A REVIEW OF ADR 38

by

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A REVIEW OF AUSTRALIAN DESIGN RULE 38.

1. INTRODUCTION

We are now into our 2nd year, and hence stage 2 of the implementation of ADR38 Trailer Brake Design Rule. Semi trailers between 20 and 60 tonne gross trailer mass have been required to comply with ADR38 since July 1st, 1984, and as from July 1st this year, dog and pig trailers from 15 tonne up are encompassed. See Fig. 1.

1.1. Comment

It is perhaps timely to review the rule in practice over the last 14 months and highlight problems that have arisen. Yes, there have been teething problems with ADR38, which was to be expected, but in fairness it must be said that the rule in general is well drafted and defined, and the changes that have been made in the demonstration of compliance procedures have been mostly fine tuning exercises or clarifications of ambignity.

Those responsible for formulating and implementing ADR38 have certainly learnt some lessons from the ill conceived and loosely defined ADR35, and herein lies the root of many of the reported complaints about newer trailers built to comply with ADR38.

By far the most common complaint reported has been a perceived reduction in trailer braking efficiency, particularly of tri axles, over older models.

In general, to stay within the upper deceleration boundary of ADR38, and minimise wheel lock, brakes on tri axle semi's have undergone some 'de-rating'. Of course the widespread capacity to lock up the fully laden tri axle of older trailers under heavy braking does not translate to shorter stopping distances, despite the confidence that many drivers derive from smoking tyres. Lateral stability is likewise jeopardised.

Tandems have been less of a problem, as individual axle loadings are higher and hence braking torque has remained much the same as previous units.

This same misguided confidence in over-aggressive brakes is evident in a number of prime movers on the road and, unfortunately, unlike ADR38, ADR35A does not restrict this tendancy with an upper performance boundary. See Fig. 2, 3 & 4. The problem is compounded by little, if any, regulation on Gross Vehicle Mass nominated for prime movers for purpose of ADR35A demonstration, whereas load ratings of trailers under ADR38 must correlate with legal axle limits.

The Federal Department of Transport (D.O.T.) are well aware of the above outlined anomalies between ADR38 and ADR35A, and a review of ADR35A is pending.

1.2. Compliance

Turning now to a more detailed look at compliance procedures for ADR38, D.O.T. has initiated a system which allows the trailer manufacturer to demonstrate that his trailer complies with the design rule in several ways.

Firstly, the manufacturer can complete a series of road tests to demonstrate compliance. Secondly, he may submit a trailer complying to ECE 13 which is acceptable, however, we do not believe it to be economic to import European manufactured trailers.

Thirdly, and it is in this area where we have most interest, is compliance by calculation. Of the three methods, we do believe that the compliance by calculation has been the most favoured, particularly by the smaller manufacturers of trailers.

1.3. Methods of Compliance

To gain compliance for a trailer, the manufacturer uses D.O.T. approved components which comprise (a) control system (b) foundation brakes (c) suspension or (d) a complete brake assembly. See Fig. 5. From the data supplied by the component supplier or the brake assembly supplier the trailer manufacturer performs some relatively simple calculations and consolidates the data onto D.O.T. supplied forms and then forwards the information for approval. D.O.T. then processes the information through their data base and check to see that the numbers come out correctly and if this is the case a compliance plate is issued. This then allows the trailer manufacturer to market his trailer within the Commonwealth.

2. PREPARATION BY INDUSTRY

Prior to ADR38 being gazetted, many in industry had invested time in developing products or systems which they believed would be suitable for the design rule. Many will be aware that D.O.T. conducted validation tests

in order to determine if the levels of ADR38 could be attained. Other tests were conducted by Telecom which proved to be useful in determining behaviour of combinations of laden and unladen vehicles.

From these tests industry gained additional base knowledge which assisted in refining system design. Much of this assisted us in preparing our control systems to gain the necessary certification.

2.1. Internal Preparation

To develop our comprehensive range of kits, we firstly categorized trailers into semi trailers by number of axles, low loaders, road train trailers, dog, pig, dolly and full trailers. The next consideration was effectiveness date and finally population of trailers.

2.2. Selection

This then gave us tri axle and tandem axle semi trailers as our first priority, followed by single axle semi trailers, road train semi trailers and finally quad axle trailers for target date of July 1, 1984. As dog trailers, dolly, etc., came under the 1985 date these were treated as a lesser priority.

Having selected the tri axle and tandem axle semi trailer, we then had the choice of using 2 types of spring brake relay valves, one uses a separate reservoir, whilst the second uses part of the service reservoir system

to control spring brakes. As we saw a market for both types of valves we elected to offer kits accordingly.

2.3. Control System Requirements

The performance characteristics of the control system can be divided into 4 areas:

1. Operational Logic
2. Time Response
3. Input to Output Characteristics
4. Characteristics of Spring Brakes

As stated, the characteristics of the control system sub assembly must be validated and shown to comply with ADR38 requirements.

Its characteristics can be divided into 4 general areas as indicated, and these will now be discussed in more detail.

2.3.1. Operational Logic

This refers to the function of the various valves in the circuit as related to certain requirements of the rule such as protection of reservoir air, prevention of automatic springbrake application except in breakaway situation, use of polarized couplings, etc.

2.3.2. Time Response

This involves actual testing of the system, using oscillograph recorder to measure pressure rise in the service brake chambers against a reference 'time zero', provided by a standard calibrated simulator, rather than an actual prime mover prone to variation. See Fig. 6.

2.3.3. Input to Output Ratio

Recognizing that pneumatic relay valves do not necessarily deliver exactly the same pressure as their control pressure, ratios of pressure in chamber over pressure at coupling are required at various levels of input roughly corresponding to 130, 260, 390, 520 and 650 kpa. See Fig. 7.

This characterizes the inherent pressure gains or losses within the control system, which ultimately affects the slope of the retardation graph.

2.3.4. Springbrake Performance

The output force of the nominated springbrake chamber must be related to an equivalent air pressure on a particular diaphragm area. This is largely to enable the same formulas to be used for emergency and parking calculations as for service brake calculation. Springbrake output must also be related to push rod stroke, as force and hence holding power decreases with some long stroking foundation brake assemblies. See Fig. 8.

The supply line pressure at which the springbrakes apply must also fall within an upper and lower limit, the upper limit to prevent dragging of brakes before low pressure warning, the lower limit to ensure emergency brakes can be effective before service brakes become ineffective.

