Rubber Tyred Vehicles
Technical Bulletin

Bulletin Number: TB0903 Date: 17/06/2009

Subject: Cat3126 DES Design Registration

Purpose

To inform the industry of the New South Wales registration and exemption of the Transport Braking System for the Sandvik Cat3126 Diesel Engine System.

Applicable to

Sandvik Loaders and Haulers - LS160 (former name ED6), LS170 (former name ED7), LS170L (former name ED7LP), LS190 (former name ED10, 220), TS350 (former name ED25), TS355 (former name ED30), TS490 (former name ED40)

Description

New South Wales design registration and design registration exemption has been granted for the Sandvik Mining and Construction Tomago Pty Ltd Caterpillar 3126 DITA Diesel Engine System.

The registration MDR 089003 DES applies to all Sandvik Cat3126 Diesel Engine Systems manufactured after 14th January 2009 and used within New South Wales.

The Exemption Order No. 090264 applies to all Sandvik Cat3126 Diesel Engine Systems manufactured prior to 14th January 2009 and used within New South Wales. Note that the exemption order expires 30th June 2009. Before this time, End Users in New South Wales will be required to upgrade their DES's to comply with the registration requirements. In the majority of cases the only required modification will be a new nameplate (BD00003888).

Note that additional (non-mandatory) changes are recommended as an outcome of the risk assessment and information on these will be released via technical bulletins when they become available. The mandatory and recommended changes are nominated in A2U900-860132 (attached).

Although the registration applies to vehicles operating in NSW coal workplaces, recommendations and the attachments to this technical bulletin are applicable to all End Users.

Changes

Required changes to existing vehicles are nominated in A2U900-860132.

Contact

Contact your Sandvik representative for further information or any questions you may have.

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Rubber Tyred Vehicles
Technical Bulletin

Attachments

	DOCUMENT NO.	ISSUE	DATE	TITLE
1	MDR 089003 DES		14/01/09	Notice of Registration of Plant Design (Diesel Engine System)
2	090264		23/01/09	Exemption Order
3	A2U900-860132	A	03/02/09	Compliance Statement, Conditions Of Use, MDR 089003 DES
4	A2U220-830553	E	26/11/08	General Arrangement, Diesel Engine System, Cat 3126 DITA
5	A2U220-830555	3	20/11/06	Safety Circuit, Cat3126 DITA DES 220 LHD
6	A2U900-830750	C	28/11/08	Emergency Shut Down Diesel Engine System, Cat 3126 DITA
7	RA0023	A	25/11/08	Non-Conformance Risk Assessment for Cat3126 Diesel Engine System against AS/NZS 3584.2:2008

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REGISTRATION SCHEDULE

1 Detailed Description of Registered Item (s) and Variation (s):

Sandvik Mining and Construction Tomago Pty Ltd modified 150 kW Caterpillar 3126 DITA explosion protected diesel engine system with wet exhaust system comprising; exhaust catalytic converter, water based conditioner, particulate filter assembly an pneumatic/hydraulic shutdown system as identified by registration number MDR 089003 DES and listed documents herein.

1.1 Assessment Criteria

Performance criteria specified in the NSW Government Gazette No. 24 of 2 February 2007 page 667, *Requirements for Design Registration of Diesel Engine System Designs.*

1.2 Engine specifications

Description of Diesel Engine System including its major components:

Combustion System		Direct injection exhaust drive turbocharged
Piston Displacement	L	7.24
Cylinder bore and stroke	mm	110 x 127
Firing order		1,5,3,6,2,4
Compression Ratio		15:1
Testing Dynamometer		
Power Rating / speed	kW / rpm	150/2300
Rated Torque / speed	Nm / rpm	736/1900
Fuel setting	mm	7.79
Fuel timing	mm	65.34
In service		
Torque stall power / speed	kW / rpm	150 kW @ 2,250 rpm
High idle	rpm	2600
Idle speed	rpm	800
Minimum ventilation requirements (gas)	m^3/sec	9.1
Diesel particulate signature ($Q_{DP(min)}$) with filter	$m^{3/}$sec	0.3
Diesel particulate signature ($Q_{DP(min)}$) with no filter	m^3/sec	13.5

