INCLUDES ALL THREE VOLUMES

1968 FORD TRUCK

SHOP MANUAL

DEMO

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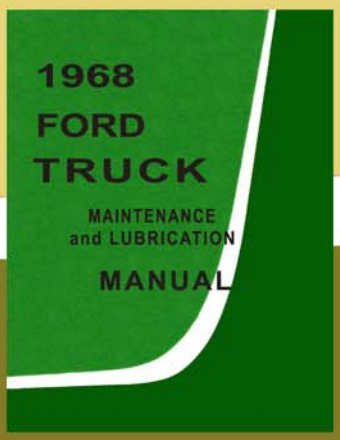

Bonus - Includes the 1968 Ford Truck Maintenance and Lubrication Manual

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1968 FORD TRUCK

SHOP MANUAL

VOLUME ONE

- VEHICLE IDENTIFICATION
- BRAKES
- SUSPENSION, STEERING, WHEELS AND TIRES
- REAR AXLE
- DRIVE SHAFT AND CLUTCH
- MANUAL SHIFT TRANSMISSION
- AUTOMATIC TRANSMISSION

1968 FORD TRUCK

SHOP MANUAL

VOLUME ONE

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VOLUME TWO

VOLUME THREE

SPECIFICATIONS AND SPECIAL SERVICE TOOLS AT END OF EACH GROUP

Ford SERVICE PUBLICATIONS

FIRST PRINTING—APRIL, 1968

FOREWORD

The three volumes of this shop manual provide the Service Technician with complete information for the proper servicing of all 1968 Ford Trucks except Bronco, Econoline Van and Ranchero.

The maintenance schedule and procedures for maintenance operations are published in the 1968 Truck Maintenance and Lubrication Manual.

The information is grouped according to the type of work being performed, such as diagnosis and testing, frequently performed adjustments and repairs, in-vehicle adjustments, overhaul, etc. Specifications, maintenance information and recommended special tools are included.

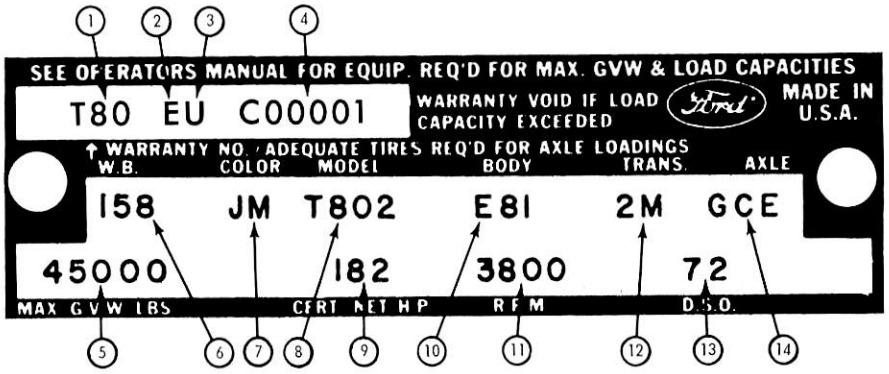
Refer to the opposite page for important vehicle identification data.

The descriptions and specifications in this manual were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.

Ford SERVICE PUBLICATIONS

Vehicle Identification

GROUP 1



1. TRUCK SERIES CODE
2. ENGINE CODE
3. ASSEMBLY PLANT CODE
4. CONSECUTIVE UNIT NO.
5. RECOMMENDED MAX. GROSS VEHICLE WEIGHT
6. WHEELBASE
7. EXTERIOR PAINT CODES
8. MODEL CODE
9. CERTIFIED NET HORSEPOWER
10. TRIM AND CAB OR BODY TYPE CODE
11. SPECIFIED RPM
12. TRANSMISSION CODES
13. DISTRICT/SPEC. ORDER CODES
14. REAR AXLE CODES

P1116-E

FIG. 1—Typical Truck Rating Plate

P1182-A

FIG. 2—Truck Vehicle Identification Number (VIN) Tab

RATING PLATE

Figure 1 illustrates a typical truck Rating Plate. The Rating Plate is riveted to the rear (lock) face of the left front door on Conventional Cabs, 89 inch BBC (bumper-to-back of cab) and Tilt Cab Trucks. On cowl and windshield units, the Rating Plate is mounted on the upper cowl panel in the engine compartment.

VEHICLE IDENTIFICATION NUMBER

The official Vehicle Identification Number (VIN) for title and registration purposes will be stamped on an aluminum tab (Fig. 2) that will be riveted to the instrument panel close to the windshield on the passenger side of the truck and will be visible from outside.

VEHICLE WARRANTY NUMBER

The Warranty Number is the first line of numbers and letters appearing on the Rating Plate (Fig. 1). The first letter and two numbers indicate the truck model and series (the letter prefix identifies the type of body or cab and the numbers are the first two numbers of a truck series). The letter following the truck series code designates the engine identification code. The letter following the engine identification code indicates the assembly plant at which the vehicle was built. The remaining numbers indicate the consecutive unit number. The charts that follow list the various vehicle warranty number codes.

VEHICLE DATA

The Vehicle Data appears on the Rating Plate on the two lines following the Warranty Number. The first three digits under W.B. designate the wheel-

base in inches. The one or two letters under COLOR identify the exterior paint color (two letters designate a two-tone). The letter and three digits under MODEL designate the truck model within a series. The letter and numerals under BODY designate the interior trim and body type (the letter identifies the interior trim scheme and the numerals identify the body or cab type). The transmission installed in the vehicle is identified under TRANS by either a numeric or alphabetical code (if two symbols appear, the first identifies the auxiliary transmission, if so equipped, and the second symbol identifies the main transmission). A letter and a number or two numbers under AXLE identify the rear axle ratio (when required, a letter is also stamped behind the rear axle code to identify the front axle capacity). The maximum gross vehicle weight in pounds is stamped under MAX. G.V.W. Following MAX. G.V.W., the horsepower rating of the engine with which the vehicle is equipped is stamped under CERT. NET H.P. and the rpm required to develop the given horsepower is stamped under R.P.M. A two-digit number is stamped under D.S.O. to identify the district which ordered the vehicle. If the vehicle is built to special order (Domestic Special Order, Foreign Special Order, Limited Production Option, or other special order), the complete order number will also appear under D.S.O. The charts that follow list the various vehicle data codes.

W.B. (Wheelbase)

The wheelbase in inches is entered in this space.

MAX. G.V.W. Lbs.

The maximum gross vehicle weight in pounds is recorded in this space.

CERT. Net H.P. R.P.M.

The certified net horsepower at specified rpm is marked at this location.

D.S.O.

If vehicle is built on a D.S.O., F.S.O., L.P.O. (special orders) the complete order number will be reflected under the DSO space including the District Code Number.

ASSEMBLY PLANT CODES

Code Letter	Assembly Plant	Code Letter	Assembly Plant
C	Ontario	N	Norfolk
D	Dallas	P	Twin Cities
E	Mawah	R	San Jose
H	Lorain	S	Pilot Plant
K	Kansas City	U	Louisville
L	Michigan Truck		

MODEL CODE PREFIX

Prefix	Type
B	School Bus Chassis–Gas
C	Tilt Cab 2 Axle–Gas
D	Tilt Cab 2 Axle–Diesel
F	Conventional 2 Axle–Gas
K	Conventional 2 Axle–Diesel
L	Tilt Cab Tandem Rear Axle–Gas
N	89" BBC Conventional 2 Axle–Gas
P	Parcel Delivery
Q	Tilt Cab Tandem–Diesel
R	89" BBC Conventional 2 Axle–Diesel
S	89" BBC Conventional Tandem Rear Axle–Gas
T	Conventional Tandem Rear Axle–Gas
U	Conventional Tandem Rear Axle–Diesel
V	School Bus Chassis–Diesel
W	89" BBC Conventional Tandem Rear Axle–Diesel
X	Fwd. Axle Tilt Cab Tandem Rear Axle–Diesel
Z	Fwd. Axle Tilt Cab 2 Axle–Diesel

The uniform sequential serial and numbering system for the 1968 model truck program is as follows:

1967 (calendar year)	
Aug.–1968 Model	C00,000 thru C13,999
Sept.	C14,000 thru C27,999
Oct.	C28,000 thru C41,999
Nov.	C42,000 thru C55,999
Dec.	C56,000 thru C69,999
1968 (calendar year)	
Jan.	C70,000 thru C83,999
Feb.	C84,000 thru C97,999
Mar.	C98,000 thru D11,999
Apr.	D12,000 thru D25,999
May	D26,000 thru D39,999
June	D40,000 thru D53,999
July	D54,000 thru D67,999
Aug.	D68,000 thru D81,999

INTERIOR TRIM CODES

Code	Trim Scheme
1	Gray Block Weave & Crush Vinyl
2	Med. Blue Ladder & Crush Vinyl
3	Med. Beige Ladder & Crush Vinyl
4, 43	Black Ladder & Crush Vinyl
5	Red Ladder & Crush Vinyl
14, A4, J4	Parchment Rosette and Crinkle Vinyl
23, B	Med. Blue Woven Plastic & Crush Vinyl
24, B4, K4	Dk. Blue Rosette & Crinkle Vinyl
33, C	Med. Beige Woven Plastic & Crush Vinyl
43, D	Black Woven Plastic & Crush Vinyl
44, D4, M4	Black Rosette & Crinkle Vinyl
53, E	Red Woven Plastic & Crush Vinyl
54, E4, N4	Red Rosette & Crinkle Vinyl
A, 13	Gray Twill Stripe Vinyl & Multicolor Woven Plastic
J	Parchment Granada & Crinkle Vinyl
K	Med. & Dk. Blue Granada & Crinkle Vinyl
M	Black Granada & Crinkle Vinyl
N	Red & Dk. Red Granada & Crinkle Vinyl

The following codes are all Black Leather Grain Vinyl with the indicated component color, differentiated only by seat types.

			4E,	4F,	4N,	4Ø,	4P,	4V,	4W
2B,	2C,	BB,	BE,	BF,	BN,	BØ,	BP,	BV,	BW (W/Blue)
3B,	3C,	CB,	CE,	CF,	CN,	CØ,	CP,	CV,	CW (W/Beige)
4B,	4C,	DB,	DE,	DF,	DN,	DØ,	DP,	DV,	DW (W/Black)
5B,	5C,	EB,	EE,	EF,	EN,	EØ,	EP,	EV,	EW (W/Red)

EXTERIOR PAINT COLOR CODES

Code	M-30J/M-32J Spec. Number ①	Color
A	1724-A	Black
B	3059-A	Royal Maroon
C	1525-A	White
D	1638-A	Peacock Blue
E	1906-A	Lt. Blue
G	1526-A	Chrome Yellow
J	1515-A	Red
L	1237-A	Dark Green
M	1619-A	White
O	3286-A	Dk. Blue
P	3150-A	Boxwood Green
U	2097-A	Med. Green
W	3120-A	Yellow
3	1635-A	Gold
6	1631-A	Lt. Beige
7	2098-A	Dk. Blue

① M-32J Acrylic Enamel Alternate with M-30J Alkyd.

DISTRICT CODES

Code	District	Code	District
11	Boston	51	Denver
13	New York	52	Des Moines
15	Newark	53	Kansas City
16	Philadelphia	54	Omaha
17	Washington	55	St. Louis
21	Atlanta	61	Dallas
22	Charlotte	62	Houston
24	Jacksonville	63	Memphis
25	Richmond	64	New Orleans
27	Cincinnati	65	Oklahoma City
28	Louisville	71	Los Angeles
32	Cleveland	72	San Jose
33	Detroit	73	Salt Lake City
34	Indianapolis	74	Seattle
35	Lansing	75	Phoenix
37	Buffalo	83	Government
38	Pittsburgh	84	Home Office Reserve
41	Chicago	85	American Red Cross
42	Fargo	89	Transportation
43	Milwaukee	90's	Export
44	Twin Cities		
45	Davenport		
Ford of Canada			
B1	Central	B4	Midwestern
B2	Eastern	B6	Western
B3	Atlantic	B7	Pacific
I1 thru I7	Export		

DIESEL ENGINE CODES

Code	Engine Model No.	C.I.D. (Cu. in.)
U	V-150 Caterpillar (#1140)	522
V	V-175 Caterpillar (#1145)	522
4	V-200 Caterpillar (#1150)	573
C	V-225 Caterpillar (#1160)	636
K	1673-B Caterpillar (225 HP)	525
L	1673-B Caterpillar (245 HP)	525
Z	C-160 Cummins	464
Y	C-180 Cummins	464
X	CF-160 Cummins	464
B	V6E-195 Cummins	588
D	NHE-195 Cummins	743
E	NH-220 Cummins	743
F	V8E-235 Cummins	785
G	V8-265 Cummins	785
A	NHC-250 Cummins (225 HP)	855
J	NHC-250 Cummins (250 HP)	855
M	NTC-335 Cummins (260 HP)	855
N	NTC-335 Cummins (280 HP)	855
P	NTC-335 Cummins (300 HP)	855
Q	NTC-335 Cummins (320 HP)	855
R	NTC-335 Cummins (335 HP)	855
1	NH-230 Cummins	855
8	6V-53N Detroit	318
S	6-71N Detroit (218 HP)	426
2	6-71N Detroit (238 HP)	426
9	6-71NE Detroit	426
6	8V-71N Detroit (290 HP)	568
T	8V-71N Detroit (318 HP)	568
7	8V-71NE Detroit	568
J	242 Dorset	242
W	363 Dorset	363

GASOLINE ENGINE CODES

Code	Engine
A	6 Cyl. 240 CID 1V
B	6 Cyl. 300 CID 1V LD
B	6 Cyl. 300 CID 1V HD
C	8 Cyl. 330 CID 2V MD
D	8 Cyl. 330 CID 2V HD
E	8 Cyl. 361 CID 2V
F	8 Cyl. 391 CID 4V
H	8 Cyl. 390 CID 2V
H	8 Cyl. 401 CID 4V
K	8 Cyl. 477 CID 4V
L	8 Cyl. 534 CID 4V
U	8 Cyl. 330 CID 2V ①
W	8 Cyl. 361 CID 2V ①
Y	8 Cyl. 360 CID 2V
1	6 Cyl. 240 CID 1V ②
2	6 Cyl. 300 CID 1V ②
3	8 Cyl. 330 CID 2V MD ②
4	8 Cyl. 330 CID 2V HD ②
5	8 Cyl. 361 CID 2V ②
8	8 Cyl. 360 CID 2V ②
9	8 Cyl. 534 CID 4V ①

① Low propane gas
② Low compression

FRONT AXLE CODES

Code	Capacity
B	5.5M ①
C	6M ①
D	7M ①
E	9M ①
F	12M ①
G	12M ①
H	15M ①
I	18M ①
K	3.5M ①
L	6M ① ②

① Pounds Capacity in Thousands.
② Heavy Duty Front Brakes.

TRANSMISSION CODES -100 -600 SERIES

Code	Description
A	4-Speed New Process
B	3-Speed O/Drive
C	3-Speed Ford L. D.
D	3-Speed Warner M. D.
E	3-Speed Warner H. D.
F	4-Speed Syn. Warner
G	Automatic (C-4)
M	5-Speed Clark 285-V Dir.
O	5-Speed New Process 541-F Dir.
P	4-Speed Warner
T	5-Speed New Process 541-FO O/Dr.
2	5-Speed Clark 282-V Dir.
4	5-Speed Clark 280-VO O/Dr.
9	5-Speed New Process 541-FD Dir.