3. MARKETING

In the marketing of certified kits it is important to remember that the kit is an integral item. That is to say that the kit is complete, the bill of material for the kit is stamped with the approval number i.e. 9001 CS, and no parts of the kit may be substituted. Should the supplier of a certified kit, foundation brake or suspension have a need to change any component in the kit he may seek to do this through the variant system.

3.1. Changes to Certified Componentry

Before effecting any changes he must firstly satisfy the Board that the change does not alter the performance, if this is the case then the Board will allow this as a running parts list change. If the change is likely to alter the performance from the original data then it is classified as a variant.

3.1.1. Example

Perhaps it is better described using the case of a trailer builder. If a trailer builder has a base model using an approved control system, foundation brake and suspension which comprises the brake system, and has

gained compliance, then elects at a later date to use a different brand of brake system; then provided he can successfully demonstrate that where the GTMR plus number of axles is the same and the braking is within the upper and lower limits as required by the rule, then his newer model is classed as a variant but it still uses the same compliance number.

3.2. Obligations

Returning to the certified kits, it is essential that the components which form the kit comply in all ways with the parts list. The parts must be installed in accordance with the specific instructions issued and contained in the certified kit.

There is an obligation also for the trailer builder to ensure that the equipment fitted to his trailer agrees entirely with the compliance request. If the Board discovers a non compliance or a non conformity then they can request that the transgression be rectified. They hold the power to insist that the trailer manufacturer or component supplier recall all units thought to be at variance with the original approval.

4. DOG TRAILERS

As mentioned earlier, July 1, 1985, saw the rule incorporate dog trailers and other trailers. System design for dog trailers has proven to be quite an interesting exercise due to problems caused by short wheel base and load transfer. The problems are quite severe with 2 axle dogs as compared with 3 axle dog trailers.

4.1. Compliance for Dog Trailer Kits

The method of gaining compliance was similar to that followed for semi trailers. See Fig. 8. Firstly, we reviewed the axle and foundation brake data of the axle types commonly used by the dog trailer manufacturers, we looked at the worst cases, i.e. short wheel bases, looked at the centre of gravity and axle loadings, and finally worked on the ratio of front to rear braking to meet the requirements of the rule. Due to dog trailer characteristics we had very carefully evaluated the actuator size and slack adjuster arm length and then determine whether or not a pressure limiting device was needed. We minimised the options in the control system as follows:

4.1.1. Performance Requirements

The 'friction utilisation' requirements for dog trailers in ADR38 has been lifted directly from ECE 13, and in effect requires more braking force on the front axle than the rear. This tends to conflict with previous practice in this country. However, recent validation testing on behalf of D.O.T. indicate that this requirement will enhance combination stability under braking.

The required ratio of front to rear braking torque is ultimately determined by the ratio of wheelbase to centre of gravity height, and can be over 2:1 for extreme cases in 2 axle dogs. This can not always be easily accommodated with differing slack length/brake chamber sizes, and so we have resorted to limiting pressure to the rear axle to about 75% of front axle pressure.

4.1.2. Options

A number of options were considered, including variable ratio or load sensing valves, but in the interests of simplicity, cost effectiveness, and ease of installation, we have opted for a fixed ratio valve.

Fine tuning to different wheelbase trailers can be made by varying booster sizes or slack lengths for a given model.

5. FUTURE REQUIREMENTS

The final part of ADR38 which comes into effect on July 1 next year, calls for all trailers with GTMR of 4.6 tonne to 60 tonne to conform to the rule.

Trailers at the lower end (i.e. 4.6 tonne) are typically plant trailers, mobile personnel carriers, reel carriers; the types of units hauled behind flat top trucks used by local Councils, Water Boards, Electricity Boards, Telecom, etc.

5.1. Vacuum Brakes

In the past these types of trailers have been vacuum braked. The various authorities operating these trailers are with trucks now fitted with air or air/hydraulic systems. A few of the innovative authorities are switching to air operation on the trailers.

There are some of these authorities who pay a high price to have vacuum equipment fitted to new trucks purchased every 3 or 4 years so that they can be operated with older vacuum braked trailers. The money could have been better spent in converting the trailers to air during these past years.

5.1.1. Inadequacies of Vacuum System

All indications are that new trailers built to meet this low GTMR will be fitted with pneumatic brake systems and vacuum brakes will disappear from the scene as it is highly unlikely that vacuum systems can meet certain ADR requirements.

5.1.2. Stability of Small Trailers

The testing carried out by Telecom on trailers in this category has indicated that pneumatic systems perform quite well. Because of the very nature of these small trailers it was found that for unladen stability load sensing valves were a necessary requirement and all plant ordered by Telecom is now so fitted.

6. ABS SYSTEMS

A few words now on ABS anti lock brake systems which have now been with us in Australia for about 4 years, originally only available on Mercedes Benz vehicles. We believe that they have had no major service problems with any of the vehicles fitted with ABS now in service.

6.1. Availability of ABS

ABS is now available as an option on all European trucks, tractors or buses sold in this market. We are rather surprised that a demand for ABS fitted trailers has not developed as the benefits are considerable.

6.2. Benefits of ABS

A case in point which demonstrates these benefits is on trailers where the braking potential may be above the upper limit line of the graph. Additionally, for dog trailers where certification requirements are more complex the fitment of ABS negates the need to meet the friction utilization requirements of ADR38.

7. CHANGES TO TRUCK RULE

We have indicated earlier that some of the problems with ADR38 trailers in the field have been caused by the hauling vehicle which is built to ADR35A requirements.

Rumours circulating indicate that D.O.T. is reviewing ADR35A and will pick up ECE 13 for the trucks. This does make sense to a certain extent as ADR38 is quite close to that rule.

7.1. Utilization of Spring Brakes

We would make some comments on the universal option of ECE 13. The fact that we now have trailers built with parking brakes necessitates a complimentary change to the truck rule so that when the parking control of the truck is operated parking on the trailer is effected simultaneously.

The majority of European built tractors are not piped in this manner whereas North American trucks either are or can be quickly modified to give this desirable feature. We would therefore expect that when ADR35A is re-written that operation of either the tractor protection control or the park brake valve will also bring the trailers parking brakes into operation.

7.2. Balanced Braking

A second item that causes imbalance between tractor and trailer is the service pressure differential and response time when measured at the actuators and compared to that pressure available at the service line glad hand. The problem is more noticeable at low pressures where the prime mover appears to be providing the greater part of braking effort. As the air pressure rises the differential diminishes however as most service braking is effected at pressures between 20 and 25 Psi (138 & 172 Kpa) this is a problem that needs to be addressed.