1.3 Typical test results at approved power rating

Speed	(rpm)	2300
Torque	(Nm)	638
Power	(kW)	153
Turbo Boost	(kPa)	128
Inlet Vacuum	(kPa)	1.87 kPa (14 mmHg)
Exhaust Pressure	kPa	6.0kPa (45 mmHg)
Fuel Consumption	kg/hr	36.6
Maximum surface temperature / location	^{0}C	146 ^{0}C Aftercooler housing
Conditioner water consumption over 1 hour		128.41
Carbon Dioxide $C0_2$	%	7.0 / 7.0

(before/after treatment)		
Carbon Monoxide CO (before/after treatment)	ppm	96/21
Oxides of Nitrogen NO_x (before/after treatment)	ppm	632/656
Nitrogen Oxide NO (before/after treatment)	ppm	595/612
Nitrogen Dioxide NO_2 (before/after treatment)	ppm	37/44
Smoke – Single point (before/after treatment)	Bosch	0.55 / 0.35

2 Documents Submitted for Registration

2.1 Documents and Drawings to be Submitted to the Owner and Person in Control

The documents listed must be supplied to the owner and person in control of each item of design registered plant. Refer to clauses 96, 105 and 122 of the OHS regulation.

DOCUMENT No:	ISSUE	DATE	TITLE
A2U220-830553 Sheets 1 to 4 inclusive	E	26/11/08	GENERAL ARRANGEMENT, DIESEL ENGINE SYSTEM, CAT 3126 DITA
A2U220-830555	3	20/11/06	SAFETY CIRCUIT, CAT 3126 DITA DES 220 LHD
A2U900-830750 Sheets 1 to 3 inclusive	C	28/11/08	EMERGENCY SHUT DOWN DIESEL ENGINE SYSTEM, CAT 3126 DITA

2.2 Other Documents Submitted for DPI Reference and Assessment

The following documents are listed for DPI assessment only and need not be supplied to the end user.

DOCUMENT No:	ISSUE	DATE	TITLE
RA0023	A	25/11/08	Non-conformance Risk Assessment for Cat 3126 DITA Diesel Engine System against AS/NZS 3584.2:2008
CR0326	A	26/11/08	Compliance of the Sandvik Cat 3126 DES to AS/NZS 3584.2-2008
CR0207	0	16/11/06	Compliance Statement by Designer
A2U220-860065	0	23/11/06	Verification Statement by Design Verifier
0072	0	23/11/06	Cat 3126A Blocked Filter Bypass Testing
RTV Particulate Filter Operation	1	22/11/06	Attention/Memo Operation Guide for all RTVs which have the Particulate Filter/Horn arrangement fitted
A2U130-240068	4	18/12/06	Retro Fit Kit – air Intake (ED7)
A2U130-240070	F	10/11/08	Air Intake Line (ED7)
A2U220-240065	4	7/02/07	Retro Fit Kit – Air Intake (ED10)
AU220-240072	F	12/11/08	Air Intake Line (ED10)
A2U900-241058	F	11/11/08	Shut Down Valve
0050	3	8/12/06	FMEA – Emergency Shutdown System – Engine Strangler Valve
0054	0	13/03/06	Test Report – Measure Time to Stop and Exhaust Vacuum Under Emergency Shutdown

