

AIR BRAKE EQUIPMENTS.GENERAL:

In order to select the proper size air compressor as well as the type of air brake equipment best suited to meet the operating conditions, information included in form shown on Page 0.2 should be forwarded. Where cars are operated in trains the type of coupler used should be stated. Very frequently this point is overlooked.

If the air brakes are to operate in trains with air brakes of other manufacture be sure to specify the type of equipment, motorman's valve, triple or emergency valve, as well as any special features which the equipment may include.

Complete lists of parts and piping diagrams of air brake equipments for various classes of service are included in the Railway Equipment Price & Data Book.

On the page 0.3 will be found recommendations on the proper equipment to use for various classes of service. These recommendations cover what may be termed standard equipments in which the number of parts, the size of compressor, brake cylinder, and reservoirs are definitely specified.

In some cases it will be found that the size of brake cylinder and reservoirs specified is not correct for the weight of the car on which the equipment is to be installed. On page 0.6 of this section, a table is given from which the proper size of brake cylinder and reservoirs can be selected.

The size of compressor to recommend depends upon widely varying service conditions, such as weight of car, frequency of stops, use of whistles, pneumatic door openers, sanders etc. With these conditions known, from the tables given on Pages 0.4, 0.5, 0.6, an approximation of the amount of air required for a given service can be obtained and from the table on 8.4 the amount of air delivered by the different size compressors when operating 50% of the time on various voltages and pressures can be determined.

These tables are intended for general information and to be used only in preliminary negotiations.

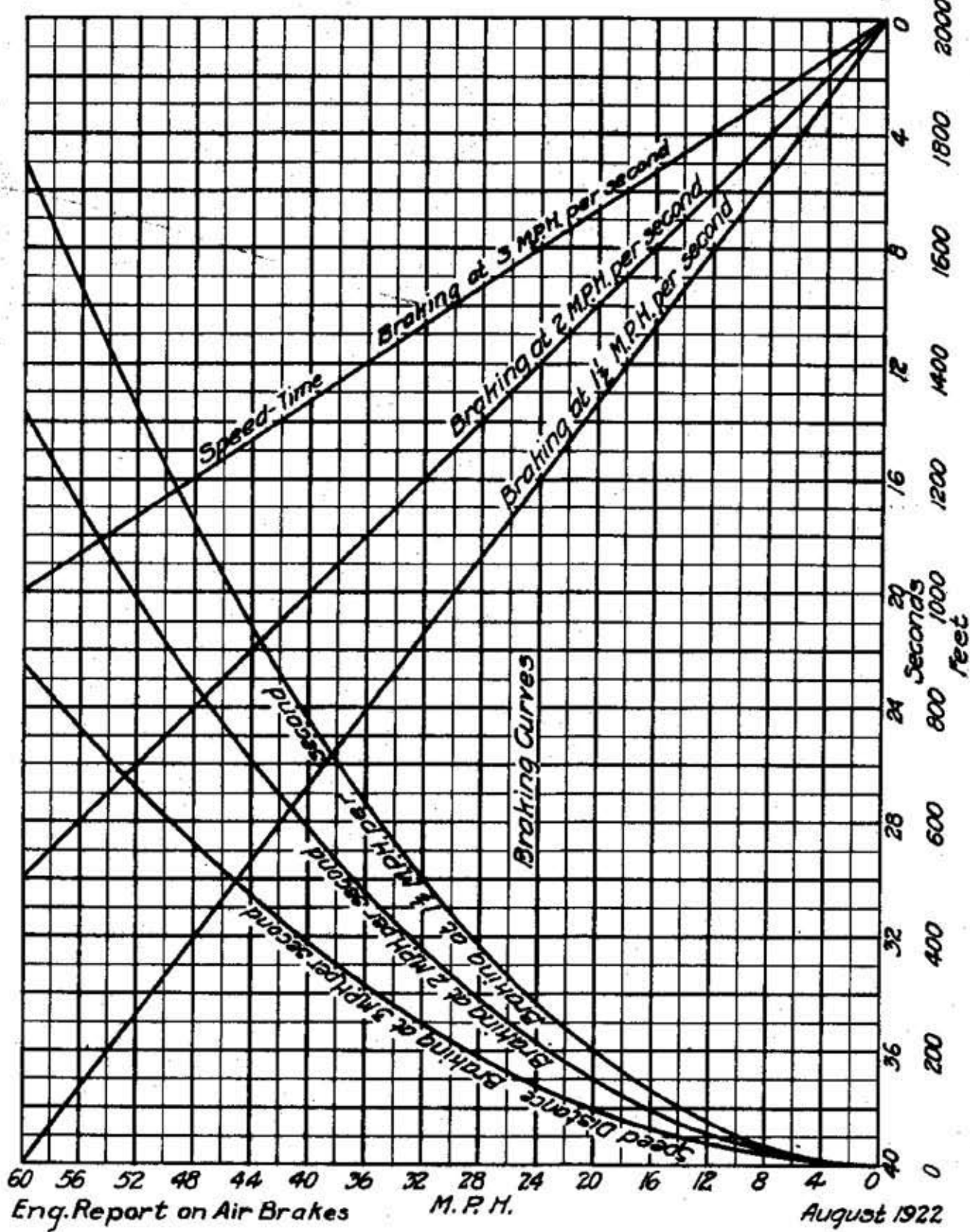
In connection with concrete propositions, unless the size of air compressor required is definitely known, recommendations should be obtained from the factory engineers.