7.3. Service Line Protection

In another comment relating to the review of ADR35A, we would mention that as devices are incorporated into the tractor to protect it should a

trailer breakaway or emergency line disconnection occur, it is now time to address ourselves to a similar situation only this time relating to the service line. See Fig. 9 & 10.

If we take the case of a failed service line downstream of the tractor protection valve then depending on the size of the break and the rate of pressure decay - the available service pressure in the reservoirs will drop, however, no service braking will occur on the trailer. Devices to overcome such an event are available now and deserve consideration.

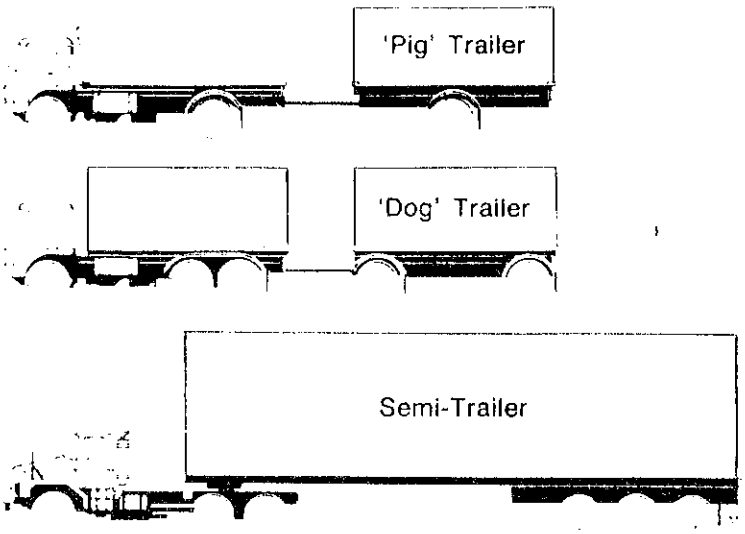
One such device is the Service Line Protection Valve and this is mounted adjacent to the tractor protection valve. It senses delivery pressure at the foot valve and from the outlet of the tractor protection valve and monitors the difference. Should the valve sense a difference then it will exhaust the emergency line of the tractor through the tractor protection valve thereby closing off the service pressure loss and simultaneously vent the emergency line of the trailer thereby applying the trailer emergency brake.

When the foot brake valve is released the system reverts to normal and the cycle may be repeated 6 or 7 times until an automatic tractor protection application occurs, unless the driver has already noted the problem and brought his vehicle to a safe stop at the side of the road.

8. CLOSING REMARKS

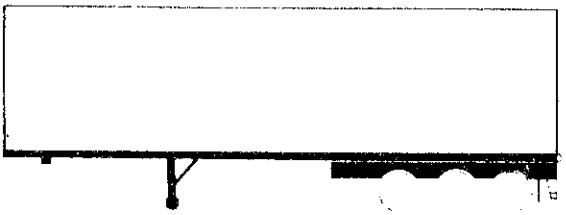
Finally, on ADR35A review, we would hope to see more industry input as was the case with ADR38. It has been clearly shown that ADR38 is a very workable rule. This is due to two reasons; one that industry had considerable input in the early formulation and secondly engineers from D.O.T. have been visible to the industry and have been readily accessible wherever problems have arisen.

If the same readiness is exhibited by D.O.T. when ADR35A is reviewed then it too will be a very workable rule.



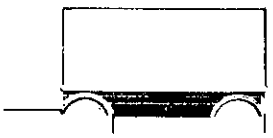
ADR 38 APPLIES TO:

— from 1 July 84 all new Semi-trailers with a Gross Trailer Mass Rating greater than 20 tonne and less than 60 tonne.



(Gross Trailer Mass Rating is the Trailer tare plus the manufacturer's maximum rated payload)

— and from 1 July 85 all new Trailers, other than Semi-trailers, with a Gross Trailer Mass Rating greater than 15 tonne and less than 60 tonne.



— and from 1 July 86 all new Trailers with a Gross Trailer Mass Rating of 4.5 tonne or more and less than 60 tonne.

