

Caterpillar 793D Braking System

System Specific
+ Safety Case +
Report

Proof of Continued Brake Effectiveness

- *Applies to Cat 793D Trucks supported by Hastings Deering. ✓*
- *Continued Brake Effectiveness proven - the Case Rests. ✓*
- *Zero Harm proven as a presumption in the Case. ✓*



(Includes Free Tools for Mines & Quarries to Declare Proof of Continued Brake Effectiveness)

Prepared for: Mines & Quarries* supplied by Hastings Deering
Prepared by: Hastings Deering, Kerry Rd, Archerfield, Qld 4108
On behalf of: Stakeholders in Mining & Quarrying Industries
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* Caterpillar 793D Mining Trucks not used in Quarries in this revision of the Safety Case.

Table of Contents

Head of Report	(Soft Copy Uncontrolled - Free)	2
FAQ		3
Steps 1 and 2		4
Specific Conditions of Use Tool		5
<i>Permit</i> Tool		11
Proclaimer, Disclaimer & Claimant		12
Body of Report	(Hard Copy Stamped Issue - Buy)	13
Declaration of Independence		14
Finding (for the affirmative and proclamation)		14
Summary		15
1.0 Particulars of this Safety Case		16
2.0 Revision Sheet		17
3.0 Distribution Recipients		17
4.0 Referenced Documents		17
5.0 Acronyms, Abbreviations and Terminology		18
6.0 Context		19
7.0 Framework		20
8.0 Outline		21
9.0 Objectives / Claims		22
10.0 System Description (SD)		23
11.0 Formal Safety Assessment (FSA)		24
12.0 Safety Management System (SMS)		26
14.0 Annexure		28

System Specific Safety Case FAQ

(Frequently Asked Questions)

What is a System Specific Safety Case?

A System Specific Safety Case is a way (a Tool) to confront Critical Consequence Technological Risk that Enterprise is obliged to control in our Technological Age. It gathers professional skills, experience, resources, established facts, evidence and means of control and communication to increase the information quality of the safety knowledgebase of the system. The system specific knowledge targeted by the living Safety Case helps to ensure/assure that inherent flaws/faults/errors are prevented from spawning unseen into Specific Critical Consequence Events.

What can't this Safety Case do?

This is a Regulator Free Safety Case. It has no influence on the Safety & Health Obligations/Duties to the Crown, of Industry stakeholders. Every stakeholder including management and workers is bound by their Crown and Common Obligations. Properly constituted Legal Cases look for truth after the fact and behind the facts so people can know what was done to avoid the contravention(s) and consequence(s) and to see if more is required to avoid repeat contraventions. Specific Safety Case Findings of fact do not change truth which lies with generic provisions of the Crown.

Belief of Proof in a Safety Case NEVER precedes the sum of actions taken in respect of our Obligations to the Safety & Health of others that our work & enterprise influences.

So what can this Safety Case do?

This Safety Case works with specific fact to present Mines & Quarries, means to declare Proof of Continued Brake Effectiveness by their adherence to the SCU - Specific Conditions of Use Tool from the Safety Case, and ensure adherence to the SCU by site enforcement/passing out (via the Permit Tool). This Safety Case is specific text (not generic text) assisting Mines & Quarries in the context of specialised technical knowledge offered as specific limits and guidance for their management of risk. Proof of Zero Harm is declared as a presumption in the Safety Case.

So what can Industry do now?...

*Step 1 (Recommended)...**Declare Proof of Zero Harm*

Hastings Deering supported Mines & Quarries using Caterpillar 793D Mining Trucks are invited to use Tools from Safety Case SCR_002_R00.

Safety Case Tools enable a Mine or Quarry's **Safety Management System** to declare Proof of Zero Harm in the Case of Continued Brake Effectiveness.

1. Proof in the Safety Case is **assured** by complete and proper use by that SMS, of the Specific Conditions of Use (SCU) Tool.
2. Proof in the Safety Case is **ensured** by a Permit Tool which enforces in that SMS, complete and proper use of the SCU Tool prior to haul truck operation.

SCU/Permit Tools also provide:

3. A way for the SMS of a Coal Mine to declare conformity with Qld Coal Mining Regulation 2001, Section 66.
4. A way for a Mine or Quarry to prove "just cause" in:
 - ✓ Dispensing with AS2958.1 In Service Dynamic Brake Testing.
 - ✓ Disposing of on-board plastic Wheel Chocks.

