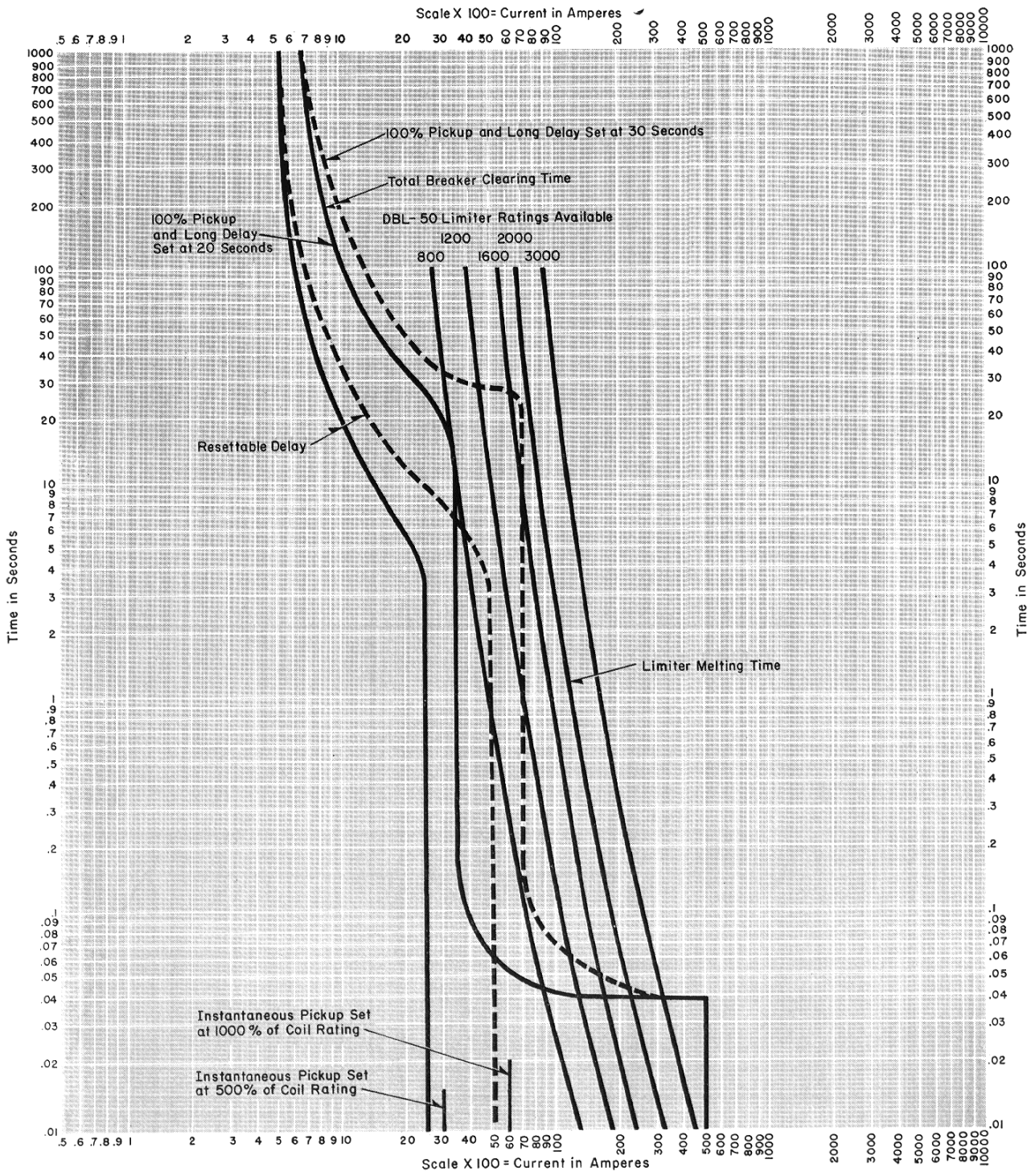
Curve 2: 600 Ampere Type DB-50 Breaker with 800, 1200, 1600 or 2000 Ampere Limiters