AUXILIARY TRANSMISSION CODES

Code ①	Type	Ratio
1	3 Speed Spicer....5831-C	1.27 / .85
2	3 Speed Spicer....5831-D	2.0 / .85
3	3 Speed H. D. Spicer....7231-B	1.24 / .86
4	3 Speed H. D. Spicer....7231-D	2.14 / .86
5	4 Speed Spicer....8341-C	2.40 /1.29 /.84
6	3 Speed Spicer....8031-C	2.59 / .79
7	3 Speed Spicer....8031-P	1.19 / .84
8	4 Speed Spicer....7041	2.31 /1.21 /.83
9	3 Speed Fuller....3D65	2.221/ .804
A	3 Speed Fuller....3J65	1.17 / .86
B	3 Speed Fuller....4C75	2.22 /1.18 /.85

NOTE: When required, the auxiliary transmission code will be stamped directly in front of the transmission code.

① If the "New Process" transmission is installed, the auxiliary transmission code will bear the suffix "N".

TRANSMISSION CODES -700-1000-N500-N600 NC550-C600 SERIES

Code	Description
A	4-Speed New Process 435
B	10-Speed Fuller R-96 Direct①
C	10-Speed Fuller RT 510 Direct①
D	5-Speed Clark 387V Direct①
E	5-Speed Fuller 5H74 Direct①
F	Fuller 5HA74 (Aluminum)②
F	4-Speed Warner T-18
G	5-Speed Clark 380 VØ O/Drive①
H	5-Speed Clark 305V Direct①
I	5-Speed Clark 307V Direct①
J	5-Speed Clark 264 VØ O/Drive①
K	5-Speed Spicer 6453A Direct①
L	5-Speed Clark 2653V1 Direct①
M	5-Speed Clark 285V Direct①
N	5-Speed Spicer 6352 Direct①
Ø	5-Speed Fuller T905B Direct②
Ø	5-Speed New Process 541FL Direct
P	4-Speed Warner T-19①
Q	5-Speed Spicer 5652 Direct①
R	5-Speed Clark 2622V1 Direct①
S	5-Speed Spicer 5756B Direct①
T	5-Speed New Process 541FØ O/Drive
U	5-Speed Spicer 6852G Direct①
V	10-Speed Fuller RT 910 Direct②
W	5-Speed Spicer 6352B Direct①
X	6-Speed Transmatic MT30
X	5-Speed Fuller T905A Direct②
Y	6-Speed Transmatic MT40
Y	6-Speed Transmatic MT41②
Z	DSO Transmission
1	5-Speed Spicer 8552A Direct②
1	6-Speed Transmatic MT42
2	5-Speed Clark 282V Direct①
3	5-Speed Spicer 5852 Direct②
4	5-Speed Clark 280VØ O/Drive①
5	10-Speed Fuller RTØ 910 O/Drive②
6	15-Speed Fuller RTØ 915 O/Drive②
7	5-Speed Clark 385V Direct①
8	12-Speed Spicer 8312 O/Drive②
9	5-Speed New Process 541FD Direct②

① Gasoline or Diesel engines ② Diesel only

REAR AXLE CODES
F-B-P-100 thru 600

Code	Ratio and Rating
05	Ford....4.11–3.3M①
08	Ford....3.50–3.3M①
09	Ford....3.70–3.3M①
17	Ford....3.25–3.3M①
22	Dana #70....4.88–7.4M①
23	Dana #70....5.13–7.4M①
24	Dana #60....4.10–5.2M①
25	Dana #60....4.56–5.2M①
27	Dana #70....4.10–7.4M①
28	Dana #70....4.56–7.4M①
30	Rockwell C-100....5.29–11M①
32	Rockwell C-100....6.20–11M①
34	Rockwell C-100....6.80–11M①
36	Dana #70....3.73–7.4M①
37	Dana #60....3.54–5.2M①
38	Dana #60....3.73–5.2M①
41	Rockwell D-100W....5.83–13M①
42	Rockwell D-100N....6.20–13M①
44	Rockwell D-100N....6.80–13M①
52	Rockwell H-170....5.86–17.5M①
53	Rockwell H-170....6.14–17.5M①
54	Rockwell H-170....6.83–17.5M①
55	Rockwell H-170....7.17–17.5M①
62	Rockwell F-106....6.20–15M①
64	Rockwell F-106....6.80–15M①
66	Rockwell F-106....7.20–15M①
71	Rockwell H-140....5.83–17M①
74	Rockwell H-140....6.80–17M①
76	Rockwell H-140....7.20–17M①
A8	Dana #44....3.54–3.3M①②
B4	Dana #60....4.10–5.2M①②
B5	Dana #60....4.56–5.2M①②
C1	Dana #44-3....3.31–3.3M①②
C2	Dana #44-3....3.73–3.3M①②
C4	Dana #44-3....4.09–3.3M①②
C5	Dana #60-2....4.10–3.3M①②
C7	Dana #60....3.54–5.2M①②
C8	Dana #60....3.73–5.2M①②
D2	Dana #70....4.88–7.4M①②
D6	Dana #70....3.73–7.4M①②
D7	Dana #70....4.10–7.4M①②
D8	Dana #70....4.56–7.4M①②
E1	Eaton 16244....5.57/7.75–17.5M①
E2	Eaton 16244....6.17/8.58–17.5M①
E3	Eaton 16244....6.50/9.04–17.5M①
E5	Dana #60-3....4.10–3.6M①②
E9	Dana #60-3....3.54–3.6M①②
F1	Eaton 15201....5.14/7.17–15M①
F2	Eaton 15201....5.83/8.17–15M①
F3	Eaton 15201....6.33/8.81–15M①
F7	Eaton 13802....5.83/8.12–15M①
F8	Eaton 13802....6.33/8.81–15M①
G2	Eaton 16802....5.57/7.75–17M①
G3	Eaton 16802....6.50/9.04–17M①
G4	Eaton 16802....6.14/8.55–17M①

① Pounds Capacity in Thousands.
② Locking.

REAR AXLE CODES -700 -1000 SERIES, N-500-600, C-550-600

ROCKWELL C-100 – 11M①

Code	Ratio
32	6.20
34	6.80

ROCKWELL D-100 – 13M①

Code	Ratio
41	5.83
42	6.20
44	6.80

ROCKWELL F-106 – 15M①

Code	Ratio
62	6.20
64	6.80
66	7.20

EATON 13802 – 15M①

Code	Ratio
F7	5.83/8.12
F8	6.33/8.81

EATON 15201 – 15M①

Code	Ratio
F1	5.14/7.17
F2	5.83/8.12
F3	6.33/8.81

ROCKWELL H-140 – 17M①

Code	Ratio
71	5.83
74	6.80
76	7.20
77	4.63
78	5.29
79	6.20

EATON 16802-3 – 17M①

Code	Ratio
G2	5.57/7.75
G3	6.50/9.04
G4	6.14/8.55

ROCKWELL H340 – 17M

Code	Ratio
81	5.41/7.17
82	6.16/8.48

ROCKWELL H170 – 17.5M①

Code	Ratio
51	5.38
52	5.86
53	6.14
54	6.83
55	7.17

EATON 16244 – 17.5①

Code	Ratio
E1	5.57/7.75
E2	6.14/8.55
E3	6.50/9.04

ROCKWELL L-146 – 17.5M①

Code	Ratio
91	5.83
92	6.50

EATON 1790-A–18.5 M①

Code	Ratio
1Q	4.33
2Q	4.56
3Q	4.88
4Q	5.29
5Q	5.57
6Q	6.14
7Q	6.50
8Q	7.17
9Q	7.67

EATON 17800 – 18.5M①

Code	Ratio
1H	4.33/5.91
2H	4.56/6.21
3H	4.88/6.65
4H	5.29/7.21
5H	5.57/7.60
6H	6.14/8.38
7H	6.50/8.87
8H	7.17/9.77

EATON 17101 – 18.5M①

Code	Ratio
AQ	4.33
BQ	4.56
CQ	4.88
DQ	5.29
EQ	5.57

EATON 17121 – 18.5M①

Code	Ratio
FQ	6.14
GQ	6.50
HQ	7.17
IQ	7.60

EATON 17201 – 18.5M①

Code	Ratio
AH	4.35/5.90
BH	4.56/6.21
CH	4.88/6.65
DH	5.29/7.21
EH	5.57/7.60

EATON 17221 – 18.5M①

Code	Ratio
FH	6.14/8.38
GH	6.50/8.87
HH	7.17/9.77

ROCKWELL L-346 – 18.5M①

Code	Ratio
Q1	4.92/6.76
Q2	5.63/7.73
Q3	6.00/8.24
Q4	6.39/8.78
Q5	6.65/9.13
Q6	7.10/9.76

EATON 8802 – 22M①

Code	Ratio
1J	5.91
2J	6.21
3J	6.65

EATON 18301 – 22M①

Code	Ratio
AJ	5.91
BJ	6.21
CJ	6.65

EATON 1880 – 22M①

Code	Ratio
1K	4.88
2K	5.57
3K	6.14
4K	6.50
5K	7.17
6K	5.29

EATON 18101 – 22M①

Code	Ratio
AK	4.88
FK	5.29
BK	5.57

EATON 18121 – 22M①

Code	Ratio
CK	6.14
DK	6.50
EK	7.17

ROCKWELL Q246 – 22M①

Code	Ratio
L1	4.92
L2	5.63
L3	6.04
L4	6.39
L5	7.27

EATON 18802 – 22M①

Code	Ratio
1B	4.33/5.91
2B	4.56/6.21
3B	4.88/6.65
4B	5.57/7.60
5B	6.14/8.38
6B	6.50/8.87
7B	7.17/9.77
8B	5.29/7.21

EATON 18201 – 22M①

Code	Ratio
AB	4.33/5.91
BB	4.56/6.21
CB	4.88/6.65
HB	5.29/7.21
DB	5.57/7.60

① Pounds Capacity in Thousands

REAR AXLE CODES -700 -1000 SERIES, N-500-600, C-550-600 (Cont'd.)

EATON 18221 – 22M①

Code	Ratio
EB	6.14/8.38
FB	6.50/8.87
GB	7.17/9.77

ROCKWELL Q346 – 22M①

Code	Ratio
T1	4.92/6.76
T2	5.63/7.73
T3	6.00/8.24
T4	6.39/8.78
T5	7.33/10.07

EATON 1918 – 23M①

Code	Ratio
1G	4.11
2G	4.33
3G	4.88
4G	5.43
5G	6.17
6G	6.67
7G	3.70
8G	4.56

EATON 19121 – 23M①

Code	Ratio
GG	3.70
AG	4.11
BG	4.33
HG	4.56
CG	4.88
DG	5.43
EG	6.17
FG	6.67

EATON 9502 – 23M①

Code	Ratio
1X	5.90
2X	6.64

EATON 19301 – 23M①

Code	Ratio
AX	5.89
BX	6.64

ROCKWELL RT 241 – 23M①

Code	Ratio
P1	4.62
P2	4.99
P3	5.46
P4	6.10
P5	7.21

ROCKWELL R-171 – 23M①

Code	Ratio
H1	4.11
H2	4.33
H3	4.63
H4	4.88
H5	5.29
H6	5.86
H7	6.14
H8	6.83
H9	3.70

EATON 19800 – 23M①

Code	Ratio
1P	4.33/5.89
2P	4.88/6.63
3P	5.43/7.39
4P	6.17/8.40
5P	6.67/9.08
6P	3.70/5.04
7P	4.11/5.60
8P	4.56/6.21

EATON 19221 – 23M①

Code	Ratio
FP	3.70/5.04
GP	4.11/5.60
AP	4.33/5.90
HP	4.56/6.21
BP	4.88/6.64
CP	5.43/7.39
DP	6.17/8.40
EP	6.67/9.08

ROCKWELL RT-341 – 23M①

Code	Ratio
X1	4.68/5.88
X2	5.06/6.35
X3	5.34/6.71
X4	6.18/7.76
X5	7.01/8.80

ROCKWELL R-302 – 23M①

Code	Ratio
Y1	4.41/5.64
Y2	4.89/6.23
Y3	5.54/7.09
Y4	6.42/8.38
Y5	7.09/9.07

ROCKWELL SHHD – 30M①

Code	Ratio
W1	5.29
W2	5.83
W3	6.17
W4	6.80
W5	7.20
W6	7.80

EATON 30 DS – 32M①

Code	Ratio
1C	4.62
2C	4.88
3C	5.57
4C	6.14
5C	6.50
6C	7.17
7C	7.60
8C	6.43

EATON 30 DSC – 32M①

Code	Ratio
AC	4.62
BC	4.88
CC	5.57
DC	6.14
EC	6.50
FC	7.17
GC	7.60
HC	6.43

EATON 30 DP – 32M①

Code	Ratio
1D	6.43
2D	6.78
3D	7.75
4D	8.55

EATON 30 DPC – 32M①

Code	Ratio
AD	6.43
BD	6.78
CD	7.75
DD	8.85

EATON 30 DTA – 32M①

Code	Ratio
1L	4.62/6.43
2L	4.88/6.78
3L	5.57/7.75
4L	6.14/8.55
5L	6.50/9.04
6L	7.17/9.77

EATON 30 DTC – 32M①

Code	Ratio
AL	4.63/6.43
BL	4.88/6.78
CL	5.57/7.75
DL	6.14/8.55
EL	6.50/9.04
FL	7.17/9.97

EATON 30 D-3 – 32M①

Code	Ratio
3S	4.63/5.53/6.43
4S	4.88/5.83/6.78
5S	5.57/6.66/7.75
6S	6.14/7.35/8.55
7S	6.50/7.77/9.04

EATON 30 DTC (3 Spd.) – 32M①

Code	Ratio
CS	4.63/5.53/6.43
DS	4.88/5.83/6.78
ES	5.57/6.66/7.75
FS	6.14/7.35/8.55
GS	6.50/7.77/9.04

① Pounds Capacity in Thousands

REAR AXLE CODES -700 -1000 SERIES, N-500-600, C-550-600 (Cont'd.)