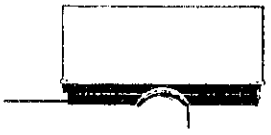


fig. 1

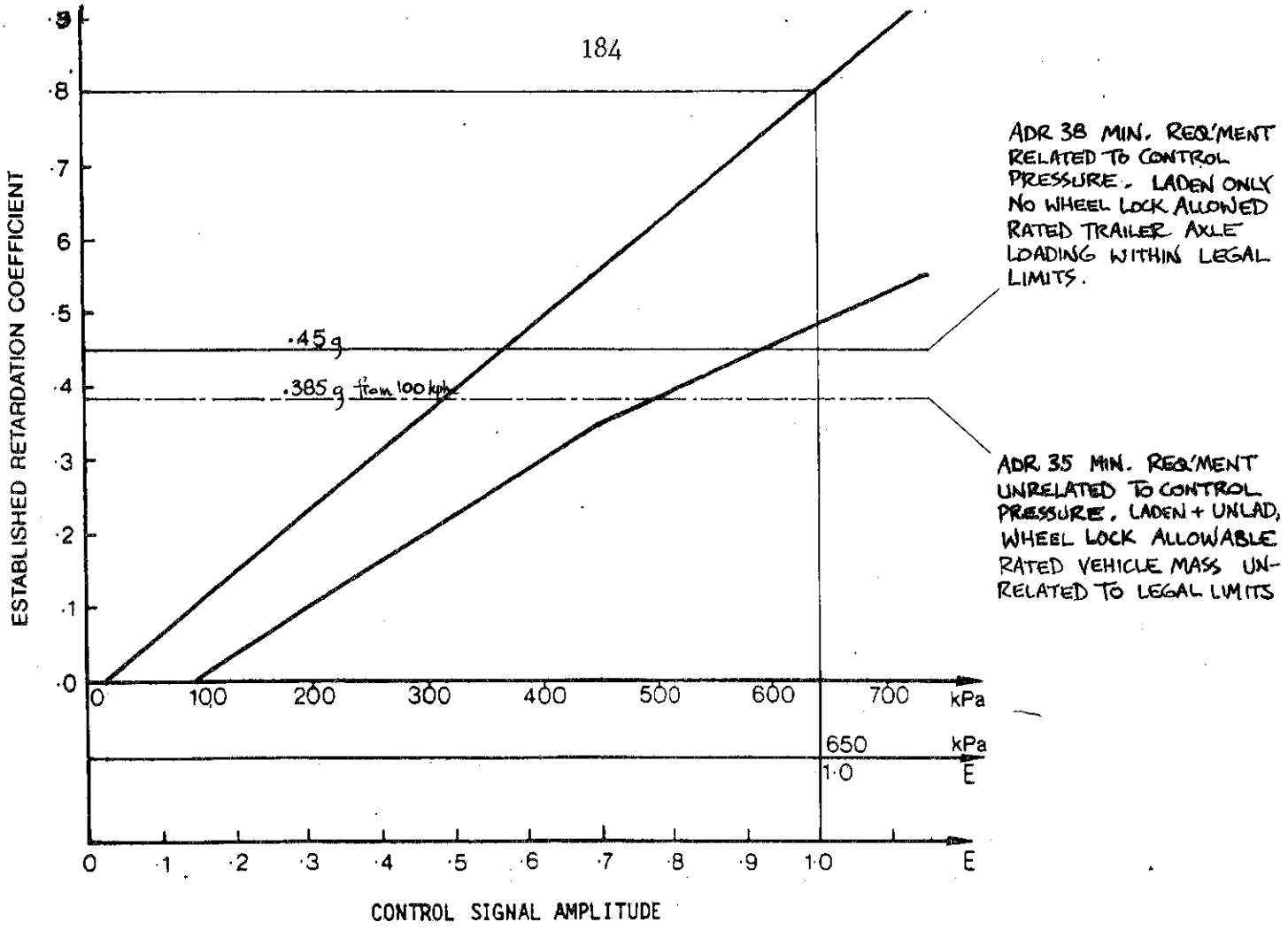

ESTABLISHED RETARDATION COEFFICIENT
·9
·8
·7
6
·5
·4
·3
·2
·1
·0
·45g
·385g from 100 kph
0
100
200
300
400
500
600
700
kPa
650
kPa
1·0
E
0
·1
·2
·3
·4
·5
·6
·7
·8
·9
1·0
E
CONTROL SIGNAL AMPLITUDE
ADR 38 MIN. REQ'MENT RELATED TO CONTROL PRESSURE. LADEN ONLY NO WHEEL LOCK ALLOWED RATED TRAILER AXLE LOADING WITHIN LEGAL LIMITS.
ADR 35 MIN. REQ'MENT UNRELATED TO CONTROL PRESSURE, LADEN + UNLAD, WHEEL LOCK ALLOWABLE RATED VEHICLE MASS UNRELATED TO LEGAL LIMITS

fig. 2

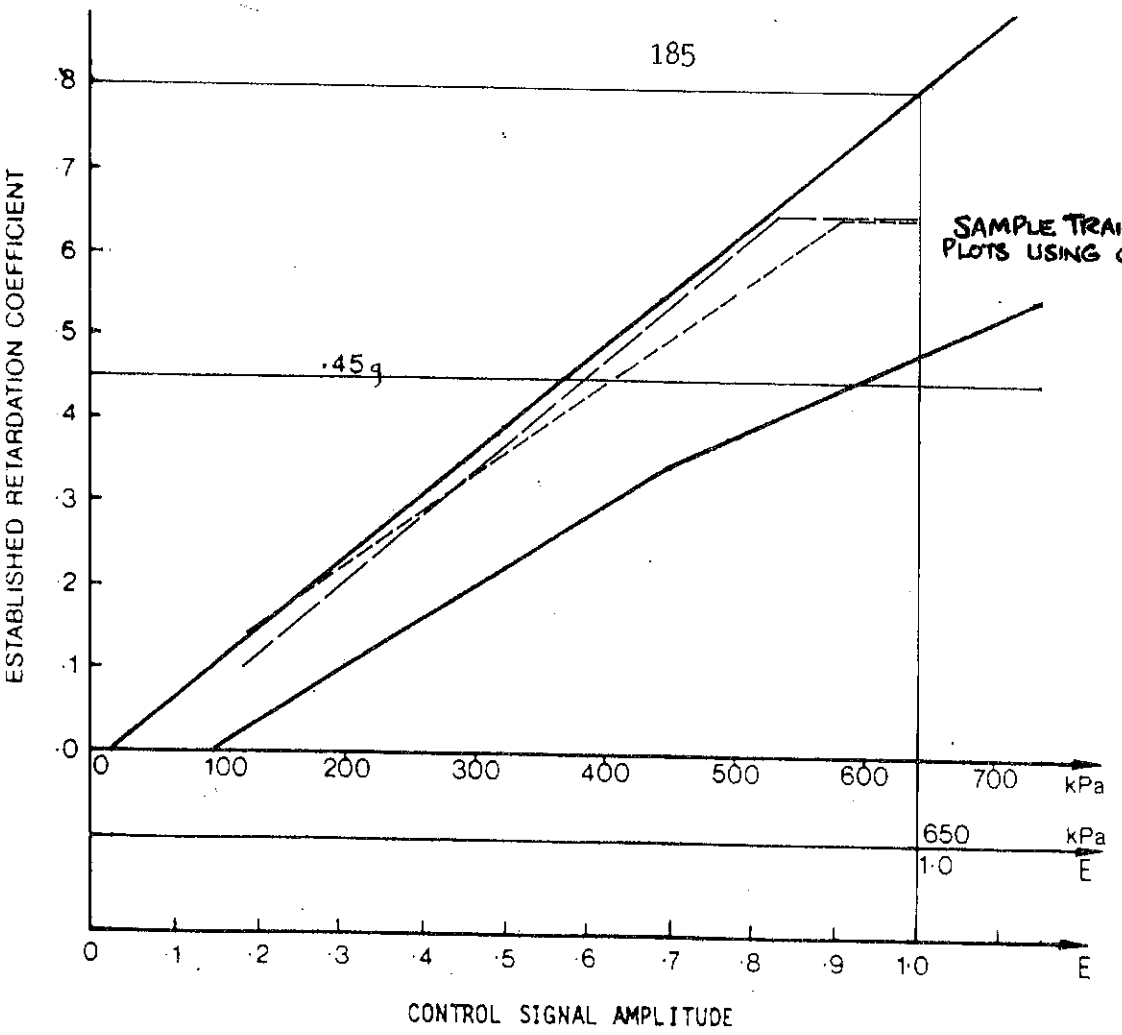

SAMPLE TRAILER RETARDATION PLOTS USING COMPLIANCE BY CALC.
ESTABLISHED RETARDATION COEFFICIENT
·45g
0 100 200 300 400 500 600 700 kPa
650 kPa
1·0 E
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0 E
CONTROL SIGNAL AMPLITUDE