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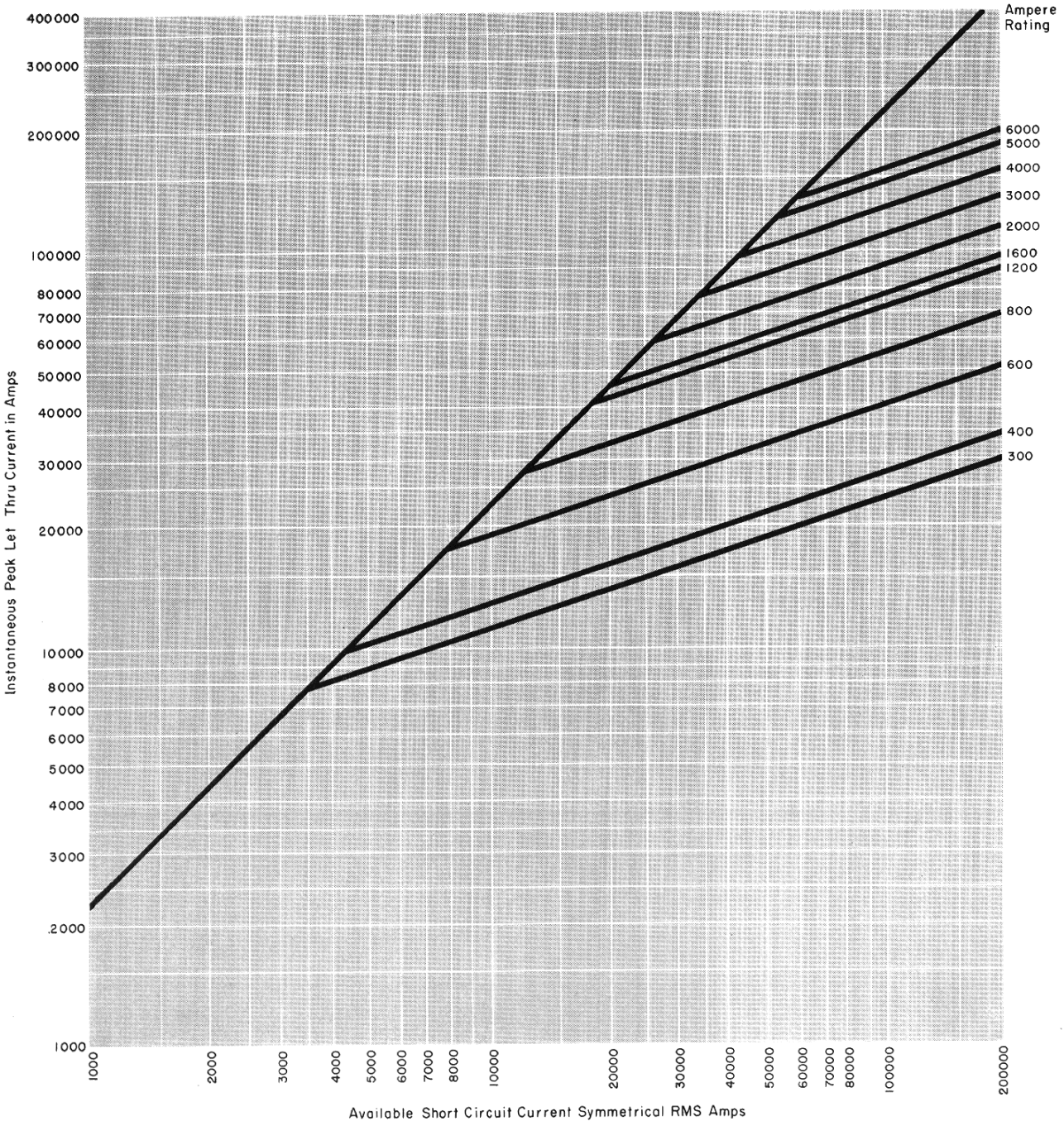
Curve 3: Current Limiting Effect – Type DBL Limiters