*Step 2 (Optional)...**Add to the safety Case*

Rising community expectations forever increase the burden and scope of proof provided. Reliability of Haul Trucks are reliant more on practical experience than on reliability engineering and science. Inputs to this Safety Case reflected this. It is acknowledged a gap exists together with an opportunity for stakeholders to work together to review it. Consequently there may be call in the future for more weight of evidence to be added to the Case. However the Safety Case remains strong, in a Rested and proclaimed live state of the art.

A Mine or Quarry may have evidence showing that a site specific Safety Case is more appropriate to their environment of use. A Safety Case with site specific Service Intervals for example, may be appropriate provided there is necessary additional resources to Determine Merit & Admissibility of supporting evidence. Interested parties are invited to provide further evidence to the case as it becomes available.

Caterpillar 793D Braking System

+ Safety Case + SCU* Tool

Specific Conditions of Use

a free *Tool to Prove Continued Effectiveness*
*SCU_Tool_SCR_002_R00**

:

	<i>Specific Conditions of Use</i>
Testing	<i>SCU1</i>
Preventative Maintenance	<i>SCU2</i>
Other Aspects of Operation & Maintenance	<i>SCU3 to SCU12</i>
Conformity & Harmonisation	<i>SCU13 to SCU21</i>

Adherence to these *Specific Conditions (SCU1 to SCU21)* proves the Safety Case for Continued Effectiveness of the Cat 793D Braking System including provision for Dynamic Brake Testing.

* *Specific Conditions of Use Tool* derived from Hastings Deering Safety Case Report SCR_002_R00 Grp_Eng Database EJ5752

Specific Conditions of Use for Testing

SCU1

(inc Routine Inspection of the Cat 793D)

Record any abnormalities as an action item in the test records and report immediately.

a	Daily Inspection	1	Perform visual machine walk around daily inspection. This should include visual inspection of the brake system such as evidence of external leakage, external damage, or excessive heat on brake components, housings or blackened oil in hydraulic tank sight gauge.
		2	Before operation, test the function of service, secondary and parking brake controls as a simple functionality of the brake system as per the Cat O&MM.
b	Static Test		Measure the available brake torque and brake lining wear as detailed in the O&MM. The O&MM will have recommended service intervals and service criteria depending on the individual machine.
c	Additional Static Test for Front Brakes		Place a chalk mark on each tyre sidewall at 6 o'clock. Whilst empty and stationary on a hard dry surface, conduct a stall test in 1st gear with Service Brake actuated, Park Brake released and front wheels pointed straight. Increase engine rpm until the engine drives through the rear brake pushing the truck forward 1 metre. It is normal for rear wheel rotation during this test; however there must be no front wheel rotation. Examine the position of all chalk marks. If either of the front wheels is seen to have rotated during the test, then the front service brakes are not properly functioning. Caution is required as unexpected machine motion (from relaxation and scuffing of distorted front tyres) is possible during and following this procedure. Tyres are to be at recommended pressure.
d	DBT during Operations		Record as an action item in the test records, alarms, or any adverse indicators or observations about the functionality or characteristics of the Service Brake and Steering under brakes assessed under normal dynamic operations. <i>This test is not intended to measure stopping distance. It records adverse operator observations. This is a functional DBT of Service Brakes (not a measured performance DBT).</i>
e	Diagnostic DBT Procedure		For the purpose of further diagnostic testing of any issues raised above, specific DBT conducted as a service procedure is as follows: Testing is to be performed on a straight flat section of dry closed haul road. The truck will be empty as this more readily feeds back any brake or vehicle control issues evident compared with a DBT of the truck laden. In 3rd gear at a minimum test speed of 20 kph, bring the truck to a stop normally without wheel lock-up or skidding. Check for abnormalities in steering or brake controllability or responsiveness. Repeat this test in 6 th gear at 50 kph recording any abnormalities.