23041	original	23/7/02	Report – Testing Caterpillar 3126A diesel engine system with wet exhaust system by TestSafe Australia
0056	0	05/04/06	Test Report – 100,000 Cycle Test of Prototype Engine Strangler
0057	0	05/04/06	Test Report – Measure of Strangler Valve Cylinder Extension Vs Air Pressure
CR0184	1	08/12/06	Strangler Valve Compliance with AS4024.1.1501-2
Training Document			Diesel Engine Emergency Shutdown System for Eimco Diesel Engine Systems
A2U220-257008 Sheet 1 to 5 inclusive	1	8/05/02	Purifier Water Cooled 220 LHD
A2U220-257011 Sheets 1 to 2 inclusive	4	9/10/06	Catalytic Purifier – ECI Water Cooled 220 LHD
A2U900-860004	2	13/06/06	Compliance Statement by Designer
RE0082	1	23/7/03	Verification Statement by Verifier
CR0037	2	26/7/03	Compliance report – development of Caterpillar 3126A Diesel Engine System with Wet Scrubber by VA Eimco Australia Pty Ltd
23550	Original	13/01/03	Report – Testing of caterpillar 3126 DITA Diesel Engine System with Wet Scrubber Exhaust System by TestSafe Australia
76001		6/08/97	Test Report – Testing & Certification Australia 3M Filter Media, Type Filtrete
41652		4/05/00	Test Report – Micro Fresh Filters Filter Media
00/A/RB-02		28/02/00	Sharp & Howells Test report on Filter Encap Adhesive
0029	0	23/06/03	ED10 fitted with caterpillar 3126 DITA with Wet Scrubber Exhaust System – Test Scrubber Operation On Inclines of 1:4 by VA Eimco Australia
NSH-103		11/06/02	Hydrostatic Test Report Exhaust Conditioner A2U220-251089
SWP 130 LHD No. 34	01	Oct 2002	Safe Work Procedure Testing Humphrey Valves Individually
0028	1	16/07/03	FMEA Caterpillar 3126A Diesel Engine System safety & Shutdown System
25571	Original	31/08/04	Report – Pressure Determination and Hydrostatic Testing of Caterpillar 3126 DITA Diesel Engine by TestSafe Australia
ED7 2.01	01	06/08/04	JSEA – Testing Humphrey Valves Individually
n.n.			Applicable vehicle model operator manual
n.n.			Applicable vehicle model service manual
n.n.			Applicable vehicle model service schedules (incorporating Cat 3126 service requirements)

3 Conditions for Supply and Use

3.1 General Conditions for Supply

1. The plant design registration number must appear in a conspicuous place and in a legible manner on each item of registered plant, unless specifically excluded.

2. The designer, manufacturer and/or supplier must provide to any person who owns the plant, or who has control of the plant or the end user all information as required by clauses 96, 105 and 122 of the Regulation and all documents listed in section 2.1 of this registration.

3. A copy of the registration of plant design documentation must be supplied to any person who owns or who has control of the registered plant. The documentation must comprise the number of pages listed in the footer block together with all documentation and drawings as listed in the Schedule specifically nominated for the purposes of installation, inspection and maintenance of the plant design.

4. The manufacturer is to certify in writing that the particular plant design supplied is in accordance with the requirements of this design registration.

5. There must be no variation in the materials, design or construction of the plant associated with this registration. Unauthorised alteration or substitution of registered plant will render this registration void.

6. New plant must not be manufactured, (or supplied) to this design registration after the specified date of expiry. If no date is specified, after 10 years from the date of registration. This does not prevent ongoing use of existing plant manufactured prior to the specified date of expiry.

3.2 General Conditions for Use

1. The coal operator must conduct a site specific operational risk assessment in respect to the introduction of the plant items detailed in this notice and implement all barriers to risk identified in the risk assessment prior to the introduction of the plant into a coal workplace. This operational risk assessment must be reviewed when operating conditions vary.

2. A copy of the design registration document must be held at the coal work place where the specified plant is being used.

3. The coal operator must ensure that adequate information is retained at the coal workplace to enable the plant to be correctly operated, tested and maintained in the registered condition. This information must also be made available wherever the plant is overhauled or repaired.

4. This design registration remains valid only when the plant is designed, modified, examined, tested, maintained, overhauled and repaired in accordance with the registration conditions, the registration documents, the *Coal Mines Health And Safety Act 2002* and the *Coal Mine Health and Safety Regulation 2006.*

7. The Mine Safety Management System must include provision to notify the registration holder or supplier when the plant is seen not to comply with the registration notice or when safety related defects occur.