EATON 34 DS – 34M①

Code	Ratio
1F	4.11
2F	4.33
3F	4.56
4F	4.88
5F	5.29
6F	5.57
7F	6.14
8F	6.50
9F	7.17
0F	7.60
AF	3.70

EATON 34 DSE – 34M①

Code	Ratio
GF	6.14
HF	6.50
IF	7.17
KF	7.60

EATON 34 DSC – 34M①

Code	Ratio
LF	3.70
JF	4.11
BF	4.33
CF	4.56
DF	4.88
EF	5.29
FF	5.57

EATON 34 DP - 34M①

Code	Ratio
1N	5.05
2N	5.60
3N	5.91
4N	6.21
5N	6.65
6N	7.60
7N	8.38

EATON DFE – 34M①

Code	Ratio
GN	8.38

EATON 34 DPC – 34M①

Code	Ratio
AN	5.05
BN	5.60
CN	5.91
DN	6.21
EN	6.65
FN	7.60

EATON 34 M – 34M①

Code	Ratio
1E	4.56
2E	5.85
3E	6.69
4E	7.80
5E	8.60

EATON 34 DTA – 34M①

Code	Ratio
1W	4.11/5.61
2W	4.33/5.91
3W	4.56/6.21
4W	4.88/6.65
5W	5.57/7.60
6W	6.14/8.38
7W	6.50/8.86
8W	7.17/9.77
9W	3.70/5.05
0W	5.29/7.21

EATON 34 DTC - 34M①

Code	Ratio
IW	3.70/5.05
AW	4.11/5.61
BW	4.33/5.91
CW	4.56/6.21
DW	4.88/6.65
KW	5.29/7.21
EW	5.57/7.60

EATON 34 DTE – 34M①

Code	Ratio
FW	6.14/8.38
GW	6.50/8.87
HW	7.17/9.77

EATON 34 D-3 – 34M①

Code	Ratio
1T	4.11/4.86/5.61
2T	4.33/5.12/5.91
3T	4.56/5.39/6.21
4T	4.88/5.77/6.65
5T	5.57/6.59/7.60
6T	6.14/7.26/8.38
7T	6.50/7.68/8.86
8T	3.70/4.37/5.05
9T	5.29/6.25/7.21

ROCKWELL SLDD – 34M①

Code	Ratio
N1	4.88
N2	5.09
N3	5.56
N4	5.90
N5	6.41
N6	7.67
N7	8.44
N8	6.70

ROCKWELL SLHD – 34M①

Code	Ratio
B1	4.11
B2	4.44
B3	4.63
B4	4.88
B5	5.29
B6	5.83
B7	6.17
B8	6.83
B9	7.80
B0	8.60
BA	3.55

ROCKWELL SLHD(Lt.wt.) – 34M①

Code	Ratio
K1	4.11
K2	4.44
K3	4.63
K4	4.88
K5	5.29
K6	5.83
K7	6.17
K8	6.83
K9	7.80
K0	8.60
KA	3.55

EATON 38 DS – 38M①

Code	Ratio
1I	4.56
2I	4.88
3I	5.57
4I	6.14
5I	6.50
6I	4.11
7I	4.33
8I	5.29

EATON 38 DSC – 38M①

Code	Ratio
FI	4.11
GI	4.33
AI	4.56
BI	4.88
HI	5.29
CI	5.59

EATON 38 DSE – 38M①

Code	Ratio
DI	6.14
EI	6.50

EATON 38 DP – 38M①

Code	Ratio
1R	5.05
2R	5.60
3R	5.91
4R	6.21
5R	6.65
6R	7.60
7R	8.38

EATON 38 DPC – 38M①

Code	Ratio
AR	5.05
BR	5.61
CR	5.91
DR	6.21
ER	6.65
FR	7.60

① Pounds Capacity in Thousands

REAR AXLE CODES -700 -1000 SERIES, N-500-600, C-550-600 (Cont'd.)

EATON 38 DPE – 38M①

Code	Ratio
GR	8.38

ROCKWELL SQHD – 38 M①

Code	Ratio
D1	4.11
D2	4.44
D3	4.63
D4	5.29
D5	5.83
D6	6.83
D7	7.80
D8	8.60
D9	3.55
D0	4.88
DA	6.17

ROCKWELL SQHD (Lt.Wt.) – 38M①

Code	Ratio
M1	4.11
M2	4.44
M3	4.63
M4	5.29
M5	5.83
M6	6.83
M7	7.80
M8	8.60
M9	3.55
M0	4.88
MA	6.17

ROCKWELL SQDD – 38M①

Code	Ratio
Z1	7.54
Z2	8.31

EATON 38 D-3 – 38M①

Code	Ratio
1Z	4.11/4.86/5.61
2Z	4.33/5.12/5.91
3Z	4.56/5.39/6.21
4Z	4.88/5.76/6.65
5Z	5.57/6.59/7.60
6Z	6.14/7.26/8.38
7Z	6.50/7.68/8.86

EATON 38 DTC – 38M①

Code	Ratio
AZ	4.11/4.86/5.61
BZ	4.33/5.12/5.91
CZ	4.56/5.39/6.21
DZ	4.88/5.77/6.65
EZ	5.57/6.59/7.60

EATON 38DTE – 38M①

Code	Ratio
FZ	6.14/7.29/8.38
GZ	6.50/7.68/8.86

EATON 42 DP – 44M①

Code	Ratio
1V	7.60
2V	8.38

① Pounds Capacity in Thousands

SERIES, MODEL CODES, AND GROSS VEHICLE WEIGHTS (G.V.W.)- -350 AND P SERIES

Series	Model Code	Rating G V W (lbs)
F-100	F-100	5,000
	F-101	4,200
	F-102	5,000
	F-103	4,500
	F-104	4,800
F-100 (4x4)	F-110	5,600
	F-111	5,000
	F-112	5,600
	F-113	4,600
F-250	F-250	7,500
	F-252	7,500
	F-253	6,100
	F-254	6,900
	F-255	6,100
	F-256	6,900
F-250 (4x4)	F-260	6,800
	F-262	7,700
	F-263	6,300
	F-264	7,700

Series	Model Code	Rating G V W (lbs)
F-350	F-350	10,000
	F-351	8,000
	F-352	8,000
	F-353	6,600
	F-354	8,300
	F-355	9,000
P-350	P-350	8,000
	P-351	6,100
	P-352	6,500
	P-353	8,000
P-400	P-400	10,000
	P-401	7,700
	P-402	8,000
	P-403	7,000
P-500	P-500	15,000
	P-501	10,000
	P-502	8,000

Series	Model Code	Rating G V W (lbs)
P-600	P-600	17,000
	P-601	15,000
P-3500	G-350	8,000
	G-351	6,100
	G-352	6,500
P-4000	G-400	10,000
	G-401	7,700
	G-402	8,000
	G-403	7,000
P-5000	G-500	15,000
	G-501	10,100
	G-502	8,000
P-6000	G-600	17,000
	G-601	15,000

SERIES, MODEL CODES, AND GROSS VEHICLE WEIGHTS (G.V.W.) -500 -800 SERIES

Series	Model Code	Rating G V W (lbs)
B-500	B-500	15,000
	B-501	10,000
	B-502	16,000
	B-503	17,000
	B-504	18,000
	B-505	20,000
B-600	B-600	19,500
	B-601	15,000
	B-602	20,000
	B-603	17,000
	B-610	21,000
	B-611	22,000
	B-612	23,000
	B-613	24,000
	B-614	19,700
B-6000	J-600	20,000
	J-601	15,000
	J-602	19,500
	J-603	17,000
B-700	B-700	20,500
	B-701	17,000
	B-702	21,000
	B-703	22,500
	B-704	23,000
	B-705	24,000
	B-706	25,500
	B-707	23,000
	B-708	23,000
	B-709	22,000
B-7000	J-700	20,500
	J-701	17,000
	J-702	21,000
	J-703	22,500
	J-704	23,000
	J-705	24,000
	J-706	25,500
	J-707	23,000
	J-708	23,000
	J-709	22,000
B-750	B-750	22,500
	B-751	17,000
	B-752	23,000
	B-753	24,000
	B-754	25,500
	B-755	23,000
	B-756	23,000
C-550	C-550	15,000
	C-551	10,000
	C-552	17,000
	C-553	19,000
	C-554	20,000
C-600	C-600	20,000
	C-601	15,000
	C-610	21,000
	C-611	22,000
	C-612	23,000
	C-613	23,000
	C-614	23,000
	C-615	19,700
C-6000	D-600	20,000
	D-601	15,000
	D-610	21,000
	D-611	22,000
	D-612	23,000
	D-613	23,000
	D-614	23,000

Series	Model Code	Rating G V W (lbs)
C-700	C-700	24,000
	C-701	17,000
	C-702	25,500
	C-703	25,500
	C-704	25,500
C-7000	D-700	24,000
	D-701	17,000
	D-702	25,500
	D-703	25,500
	D-704	25,500
C-750	C-750	24,000
	C-751	17,000
	C-752	25,500
	C-753	25,500
	C-754	25,500
	C-755	27,500
	C-756	27,500
C-800	C-800	27,000
	C-801	20,000
	C-802	27,500
	C-803	27,500
	C-804	27,500
	C-805	27,500
	C-806	27,500
C-8000	D-800	27,000
	D-801	20,000
	D-802	27,500
	D-803	27,500
	D-804	26,000
	D-805	24,000
CT-800	L-800	43,000
	L-801	27,000
	L-802	39,000
	L-803	45,000
	L-804	49,000
	L-805	41,000
CT-8000	Q-800	43,000
	Q-801	27,000
	Q-802	39,000
	Q-803	45,000
	Q-804	49,000
	Q-805	51,000
F-500	F-500	15,000
	F-501	10,000
	F-502	16,000
	F-503	17,000
	F-504	18,000
	F-505	20,000
F-600	F-600	19,500
	F-601	15,000
	F-602	20,000
	F-603	17,000
	F-610	21,000
	F-611	22,000
	F-612	23,000
	F-613	23,000
	F-614	23,000
	F-615	24,000
	F-616	19,700
F-6000	K-600	20,000
	K-601	15,000
	K-602	19,500
	K-603	17,000
	K-610	21,000
	K-611	22,000
	K-612	23,000
	K-613	23,000
	K-614	23,000
	K-615	24,000
	K-616	19,700

Series	Model Code	Rating G V W (lbs)
F-700	F-700	22,000
	F-701	17,000
	F-702	23,000
	F-703	24,000
	F-704	25,500
	F-705	23,000
	F-706	23,000
	F-707	25,500
F-7000	K-700	22,000
	K-701	17,000
	K-702	23,000
	K-703	24,000
	K-704	25,500
	K-705	23,000
	K-706	23,000
	K-707	25,500
F-750	F-750	22,500
	F-751	17,000
	F-752	23,000
	F-753	24,000
	F-754	25,500
	F-755	23,000
	F-756	25,500
	F-757	23,000
	F-758	27,500
	F-759	28,000
F-800	F-800	23,000
	F-801	17,000
	F-802	24,000
	F-803	25,500
	F-804	27,500
	F-805	23,600
	F-806	25,500
	F-807	27,500
	F-808	27,500
	F-809	25,500
	F-810	30,000
F-8000	K-800	24,000
	K-801	20,000
	K-802	25,500
	K-803	27,500
	K-804	27,500
	K-805	27,500
	K-806	24,000
	K-807	24,500
N-500	N-500	15,000
	N-501	10,000
	N-502	16,000
	N-503	17,000
	N-504	18,000
	N-505	20,000
N-600	N-600	19,500
	N-601	15,000
	N-602	20,000
	N-603	17,000
	N-610	21,000
	N-611	22,000
	N-612	23,000
	N-613	23,000
	N-614	23,000
	N-615	24,000
	N-616	19,700
N-6000	R-600	20,000
	R-601	15,000
	R-610	21,000
	R-611	22,000
	R-612	23,000
	R-613	23,000
	R-614	23,000
	R-615	24,000

SERIES, MODEL CODES, AND GROSS VEHICLE WEIGHTS (G.V.W.) -500 -800 SERIES (Cont'd.)

Series	Model Code	Rating G V W (lbs)
N-700	N-700	22,000
	N-701	17,000
	N-702	23,000
	N-703	24,000
	N-704	25,500
	N-705	23,000
	N-706	23,000
	N-707	25,500
	N-708	25,500
N-7000	R-700	22,000
	R-701	17,000
	R-702	23,000
	R-703	24,000
	R-704	25,500
	R-705	23,000
	R-706	23,000
N-750	N-750	22,500
	N-751	17,000
	N-752	23,000
	N-753	24,000
	N-754	25,500
	N-755	23,000
	N-756	25,500
	N-757	23,000
	N-758	25,500

Series	Model Code	Rating G V W (lbs)
N-8000	R-800	25,000
	R-801	20,000
	R-802	25,000
	R-803	27,000
	R-804	27,000
	R-805	27,000
	R-806	25,500
	R-807	27,500
	R-808	25,500
	R-809	34,000
	R-810	28,000
	R-811	29,000
	R-812	30,000
	R-813	31,000
	R-814	32,000
	R-815	32,000
	R-816	33,000
NT-8000	W-800	39,000
	W-801	27,000
	W-802	41,000
	W-803	43,000
	W-804	43,000
	W-805	45,000
	W-806	49,000
	W-807	43,000
	W-808	45,000
	W-809	51,000

Series	Model Code	Rating G V W (lbs)
T-800	T-800	43,000
	T-801	27,000
	T-802	45,000
	T-803	49,000
	T-804	43,000
	T-805	36,000
	T-806	37,000
	T-807	39,000
	T-808	41,000
	T-809	29,000
T-8000	U-800	39,000
	U-801	27,000
	U-802	41,000
	U-803	43,000
	U-804	45,000
	U-805	49,000
	U-806	56,000
	U-807	62,000
	U-808	53,000
	U-809	59,000

SERIES, MODEL CODES, AND GROSS VEHICLE WEIGHTS (G.V.W.) -850 -1000 SERIES

Series	Model Code	Rating G V W (lbs)
C-850	C-850	27,000
	C-851	20,000
	C-852	27,000
	C-853	27,000
	C-854	27,000
	C-855	27,500
	C-856	27,500
CT-850	L-850	39,000
	L-851	27,000
	L-852	41,000
	L-853	43,000
	L-854	45,000
	L-855	49,000
C-950	C-950	30,000
	C-951	24,000
	C-952	30,000
	C-953	32,000
	C-954	32,000
	C-955	34,000
	C-956	34,000
	C-957	31,000
	C-958	33,000
CT-950	L-950	47,000
	L-951	30,000
	L-952	49,000
	L-953	51,000
C-1000	C-000	32,000
	C-001	26,000
	C-002	34,000
	C-003	36,000

Series	Model Code	Rating G V W (lbs)
F-850	F-850	25,000
	F-851	20,000
	F-852	25,000
	F-853	27,000
	F-854	27,000
	F-855	27,000
	F-856	25,500
	F-857	27,500
	F-858	25,500
	F-859	32,000
F-950	F-950	28,000
	F-951	24,000
	F-952	30,000
	F-953	30,000
	F-954	32,000
	F-955	32,000
	F-956	34,000
	F-957	29,000
	F-958	31,000
	F-959	33,000
F-950-D	K-950	28,000
	K-951	24,000
	K-952	30,000
	K-953	30,000
	K-954	32,000
	K-955	32,000
	K-956	34,000
	K-957	29,000
	K-958	31,000
	K-959	33,000
	K-960	25,500
	K-961	27,500

Series	Model Code	Rating G V W (lbs)
F-1000	F-000	32,000
	F-001	26,000
	F-002	34,000
	F-003	36,000
F-1000-D	K-000	32,000
	K-001	26,000
	K-002	34,000
	K-003	36,000
N-850	N-850	25,000
	N-851	20,000
	N-852	25,000
	N-853	27,000
	N-854	27,000
	N-855	27,000
	N-856	25,500
	N-857	27,500
	N-858	25,500
NT-850	S-850	39,000
	S-851	27,000
	S-852	41,000
	S-853	43,000
	S-854	43,000
	S-855	45,000
	S-856	49,000
	S-857	43,000
	S-858	45,000
NT-850-D	W-850	43,000
	W-851	27,000
	W-852	39,000
	W-853	41,000
	W-854	45,000
	W-855	49,000

SERIES, MODEL, CODES, AND GROSS VEHICLE WEIGHTS (G.V.W.) — 850-1000 SERIES (Cont'd.)