fig. 3

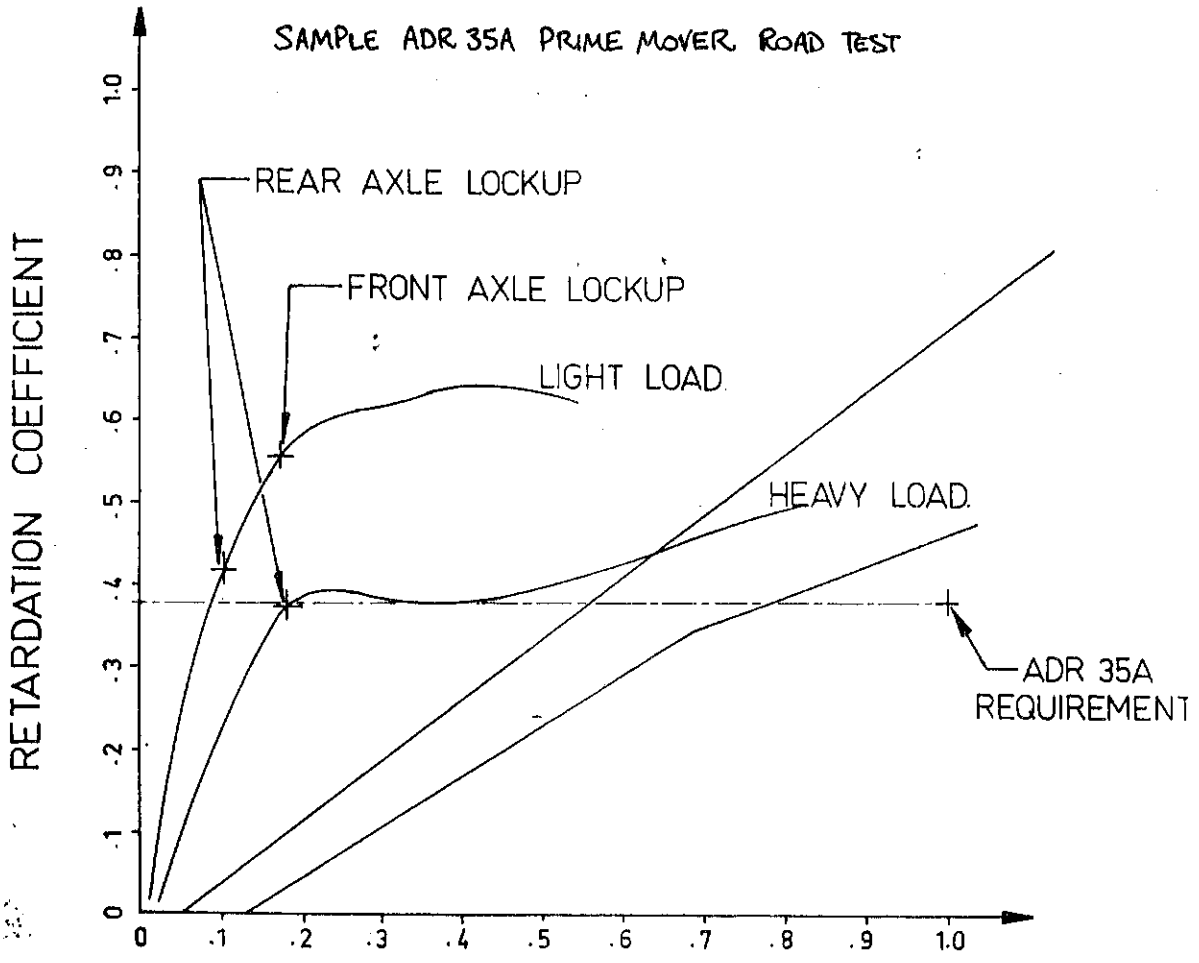
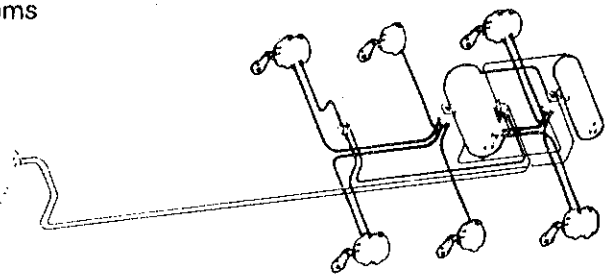

SAMPLE ADR 35A PRIME MOVER ROAD TEST
RETARDATION COEFFICIENT
REAR AXLE LOCKUP
FRONT AXLE LOCKUP
LIGHT LOAD
HEAVY LOAD
ADR 35A REQUIREMENT
0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