8. The owner of the plant must conduct a safety audit of the registered plant. This safety audit must be carried out at intervals not exceeding five (5) years, be documented and must include:

    a) an assessment for compliance against these registration conditions, and

    b) an assessment for compliance against the current community standards and gazettal criteria, applicable to the registered plant at the time of the audit, and implementation of interim control measures to reduce risk to an acceptable level, and

    c) an assessment of the safety defects identified since the previous audit and a review of the improvements required to minimise these defects.

    d) A review of the site-specific operational risk assessment.

9. The owner and the person in control must ensure that safety related recommendations of the designer, manufacturer or supplier are complied with as far as they relate to the safe use of the plant, unless an appropriately documented risk assessment is used to identify alternative risk controls as providing an equivalent level of safety and these risk controls being implemented.

OCCUPATIONAL HEALTH AND SAFETY ACT 2000

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Registration No: MDR 089003 DES
File: 08/9003
Date: 14 January 2009

NOTICE OF REGISTRATION OF PLANT DESIGN (DIESEL ENGINE SYSTEM)

It is hereby notified that the plant design listed herein is registered in accordance with the *Occupational Health and Safety Act 2000* (the Act), Subdivision 1 of Division 3 of Part 5.2 of the *Occupational Health and Safety Regulation 2001* (the Regulation) and appropriate standards or gazetted requirements under Clause 107 (2) of the Regulation. This registration is issued pursuant to the provisions of Clause 109 (1) (a) of the Regulation.

This registration is issued to:	Sandvik Mining and Construction Tomago Pty Ltd, ABN 38 070 973 330
Address of supplier:	Old Punt Road, TOMAGO NSW 2322 PO BOX 595 RAYMOND TERRACE NSW 2324
Registration number:	MDR 089003 DES
Date of expiry:	January 2014 (5 Years)
Description of plant:	Sandvik Mining and Construction Tomago Pty Ltd modified 150 kW Caterpillar 3126 DITA explosion protected diesel engine system with wet exhaust system comprising; exhaust catalytic converter, water based conditioner, particulate filter assembly an pneumatic/hydraulic shutdown system as identified by registration number MDR 089003 DES and listed documents herein.
Make:	Caterpillar
Model:	3126
OHS Registration Clause:	Part 2 of the table to clause 107 of the Regulation, 'Mining Specific Plant'
Specific Registration Category:	Diesel engine systems used in underground mines at a coal workplace.

This registration is issued subject to compliance with the requirements of the Act.

The registration has appended to it, for the purposes of the Act, a schedule and a list of conditions, (including drawings, documents, etc.) that are applicable to this registered plant design, as identified during test and/or assessment, to assist the designer, manufacturer, supplier and user to comply with the obligations of the Act. These conditions must be complied with for the registration to remain valid. The designer, manufacturer and/or supplier must ensure that the supplied item of registered plant does not deviate in plant design and is not inferior in any way to the item tested and/or assessed.

The owner, the person in control of the plant and the user must ensure the supplied item is installed, operated and maintained in accordance with designer/manufacturer's instructions and in accordance with the registration conditions of this notice.

The Chief Inspector has the right to vary or revoke this registration at any time.

P A Sunol
Acting Senior Inspector Mechanical Engineering
(by delegation)

3.3 Specific Conditions

1. Design registration number MDR 089003 DES, the Suppliers name or mark and the required minimum ventilation quantity of 9.1m^3/sec must be inscribed on a durable plate fixed in a prominent position on the equipment.

   In addition, the design registration number must be stamped on each of the following components:

   a) Inlet manifold assembly.
   b) Exhaust manifold
   c) Exhaust pipe assembly
   d) Wet exhaust conditioner
   e) Exhaust gas catalytic converter and oxidiser
   f) Exhaust particulate filter assembly
   g) Emergency shutdown valve

2. An individual item registration number must be allocated for each diesel engine by the Department of Primary Industries Mine Safety unit. This number must be stamped on the engine block in an accessible location.