Series	Model Code	Rating G V W (lbs)
N-950	N-950	28,000
	N-951	24,000
	N-952	30,000
	N-953	30,000
	N-954	32,000
	N-955	32,000
	N-956	34,000
	N-957	29,000
	N-958	31,000
	N-959	33,000
NT-950	S-950	47,000
	S-951	30,000
	S-952	49,000
	S-953	51,000
NT-950-D	W-950	47,000
	W-951	30,000
	W-952	49,000
	W-954	51,000
N-1000	N-000	32,000
	N-001	26,000
	N-002	34,000
	N-003	36,000

Series	Model Code	Rating G V W (lbs)
N-1000-D	R-000	32,000
	R-001	26,000
	R-002	34,000
	R-003	36,000
	R-004	27,500
T-850	T-850	39,000
	T-851	27,000
	T-852	41,000
	T-853	43,000
	T-854	43,000
	T-855	45,000
	T-856	49,000
	T-857	43,000
	T-858	45,000
	T-859	51,000
T-850-D	U-850	39,000
	U-851	27,000
	U-852	41,000
	U-853	43,000
	U-854	45,000
	U-855	49,000
	U-856	51,000

Series	Model Code	Rating G V W (lbs)
T-950	T-950	47,000
	T-951	30,000
	T-952	49,000
	T-953	53,000
	T-954	55,000
	T-955	59,000
	T-956	65,000
	T-957	75,000
	T-958	78,000
	T-959	62,000
T-950-D	U-950	47,000
	U-951	30,000
	U-952	49,000
	U-953	53,000
	U-954	56,000
W-1000	Z-000	32,000
	Z-001	26,000
	Z-002	34,000
	Z-003	36,000
WT-1000	X-000	41,000
	X-001	32,000
	X-002	45,000
	X-003	49,000

Brakes

GROUP 2

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1 DIAGNOSIS AND TESTING

Hydraulically operated service brakes are standard equipment on all 100 through 800 Series and on some 850 and 950 Series Ford trucks.

Automatic brake shoe adjusters are used on all 500 through 950 Series Ford trucks with hydraulic brakes.

A dual-master cylinder brake system is used as standard equipment on F-100 through F-350 and P-350-400-3500-4500 vehicles. The dual-master cylinder is also used with the Split Hydraulic brake system of the B-500 -750 Series vehicles.

Front disc brakes are standard on F-250 vehicles equipped with 390 CID engines and are optional on the other F-250 and F-350 trucks.

The standard hydraulic brake system on some vehicles may be assisted by a vacuum booster installed as either standard or optional equipment. Service information on the vacuum booster unit is given in Part 2-4.

The full air brake system, optional on some moddls and standard on most 850 through 1000 models, is covered in Part 2-6. Automatic brake shoe adjusters are also included on some air brake systems.

BRAKE SYSTEM TESTS

HYDRAULIC BRAKE FLUID LEVEL AND HYDRAULIC SYSTEM

1. Always check the fluid level in the brake master cylinder reservoir(s) before performing the test procedures. If the fluid level is not within 1/4 inch of the top of the master cylinder reservoirs, add Ford Brake Fluid —Super-Heavy Duty—Part Number B7AZ-19542-A, B7A-19542-B or C.

DUAL-MASTER CYLINDER BRAKE SYSTEM

1. Turn the ignition switch to the ACC or ON position. If the light on the brake warning lamp remains on, the condition may be caused by a shorted or broken switch, grounded switch wires or the differential pressure valve is not centered. Centralize the differential pressure valve as outlined under Hydraulic System Bleeding and Centralizing of the Differential Valve in this section of the manual. If the warning light remains on, check the switch connector and wire for a grounded condition and repair or replace the wire assembly. If the condition of the wire is good, replace the brake warning lamp switch.

2. Turn the ignition switch to the start position. If the brake warning lamp does not light, check the light

and wiring and replace or repair wiring as necessary.

When both brake systems are functioning normally, the equal pressure at the pressure differential valve during brake pedal application keeps the valve centered. The brake warning light will be on only when the ignition key is in the **START** position.

3. If the brake warning lamp does not light when a pressure differential condition exists in the brake system, the warning lamp may be burned out, the warning lamp switch is inoperative or the switch to lamp wiring has an open circuit. Check the bulb and replace it, if required. Check the switch to lamp wires for an open circuit and repair or replace them, if required. If the warning lamp still does not light, replace the switch.

The trouble-diagnosis symptoms, causes, and corrections given under Diagnosis Guide-Standard Hydraulic Brakes, apply to all truck hydraulic brakes including those with a dual brake system or a vacuum booster system.

PRELIMINARY CHECKS

Push the brake pedal down as far as it will go. If the pedal travels more than halfway between the released position and the floor, adjust the brakes. If the vehicle is equipped with automatic brake adjusters, several sharp brake applications while backing up may be necessary to adjust the brakes.

Road test the vehicle and apply the brakes at a speed of about 20 mph to see if the vehicle stops evenly. If not, the brakes should be adjusted. **Perform the road test only when the brakes will apply and the vehicle can be safely stopped.**

PRELIMINARY TESTS—POWER BRAKES

With the engine stopped, eliminate all vacuum from the system by pumping the brake pedal several times. Then push the pedal down as far as it will go, and note the effort required to hold it in this position. If the pedal gradually moves downward under this pressure, the hydraulic system is leaking and should be checked by a hydraulic pressure test.

With the brake pedal still pushed down, start the engine. If the vacuum system is operating properly, the pedal will move downward. If the pedal position does not change, the vacuum system is not operating properly and should be checked by a vacuum test.

VACUUM TESTS

CHECK VALVE TEST

Disconnect the line from the bottom of the vacuum check valve, and connect a vacuum gauge to the valve. Start the engine, run it at idle speed, and check the reading on the vacuum gauge.

The gauge should register 17-19 inches with standard transmission and 14-15 inches in Drive range if equipped with an automatic transmission. Stop the engine and note the rate of vacuum drop. If the vacuum drops more than one inch in 15 seconds, the check valve is leaking. If the vacuum reading does not reach 18 inches or is unsteady, an engine tune-up is needed.

Remove the gauge and reconnect the vacuum line to the check valve.

BOOSTER TEST—BENDIX PISTON TYPE

Disconnect the vacuum line from the booster end plate. Install a tee fitting in the end plate, and connect a vacuum gauge (No. 1) and the vacuum line to the fitting. Install a second vacuum gauge (No. 2) in place of the pipe plug in the booster control valve body.

Start the engine, and note the vacuum reading on both gauges. If both gauges do not register manifold vacuum, air is leaking into the vacuum system. If both gauges register manifold vacuum, stop the engine and note the rate of vacuum drop on both gauges. If the drop exceeds one inch in 15 seconds on either gauge, air is leaking into the vacuum system. Tighten all vacuum connections and repeat the test. If leakage still exists, the leak may be localized as follows:

1. Disconnect the vacuum line and gauge No. 1 from the booster.

2. Connect vacuum gauge No. 1 directly to the vacuum line. Start the engine and note the gauge reading. Stop the engine and check the rate of vacuum drop. If gauge No. 1 does not register manifold vacuum, or if the vacuum drop exceeds 1 inch in 15 seconds, the leak is in the vacuum line or check valve connections.

3. Reconnect vacuum gauge No. 1 and the vacuum line to the tee fitting. Start the engine, and run it at idle speed for one minute. Depress the brake pedal sufficiently to cause vacuum gauge No. 2 to read from zero to 1 inch of vacuum. Gauge No. 1 should register manifold vacuum of 17-19 inches with standard transmission and 14-16 inches in Drive range if equipped with an automatic transmission. If the drop of vacuum on gauge No. 2 is slow, the air cleaner, or air cleaner line, may be plugged. Inspect and if necessary, clean the air cleaner.

4. Release the brake pedal and observe the action of gauge No. 2. Upon releasing the pedal, the vacuum gauge must register increasing vacuum until manifold vacuum is reached. The rate of increase must be smooth, with no lag or slowness in the return to manifold vacuum. If the gauge readings are not as outlined, the booster is not operating properly and should be removed and overhauled.

BOOSTER TEST—MIDLAND DIAPHRAGM TYPE (FRAME-MOUNTED) P-500, 5000

Remove the pipe plug from the rear half of the booster chamber, and install a vacuum gauge. Start the engine and run it at idle speed. The gauge should register 18-21 inches of vacuum.

1. With the engine running, depress the brake pedal with enough pressure to show a zero reading on the vacuum gauge. Hold the pedal in the applied position for one minute. Any downward movement of the pedal during this time indicates a brake fluid leak. Any kickback (upward movement) of the pedal indicates brake fluid is leaking past the hydraulic piston check valve.

2. With the engine running, push down on the brake pedal with sufficient pressure to show a zero reading on the vacuum gauge. Hold the pedal down, and shut the engine off. Maintain pedal position for one minute. A kickback of the pedal indicates a vacuum leak in the vacuum check valve, in the vacuum line connections, or in the booster.

HYDRAULIC PRESSURE TEST

Connect a 2000-psi hydraulic pressure gauge to a bleeder screw opening at one of the brake cylinders. **Bleed the air from the hydraulic system at the point of attachment of the gauge.**

Remove the pipe plug from the rear of the booster body or the trailer brake control line port, and connect a vacuum gauge at this point. With the engine running, apply the brakes enough to obtain a zero reading on the vacuum gauge. Then, note the reading on the pressure gauge. The minimum hydraulic pressure for each type and side of vacuum booster is given in the Specifications, Part 2-8. **If the engine vacuum is higher or lower than 20 inches Hg, the vacuum booster hydraulic pressure will be proportionately higher or lower than the pressure given in Part 2-8.**

Hold the brakes in the fully-applied position for at least one minute, and note the reading on the pressure gauge. The hydraulic system should hold pressure for at least one minute without losing pressure. A low pressure reading or a drop in pressure, indicates leakage in the booster or in the hydraulic system.

AIR SUPPLY SYSTEM

The air supply system is used with the full air brake system (Part 2-7). In the full air system, air pressure is applied directly to the shoes through a diaphragm and mechanical linkage.

If the brake system is not operating properly, the air supply system should be checked first.

OPERATING TESTS

Before performing any of the following tests, operate the engine until the air pressure builds up to 90 psi. With the air brake system charged, open the drain cocks in each reservoir. Close the drain cocks after all moisture is drained from the reservoirs. Some models have automatic moisture ejector valves and do not require manual draining.

Low Pressure Indicator

Exhaust the brake system pressure and observe the pressure at which the warning buzzer sounds. The contacts in the indicator should close the circuit to the buzzer, when reservoir pressure is between 58 psi minimum and 65 psi maximum. If the buzzer does not start to sound within this pressure range during discharge, or if a sounding buzzer does not stop within this pressure range during the pressure buildup, the electrical connections are loose or the indicator valve is not operating properly.

Reservoir Safety Valve

To determine if the safety valve is operative, pull the exposed end of the valve stem. If the safety valve does not blow off when the stem is pulled, the valve ball is probably stuck in its seat. In such a case, remove and disassemble the valve for cleaning.

Governor

With the engine running, build up air pressure in the system, and observe at what pressure reading on the dash gauge the pressure stops climbing. This is the point of governor cutout which should be between 118 and 125 pounds.

With the engine still running, slowly reduce the air pressure in the system by applying and releasing the brakes. Observe the pressure reading on the dash gauge at the point where the pressure starts to build up again. This is the point of governor cut-in which should be between 98 and 104 pounds.

If the governor does not cut the compressor in and out according to these specifications, adjust the governor pressure settings. Before adjusting the governor, check the accuracy of the dash gauge with a test gauge.

Check Pressure Build-Up

With the engine running at fast idle speed, observe the time required to raise system pressure from 50 to 90 pounds. If more than five minutes is required, perform the leak tests as outlined in the following paragraphs.

Also check for no unloading valve clearance, low engine idle speed, a slipping compressor drive belt, excessive carbon in the compressor cylinder head, or a worn out air compressor.

LEAK TESTS

Compressor

With the engine stopped, discharge valve leakage can be detected by carefully listening at the compressor for the sound of escaping air. With air pressure applied to the unloader cavity (with governor cut-out), remove the air filter or the air pick up tube on SD V-8 engines and check for air leaks by squirting oil around the unloader plunger and stem. If excessive air leaks are found, replace the piston seal.

Governor

With the governor in the cutout position, test for leakage at the exhaust valve by applying soap suds to the exhaust vent in the body.

With the governor in the cut-in position, test for leakage of the inlet valve by applying soap suds to the exhaust vent in the body.

In either of the foregoing tests, leakage in excess of 1-inch soap bubble in three seconds indicates the governor should be replaced.

Coat the entire governor with soap suds to detect diaphragm, gasket, and cap screw leakage. No leakage is permissable.

Reservoir Safety Valve

Coat the end of the safety valve with soap suds. Leaks causing not more than a 3-inch soap bubble in three seconds are permissable.

AIR BRAKES

Some of the air brake system components vary slightly from one vehicle model to another in design or location. However, all components are essentially the same in principle and service procedure.

First make the trouble diagnosis checks outlined under Air Supply System, and then perform the tests outlined in the following paragraphs.

OPERATING TESTS

Check Stop Light Switch

With all air pressure exhausted from the air brake system, start the engine and move the brake valve to the applied position. Stop lights should light before the dash gauge registers 10 psi pressure. Release the brakes.

Quick Release Valve and Relay Valve

With the air brake system fully charged, apply the brakes. Inspect the brake action on the wheels controlled by the quick release valve or relay valve in question. The brakes should apply promptly. Release the brakes and inspect to be sure that the air pressure is exhausted rapidly from the exhaust port. Be sure the exhaust port is not restricted.

LEAK TESTS

With the engine stopped and the brakes fully applied, watch the rate of

drop in air pressure as registered by the dash gauge. With the engine stopped and the reservoirs charged to the governor cutout pressure (118-125 psi), the rate of drop should not exceed 2 psi per minute. The rate of drop should also not exceed 3 psi per minute after the initial drop with brakes fully applied. If the pressure drops faster than specified, check the items outlined in the following paragraphs.

Brake Valve

With the pedal fully released, coat the exhaust port with soap suds to check for leaks. With the pedal fully applied, coat the exhaust port with soap suds and check for leaks. Leaks causing not more than a three inch soap bubble in three seconds are permissable.

Brake Chambers

With the brakes fully applied, coat the clamp ring and bolt flanges holding the diaphragm in place with soap suds. No leaks are permissable.

Quick Release Valve

With brakes applied, coat the exhaust port with soap suds to detect leakage. Leakage in excess of a 3-inch soap bubble in three seconds is not permissable.

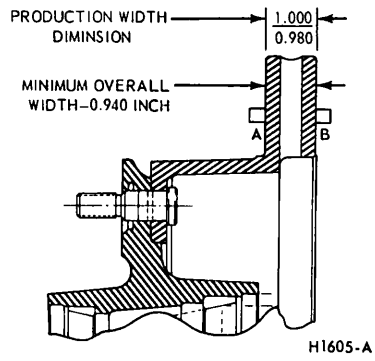

FIG. 1—Disc Brake Rotor Service Limits

Relay Valve

With the brakes **released**, coat the exhaust port with soap suds and observe the leakage.

