An Investigation of Brake Application Delays in Australian Train Brake Systems

By

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Submitted in fulfilment of the requirements
for the degree of Master of Engineering

at the

**James Goldston Faculty of
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Central Queensland University

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Abstract

An investigation of brake application delays in Australian train brake systems began with a literature review of pneumatic train braking systems. Data located in the review gave examples of brake application delays of pre 1990 designs from the U.K., India and North America. Information on application delays on later Australian designs was scarce. Reading of literature has shown a difference between the Australian and North American control valves in the way the propagation of the pressure reduction rate in the brake pipe is maintained. Control valves of the North American style allow the brake pipe air to be connected for a short time to a small cavity or quick service volume of each valve. The quick service volume is then released to atmosphere. The action of exhausting a small amount of air from the brake pipe helps to ensure a propagation of an adequate pressure reduction rate as it travels to the next valve. Australian control valves rely on the ratio of the volume of brake pipe between control valves and the size of the quick service volume or 'bulb' to ensure the propagation of an adequate pressure reduction as it travels to the next valve. The air in a bulb of an Australian valve is not expelled to atmosphere until a brake release is made.

The research explored possible reductions in application delays by utilizing an experimental pipe test rack that included 4 control valves and 120 meters of brake pipe. Experiments with different configurations of exhaust orifices or chokes, valves and branch pipe lengths that supplied the valves gave a record acquired by data acquisition of the timing of each valve and the local pressure drop from a valve or each valve for comparison.

Experiments with exhaust chokes that gave a reduction drop rate in the brake pipe that approached the minimum required to operate a control valve resulted in instability of the application operation of the control valve. The quick service volume of different sizes was included in the experiments to give comparisons in the propagation of the pressure reduction toward the end of a long train. Further increases into the size of the bulb of a control valve to enhance the propagation features toward the end of a long train are discussed. The branch pipe with different diameters from 12 mm to 20 mm and lengths from 160 mm to 800 mm when fitted to an adaptor pipe bracket were investigated and results show that larger diameters gave larger gulps in the brake pipe.

Other components that were studied included the pipe bracket that is fitted on some control valves. The pipe bracket and isolation cock was found to add 282 mm of additional length to the air path and while not changing the operation of the valve, the results showed a smaller drop in local pressure in the brake pipe to assist the pressure reduction rate than shown in valves without pipe brackets.

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Glossary of Terms

Abbreviations

AAR	Association of American Railroads
AAV	Accelerated Application Valve
AB	North American Westinghouse triple valve (1936)
AF2	Australian freight triple valve (1960)
ABD	North American Westinghouse triple valve (1965)
ABDW	North American Westinghouse triple valve (1976)
ABDX	North American Westinghouse triple valve (1989)
BCP	Brake Cylinder Pressure
BP	Brake Pipe
DB-60	North American triple valve by New York Air Brake Company
ES	United Kingdom triple valve by Davies and Metcalf
EX	Normal exhaust position, grade control valve
IP	Intermediate pressure position, grade control valve
ITV	Australian improved triple valve (1950)
HP	High pressure position, grade control valve
K	North American triple valve (1902)
KE	European triple valve by Knorr-Bremese
kPa	Kilopascal SI unit of pressure.
I.D	Internal diameter
NB	Nominal bore (pipe size)
m/s	Velocity, meters per second
P.B.	Pipe Bracket
PSI	Pounds per square inch unit of pressure
PSIA	Pounds per square inch atmosphere
PSIG	Pounds per square inch gauge
SW4	Sab Wabco distributor
Q6	Queensland rail permanent restrictor grade control valve
Q.A	Quick Action
Q.S	Quick Service bulb
Q.S.1	Preliminary Quick Service bulb
Q.S.2	Secondary quick service bulb
UK	United Kingdom
UIC	International Union of Railways
VSH	Queensland Rail 100t mineral hopper wagon
VSAL	Queensland Rail 104t lead tandem mineral hopper wagon
VSAS	Queensland Rail 104t slave tandem mineral hopper wagon
WF	Australian Westinghouse ‘W’ series diaphragm and poppet valve triple valve (1967)

Glossary of functions

Accelerated Release	Each control valve connects a reservoir of initial BP air to the BP in a brake release application to assist BP build up
Accelerated Application Valve	Vents air from the BP whenever a pressure reduction is initiated
Accelerated release reservoir	Supplies air to the brake pipe on a brake release
Auxiliary reservoir	Holds brake pipe air for triple valve differential operation
Bulb	Term for control valve quick service volume
Dummy brake cylinder volume	Stores air in a brake application
End-of-Train	Electronic operated valve to exhaust the brake pipe air at the rear of a train
Gulp	Term for the sharp local drop of air pressure seen in a brake pipe in a control valve operation
Inshot	Allows an initial quick build up of BCP, then with chokes restricts auxiliary air to the brake cylinders
Supplementary reservoir	Used in conjunction with the dummy brake cylinder to supply air to the brake cylinders
Locomotive brake controller	Controls the reduction and charge of the train brake pipe
Local gulp	Term for drop of air pressure seen at the control valve
Quick action	Assists reducing BP in emergency applications by connecting the BP to a small chamber
Quick service	Connects the brake pipe air to the brake cylinder or to atmosphere so each control valve assists the transmission of brake pipe air reduction in a service application
Release ensuring	Connects the auxiliary to atmosphere only on cars where the pressure differential in the BP exceeds the pressure in the diaphragm in the release ensuring valve
Retarded recharge	Restricts flow into the emergency and auxiliary reservoirs on a brake release application
Reduction ensuring	Connects air from either the quick service bulb or BP to the brake cylinder and ensures a sufficient initial reduction of BP is produced through out the train.

Publications list

Unpublished Industry Report (Confidential)

Cole. C and Ripley. I *Investigation of Applications Delays in Australian Train Brake Systems* October 2004

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Ripley. I *Development of the Railway Air Brake Triple Valve in America and Australia* June 2003

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Declaration

I declare to the best of my knowledge this thesis does not contain any material previously published or written by another person except where due reference is made in the text. The contents of this thesis have not been included in any other work submitted by the author for another degree or diploma at any other tertiary institution.

Signed: …… Dated:……