3. MDG32, AS3584.3 or any relevant Australian Standard must be considered in the development of the mine's mechanical engineering management plans under Clause 20 of the *Coal Mine Health and Safety Regulation 2006.*

4. Each installation of this engine type must be checked to ensure compliance with Australian Standard AS 3584.2-2003. These checks shall include but are not limited to:

   a) Protection of exposed Aluminium or light metal alloys.
   b) Operation of the engine and emergency shutdown system.
   c) All checks as identified in clause 4.4 of AS3584.2:2003.

5. Diesel fuel must comply with that specified by gazettal under Clause 73 of the *Coal Mines Health and Safety Regulation 2006.*

6. The exhaust gas emissions must comply with that specified by gazettal under Clause 74 of the *Coal Mines Health and Safety Regulation 2006.*

7. Routine testing of exhaust gas emissions must be carried out by a licensed laboratory and must not exceed those results obtained during type testing, as specified by gazettal under Clause 74 of the *Coal Mine Health and Safety Regulation 2006.*

8. All emergency activations of the emergency shutdown system and failures of the normal shutdown system must be documented and reported to the Department Inspectorate.

9. After activation of the emergency shutdown system there must be a risk assessment to determine the issues of resetting and the continued safe operation of the diesel engine system.

10. Each diesel engine system must be inspected and maintained by people with appropriate training, qualifications, experience and knowledge of the explosion protection characteristics of the diesel engine system.

P A Sunol
Acting Senior Inspector Mechanical Engineering
(by delegation)

OCCUPATIONAL HEALTH AND SAFETY ACT 2000

Occupational Health and Safety Regulation 2001

Use of Plant - Design Registration Requirements in Coal Workplaces

Exemption Order No 090264

I, PETER ALSINA SUNOL Acting Senior Inspector of Mechanical Engineering under the *Coal Mine Health and Safety Act 2002*, with the delegated authority of the Director General pursuant to section 137A(2) of the *Occupational Health and Safety Act 2000* (the Act) and pursuant to clause 348 of the *Occupational Health and Safety Regulation 2001* (the Regulation), hereby make the following Exemption Order as specified in the Schedule.

Words and expressions used in this Order have the same meanings as those used in the Act and the Regulation.

SCHEDULE

1 Exemptions

Subject to the conditions and for the period (if any, as applicable to a matter) specified in clause 2, this Order exempts:

a) Employers at coal workplaces from complying with the requirements of clause 136(5) of the Regulation in relation to the specified plant in clause 2, and

b) Hirers from complying with the requirements of clause 127(2)(c) of the Regulation in relation to the specified plant in clause 2.

2 Application, conditions and duration of exemptions

2.1 This exemption only applies to Sandvik Mining and Construction Tomago Pty Ltd modified Caterpillar 3126 DITA explosion protected diesel engine systems (used in an underground mine at a coal workplace) in compliance with previous approvals MDA DES 030043 (file C03/0043) as amended.

2.2 Each diesel engine system must comply with all applicable conditions of approval as specified in MDA DES 030043 as amended.

2.3 Each diesel engine system must hold a current item registration issued under Subdivision 2 of Division 3 of Part 5.2 of the Regulation before the plant is used.

2.4 Each diesel engine system must be inspected, tested and maintained;

2.4.1 by competent people with appropriate training, qualifications, experience and knowledge of risk controls on the diesel engine system, and

2.4.2 in accordance with AS3584.2:2008; AS3584.3:2005; and MDG-29, and

2.4.3 in accordance with the designer/manufacturer's recommendations or as otherwise recommended and documented in writing by a competent person in accordance with clauses 136 and 137 of the Regulation

2.5 Without limiting the requirements of clause 2.4, each diesel engine system must be maintained in accordance with the current Sandvik Mining and Construction Tomago service schedule.