Propositions involving 1200 & 1500 volt apparatus should in all cases be referred to the factory engineers for recommendations.

The curves on the following page show the distance and the time required to bring a car to a stop when braking at uniform rates of 3 miles per hour per second, 2 miles per hour per second, and 1 1/2 miles per hour per second.

To find the DISTANCE required to bring a car to a stop from an initial speed of 40 miles per hour at a uniform braking rate of 2 miles per hour per second;—Note the point at which the line representing a speed of 40 miles per hour intersects the 2 mile per hour per second SPEED DISTANCE braking curve. From this point read down to the row of figures under DISTANCE — FEET which will show that the distance in feet is 586.6.

To find the TIME required to bring a car to a stop from an initial speed of 40 miles per hour at a uniform braking rate of 2 miles per hour per second:— Note the point at which the line representing a speed of 40 miles per hour intersects the 2 miles per hour per second SPEED TIME braking curve. From this point read down to the row of figures under TIME — SECONDS which will show the time in seconds is 20.



PARTIAL LIST OF USERS
GENERAL ELECTRIC COMPANY'S AIR BRAKE EQUIPMENT.

<u>STRAIGHT AIR BRAKE EQUIPMENTS:</u>	No. of Equipments.
Atlantic City & Shore R.R.Co.,	16
Atlantic Shore Line Elec.Ry.,	30
Bartlettsville Int. Ry.Co.,	9
Berkshire St. Ry. Co.,	23
Biddeford & Saco R.R.Co.,	10
Boston & Worcester St. Ry.Co.,	28
Buffalo & Lake Eric Tr.Co.,	18
Cedar Rapids & Marion City Ry.Co.	26
Chattanooga Ry. Lt.& Pr.Co.,	30
Chicago Surface Lines,	468
Columbus Ry. & Lt.Co.,	294
Connecticut Co.,	263
Cumberland County Pr.& Lt.Co.,	26
Dallas Ry.Co.,	18
Denver & Interurban R.R.Co.,	6
Des Moines City Ry.Co.,	15
Dubuque Elect. Co.,	25
Eastern Mass.St. Ry.Co.,	369
East Liverpool Tract.& Lt.Co.,	15
East St.Louis & Suburban Ry.Co.,	32
Empress Electricas Asociadas,	30
Footscray Tramways,	20
Ft. Smith Lt. & Tr.Co.,	11
Gary & Interurban R.R.Co.,	28
Georgia Ry. & Pr.Co.,	15
Grand Rapids Ry. Co.,	68
Hammond Whiting & E. Chic.Ry.Co.	10
Hankai Elect. Ry. Co.,	57
Harrisburg Rys. Co.,	6
Havana Central Ry.,	50
Hobart Municipal,	10
Honolulu Rapid Transit & Land Co.	21
Holyoke St.Ry.Co.,	26
Hudson Valley Ry.Co.,	33
International Ry.Co.,	373
Jacksonville Tr. Co.,	49
Kyuschu Elect.Ry.,	27
Kobe Municipal Ry.,	55
Lehigh Valley Tr.Co.,	13
Lewistown Augusta & Waterville St. Ry Co.,	16
Lincoln Tr.Co.,	23
Macon Ry. & Lt. Co.,	29
Mexico Tramways,	20
Minoma Arima Elec. Ry.,	40
Mobile Lt. & R.R.Co.	8
Montreal Tramways,	337
Nankin Elec. Ry.Co.	11
Atlantic City, N.J.	16
Sanford, Me.	30
Bartlettsville, Okla.	9
Pittsfield, Mass.	23
Biddeford, Me.	10
Boston, Mass.	28
Erie, Pa.	18
Cedar Rapids, Ia.	26
Chattanooga, Tenn.	30
Chicago, Ill.	468
Columbus, Ohio	294
New Haven, Conn.	263
Portland, Me.	26
Dallas, Tex.	18
Denver, Col.	6
Des Moines, Ia.	15
Dubuque, Ia.	25
Boston, Mass.	369
East Liverpool, Ohio	15
East St.Louis, Ill.	32
Peru, S.A.	30
Australia	20
Ft. Smith, Ark.	11
Gary, Ind.	28
Atlanta, Ga.	15
Grand Rapids, Mich.	68
Hammond, Ind.	10
Japan	57
Harrisburg, Pa.	6
Havana, Cuba	50
Australia	10
Hawaii	21
Holyoke, Mass.	26
Glens Falls, N. Y.	33
Buffalo, N.Y.	373
Jacksonville, Fla.	49
Japan	27
Japan	55
Allentown, Pa.	13
Lewistown, Me.	16
Lincoln, Neb.	23
Macon, Ga.	29
Mexico City	20
Japan	40
Mobile, Ala.	8
Montreal, Que.	337
Japan	11