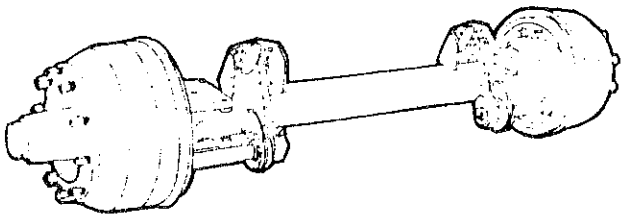
fig. 4

Approvals are available for four types of sub-assemblies

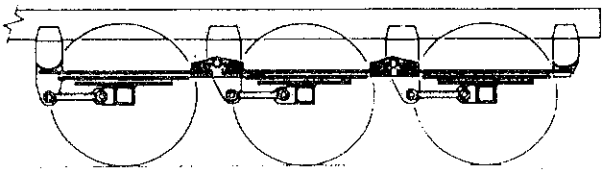
a) Control Systems



b) Foundation Brakes



c) Suspensions



d) Total Brake Systems

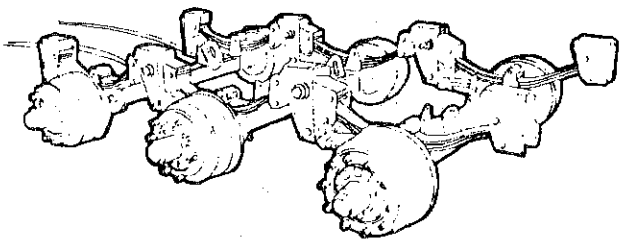


fig. 5

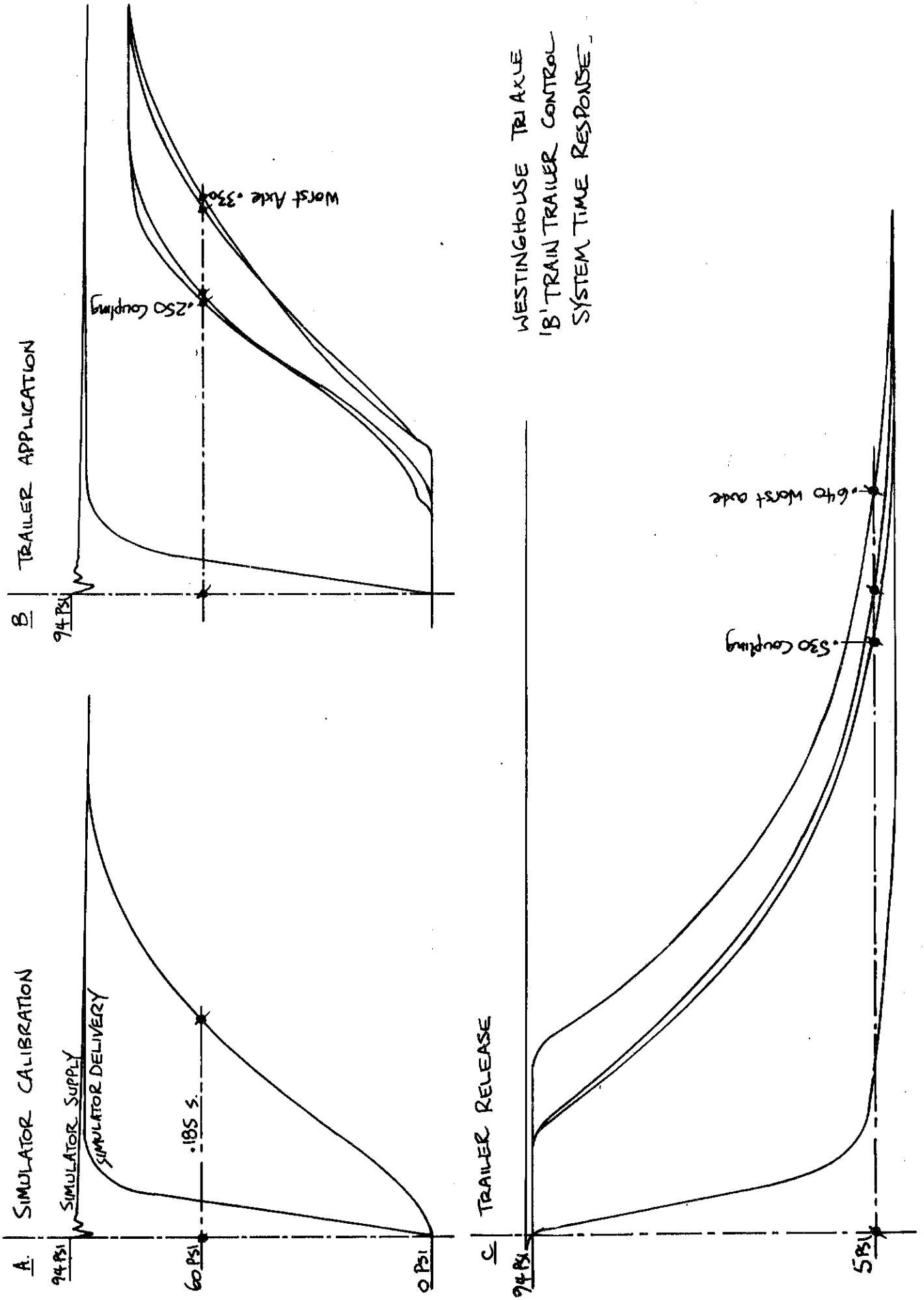

WESTINGHOUSE TRI AXLE
'B' TRAIN TRAILER CONTROL
SYSTEM TIME RESPONSE
A. SIMULATOR CALIBRATION
SIMULATOR SUPPLY
SIMULATOR DELIVERY
94 PSI
60 PSI
0 PSI
.185 S.
B TRAILER APPLICATION
94 PSI
.250 Coupling
Worst Axle .330
C TRAILER RELEASE
94 PSI
.530 Coupling
.640 Worst Axle
5 PSI

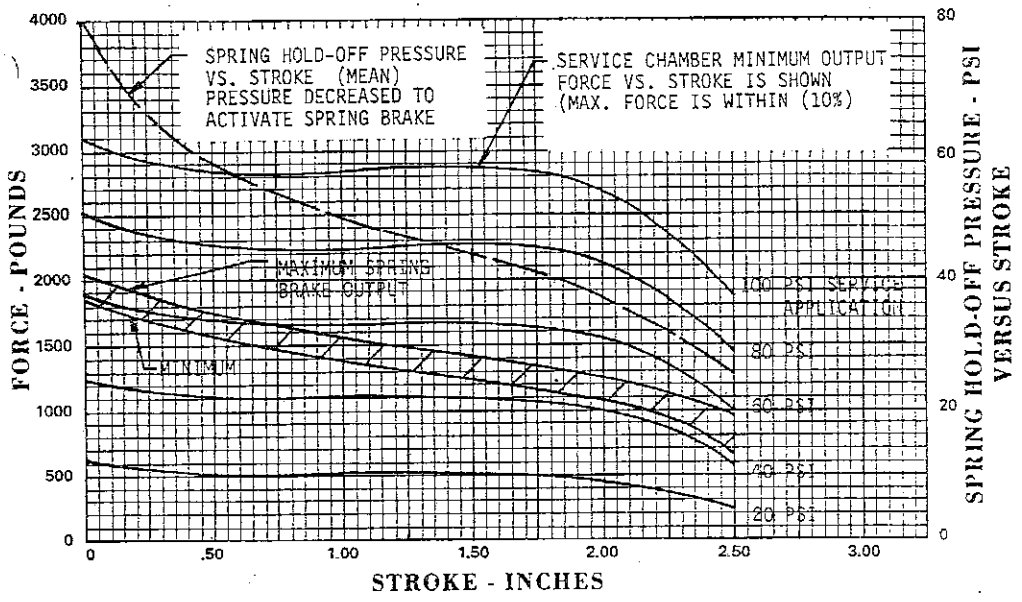
fig. 6

MGM Brakes

PRODUCT PERFORMANCE DATA

MODEL SG30E

TYPE 30



PERFORMANCE DATA

2.50 IN. Rated Stroke – Service Application
37.80 CU. IN. Volume Displaced @ 100 psi – Rated Stroke

2.566 IN. Maximum Stroke – Service Application
90.00 CU. IN. Volume Displaced @ 100 psi – Max. Stroke

2.48 IN. Maximum Stroke of Service Chamber when applied by Spring Brake
92.00 CU. IN. Volume Displaced by Spring Brake when fully deactivated @ 100 psi