2.6 A specified diesel engine system may only be altered if the alteration is in full compliance with AS3584.2:2008 and under the direction of a suitably qualified competent person. The alteration must be documented and must be kept in a plant safety file.

2.7 On or before 30 June 2009 each diesel engine system must comply with:

2.7.1 all applicable approval documents (as specified in Table 1) and

2.7.2 all applicable Sandvik Technical Bulletins (as specified in Table 2)

Approval	Description of Changes to Diesel Engine System
MDA DES 030043/6	Supplementary approval for MDA DES 33 to fit an exhaust filter bypass wastegate to Eimco Caterpillar 3306 Diesel Engine Systems. This supplementary approval allows the installation of the VAMT exhaust filter bypass wastegate, as per the listed documents, on the following diesel engine systems: (ii) MDA DES 030043 – file C03/0043
MDA DES 030043/5	Supplementary approval for the use of a VAMT emergency shutdown system as per the listed documents. This supplementary approval allows the VAMT emergency shutdown systems to be used on the following Diesel Engine Systems: (iii) MDA DES 030043 – file C03/0043
MDA DES 030043/4	Type Approval for the Diesel Engine System (DES) on a VA Eimco Australia Pty Ltd, 220 LHD machine with a Caterpillar 3126 Direct Injection, Turbo Assisted (DITA) engine rated at 150kW with wet exhaust system per the listed documents.

Table – 1 Sandvik Caterpillar 3126 Applicable Approvals

Technical Bulletin	Date	Description
0826	04-Dec-08	Ampcontrol Methane System Bypass
0825	04-Dec-08	Strangler Air Schematic Correction
0817	12-Sep-08	Cat3126 Turbo Studs Failures
0803	17-Jan-08	Strangler Valve Update
0724	18-Sep-07	Water Make-Up Valve
0723	17-Sep-07	Refuelling ED10 LHD's
0722	15-Oct-07	Cat. 3126A DITA Water Pump V-Belts
0721	14-Sep-07	Methane Monitor Air Circuit Interlock
0716	02-Jul-07	Electrical Protection - NSW Legislation Requirements
0713	17-May-07	Amendment to TB0632, TB0633, & TB0634
0712	03/05/07	Progress of Strangler Valve Redesign (3)
0710	18-Apr-07	Blocked Purifier Restrictor
0703	05-Feb-07	Progress of Strangler Valve Redesign
0634	08-Dec-06	Excessive exhaust backpressure on Cat. 3126A engine
0627	22-Sep-06	Effect of Excessive exhaust backpressure on low water shutdown
0624	01-Sep-06	Exhaust Downpipe Cooling Water Jacket Connections for LHD's
0623	21-Sep-06	Engine Cooling Group 45 Degree Elbows for ED6, ED7, ED7LP, ED10, ED25, ED30
0614	28-Jun-06	Progress of Strangler Valve Redesign
0511	12-Sep-05	Removal of transmission overtemperature sentinel
0506	20-Jul-05	Diesel engine emergency shutdown system (1)

Table 2- Caterpillar 3306 DES Applicable Sandvik Technical Bulletins

2.8 The Mechanical Engineering Management Plan (under the *Coal Mine Health and Safety Regulation 2006*) must provide systems for the safe use of each diesel engine system when in use at a underground mine at a coal workplace.

2.9 This exemption only applies to diesel engine systems manufactured before the date of the order

2.10 A copy of this exemption order must be held at the coal workplace where the specified diesel engine system is being used and must be;

2.10.1 given to all persons employed at the coal workplace in accordance with any consultation arrangements, and

2.10.2 displayed on an employee notice board for a period of 28 days.

This Order has effect from the date of publication in the Government Gazette until (and including) 30 June 2010.

Dated this 13th day of December 2009.