No. of
Equipments.

STRAIGHT AIR BRAKE EQUIPMENTS:

New South Wales Gov't. Rws.,	Sydney, Aust.	271
New York Rys. Co.,	New York City	434
New York State Rys.,	Rochester, N.Y.	101
Northern Ohio Tr. & Lt. Co.,	Akron, Ohio.	10
Ogden, Logan & Idaho Ry. Co.,	Ogden, Utah	6
Oriental Tramways,	Montevideo, Uruguay	80
Osaka Municipal Ry.,	Osaka, Japan	170
Penna. & Ohio Elect. Ry. Co.,	Youngstown, Ohio	39
Pacific Electric Ry. Co.,	Los Angeles, Cal.	10
Philadelphia Rapid Transit Co.,	Philadelphia, Pa.	1567
Portsmouth St. R.R. & Lt. Co.,	Portsmouth, Ohio	21
Portland Ry. Lt. & Pr. Co.,	Portland, Oregon	50
Public Service Ry. Co.,	Newark, N.J.	739
Reading Transit & Lt. Co.,	Reading, Pa.	61
Rhode Island Co.,	Providence, R.I.	138
St. Joseph Ry. Lt. & Pr. Co.,	St. Joseph, Mo.	35
San Diego Elec. Rwy. Co.,	San Diego, Calif.	26
San Francisco-Oakland Terminal Rws.	Oakland, Calif.	80
Scranton Ry. Co.	Scranton, Pa.	31
Sheridan Rwy. Co.,	Sheridan, Wyo.	6
South Manchurian Ry. Co.	Manchuria	36
Southern Tr. Co.	Dallas, Tex.	30
Springfield St. Ry. Co.,	Springfield, Mass.	99
Tacoma Ry. & Lt. Co.,	Tacoma, Wash.	12
Tokio Municipal Rwy.	Tokio, Japan	200
Toledo Ry. & Lt. Co.	Toledo, Ohio	222
Topeka Rwy. Co.,	Topeka, Kansas	12
Tri City Ry. Co.,	Davenport, Ia.	121
Tulsa St. Ry. Co.,	Tulsa, Okla.	29
Twin City Rapid Tr. Co.,	Minneapolis, Minn.	785
Union St. Ry. Co.,	New Bedford, Mass.	54
United Tr. Co.	Albany, N.Y.	52
United R. R. of San Francisco,	San Francisco, Cal.	95
Virginia Ry. & Pr. Co.,	Richmond, Va.	93
Washington Ry. & Elec. Co.	Washington, D. C.	138
Washington Water Pr. Co.,	Spokane, Wash.	72
Wellington Tramways,	Wellington, N.Z.	36
Wilkes Barre Rwy. Co.	Wilkes-Barre, Pa.	23
Wilmington & Phila. Tr. Co.,	Wilmington, Del.	39
Winnipeg Elect. Ry. Co.	Winnipeg, Canada.	44
Worcester Consolidated St. Ry. Co.,	Worcester, Mass.	129
STRAIGHT AIR BRAKE EQUIPMENTS WITH EMERGENCY FEATURE:		
Adelaide Tramways,	Australia	26
Atlantic City & Shore R.R. Co.,	Atlantic City, N.J.	10
Auburn & Syracuse Elec. R.R. Co.,	Syracuse, N.Y.	19
Buffalo & Lake Erie Tract. Co.,	Erie, Pa.	10
Christchurch Tramways,	New Zealand	26
Cincinnati, Lawrenceville & Aurora St. Rwy.	Cincinnati, Ohio.	7
Cienfuegos, Palmira & Cruces Rwy. & Pr. Co.	Cienfuegos, Cuba	14