28.0 SQ. IN. Calculated Eff. Area – Service Piston
28.0 SQ. IN. Calculated Eff. Area – Spring Piston

*AIR PRESSURE REQUIREMENTS	
STROKE RANGE @ 85 PSIG RELEASE PRESS.	% FULL STROKE
2.50 MAX.	100%
2.375 MIN.	95%

*AIR PRESSURE APPLIED TO DEACTIVATE SPRING BRAKE CHAMBER

4.61 IN. Center of Gravity – Tandem (From Mounting Surface)

95.0 IN.LBS. Bending Moment – Tandem

PRODUCT INFORMATION

8067020 Power Spring
1.529 IN. Power Spring Shut-Height in unit
8017030 Service Diaphragm used
8017030 Spring Diaphragm used
8015032 Non-Pressure Chamber used
_____ Pressure Cap used

NOTE: (1) Tandem output-force measured after power spring clamped to cylinder shut height for 24-hours.
(2) All out-put force readings measured at end of service brake piston rod. SERVICE DIAPHRAGM PRESET FOR 24 HRS. @ 100 PSI.

_____ Weight of Chamber Assembly
20.61 LBS. Weight of Tandem Assembly (w/8.00" Rod)
12.69 LBS. Weight of Single Assembly
NOTE: Weights are measured without yoke assembly & mounting hdwr.

CERTIFICATION DATE 5-12-80

This information is taken from actual test data and is true to the best of my knowledge.