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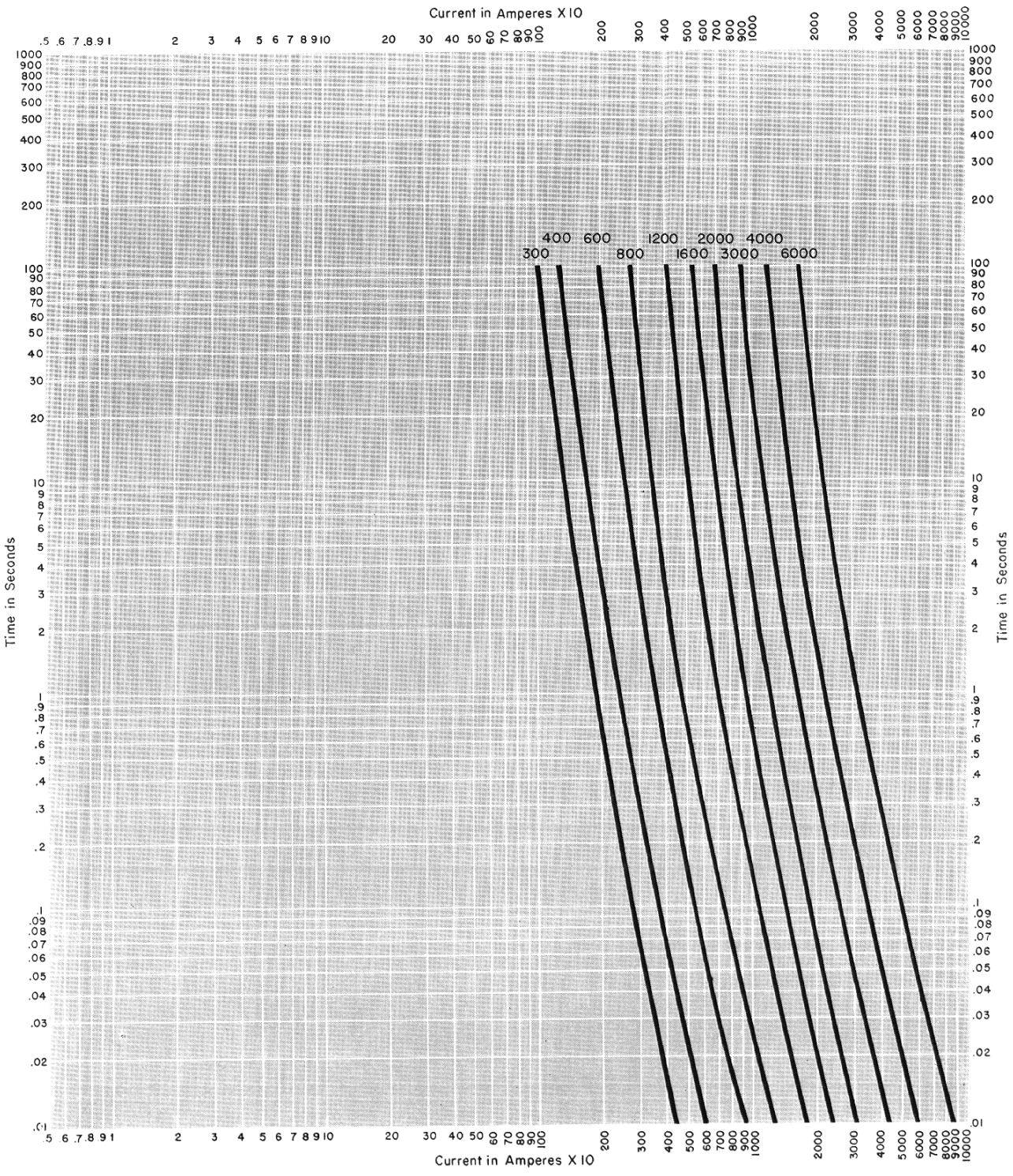
Curve 4: Type DBL Limiters – Melting Time