With the brakes fully **applied**, coat the exhaust port with soap suds and observe the linkage.

Leakage in either of the foregoing tests should not exceed a 3 inch soap bubble in three seconds.

DISC BRAKE ROTOR RESURFACING

Normal concentrically grooved rotors are acceptable for running with new replacement shoe and lining assemblies. Damaged rotors may be turned removing equal amounts off each side to the minimum rotor width of .940 inches.

Inspect the rotor and replace the hub and rotor assembly if the rotor is cracked or if the machining requirements to resurface the rotor exceed the specified limits.

The disc brake rotor may be resurfaced using dealer available tools. **The following specifications must be maintained when resurfacing the brake rotor. Refer to Fig. 1.**

1. A maximum of .020 inch material may be machined equally off each surface (A and B), maintaining the .940 inch as an absolute minimum overall width.

2. After machining, the thickness variation between surfaces A and B must not exceed .001 inch measured at equally spaced points on the rotor. **Brake roughness or vehicle shudder can be induced if the rotor thickness variation exceeds .001 inch.** The wheel stud locations can be used to determine the equally spaced areas for checking the rotor thickness.

3. Surface B must be flat within .010 inch total indicator reading.

4. The surface finish on surface A and B must be within 15-80 R.M.S.

2 COMMON ADJUSTMENTS AND REPAIRS

AIR CHECK OF BOOSTER PUSH ROD ADJUSTMENT—MIDLAND ROSS BOOSTER (DASH MOUNTED—HEAVY TRUCKS ONLY)

Whenever the master cylinder or booster has been repaired or replaced, the brake system must be checked for proper return flow of hydraulic brake fluid from the wheel cylinders to the reservoir of the master cylinder. This check will assure that the brake booster to master cylinder push rod is properly adjusted to allow the master cylinder compensating valve to open when the brake pedal is in the fully-released position.

The air check is made after the brake booster and master cylinder has been installed and before the master cylinder hydraulic line connection is made and the reservoir is filled with brake fluid.

1. Connect the brake vacuum line to the vacuum booster, if required. Start the engine.

2. Position the nozzle of an air hose to the master cylinder discharge port. Place a hand over the master cylinder reservoir and apply air pressure through the air hose nozzle.

If free passage air pressure is felt on the hand located over the master cylinder reservoir, the brake booster push rod is properly adjusted.

If no air pressure is felt on the hand located over the reservoir, the master cylinder must be removed and the push rod length shortened. To shorten the push rod length, turn the acorn-type screw on the brake booster push rod inward, one turn at a time, until the air check shows the brake master cylinder compensating valve is open.

BRAKE PEDAL ADJUSTMENT

On dual-brake master cylinder or dash mounted vacuum booster equipped vehicles, the brake systems are designed to permit full stroke of the master cylinder when the brake pedal is fully depressed. A brake pedal clearance adjustment is not required.

In order to release the brakes, fluid in a hydraulic brake system must flow back to the master cylinder when pedal pressure is released. A port is provided in the master cylinder to allow this flow, but the piston must move back far enough to expose the return port. To be sure that this will always happen, free-travel is built into the pedal linkage on standard and on frame-mounted booster systems. This free-travel prevents the piston from becoming trapped in a partially released position. Pedal free travel is not always perceptible in dash-

mounted booster systems, however, because the operating clearance for the piston is adjusted at the booster push-rod, rather than the pedal linkage. (Refer to Part 2-5 for instructions on dash-mounted booster push-rod adjustments).

Pedal free travel is not adjustable on 500-1000 series trucks with a dash-mounted booster and a single or dual system or units with a dual system and a frame-mounted booster.

If the pedal free travel in a standard hydraulic brake system or frame mounted hydraulic booster system is less than 3/16 inch or more than 3/8 inch (Fig. 1), the pedal should be adjusted.

To adjust free-travel:

1. Push the brake pedal down by hand pressure, and check the free travel.
2. Loosen the lock nut on the eccentric bolt, and rotate the eccentric bolt until the free travel is within 3/16-3/8 inch.

On a P-Series truck turn the hex head of the push rod to obtain the required free-travel.

3. Hold the bolt securely, and torque the lock nut to 30-35 ft-lbs.
4. Recheck the pedal free-travel to make sure that the adjustment did not change when the lock nut was tightened.

FRONT DISC BRAKES F-250 AND F-350

The front disc brake assembly is designed so that it is inherently self-adjusting. Refer to Part 2-2, Removal and Installation, Section 3 or Major Repair Operations, Section 4 for the required service procedures.

BRAKE DRUM REPAIR 250 THROUGH 1000 SERIES EXCEPT 4-WHEEL DRIVE-FRONT

The service procedures covered here apply to both hydraulic and air brakes. Since the F-100, 250 and 350 or the P-350, 400, 3500 and 4000 (front and rear) and the 4-wheel drive front brake drum procedures apply to hydraulic brakes only, they are covered in Section 3 of Part 2-2.

FRONT BRAKE DRUM

1. Raise the truck until the wheel and tire clear the floor and remove the wheel and tire from the hub. Back off the brake shoe adjusting screw so that the shoes do not contact the brake drum. Remove the grease cap and the gasket (if so equipped) from the hub.
2. With 4,000 through 7,000 lb. and 18,000 lb. front axles, remove the cotter pin, adjusting nut and flat washer from the spindle.

On trucks with a 9,000 lb. or 11,000 or 15,000 lb. axle, remove the lock nut, the dimpled washer, the locking ring and the adjusting nut and pin assembly.

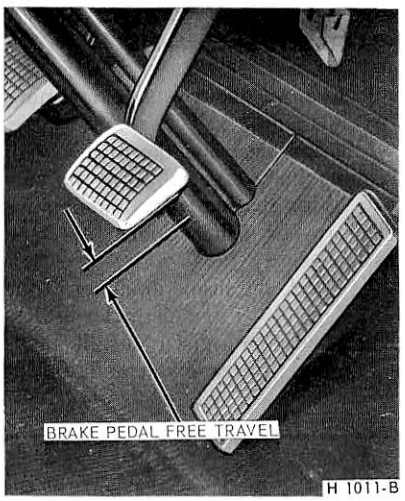

FIG. 2—Pedal Free Travel Check

3. Remove the outer bearing cone and roller. Pull the hub and drum assembly off the wheel spindle.
4. Remove the front wheel to hub retaining nuts or rim and tire attaching nuts. Remove the wheel or rim and tire from the hub and drum.
5. Remove the brake drum retainers and attaching bolts, screws, or bolts and nuts.
6. Remove the brake drum from the hub.
7. Check the drum for damage or wear, and repair or replace as necessary. If a new drum is to be installed, be sure to remove the protective coating with a suitable degreaser.

New grease retainer seals should be installed whenever a wheel and hub is removed.

8. Place the brake drum to the hub and install the retainers and retaining bolts, screws, or bolts and nuts.
9. Install the hub and drum on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.**
10. With 4,000 through 7,000 lb. and 18,000 lb. front axles, install the outer bearing cone and roller and the flat washer on the spindle, then install the adjusting nut. With front axles of 9,000 lbs., 11,000 or 15,000 lbs. capacity, install the outer bearing cone and roller and the bearing adjusting nut and pin assembly.
11. Install the wheel and tire on the hub, then install the clamps (if applicable) and the wheel stud nuts.
12. Torque the adjusting nut to specifications while rotating the wheel. Refer to Group 3 for the wheel bearing adjustment procedure.

Install the dimpled washer with the dimple indexed in one of the holes in the adjusting nut. Install the lock nut and torque to specifications. Bend the dimpled washer over a flat of the lock nut.

13. Install the gasket (if so equipped) and the grease cap, and torque the wheel stud nuts to specifications. Install the hub cap if so equipped, and adjust the brakes.

REAR BRAKE DRUM

1. Raise the truck and install stands.
2. Remove the wheel and tire as an assembly. Then back off the rear brake shoe adjustment.
3. Remove the rear axle shaft retaining nuts, adapters, axle shaft, and grease seal.
4. Remove the wheel bearing locknut, lock washer, and adjusting nut.
5. Remove the hub and drum from the axle.
6. Remove the brake drum to hub retaining screws, bolts, or bolts and nuts. Then remove the brake drum from the hub.
7. Check the drum for damage or wear, and repair or replace as necessary. If a new drum is to be installed, be sure to remove the protective coating with a suitable degreaser.

New grease retainer seals should be installed whenever a wheel and hub is removed.

8. Position the brake drum to the hub and install the attaching screws, bolts, or bolts and nuts.
9. Position the hub and drum as an assembly on the axle and start the adjusting nut.
10. Adjust the wheel bearing nut and then install the wheel bearing lock washer and locknut.
11. Install a new rear axle oil seal, axle shaft and gasket, stud adapters, and attaching nuts.
12. Install the wheel and tire as an assembly.
13. Adjust the brake shoes and then remove the stand and lower the truck.

BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned on a drum lathe. Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drums up to and including 14 1/8 inches nominal diameter are considered unsatisfactory for further service use if the original inside diameter has increased more than .090 inch. These drums should not be machined to more than .060 inch beyond the original diameter or allowed to wear more than an additional 50%.

Brake drums larger than 14 1/8 inches nominal diameter are considered unsatisfactory for further service use if the original inside diameter has increased more than .120 inch. These drums should not be machined to more than .080 inch beyond the original diameter or allowed to wear more than an additional 50%.

If the diameter of the drum is less than .030 inch oversize after refinishing, install standard linings on the brake assemblies. If the diameter is over 0.030 inch, install oversize or shimmed linings.

BRAKE SHOE RELINING

1. Remove the rivets and remove the old lining.
2. Clean the shoe thoroughly with cleaning fluid, especially the rim surface. Wipe the shoe dry and remove all burrs or rough spots from the shoe.
3. Check the inside diameter of the brake drum. If the diameter is less than 0.030 inch oversize, install standard linings. If the diameter is 0.030-0.060 inch oversize, install oversize or shimmed linings.
4. Position the new lining on the shoe and install new rivets, beginning with the rivet holes near the center of the shoe. On some vehicles, the primary lining is shorter than the secondary lining. If this condition exists, position the shorter (primary) lining to line up with the heel end of the shoe. **Do not let brake fluid oil or grease touch the brake lining. If a brake lining kit is used to replace the worn linings, install all the parts supplied in the kit.**
5. Check the clearance between the lining and shoe rim. The lining must seat snugly against the rim with not more than 0.005 inch separation midway between any two rivets. If only the linings are replaced on duo-servo single anchor brakes with fixed anchor pins, the brake linings must be cam ground 0.010 inch at the ends after the linings are riveted to the brake shoe.

3 CLEANING AND INSPECTION

FRONT DISC BRAKES

1. Remove the wheel and tire, brake shoe retainers, and the shoe and linings as outlined in Part 2-2, Section 3.
2. Make three thickness measurements with a micrometer across the middle section of the shoe and lining. Take one reading at each side and one in the center. If the assembly has worn to a thickness of 0.350 inch (Shoe and lining together) at any one of the three measuring locations, or if the lining shows evidence of brake fluid or oil contamination that is causing a brake pull, replace the shoe and lining assemblies. Replace all (4) shoe and lining assemblies if the linings are worn more than 0.030 inch from the specified nominal shoe and lining thickness of 0.380 inch.
3. Check caliper to spindle attaching bolt torque. Torque them to specification if required.
4. To check rotor runout, first eliminate the wheel bearing end play by tightening the adjusting nut to 5 inch pounds torque. After tightening the nut, check to see that the rotor can still be rotated.
5. Clamp a dial indicator to the spindle so that the stylus contacts the rotor at a point approximately 1 inch from the outer edge. Rotate the rotor and take an indicator reading. If the reading exceeds 0.002 inch total lateral runout on the indicator, replace or resurface the disc brake rotor. **The following requirements must be met when resurfacing disc brake rotors:**

Rotunda Disc Brake Attachment FRE-2249-2 is the **only approved** tool to be used to refinish the disc brake rotors. The step-by-step resurfacing procedure provided with the tool must be adhered to.

The finished braking surfaces of the rotor must be flat and parallel within 0.0007 inch; lateral runout must not exceed 0.002 inch total indicator reading, and the surface finish of the braking surfaces are to be 15-80 micro inches.

When the runout check is finished, be sure to adjust the bearings as outlined in Group 3, in order to prevent bearing failure.

6. Check the rotor for scoring. Minor scores can be removed with a fine emery cloth. If the rotor is excessively scored, refinish it as outlined in step 5 or replace the rotor if required.
7. Visually check the caliper. If it is cracked or if any leakage is evident, it should be replaced. Any leakage around the dust boot indicates the need for removal and disassembly.
8. Check brake hoses for signs of cracking, leaks, or abrasion. Replace if necessary.

BRAKE CYLINDER

1. Clean all brake cylinder parts in clean isopropyl alcohol. Inspect all parts for wear or damage. Check the cylinder bore for rust, scores, or other damage. Be sure that the bleeder screw passage is clean and open. Replace all parts that are worn or damaged.
2. If dirt is found in any part of the hydraulic system, flush the entire system with clean isopropyl alcohol.

MASTER CYLINDER

1. Clean all master cylinder parts in clean isopropyl alcohol, and inspect the parts for wear or damage, replacing them as required. **When a master cylinder repair kit is used, install all of the parts supplied in the kit.**
2. Check the ports and vents in the master cylinder to make sure that all are open and free of foreign matter.

3. On a single brake system master cylinder, check to see if the spring valve (riveted to the front end of the piston) is loose or has moved so that the piston ports are open, replace the piston.

4. Inspect the cylinder walls for scores or rust, and recondition them if necessary. Hone the cylinder walls no more than necessary (0.003 inch maximum), either to remove scores and rust, or to obtain a smooth wall surface. Remove any burrs or loose metal that may have resulted from the honing operation, and clean the cylinder with clean isopropyl.

BRAKE DRUMS AND LININGS

1. After removing one front wheel and drum and one rear wheel and drum from the vehicle, inspect the drums and brake shoe linings for wear or damage that would affect brake operation. **Do not let brake fluid, oil or grease touch the drum or linings.**

2. A brake shoe should be relined when the lining face is worn to within 1/32 inch of any rivet head, or when the lining has been soaked with brake fluid, oil or grease. If a worn lining is not replaced, the brake drum may become severely damaged. **Always replace the primary and secondary brake shoe lining assemblies on both front or both rear brake assemblies at the same time.**

3. Before relining a brake shoe, inspect the shoe for distortion, cracks, or looseness between the rim and web. If one of these conditions exists, replace the shoe. **Do not attempt to repair a damaged brake shoe.**

4. If the drum and linings are in good condition, install the wheel and drum. **The condition of the drums and linings of the opposite wheel will usually be about the same as that found at the wheel that was removed.**

5. Add enough super-heavy-duty brake fluid to the master cylinder reservoir to bring the level to within 1/4 inch of the top of the filler neck.