Brake Function Test SCU1 of SCR_002_R00

SCU2		Specific Conditions of Use <i>for Planned Maintenance</i>			✓
Component	Pre-Failure Strategy	Test & Inspection Interval	Maximum Service Interval		
a	Brake Pedals	<ol style="list-style-type: none"> Operator to alert maintenance of any issues including excessive wear, corrosion or dirt/mud build-up. 		Site Dependant	
b	Air Tanks	<ol style="list-style-type: none"> The primary and secondary air tanks should be drained of moisture and sediment The primary and secondary air tanks (Ref Cat Special Instruction REHS2398). Air dryer desiccant to be replaced. 	12000 hrs or 2 years	Daily 60,000 hrs or 10 years 1000 hrs or 6 months	
c	Treadle Valve.	<ol style="list-style-type: none"> Inspections to check for seal failure. Remove and replace Treadle Valve. 	Annually	18000 hrs or 5 years	
d	Double Check Valves	<ol style="list-style-type: none"> Inspections to check for corrosion and/or leaks. Remove and replace Double Check Valves. 	Annually	18000 hrs or 5 years	
e	Relay Valve	<ol style="list-style-type: none"> Inspections to check for corrosion and/or air leaks. Remove and replace Relay Valve. 	Annually	18000 hrs or 5 years	
f	Inverter Valve	<ol style="list-style-type: none"> Inspections to check for corrosion and/or air leaks. Remove and replace Inverter Valve. 	Annually	18000 hrs or 5 years	
g	Brake Release Pump	<ol style="list-style-type: none"> Inspections of the brake release pumps should be conducted. Pumps to be removed and replaced. 	Annually	15000 hrs or 5 years	
h	Air / Hydraulic Cylinder	<ol style="list-style-type: none"> Visual inspection as part of walk around to detect external damage to the cylinder. Air/Hydraulic Cylinder to be replaced. Removal and installation is dependent on site conditions. The Air/Hydraulic cylinder breather should be cleaned and replaced when required. 	Daily	8000 or 5 years 500 or 3 monthly	
i	Make Up Tank	<ol style="list-style-type: none"> Screens should be regularly checked, dependent on site conditions. Make up tank should be maintained cleaning, removal and installation dependent on site conditions. 	Site Dependant	Site Dependant	

SCU2		Specific Conditions of Use for Planned Maintenance Pre-Failure Strategy			Test & Inspection Interval	Maximum Service Interval	✓
Component							
j	Shuttle Valve	1	Visual inspections should be done to check for corrosion and/or leaks.		Annually	18000 hrs or 5 years	
k	VIMS Module	1	VIMS module battery to be replaced.			6000 hrs or 4 years.	
l	Air Hoses	1	Hoses to be checked for damage.		250 hrs or monthly	18000 hrs or 5 years	
		2	Remove and replaced hoses.				
m	Hydraulic Hoses	1	Hoses to be checked for damage.		250 hrs or monthly	18000 hrs or 5 years	
		2	Remove and replace hoses.				
n	Metal Pipes or Tubes	1	Visual inspections should be done to check for corrosion and/or leaks of the metal brake pipes. Pipes to be checked/maintained.		Annually	Subject to Visual Inspection	
o	Park Brake Release Valve	1	Visual inspections should be done to check for corrosion and/or leaks.		Annually	18000 hrs or 5 years	
		2	Remove and replace Park Brake Release Valve.				
p	Slack Adjuster	1	The Slack Adjuster should be maintained.		1000 hrs or 6 months	8000 hrs or 5 years	
		2	Slack adjuster to be removed and replaced. Removal and installation is dependent on site conditions.				
q	Brake Gp	1	Perform a brake, indicators and gauges test. Refer to O&MM for procedure.		Daily	Subject to Condition Measured	
		2	Thickness should be measured and recorded. A increase in thickness will indicate warped discs.		1000 hrs or 6 months		
		3	Perform a static test, refer to Cat O&MM for procedure.		250 hrs or monthly		
		4	To ensure brakes don't exceed 100% wear between change out, this Safety Case recommends the Brake Gp should be rebuilt when wear reaches 75% of the baseline value. Wear percentages available as part of testing and adjusting Services Brake Discs documentation. Sites to use the thickness measurement (taken every 1000 s/hrs) to predict change out period.				