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Limiter Selection

The primary concept of the current limiter is to protect its circuit breaker. The other equipment being supplied with power from the circuit breaker will also be protected provided that the assumption is made that all equipment protected by the breaker has a short circuit withstand rating equal to the breaker. The following procedure should be used in selecting the proper limiter for circuit breaker protection:

1 Determine the system short circuit capacity in symmetrical amperes.

2 Determine the continuous current rating of the circuit.

3 Select limiter rating which is 125% to 200% of the trip coil rating of the DBL breaker. Maximum limiter rating of 2000 amperes for DBL-25 and 3000 amperes for DBL-50. Refer to table no. 1 for recommended maximum and minimum limiter ratings.

Figure no. 1 shows a typical low voltage system in which limiters are used to extend the range of lower interrupting rating breakers so that they can be used on systems having high short circuit capability.

1 Fault current available = 100,000 amperes symmetrical.

2 From table 1, a maximum fuse size of 2000 amperes is permissible.

3 From table 1 select the minimum fuse that will coordinate with the long delay and instantaneous breaker settings.

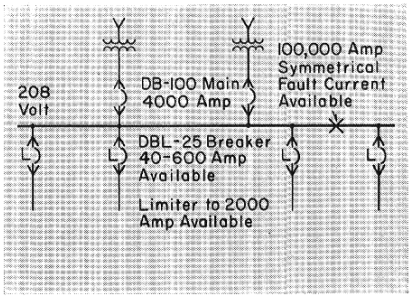


Figure 1: Use of Current Limiters to Protect Feeder Circuit Breakers.

Selection of DBL Breakers

The following procedure should be used as a guide in the selection of a limiter and circuit breaker combination:

1 Determine the short circuit capacity of the system in symmetrical amperes. (Refer to AD 33-760 if the kva ratings of the transformer bank is known).

2 Determine the continuous current rating of the circuit.

3 a Select a breaker frame size equal to, or larger than, the continuous current rating of the circuit.

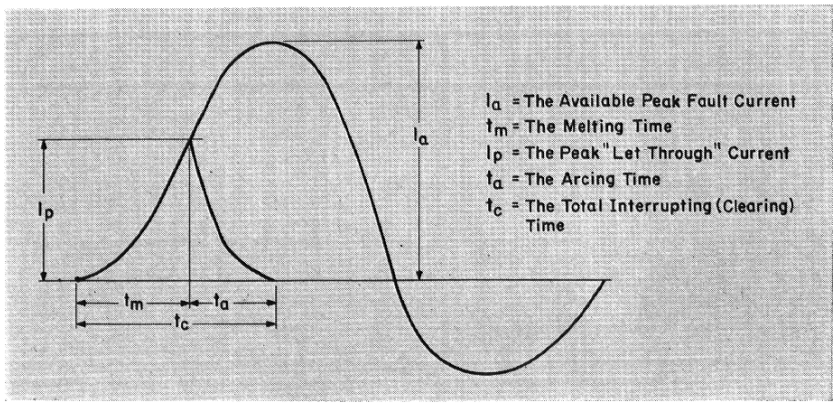
b Select a trip coil rating equal to, or greater than, the maximum continuous load to be carried. Usually a trip coil rating of about 125% of the maximum load is selected.

c Set the long delay pickup at 125% to 150% of the load to be carried. (If the coil rating is 125% of the load, the pickup should be set on the 100% point).

d The instantaneous pickup setting should be between 500 and 1000% of coil rating and will usually be at 500% to get best coordination between trip device and limiter.

e Curve ※351056 is standard for the DBL-25 (30 and 20 seconds long delay) and curve ※351057 is standard for the DBL-50. These curves are filled in AD 33-760-A.