6. Check to be sure that the parking brake handle is fully released before making any brake adjustment.

7. Check the front brake anchor pin nut with a wrench (on brake assemblies with an adjustable anchor pin). If the bolt is loose, torque it to 80-100 ft-lbs.

BRAKE BOOSTER

1. After disassembly, immerse all metal parts in a suitable cleaning solvent and dry them with compressed air. Use only isopropyl alcohol on rubber parts or parts containing rubber. After the parts have been thoroughly cleaned and rinsed in cleaning solvent, the metal parts which come in contact with hydraulic brake fluid should be rewashed in clean isopropyl alcohol before assembly. Use an air hose to blow dirt and cleaning fluid from the recesses and internal passages. When overhauling a power booster, use all parts furnished in the repair kit. **Discard all old rubber parts.**

2. Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts. If the inside of the booster body is rusted or corroded, polish it with steel wool or fine emery cloth. Replace the body shell when scored. Inspect the master cylinder bore for signs of scoring, rust, pitting or etching. Any of these conditions will require replacement of the cylinder.

CAM-TYPE AIR BRAKES

1. Inspect the camshaft bushings and replace if worn or damaged.

2. Check the anchor pins and shoe-to-cam rollers for wear or damage, and replace, if required.

3. Check thickness of the brake lining at the center of the shoe, and replace, if necessary.

4. Clean, inspect, and replace worn or damaged parts. Coat the anchor pins and cam lobes with Lubriplate before installing the shoes.

BENDIX WEDGE-TYPE AIR BRAKES

Clean the metal parts in a non-oily cleaning solvent. **Replace the rubber parts whenever the brake is disassembled.** Replace damaged or worn metal parts. **Do not use gasoline or hot water solutions on metal parts.**

Inspect the following parts and replace defective pieces:

WEDGE

Check rod and wedge surfaces for scoring. The wedge angle, 10 degrees, 14 degrees or 18 degrees, is stamped on the side of the wedge. If the wedge assembly must be replaced, use an assembly with the same wedge angle.

PISTONS

Check the outside surface for scoring. On anchoring pistons, check shoe web slot for roughness.

ADJUSTING SCREW AND NUT

Check for sheared threads. Check adjuster ring teeth for wear. Make sure that screw turns easily in nut.

LINK

Check shoe web slot for roughness and cracks.

ROLLERS

Check for score marks, cracks or flat spots.

SPRING CLIP

Check clip for fatigue cracks.

AUTOMATIC ADJUSTMENT LEVER AND SPRING

Inspect for broken spring. Check lever for fatigue cracks and distortion.

ACTUATOR CASTING (TORQUE SPIDER)

Inspect machined bores for roughness. Use emery cloth to remove any rough areas which interfere with plunger movement. Check automatic adjuster pin for corrosion or distortion. Check the shoe guide bosses and steady rest for roughness on the rubbing surfaces. Inspect the mount-ring and holes of torque spider for cracks.

POSSIBLE CAUSES OF TROUBLE	TROUBLE SYMPTOMS																
	One Brake Drags	All Brakes Drag	Hard Pedal	Spongy Pedal	Car Pulls to One Side	One Wheel Locks	Brakes Chatter	Excessive Pedal Travel	Pedal Gradually Goes to Floor	Brakes Uneven	Shoe Click After Release	Noisy or Grabbing Brakes	Brakes Do Not Apply	Brakes for the respective system do not apply.	Warning lamp stays lit.	Pedal gradually moves toward floor or dash panel.	Warning lamp does not light
Mechanical Resistance at Pedal or Shoes		X	X														
Brake Line Restricted	X	X	X		X												
Leaks or Insufficient Fluid				X				X	X				X			X	
Improper Tire Pressure					X					X							
Distorted or Improperly Adjusted Brake Shoe		X	X		X	X		X				X					
Weak Retracting Spring	X				X												
Drum Out of Round	X				X		X										
Lining Glazed or Worn			X		X	X	X	X				X	X				
Oil or Grease on Lining					X	X	X			X		X	X				
Loose Backing Plate	X					X	X										
Loose Lining							X										
Scored Drum										X		X					
Dirt on Drum Lining Surface												X					
Brake Cylinder Needs Repair	X				X	X						X					
Dirty Brake Fluid	X	X								X			X				
Master Cylinder Needs Repair		X						X	X				X			X	
Air in Hydraulic System	X			X				X					X				
Self-Adjusters Not Operating					X			X									
Insufficient Shoe to Backing Plate Lubrication	X										X	X					
Tire Tread Worn						X											
Poor Lining to Drum Contact							X										
Loose Front Suspension							X										
Threads Left by Drum Turning Tool Pulls Shoes Sideways											X						
Cracked Drum								X									
One Section Dual Brake System Is Inoperative														X	X		
Differential Pressure Valve Is Not Centered															X		
Wiring To Warning Lamp Switch Is Grounded															X		
Warning Lamp Switch Is Grounded															X		
Warning Lamp Is Burned Out																	X
Warning Lamp Switch Has An Open Circuit																	X
Wiring to Warning Lamp Has Open Circuit																	X

FIG. 3—Diagnosis Guide—Standard Hydraulic Brakes

POSSIBLE CAUSES OF TROUBLE	TROUBLE SYMPTOMS												
	Excessive Pedal Travel	Brake Roughness or Chatter (Pedal Pumping)	Excessive Pedal Effort	Pull	Rattle	Brakes Heat Up During Driving and Fail to Release	Leaky Wheel Cylinder	Grabbing or Uneven Braking Action	No Braking Effect When Pedal Is Depressed	Brakes for the Respective System Do Not Apply	Pedal Gradually Moves Toward Floor or Dash Panel	Warning Lamp Stays Lit.	Warning Lamp Does Not Light
Shoe and Lining Knock-back after Violent Cornering or Rough Road Travel	X												
Shoe and Lining Assembly not Properly Seated or Positioned	X					X			X				
Leak or Insufficient Fluid in System or Caliper	X		X						X		X		
Loose Wheel Bearing Adjustment	X			X									
Damaged or Worn Caliper Piston Seal	X						X		X				
Improper Master Cylinder Push Rod Adjustment	X												
Excessive Rotor Runout or Out of Parallel		X											
Incorrect Tire Pressure				X				X					
Frozen or Seized Pistons			X	X		X		X					
Brake Fluid, Oil or Grease on Linings		X	X	X				X					
Shoe and Lining Worn Below Specifications			X										
Proportioning Valve Malfunction			X					X					
Booster Inoperative			X										
Caliper Out of Alignment with Rotor				X				X					
Loose Caliper Attachment	X	X		X	X			X					
Metering Valve Seal Leaks								X					
Excessive Clearance Between Shoe and Caliper or Between Shoe and Splash Shield					X								
Shoe Hold Down Clips Missing or Improperly Positioned					X								
Operator Riding Brake Pedal						X							
Scores in the Cylinder Bore							X						
Corrosion Build-Up in the Cylinder Bore or on the Piston Surface			X	X			X						
Bleeder Screw Still Open									X		X		
Caliper Out of Parallel with Rotor				X									
One Section Dual Brake System Is Inoperative										X		X	
Differential Pressure Valve Is not Centered												X	
Wiring to Warning Lamp Switch Is Grounded												X	
Warning Lamp Switch Is Grounded												X	
Warning Lamp Is Burned Out													X
Warning Lamp Switch Has an Open Circuit													X
Warning Lamp Switch Is Inoperative													X
Wiring to Warning Lamp Has Open Circuit													X

FIG. 4—Diagnosis Guide—Disc Brake Trouble Symptoms and Possible Causes

BOOSTER INOPERATIVE—HARD PEDAL	The trouble may be caused by vacuum leakage. Disconnect the vacuum line at the booster, remove the vacuum manifold and check valve assembly, and look for a sticking or damaged check valve. Check all vacuum connections for leakage or obstruction. Check all hoses for a leaking or collapsed condition. Repair or replace parts as necessary. If the foregoing procedure does not eliminate the trouble, remove the	booster from the car. Separate the front shell from the rear shell, and check the valve and rod assembly reaction disc, diaphragm plate, and diaphragm assembly for damage that would cause leaks. When assembling, be sure that the diaphragm assembly is properly positioned. Improper location could cause leakage between the vacuum and atmospheric sides of the diaphragm.
BRAKES DRAG OR GRAB	The condition is probably caused by a sticking valve plunger assembly. Remove and disassemble the booster.	Clean, inspect, and replace parts as necessary.
SELF APPLICATION OF BRAKES WHEN ENGINE STARTS	Remove and disassemble the booster. Check for a leak in the rear shell. Check the diaphragm for being out of locating radii in the housing. Check for a sticking or unseated valve poppet.	Clean, inspect, and replace parts as necessary. Be sure that the diaphragm is properly located when assembling.

FIG. 5—Diagnosis Guide—Power Brakes Vacuum Booster—Bendix Dash Mounted

BOOSTER INOPERATIVE HARD PEDAL	Check as follows to see if the power unit is operating: With the engine stopped, depress the brake pedal several times to eliminate all vacuum from the system. Apply the brakes, and while maintaining pressure on the pedal, start the engine. If the unit is operating, the brake pedal will move forward slightly when engine vacuum power is added to the foot pressure on the pedal. If the unit is not operating, there will be no pedal action. If this check shows that the unit is not operating, check for the following: Brake pedal linkage sticking.	Vacuum check valve not operating properly. Collapsed or leaking vacuum hose. Plugged vacuum fittings. Leaking vacuum chamber. Vacuum check valve stuck in closed position. Leak in bellows assembly. Diaphragm assembly out of place in housing locating radii: Vacuum leak in automatic transmission T.V. vacuum line connection or fitting. Vacuum leak in forward, vacuum housing.
BRAKES DRAG	Sticking Valve Plunger.	
BRAKES GRAB	Sticking actuating valve assembly.	
SELF APPLICATION OF BRAKES WHEN ENGINE STARTS	Leak in rear housing. Diaphragm out of locating radii in housings and allowing atmospheric	pressure into rear chamber. Sticking or unseated atmospheric valve.

FIG. 6—Diagnosis Guide—Power Brakes Vacuum Booster—Midland Dash Mounted

BRAKE PEDAL KICKS BACK WHEN APPLIED	This condition may be caused by a malfunctioning hydraulic piston check valve or slave cylinder piston cup. Re-	place the slave cylinder piston and/or piston cup.
ROUGE ENGINE IDLE WITH BRAKES RELEASED	Check for vacuum leaks in the vacuum line, loose hose connections, a loose body clamp, or a weak control valve piston return spring. Check all connections and tighten them or replace damaged parts as required. This	condition may also be caused by vacuum leaks at the control valve diaphragm, at the valve piston assembly, or at the power diaphragm. Remove and overhaul the booster assembly.
ROUGH ENGINE IDLE OR STALL AND HARD PEDAL WITH BRAKES APPLIED	Check the condition of the air cleaner. If it is clogged with dirt, replace the air cleaner felt. A sticking control valve piston, leaks at the control valve diaphragm or atmospheric valve seal, dirt on the control valve	plate, or the control valve piston not seating properly on the plate may also cause this condition. In addition, the booster diaphragm may be damaged. Remove and overhaul the booster assembly.
INTERMITTENT HARD BRAKE PEDAL	Check for an obstructed air cleaner, an inoperative vacuum check valve, or a slave cylinder piston sticking in the bore due to dirt or inferior hydraulic	fluid. Clean or replace damaged parts, refill the hydraulic system with new heavy-duty type brake fluid, and bleed the system.
HARD PEDAL—BOOSTER DIAPHRAGM RUPTURED	When a ruptured diaphragm is found, check for gasoline odor on the diaphragm. Gasoline will deteriorate the diaphragm and cause a premature failure.	Gasoline can get on the diaphragm from the intake manifold if the vacuum check valve is not operating properly or if hoses are not routed correctly.
BRAKES DO NOT RELEASE	Check the rear of the vacuum chamber for damage. This condition may also be caused by a sticking control valve piston, a damaged slave cylinder piston check valve, dirty brake fluid, a sticking slave cylinder piston, a sticking push rod, or an inoperative check valve in the end cap. Remove and overhaul the booster.	In case of emergency, if a sticking control valve piston holds the brakes in an applied position, disconnect the booster vacuum line from the vacuum check valve and install a pipe plug in the check valve opening. This permits the brakes to release. Manual application of brakes may then be made without assistance from the booster.

FIG. 7—Diagnosis Guide—Power Brakes Vacuum Boosters—Frame Mounted

AIR PRESSURE BELOW NORMAL	Air gauge not reading properly. Compressor worn out. Compressor discharge valve leakage. Slipping compressor drive belt. Open reservoir drain cock. Excessive leakage at lines and fittings to reservoir tank.	Low engine speed. Excessive carbon in the compressor head or discharge line. Clogged compressor air strainer. Damaged or improperly adjusted governor. Compressor inlet valves stuck closed.
AIR PRESSURE RISES ABOVE NORMAL	Damaged or improperly adjusted governor. Compressor unloading valves stuck closed. Restriction in the passage between the governor and the compressor unloading mechanism. Air gauge not operating properly.	Excessive clearance at the compressor unloading valves. Leak at compressor unloading piston seal. Carbon deposits in cavities beneath unloading piston and passages in the compressor cylinder head.
CONTINUOUS OR INTERMITTENT COMPRESSOR KNOCKS	Loose drive pulley. Worn or burned out compressor bearings.	Excessive carbon deposits in the compressor cylinder head.
SAFETY VALVE BLOWS-OFF	Governor cut-out setting adjusted too high. Above normal system pressure.	Damaged or improperly adjusted safety valve.
EXCESSIVE OIL OR WATER IN THE BRAKE SYSTEM	Failure to drain the reservoirs at regular intervals.	Worn compressor piston rings. Dirty compressor air filter.

FIG. 8—Diagnosis Guide—Air Supply System

BRAKES WILL NOT APPLY	Compressor not operating. Broken or disconnected air line. Inoperative brake applying valve in truck or in towing vehicle.	Inoperative emergency relay valve. (If trouble is in trailer brakes only.) Punctured diaphragm in air chamber.
BRAKES APPLY BUT BRAKING IS NOT ADEQUATE	Vehicle is overloaded. Compressor drive belt is slipping. Low air pressure in brake system due to leak in lines or fittings. Leak at the air chambers.	Glazed linings in the wheel brakes. Brakes not properly adjusted. Brake drum broken or cracked. Improper brake blocks.
BRAKES APPLY TOO SLOWLY	Low air pressure in system. Restricted air hose or tubing. Excessive air leakage in system. Inoperative brake applying valve in truck or in towing vehicle.	Inoperative emergency relay valve. (If trouble is in trailer brakes only.) Leak at air chambers. Ice from condensed water in air tanks or hose.
BRAKES WILL NOT RELEASE	Defective brake applying valve in truck or towing vehicle. Two-way hand valve in towing vehicle is in emergency position. (If trouble is in trailer brakes only.) Broken wedge return spring in brake actuator housing.	Brake shoes adjusted too close to brake drum. Atmospheric vent on air chamber plugged. Insufficient air pressure to release spring brakes.
BRAKES RELEASE TOO SLOWLY	Inoperative brake applying valve in truck or towing vehicle. Restricted air line. Weak or broken brake shoe-to-shoe springs. Weak wedge return spring in actuator.	Shoe guide ledges dry or corroded. Binding of wedge actuating mechanism because of inadequate lubrication. Plungers corroded and frozen in cylinder bore.
GRABBY BRAKES OR UNEVEN BRAKING	Inoperative brake apply valve in vehicle or towing vehicle. Inoperative emergency relay valve. (If trouble is in trailer brakes only.) Grease on linings. Scored or broken brake drum. Distorted brake shoes.	Lining loose on shoes. Loose wheel bearing. Brake drum out-of-round. Binding of wedge actuating mechanism because of inadequate lubrication.
When trouble-diagnosing, investigate the entire system since braking	problems may originate in many parts of the air brake system other than	the basic wheel brakes.