ENGINEERING REPORT ON AIR BRAKES

Section IV Page 0.2
Jan. 20, 1928

GENERAL ELECTRIC COMPANY

Data Sheet No.....
Requisition No.....

AIR BRAKE DATA SHEET

This sheet properly filled out for each type of equipment and each type of car should accompany each requisition for air brake equipments.

NAME OF RAILWAY COMPANY.....
LOCATION.....
TYPE OF EQUIPMENT REQUIRED (Underline) Straight Air—Straight Air with Emergency Feature—Automatic Variable Release—Combined Straight and Automatic—Air Brake and Safety Car Control Equipment.

KIND OF SERVICE (Underline) City—Suburban—Interurban
LINE VOLTAGE Maximum.....Minimum.....Average.....
NO. OF CARS TO BE EQUIPPED Motor.....Trail.....
WEIGHT OF CARS (in lb.) fully equipped but without load—Motor.....Trail.....
DESCRIPTION OF CARS (Underline) Single Truck—Double Truck—Single End—Double End.

CLASS OF OPERATION (Underline) Single Car—Train—Both Single Car and Train.....
Maximum Train will consist of.....Motor Cars.....Trail Cars
Average Train will consist of.....Motor Cars.....Trail Cars
Cars to be equipped with (Underline) Automatic Air Couplers—Standard Hose Couplings.
If Standard Hose Couplings are used will they be attached to Radial Draw Bars?.....

AUXILIARY PNEUMATIC DEVICES. Compressed air is to be used for (Underline) Sanding—Whistling—Bell ringing—Operating Snow Scrapers.....

IF AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT IS REQUIRED GIVE THE FOLLOWING INFORMATION:

- 1st. Full Nomenclature of Car Controller.....
- 2nd. Doors to be (underline) folding—sliding.
- 3rd. Door and step controllers to be arranged for (underline) floor mounting—overhead mounting.
- 4th. Are cars to be equipped with a line breaker which has a pneumatic tripping cylinder as an inherent part?.....
- 5th. Are cars to be equipped with the LB-4 control device?.....
- 6th. If door control is to be other than standard a full description of operation should accompany this sheet.

REMARKS:

Date.....

SIGNED.....

AIR BRAKE EQUIPMENTS

Recommendations For Various Classes of Service

STRAIGHT AIR BRAKE EQUIPMENT

Single motor car operation only.

STRAIGHT AIR BRAKE EQUIPMENT WITH EMERGENCY FEATURE

City Service where a simple form of emergency equipment is desired for cars operated singly or in trains of not more than two cars.

EMERGENCY STRAIGHT AIR BRAKE EQUIPMENT

City and Suburban Service where trailers are to be handled.

AUTOMATIC VARIABLE RELEASE EQUIPMENT

Interurban Cars which are to operate both singly and in train, where cars will operate in train the greater part of the time.

COMBINED STRAIGHT AND AUTOMATIC VARIABLE RELEASE EQUIPMENTS

Interurban Cars which are to operate both singly and in train, where cars will operate singly the greater part of the time—also, Electric Locomotives, that do not weigh more than 35 tons.

AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT

Light Weight City, Suburban or Interurban Service where cars are to be operated by one man. This type of equipment is intended for single-car operation but can be modified for two-car train operation if desired.