Specific Conditions of Use

Other Aspects of Operation & Maintenance - SCU3 to SCU12

SCU3	The Caterpillar 793D Mining Truck Braking System as per its original System Description comprises 4 wheel, large area, multiple disc & plate, sealed oil immersed & cooled, spring & hydraulic applied, dual piston "wet" brakes. The brake system is specifically designed for the rigour of off road conditions found in the mining environment when used in accordance with Caterpillar's instructions. SMS conforms with this specific condition of use.	✓
SCU4	The Caterpillar 793D Mining Truck Braking System as per its original System Description is fail safe in respect of fade induced run away, fire ignition or environmental degradation in the harsh mining environment when used in accordance with Caterpillar's instructions. SMS conforms with this specific condition of use.	
SCU5	SMS ensures only genuine or Cat approved replacement brake system parts are used. Caterpillar and Hastings Deering provide state of the art quality in design, manufacture, supply, commissioning, and support of all Caterpillar Braking Systems. This means that genuine replacement parts only, are supplied, and these carry full OEM type test certification to ISO 3450 up to 100% indicated wear of brake linings.	
SCU6	Safe application limits when used by trained and competent operators are applied. Caterpillar's 10/10/20 Rule and best practice operating tips for the Cat 793D braking system (including retarding limits) are embraced.	
SCU7	Safety Management System (SMS) maintains records displaying conformity with Caterpillar's 10/10/20 Rule for payload management.	
SCU8	Safety Management System (SMS) provides for haul road gradients never to exceed the following: <ol style="list-style-type: none"> 1. Loaded downhill grades be limited to 13%. (certified Secondary Brake limit) 2. Where practicable, grades be limited to 10% (to maximise margins of safety) 3. No grade to ever exceed 15% (certified Park Brake limit) 	
SCU9	Secondary brakes are provided as a form of redundancy to the service brakes. Operators are given regular Emergency Procedure Training in the use of the secondary brake system.	
SCU10	Choice of the correct brake cooling oil is critical. Use of incorrect oil is detrimental to the continued effectiveness of the brake systems and can reduce the power rating of the retarding system. The Cat OMMS provides information on the allowable cooling oil for the braking system. Rigorous controls for hydraulic tank fill and make up using the correct oil applies at all oil dispensing facilities.	
SCU11	Plastic wheel chocks as an assured backup to the park brake system are null and void. They are a placebo devoid of performance standards, application limits, condition monitoring and pre-failure maintenance strategies. Industry practice of carrying 2 such chocks on board encourages their use on grade where they do not provide adequate park brake system redundancy. On board wheel chocks are prohibited in this case.	
SCU12	To prevent park brake roll away, a combination of Fail Safe park brakes standard on the Cat 793D together with Hastings Deering certified Park Brake roll away avoidance systems (Park Brake warning and operator egress system interlock) is fitted.	

Specific Conditions of Use Conformity & Harmonisation - SCU13 to SCU21		✓
SCU13	Fully meeting these <i>Specific Conditions of Use</i> is offered as a way of following prescribed words in the Mining & Quarrying and Coal Mining Regulations. Where prescribed, those words are the only way cited under the Safety & Health Acts to discharge a mine's Safety & Health obligations.	✓
SCU14	SMS harmonises with Queensland Mines Inspectorate Safety Bulletin No. 101 (Version 1) <i>Brake System Maintenance – Rubber Tyred Vehicles</i> http://www.dme.qld.gov.au/zone_files/mines_safety-health/safety_bulletin101.pdf	
SCU15	SMS harmonises with NSW DPI Mine Safety Operations Branch, Safety Alert No SA06-14 <i>Information to be supplied on safe operating grades for mobile equipment.</i> http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0007/89458/SA06-14-Safe-Operating-Grades-for-Mobile-Equipment.pdf	
SCU16	There is no Regulatory provision for individual performance Dynamic Brake Testing (via stopping distance measurement) of the Service Braking System of each Caterpillar 793D Mining Truck in service. (Ref. Coal Mining Safety & Health Regulation 2001 Section 66)	✓
SCU17	SMS harmonises with Caterpillar certification that its Mining Trucks present minimal risk to competent personnel provided they are operated and maintained inline with the Caterpillar Operation & Maintenance Manual, and Parts & Service Manuals supplied using genuine Caterpillar spare parts and replacement components. SMS harmonises with this condition.	
SCU18	SMS harmonises with Hastings Deering certification that the braking system on the Caterpillar 793D Mining Truck presents acceptable risk as low as reasonably practicable to competent personnel if used as stated by Caterpillar and within the <i>Specific Conditions of Use</i> of this Safety Case Report. This certification does not cover brake system parts and components supplied by 3 rd parties.	
SCU19	Residual Risk is stated as ALARP (as low as reasonably practicable) in Hastings Deering Safety Case SCR_002_R00. However in the context of the risk assessments made, risk is able to be mapped directly to ALARA, "as low as reasonably achievable" and "within acceptable limits". This presents an "acceptable level" of risk in accordance with the provisions of the Queensland Coal Mining Safety & Health Act 1999.	✓
SCU20	ISO 3450 is the international design performance standard for rubber-tired earthmoving equipment braking systems. The Caterpillar 793D has a braking system that exceeds the requirements of ISO 3450 in effect at the time of their design. This certification still applies if wear of original or genuine replacement brake linings falls between new and 100% indicated wear, fully loaded up to and including 20% overload as defined in Caterpillar's 10/10/20 Rule. SMS harmonises with this specific condition of use.	
SCU21	AS2958.1 In Service testing is not reliable in relation to the Continued Effectiveness of the service brakes. The service brake DBT is not a good reflection of the brake's core effectiveness, it's power rating. AS2958.1 also allows for a 25% degradation of brake performance, which is unacceptable under these <i>Specific Conditions of Use</i> . Full service brake effectiveness is maintained continuously, (not allowed to deteriorate by 25%) under these <i>Specific Conditions of Use</i> .	✓