FIG. 9—Diagnosis Guide—Wedge-Type Air Brakes

LEAKING SPRING BRAKE (Air Pressure Loss)	Check air lines and connections. If air exhausts constantly from service brake port when spring brake has been charged with air, replace pushrod seal. If air exhausts constantly from	breather cap opening when spring brake has been charged with air, replace main seal. If air bubbles appear from under release bolt head, replace collar seal.
NO PARKING BRAKE	Spring brake is manually released. Screw in release bolt. Spring failure. Disassemble unit and replace spring. Service brake chamber piston rod not mated with wedge shaft.	Improper adjustment of wedge brakes. Check automatic adjuster mechanism for correct assembly and operation. Damaged or incorrectly assembled wedge brake. Check mechanism.
LEAKING SERVICE BRAKE AIR CHAMBER (Air Pressure Loss)	Check all lines and connections. Charge service brake chamber with air. Soap or oil test clamp ring. If bubbles appear, tighten clamp ring. If bubbles persist, replace diaphragm. If air exhausts constantly from	spring brake port when service brake chamber has been charged with air, replace pushrod seal. Examine diaphragm for wear, cracks or rupture. Replace, if necessary.
SPRING BRAKE WILL NOT RELEASE WITH AIR	Check air lines and connections. Insufficient air pressure being delivered to spring brake. Check pres-	sure at end of air line. Damaged or incorrectly assembled wedge brake. Check mechanism.

FIG. 10—Diagnosis Guide—Air Parking and Safety Brake

INSUFFICIENT BRAKING ACTION	Low reservoir pressure. Brakes need lubrication, adjustment, or relining. Foot control valve delivery pressure too low due to a malfunction in the valve or incorrect adjustment of the treadle linkage.	
SLOW BRAKE ACTION	**SLOW APPLICATION** Lack of lubrication at brake shoe camshafts. Low reservoir pressure. Excessive leakage during brake application. Restricted or damaged pipes or hoses. Foot control valve and treadle linkage sticking or damaged.	**SLOW RELEASE** Restricted port, weak return spring, or other wear damage in foot control valve. Brakes require lubrication or adjustment. Restricted or damaged pipes or hoses. Damaged or restricted quick release valve or relay valve. Broken retraction springs or binding hold pins.
BRAKES INOPERATIVE	**BRAKES DO NOT RELEASE** Restricted brake lines. Weak return spring or other wear or damage in foot control valve. Broken brake shoe retracting springs or rusted front anchor pins.	**BRAKES DO NOT APPLY** Low reservoir pressure. Restricted or broken pipes or hoses. Defective foot control valve.
UNEVEN OR GRABBING BRAKES	Grease on brake linings. Out-of-round brake drums. Bind in brake shoe mountings. Foot control valve worn or damaged. Wet brakes.	Brakes need adjustment, lubrication, or relining. Leaking brake chambers. Broken brake chamber piston return spring.
QUICK AIR PRESSURE DROP WITH ENGINE STOPPED	**BRAKES RELEASED** Excessive leakage at foot control valve, governor, compressor discharge valve, or at other points in the system.	**BRAKES APPLIED** Excessive leakage in brake chambers, brake chamber diaphragms, tube and hose connections, or foot control valve.

FIG. 11—Diagnosis Guide—Cam-Type Air Brakes

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1 DESCRIPTION AND OPERATION

SPLIT HYDRAULIC BRAKE SYSTEM

The standard brake system on all B-500-750 Series vehicles is a split hydraulic system (Fig. 1) with automatic brake adjusters at all the wheels.

With the split hydraulic system, each of the two lines from the dual-master cylinder actuates one brake cylinder at each wheel (front and rear) for vehicles with 15 by 3-inch front brakes. On vehicles with 14 by 2-1/2-inch front duo-servo brakes, the single brake cylinders in both front wheels are actuated by one line that also operates one cylinder at each rear wheel. The line from the other master cylinder outlet port actuates the remaining brake wheel cylinder at each rear wheel. Power boosters are dash-mounted on vehicles with duo-servo front brakes and rear axle capacities up to 15,000 pounds (21,000 pounds GVW). Other vehicles (above 21,000 pounds GVW) have frame-mounted boosters.

DUAL-MASTER CYLINDER BRAKE SYSTEM

A dual-master cylinder brake system (Fig. 2) is used as standard equipment on F-100 through 350 and P-350-400-3500-4000 and B-500-750 Series Models.

A code letter is stamped on the end of each dual-master cylinder body casting for easy service identification. The truck models, type of brakes and the identification code letters are shown on the dual-master cylinder identification chart (Fig. 3).

The dual, master cylinder contains a double hydraulic cylinder with two fluid reservoirs, two hydraulic pistons (a primary and secondary) and two residual check valves, located in the outlet ports (Fig. 4). On all vehicles except the F-350 Series, the master cylinder secondary systems outlet port is connected to the rear brakes and the primary system brake outlet port is connected to the front brakes. On the F-350 Series truck models, the master cylinder front outlet port is connected to the front brakes and the rear outlet port is connected to the rear brakes.

The master cylinder primary and

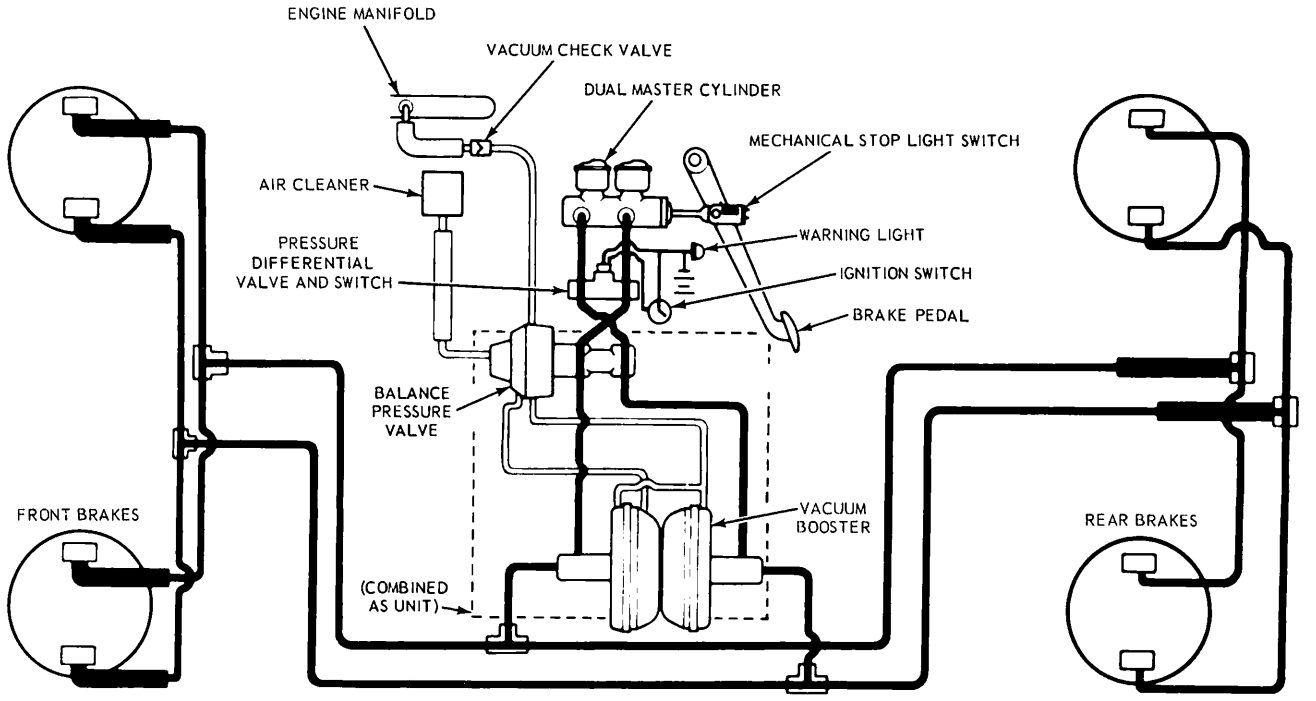

FIG. 1 — Split Hydraulic Brake System Schematic B-Series

secondary pistons function together when the primary and secondary systems are fully operative.

With the master cylinder and front and rear brake systems filled and bled, a solid column of fluid is located on both the primary and secondary pistons. Upon application of the brakes at the brake pedal, fluid is displaced by the piston into the wheel cylinders or calipers (if applicable) to activate both the front and rear brakes. Upon release of brake application, the brake fluid returns from the wheel cylinders or calipers (if applicable), through the front and rear brake lines and residual check valves to the master cylinder bore.

Failure in either the front or rear brake system does not result in failure of the entire hydraulic brake system. For example:

Should hydraulic failure occur in the rear brake system, the hydraulic pressure from the primary piston (which actuates the front brakes on all except F-350 Series models) causes the unresisted secondary piston (which acutates the rear brakes on all except F-350 Series models) to bottom out in its bore. The primary piston then proceeds to actuate the front brakes with the continued stroke of the brake pedal. Fluid under pressure will continue to be displaced by the front brake (primary) system allowing braking at the front wheels.

Should a failure occur in the primary (front brake) hydraulic system, the initial brake pedal stroke would cause the unresisted primary piston to bottom out on the secondary piston. Continued pedal stroke will move both pistons and the fluid under pressure applied by the secondary piston will apply the rear brakes.

As noted in the aforementioned description and the example above, the brake systems for the F-350 Series trucks are the reverse of the systems in the example. However, the operating principle for the F-350 Series trucks is the same.

Failure in one independent hydraulic system does not affect the hydraulic fluid displacement of the other independent system. In addition, hydraulic output pressure remains basically the same for the same pedal effort.

The increased pedal travel and pedal effort required to compensate for the loss of the failed portion of the brake hydraulic system provides adequate warning that partial brake failure has occured. **With the ignition switch turned on, a dual brake warning light on the instrument panel will also indicate a brake hydraulic system failure.**

Brake lines (tubes) are connected from the brake master cylinder primary and secondary system outlet ports to the pressure differential valve assembly (Fig. 5). The electrical brake warning switch, and the brake lines (tubes) leading from the differential valve assembly to the front and rear wheel brake cylinders or front brake calipers (disc brakes) are also shown in Fig. 5.

The brake system hydraulic pressure differential valve assembly and the mechanically operated electrical switch warning light. The spring loaded switch plunger contacts the bottom of a tapered shoulder groove in the center of the differential valve. O-ring seals are used in the seal ring lands near each end of the valve (Fig. 5).

As noted previously, the brake systems for the F-350 and P-350-400-3500-4000 Series trucks are the reverse of the F-100, and F-250 Series trucks. However, the operating principles of the differential valve are the same as noted in the following example:

Should a failure of the rear brake hydraulic system occur, hydraulic fluid pressure in the rear brake (sec-

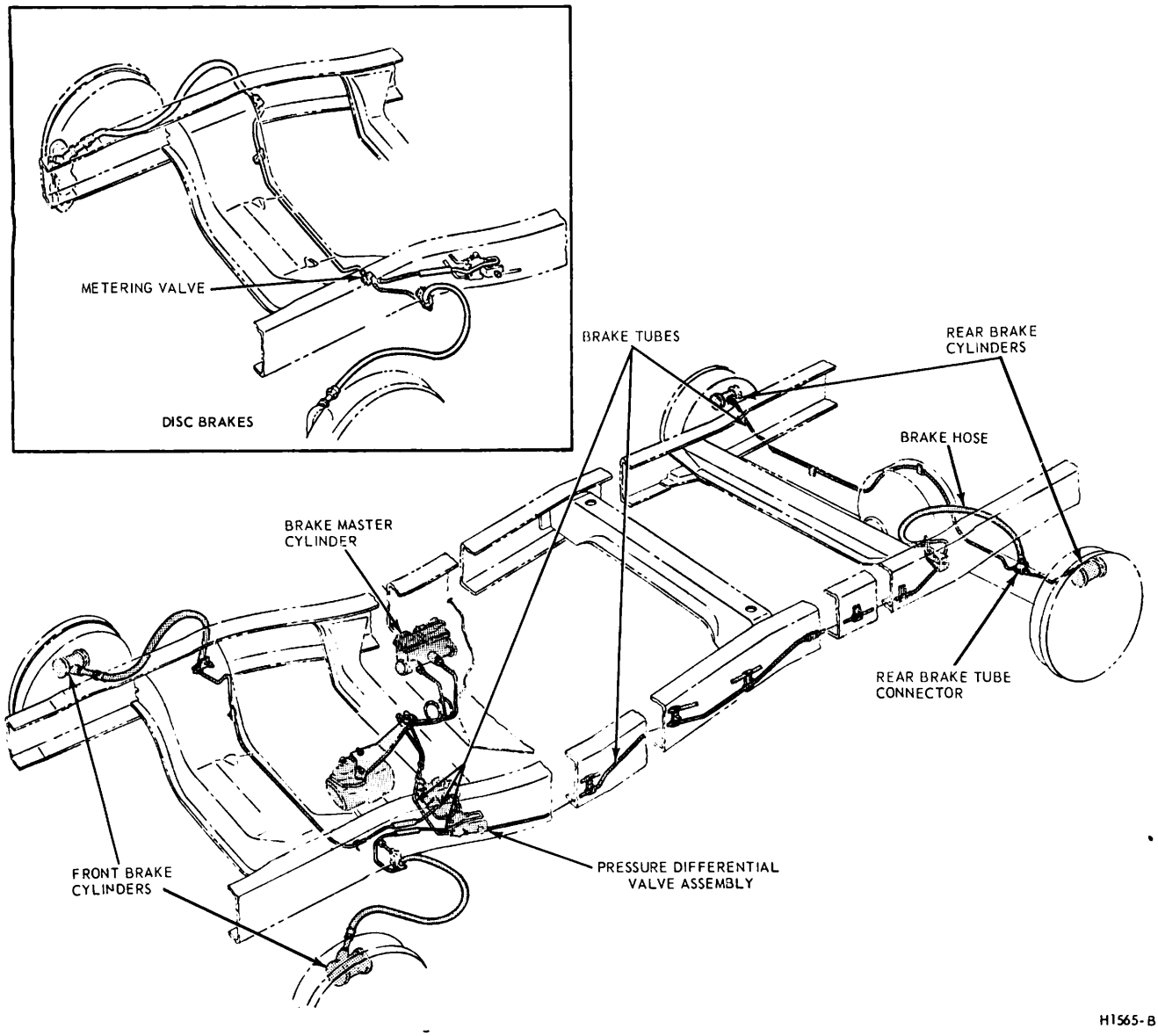

FIG. 2 — Typical Hydraulic Brake System—Dual Brake Master Cylinder F-100-350

ondary system on all except F-350 and P-350-400-3500-4000 Series trucks) system would drop. During brake pedal operation, the fluid pressure build up of the front brake system (primary system—on all except F-350 and P-350-400-3500-4000 Series trucks) would force the differential valve toward the low pressure area (secondary system outlet port). Movement of the differential valve forces the switch plunger upward over the tapered shoulder to close the switch electrical contacts and lights the dual brake system warning lamp, signaling a brake hydraulic system failure.