ENGINEERING REPORT ON AIR BRAKES

Section IV Page 0.4
Jan. 20, 1928

WEIGHTS OF AIR BRAKE EQUIPMENTS

The approximate weights of the various types of air brake equipments are given here for convenience in making preliminary calculations on propositions. It is impossible to definitely fix the compressor capacity for a car of a given weight without knowing all conditions of operation and the extent to which air will be used on the car. (See Page 0.1).

In this table conditions have been assumed to be normal and for a given weight of car the compressors are given that are most suitable for the conditions under which the car will usually operate. A small light weight car with CP-25 is assumed to be in city service where air for whistling is not required. The same car in service where whistling is required may need a CP-27. In like manner it is assumed that heavy cars will be generally used in interurban service and the compressors given are of sufficient capacity to allow for a normal amount of whistling.

STRAIGHT AIR BRAKE EQUIPMENT

Approx. Wt. of Car and Equipmt. Without Load	Comp.	6"x12"				
		8"x 8"BC	8"x12"EC	10"x12"BC	12"x12"EC	14"x12"EC
Up to 22500	CP-25	766				
	CP-27	920				
22500-30000	CP-25		791			
	CP-27		942			
30000-47000	CP-27			998		
47000-67000	CP-27				1151	
	CP-28				1439	
67000-92000	CP-28					1564
	CP-30					2063

STRAIGHT AIR BRAKE EQUIPMENT WITH EMERGENCY FEATURE

Up to 22500	CP-25	867				
	CP-27	1020				
22500-30000	CP-25		906			
	CP-27		1059			
30000-47000	CP-27			1092		
47000-67000	CP-27				1225	
	CP-28				1511	

EMERGENCY STRAIGHT AIR

APPROX. WT.
of CAR AND
EQUIP.

WITHOUT LOAD	COMP.	6" X 12"				
		8"x 8"BC	8"x 12"BC	10"x12"BC	12"x12"BC	14"x12"BC
22500-30000	CP-27		1125			
30000-47000	CP-27			1159		
47000-67000	CP-28				1554	

AUTOMATIC VARIABLE RELEASE

22500-30000	CP-27		1230			
30000-47000	CP-27			1268		
47000-67000	CP-28				1679	
67000-92000	CP-28					1796
	CP-30					2293

COMBINED STRAIGHT & AUTOMATIC VARIABLE RELEASE

APPROX. WT.
of CAR AND
EQUIPT.

WITHOUT LOAD	COMP.	6" x 12"				
		8"x 8"BC	8"x12"BC	10"x12"BC	12"x12"BC	14"x12"BC
22500-30000	CP-27		1246			
30000-47000	CP-27			1284		
47000-67000	CP-28				1695	
67000-92000	CP-28					1812
	CP-30					2309

AIR BRAKE & SAFETY CAR CONTROL EQUIPMENT

Up to 22500	CP-25	962			
	CP-27	1114			
22500-30000	CP-27		1252		
30000-47000	CP-27			1319	

These weights include all parts listed in the schedules in the Railway Equipment Book. Pipe and fittings are not included.

The weight of these for a 50 ft. car with straight air equipment is about 210 lbs. and with emergency straight and automatic equipments about 350 lbs.

For a standard safety car equipped with air brake and safety car control, the pipe and fittings will weigh 440 lbs.

The foundation air and hand brake rigging including supports will weigh from 500 to 1200 lbs.

A I R B R A K E E Q U I P M E N T S
S I Z E O F B R A K E C Y L I N D E R S A N D R E S E R V O I R S
F O R V A R I O U S C A R W E I G H T S

Weight of Car Equipped Without Load (Pounds)	Brake Cylinder	Dimensions in inches	
		Main Reservoirs	Auxiliary Reservoir
STRAIGHT AIR BRAKE EQUIPMENT			
Up to 22,500	6 by 12 or 8 by 8	2-12 by 33	
22,500 - 30,000	8 by 12	1-16 by 48 or 2-14 by 33	
30,000 - 47,000	10 by 12	1-16 by 60 or 2-16 by 33	
47,000 - 67,000	12 by 12	2-16 by 42	
67,000 - 92,000	14 by 12	2-16 by 48	