Caterpillar 793D Mining Truck Brakes

+ Safety Case + Permit

A free Tool to Ensure Proof of Continued Brake Effectiveness
*Permit_Tool_SCR_002_R00**

(Issued by Mines or Quarries ensuring Proof has been Declared using - SCU_Tool_SCR_002_R00)

Proof of Continued Effectiveness					
Cat 793D Braking System					
Safety Case Permit <i>Issued by this Participating Mine or Quarry</i>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Determination ✓ <i>of Merit & Admissibility of Material outlined has Made the Safety Case.</i> </td> <td style="width: 50%; padding: 5px;"> Assessment ✓ <i>of Safety Claim, Argument & Evidence, has Upheld the Safety Case.</i> </td> </tr> <tr> <td style="padding: 5px;"> Safety Case Report Section 8 ✓ <i>Items M1 to M12</i> </td> <td style="padding: 5px;"> Safety Case Report Sections 10,11,12 ✓ <i>Items S1 to S28</i> </td> </tr> </table>	Determination ✓ <i>of Merit & Admissibility of Material outlined has Made the Safety Case.</i>	Assessment ✓ <i>of Safety Claim, Argument & Evidence, has Upheld the Safety Case.</i>	Safety Case Report Section 8 ✓ <i>Items M1 to M12</i>	Safety Case Report Sections 10,11,12 ✓ <i>Items S1 to S28</i>
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<p style="text-align: center;">Finding ✓ <i>discovered via Summation of Determination</i> ✓ & Assessment ✓ <i>Safety Case Rests</i> as of most recent Print Date stamped.</p>					
Summary	<p>Hastings Deering certifies that: The Cat 793D Braking System, if used within <i>Specific Conditions of Use</i> of SCR_002_R00, provides continued brake effectiveness.</p> <p>This Participating Mine or Quarry certifies that: Operation of each of the Cat 793D Mining Trucks at this mine meets all applicable <i>Specific Conditions of Use</i> of the Safety Case (Hastings Deering Ref: SCR_002_R00)</p>				
Affix Permit Here					

* Permit Tool derived from Hastings Deering Safety Case Report SCR_002_R00 Grp_Eng Dbase EJ5752

Proclaimer

This System Specific Safety Case is proclaimed by Hastings Deering, to be Made, Upheld and at Rest in a Safety Case Report (SCR) on the print date disclosed. This Finding convinces us to freely publish in the public domain, the Head of the Report including its SCU and Permit Tools for the specific use in Mines and Quarries we service. Mines and quarries not serviced may have completely different application of use which disqualifies use of these Tools.

A Mine or Quarry's Declaration in this Safety Case is enabled by use of the System Specific Safety Case Tools and follows Hastings Deering's Proclamation of the Continued Effectiveness of the System Specific Safety Case Tools issued as of the print date showing at the foot of each page issued. Later revisions with later issue dates may contain further important Material. The SMS must therefore make Provision for regular revision necessary in order to remain up to date with Material issued as time marches on.

Disclaimer

Limitations to the Use of the SCR or SCR Tools

This report of the Safety Case is a controlled document from Hastings Deering's perspective. It is subject to revision as Material & Evidence is admitted from interested parties, various stakeholders, End Users, manufacturers, Caterpillar and Regulator(s).

Hastings Deering wish to disclose that not all conclusions, recommendations or outcomes have been agreed to by all or any companies or organisations appearing in Safety Case Report SCR_002_R00; nor has the Safety Case been tested or challenged under Common Law or Crown Legislation.

Consequently the information provided cannot prejudice the current or future safety management practices of any companies or persons. Readers are wholly responsible for managing all safety, commercial & other risks arising from their use of this information. To help manage such risk, users are advised to seek independent professional advice from competent legal and other registered professionals with the appropriate experience, expertise or eminence in this field.

Claimant

Hastings Deering Engineering Services Dept

Ref : SCR_002_R00

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For any person or body wishing to examine its Determination, Assessment and Finding in detail. Hastings Deering will also fully publish POA and "Commercial in Confidence", the complete SCR in controlled hardcopies uniquely stamped to that person or body. Price not to exceed \$600 per copy.