SIGNED G. Choinski

Chief Engineer G. Choinski

MGM Form 7973

fig. 8

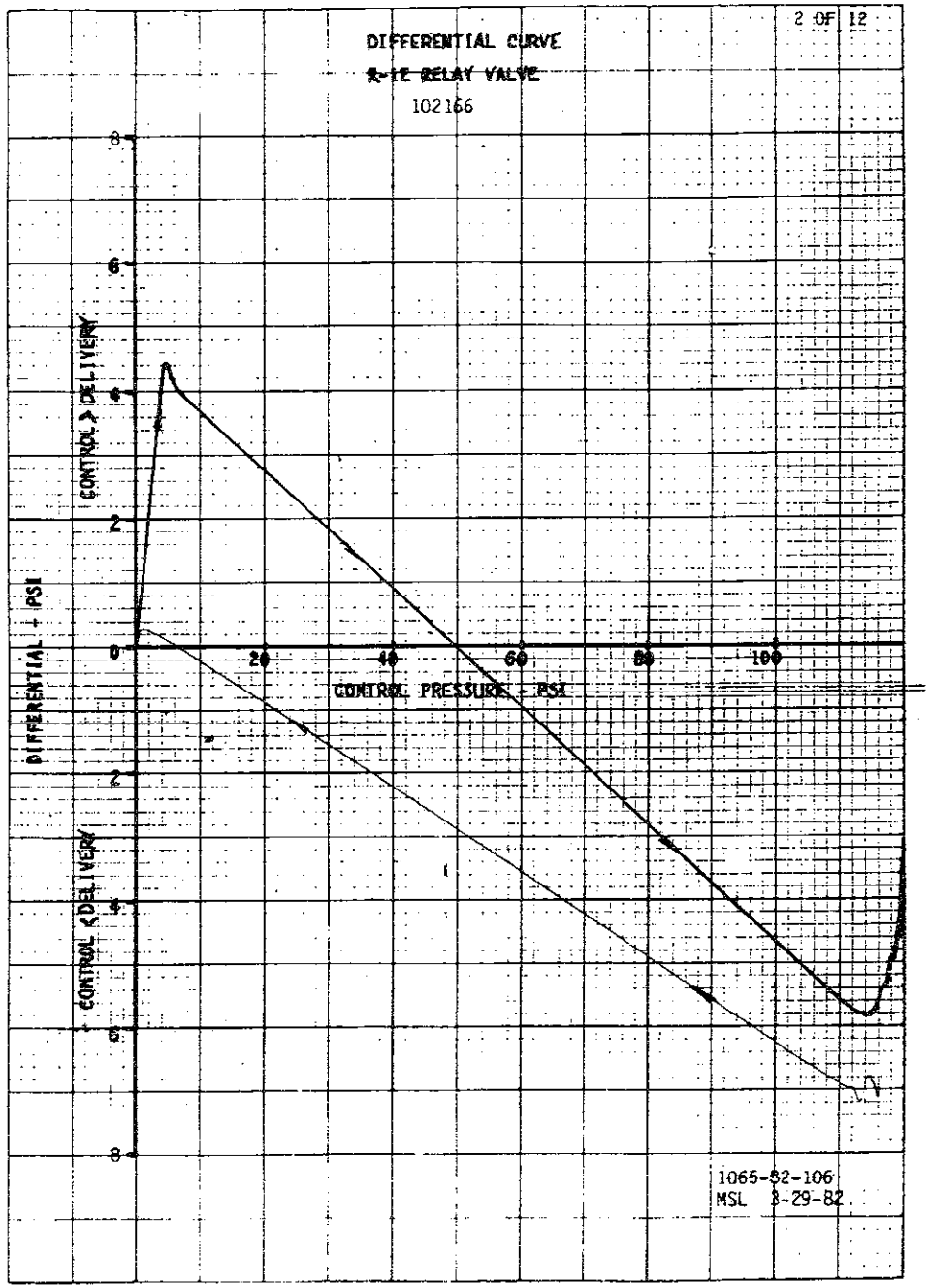


fig. 7

TYPICAL DUAL CIRCUIT

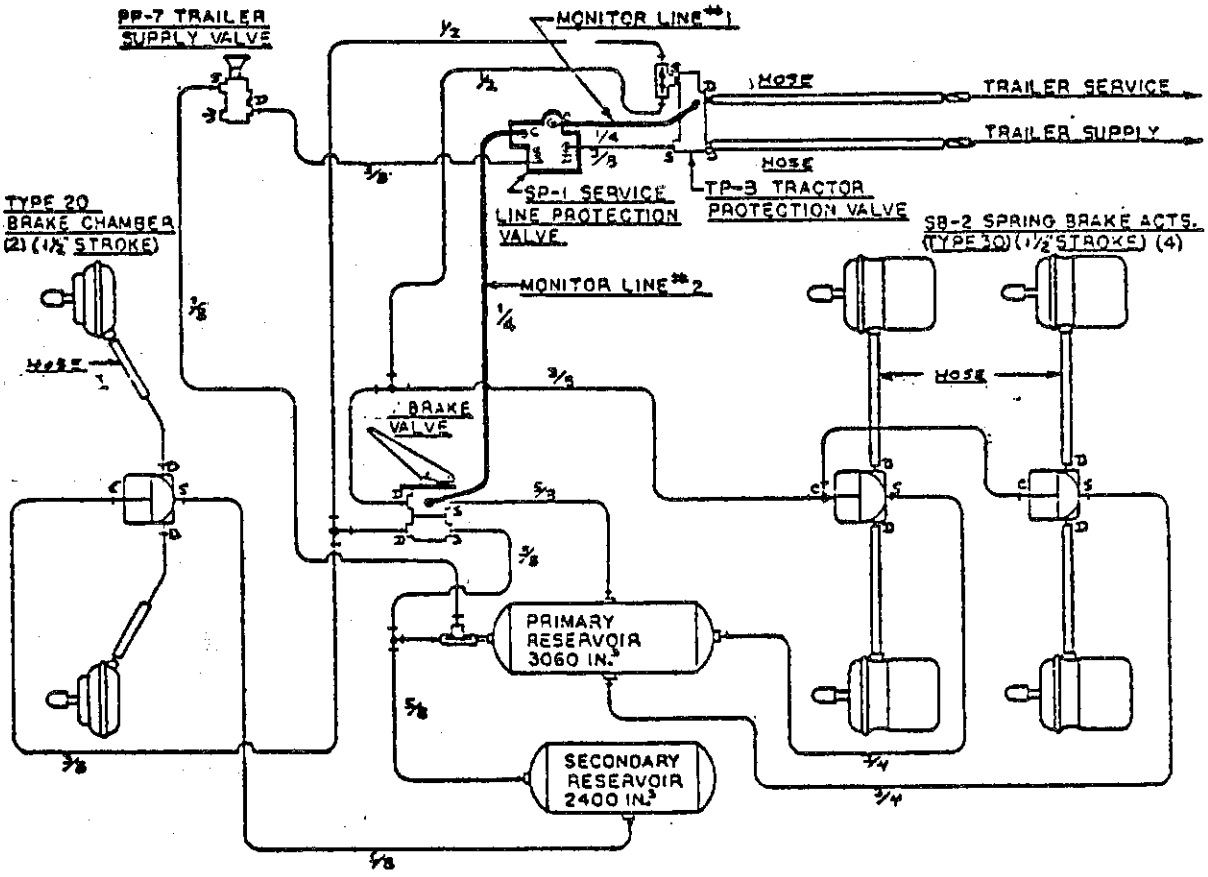


fig. 9

Service Line Protection Valve

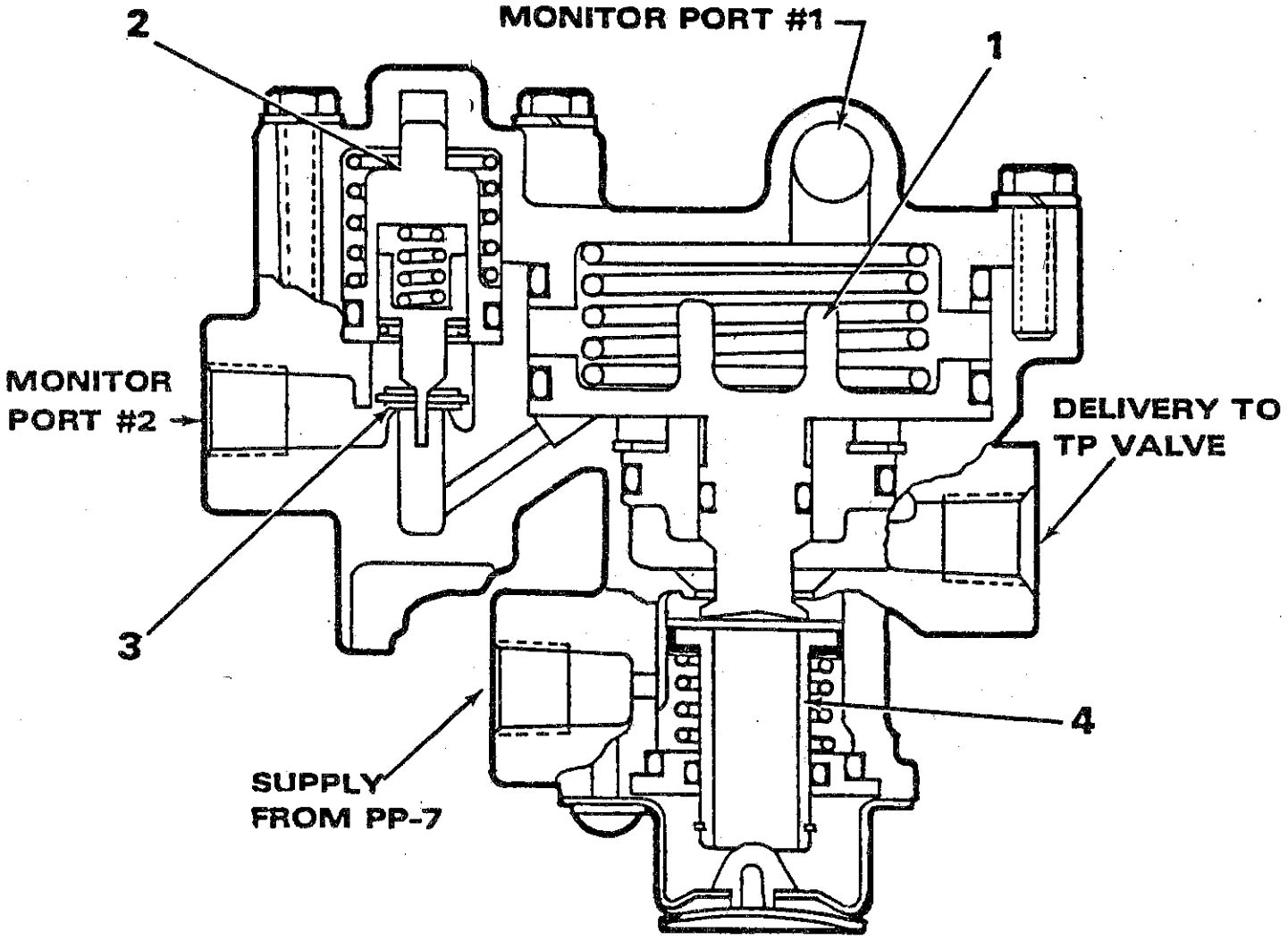


fig. 10