Conversely, failure of the primary hydraulic system (front brakes) would force the differential valve toward the low pressure area (primary brake system outlet port) and activate the brake warning switch mechanism in the same manner as described above.

The standard hydraulic brake system on some trucks is assisted by a vacuum booster which may be installed as either standard or optional equipment.

The master cylinder converts physical force from the brake pedal and booster into hydraulic pressure against the pistons in the wheel cylinders or calipers. The wheel cylinder or caliper pistons in turn convert hydraulic pressure back into physical force at the brake shoes.

All Ford truck models have internal expanding shoes, except the F-250 and F-350 which may have front disc brakes. The different types of brake assemblies vary in the way that the shoes are anchored, in the number of

Truck Model	Master Cylinder Identification Code
F-100 (4x4)	C
F-100-250 (4x2)	A
F-250 (4x4)	A
F-350	B
P-350-400-3500-4000	Z
B-Series w/14x2½ inch Front Brake	TB
B-Series w/15x3 inch Front Brake	TD

FIG. 3 — Dual Master Cylinder Identification Chart

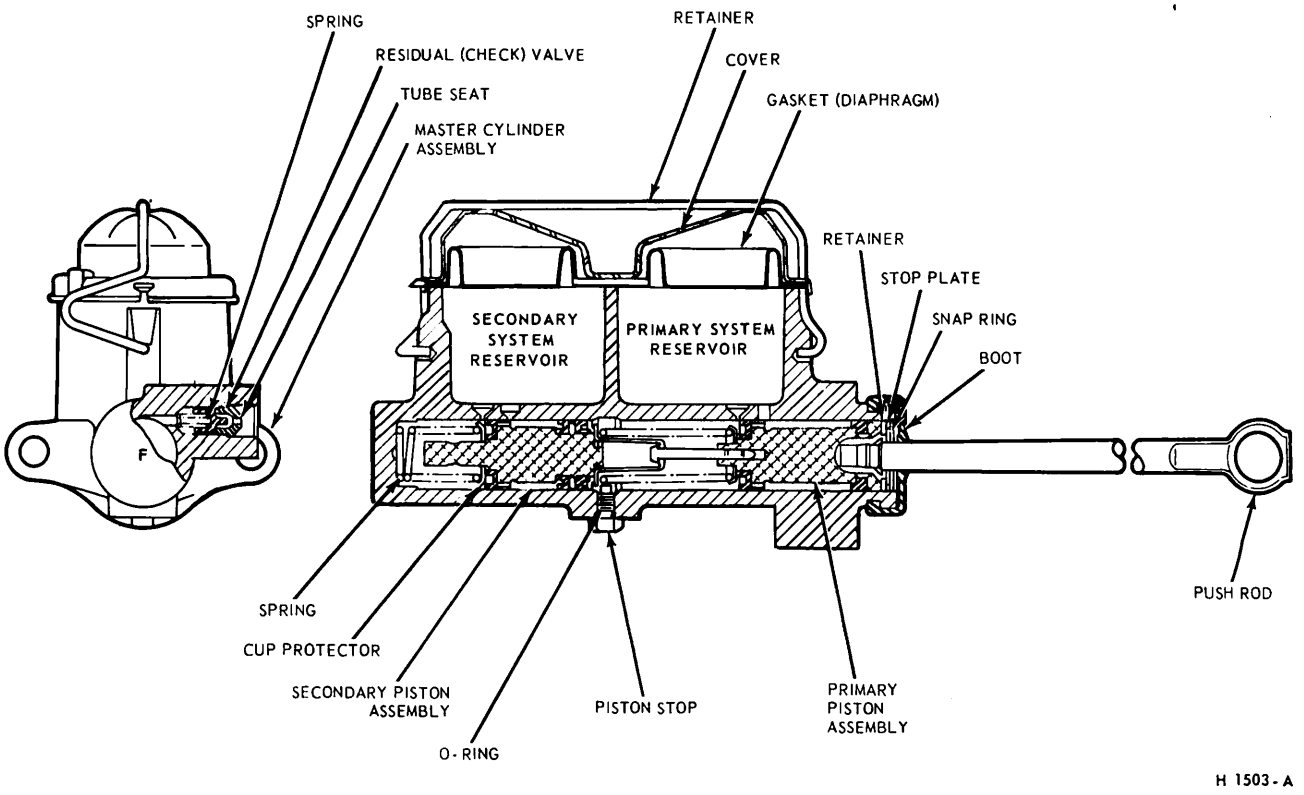

FIG. 4 — Dual Master Cylinder — P and F-Series — Typical

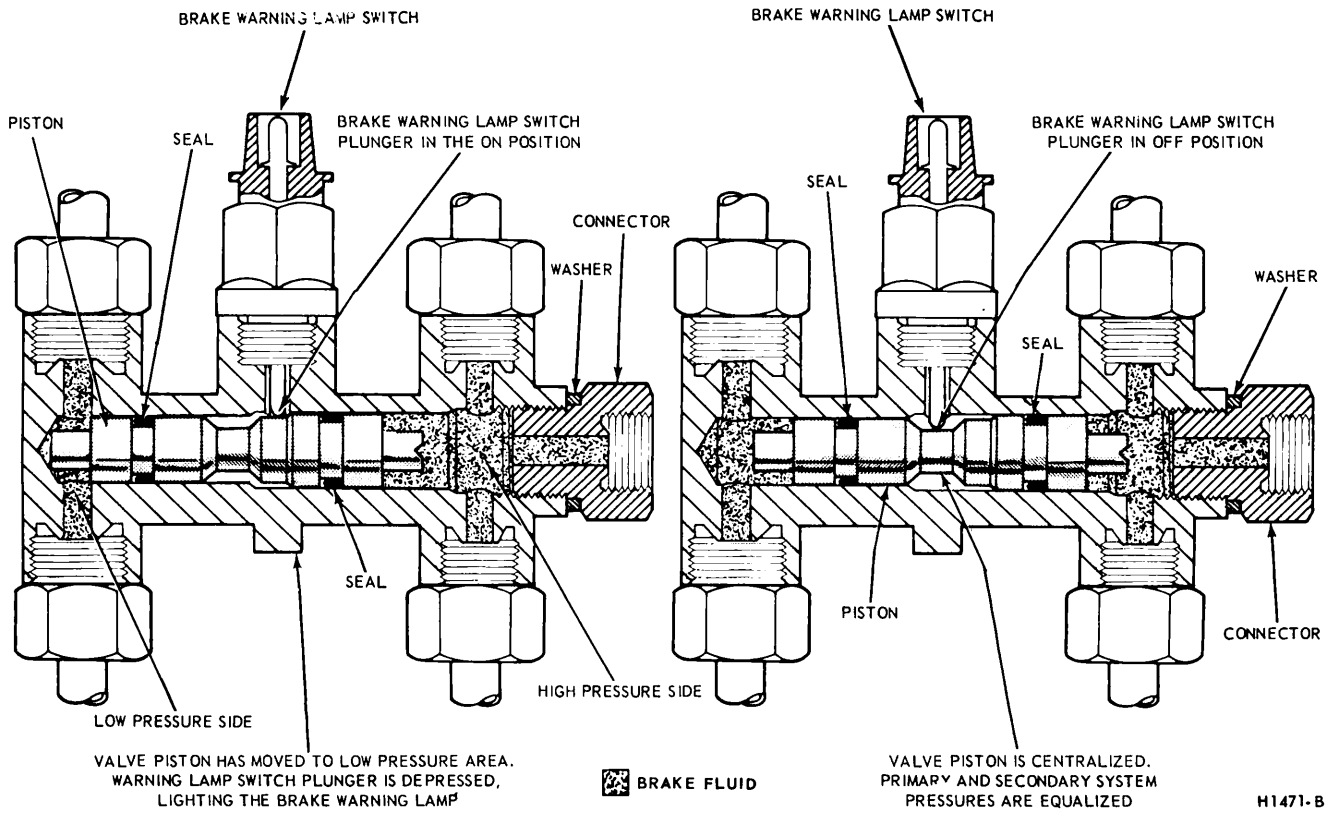

FIG. 5 — Differential Valve System—Typical

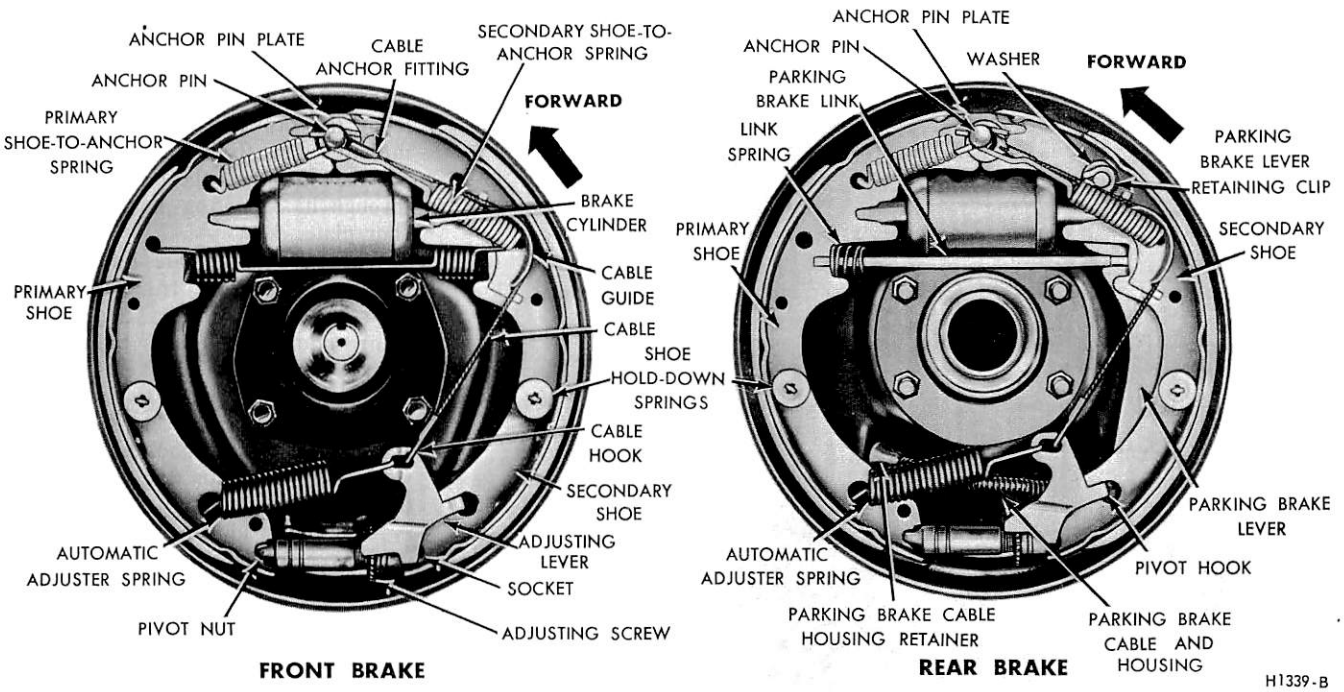

FIG. 6 — Self Adjusting Brake Assemblies—F-100 Series

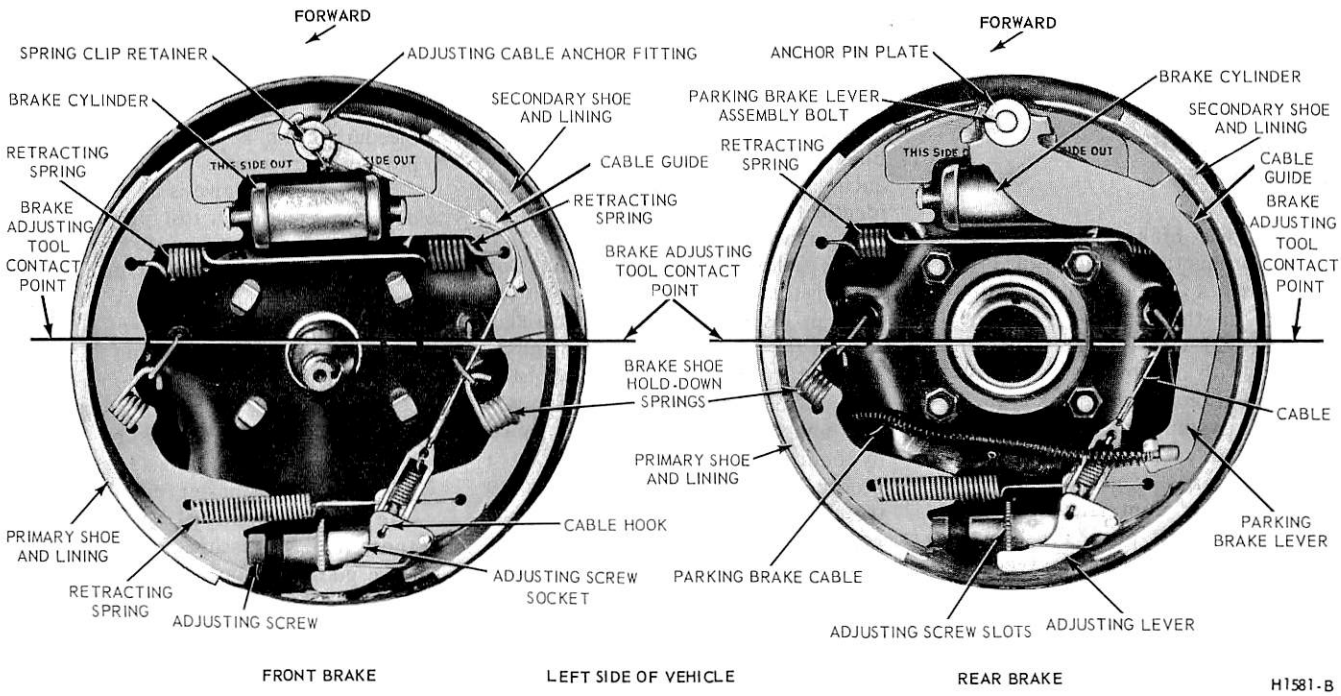

FIG. 7 — Self Adjusting Brake Assemblies — F-250 Series

wheel cylinders used at each wheel, and in the number of pistons in the wheel cylinder.

In the single anchor type, both brake shoes are mounted to the same anchor and are actuated by one wheel cylinder. In the duo-servo, single anchor brake, the wheel cylinder has two pistons. One piston exerts force against the upper end of the primary shoe; the other piston exerts force against the upper end of the secondary shoe (Figs. 6 and 7).

In the double ancho shoe is mounted to a sep The shoes are actuated servo (two piston) cyli upper end.

The front wheels of so equipped with two cylind ing one piston. The pisto inder exerts force agains one shoe; the piston in the other cylin-