STRAIGHT AIR BRAKE EQUIPMENT WITH EMERGENCY FEATURE			
Up to 22,500	6 by 12 or 8 by 8	2-14 by 33	
22,500 - 30,000	8 by 12	2-16 by 33	
30,000 - 47,000	10 by 12	2-16 by 33	
47,000 - 67,000	12 by 12	2-16 by 42	

EMERGENCY STRAIGHT AIR BRAKE			
Up to 22,500	6 by 12 or 8 by 8	1-14 by 33	1-14 by 33
22,500 - 30,000	8 by 12	1-16 by 33	1-16 by 33
30,000 - 47,000	10 by 12	1-16 by 33	1-16 by 33
47,000 - 67,000	12 by 12	1-16 by 42	1-16 by 42

AUTOMATIC VARIABLE RELEASE AND COMBINED STRAIGHT VARIABLE RELEASE AIR BRAKE EQUIPMENTS			
22,500 - 30,000	8 by 12	2-16 by 33	1-10 by 15
30,000 - 47,000	10 by 12	2-16 by 33	1-10 by 24
47,000 - 67,000	12 by 12	2-16 by 42	1-10 by 33
67,000 - 92,000	14 by 12	2-16 by 42	1-12 by 33
92,000 - 115,000	16 by 12	2-16 by 48	1-14 by 33

AIR BRAKE & SAFETY CAR CONTROL EQUIPMENT			
Up to 22,500	8 by 8	2-10 by 38	
22,500 - 30,000	8 by 12	2-12 by 48	
30,000 - 47,000	10 by 12	2-14 by 42	

CALCULATION OF BRAKING POWER.

The weight of the car fully equipped but without load is taken as the basis for all calculations on braking power. Motor cars should be braked 100% of the weight except on wheels that are not provided with motors. In this case, the braking power should be 90% of the weight of the wheels on the rails. Trail cars should be braked 90% of the weight.

The truck lever ratio must in every case be known to determine the drilling of the center hole in the cylinder levers. Truck lever ratio is determined as follows:- (See page 0.9)

Fig.1 Fulcrum between brake shoe and applied force.

$$\text{Truck lever ratio} = \frac{a}{b}$$

Fig.2 Brake shoe between fulcrum and applied force.

$$\text{Truck lever ratio} = \frac{a + b}{b}$$

Fig.3 Applied force between brake shoe and fulcrum.

$$\text{Truck lever ratio} = \frac{b}{a + b}$$

DRILLING OF CYLINDER LEVERS.

The following examples will illustrate the calculation necessary to locate the center hole in the cylinder lever of a double truck car to give 100% braking power on all wheels.

Weight of car 32,000 lbs.

Truck lever ratio 3 3/4 to 1.

Size of brake cylinder 8" diameter.

Number of brake beams on car = 4

Length of cylinder levers between centers of end pin holes = 26"

Governor adjusted 55 to 65 lbs.

Force on brake cylinder push rod with 55 lbs. brake cylinder pressure = 2760 lbs.

Force on one brake beam to give 100% braking power -

$$\frac{\text{Weight of car}}{4} = \frac{32,000}{4} = 8,000 \text{ lbs.}$$

Pull required on brake rod to give 100% braking power =

$$\frac{\text{Force on brake beam}}{\text{Truck lever Ratio}} = \frac{8,000}{3.3/4} = 2133 \text{ lbs.}$$

Distance on cylinder lever from center of pin hole on cylinder end to center of pin hole for tie rod =

Brake rod pull x distance between centers of pin holes in ends of cylinder levers

Brake rod pull + push rod force.

$$\frac{2133 \times 26}{2133 + 2760} = \frac{55458}{4893} = 11.334 = 11-11/32 \text{ approx.}$$

Therefore the hole for the tie rod should be drilled 11-11/32 from the hole in the brake cylinder end of the cylinder lever.

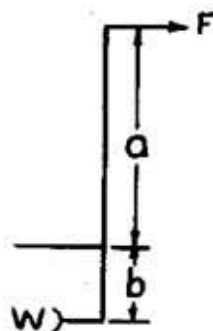


Fig.1



Fig.2

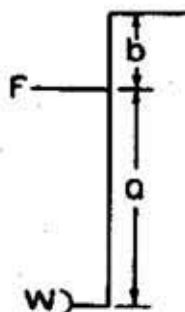


Fig.3