Curve 5: Current Limiting Effect of Type DBL Limiters



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Protection

Secondary Distribution Apparatus

As previously stated, the primary concept of the current limiter is to protect its circuit breaker. However, many applications will arise where the customer's system can produce fault currents which can be satisfactorily handled by standard DB breakers but the secondary distribution equipment may have a short circuit withstand rating which is less than the circuit breaker. Limiters will be required, in these cases. to protect the secondary distribution equipment instead of the circuit breaker.

Figure number 2 shows a low voltage system in which the feeder circuit breakers have adequate interrupting capacity but they are equipped with limiters for the purpose of protecting secondary distribution apparatus such as bus ducts, panelboards, etc.

When the equipment to be protected by the breaker has a short circuit rating less than the DB breaker, curve number 3 must be used to determine the maximum limiter rating that be used. The following procedure should be followed.

1 Determine the short circuit capacity of the system in symmetrical amperes.

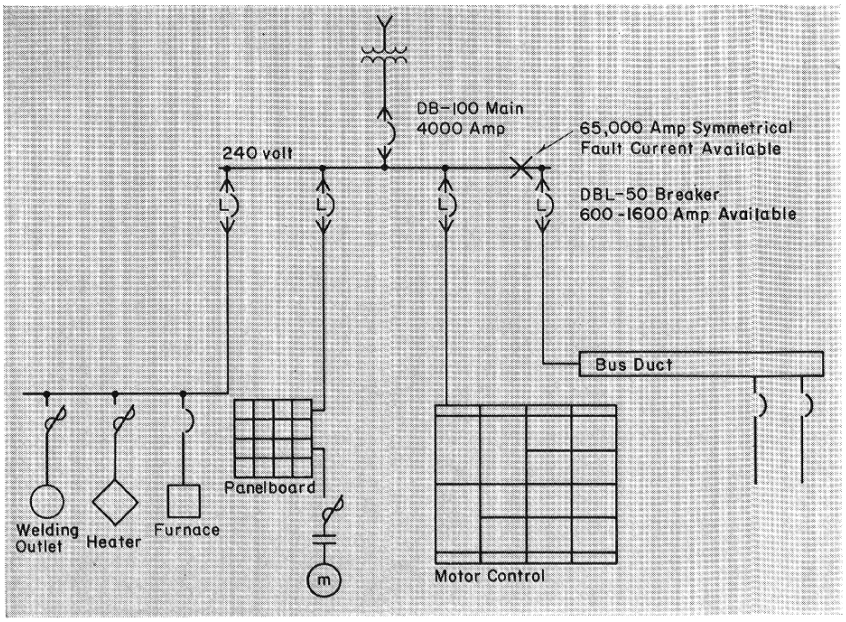
2 Determine the peak instantaneous amperes that the equipment can withstand by multiplying the short circuit rating of the equipment (symmetrical amperes) by 2.3.

3 Select the maximum limiter rating from curve number 3 which lies equal to or below the intersection of the system short circuit current and the peak ampere coordinates.

Withstand Rating

DB breakers have been designed and tested to meet the short time requirements indicated in table 1, part B. The limiter sizes shown in this table have been thoroughly tested and found to perform satisfactorily.

Figure 2: Type DBL Current Limiters Used to Protect Secondary Distribution Apparatus.



1 Maximum fault current available = 65,000 amperes symmetrical.

2 Assume secondary distribution apparatus can withstand only 25,000 amperes symmetrical. This is equivalent to 25,000 x 2.3 or 57,500 peak amperes that the equipment can withstand.

3 From curve no. 3 read peak let-through current when maximum fault current is 65,000 amperes as follows:
800 A limiter = 50,000 peak amperes
1200 A limiter = 65,000 peak amperes
1600 A limiter = 72,000 peak amperes
2000 A limiter = 85,000 peak amperes

4 As can be seen, maximum limiter that can be used to protect secondary distribution apparatus is the 800 ampere rating. Since the limiter must be rated at least 125% of the trip coil rating the maximum coil rating that can be used is the 600 ampere trip coil.

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