PETER ALSINA SUNOL,
Acting Senior Inspector of Mechanical Engineering
NSW Department of Primary Industries

TECHNICAL STATEMENT

DOCUMENT No.: A2U900-860132

TITLE: COMPLIANCE STATEMENT, CONDITIONS OF USE, MDR 089003 DES

JOB No.: EN9105

PROJECT:

PRODUCT LINE: RUBBER TYRED VEHICLES

MACHINE MODEL(S): CAT3126 DITA DIESEL ENGINE SYSTEM

SERIAL NO.(s):

REFERENCE: MDR 089003 DES

Approved by:

Mark Peristy
Design Engineer
Sandvik Mining and Construction
Tomago Pty Ltd

REV	DATE	DESCRIPTION	AUTHOR
A	3.02.2009	Initial Release	Mark Peristy

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1 Compliance Statement

1.1 The following compliance statement is applicable to Caterpillar 3126 DITA diesel engine system (DES) designed, manufactured and supplied by Sandvik Mining and Construction Tomago Pty Limited (hereby referred to as Sandvik) into the New South Wales market.

1.2 The diesel engine system design and any acceptable variation to it specified in documents listed in MDR 089003 DES Section 2.1 complies with the following standard, with the exceptions as listed in Section 2 of this document.

- AS/NZS 3584.2:2008 – Diesel engine systems for underground coal mines, Part 2: Explosion protected.

1.3 This compliance statement must be read in conjunction with Sandvik Compliance Statement A2U900-860004.

2 Schedule of Partial and Non-Compliances

2.1 Refer to Sandvik Risk Assessment RA0023 for listing of non-compliances and for recommended end user actions and residual risks arising from these non-compliances.

3 Document Schedule

3.1 The design of the Cat3126 DES has been examined and tested as recorded in MDR 089003 DES Section 2.2.

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4 Design Changes and End User Actions

4.1 This registration applies to both new and existing diesel engine systems. There are some changes from MDA DES 030043/4, 5, 6.

4.2 Loader Modifications

4.2.1 Owners and operators of existing loaders are required to perform the modifications listed below in Table 1 in order to comply with the requirements of MDR 089003 DES.

Table 1 – Required DES Modifications

Item	Reference	Design Change
1	MDR 089003 DES	Fit new compliance registration nameplate BD00003888 and remove existing DES nameplates (compliance plate A2U220-171724 and specification plate A2U220-171725).
2	MDA DES 030043/6	Installation of exhaust filter bypass wastegate.
3	MDA DES 030043/5	Addition of emergency shutdown system (strangler).
4	MDA DES 030043/4	Initial current design.
5	MDA DES 030043/3	Superseded.
6	MDA DES 030043/2	Superseded.
7	MDA DES 030043/1	Superseded.
8	MDA DES 030043	Superseded.

4.2.2 The modifications in Table 3 are not mandatory for registration, however they are recommended as an outcome of risk assessment RA0023.

4.2.3 As at the time of writing this Technical Statement a number of the recommendations were being engineered. When these are available, Sandvik will issue Technical Bulletins providing details.

Table 2 – Recommended Loader Modifications

Item	Reference	Design Change
1	RA0023	Fit fuel shutoff valve label, and move valve to downstream of fuel/water separator.
2	RA0023	Fit mesh to ED7/LS170 as per TB0719.
3	RA0023	Fit belt tensioner and use of tension indicator tool.
4	RA0023	Fit retrofit radiator cap.
5	RA0023	Fit of radiator expansion tank (where possible).

4.3 Changes to Testing or Procedures

4.3.1 Owners and operators of existing loaders are required to implement or change testing or procedures listed below in Table 2.

4.3.2 Additional End User requirements to comply with conditions of registration are in Appendix A.

Table 3 – Required Changes to Testing or Procedures and End User Actions

Change From Previous Design	End User Action Required For Existing Loaders
In-service testing requirements have been revised.	Update mechanical engineering management plan in accordance with requirements in MDR 089003 DES.

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5 General Requirements for End Users Regarding Diesel Engine Systems

5.1 These recommendations are additional to those provided in the loader Operator and Service Manuals (including addendums), and relevant alerts and bulletins issued by Sandvik or the industry.

5.2 Engine system specifications stated on nameplates and in documentation are valid only for adequately maintained engine systems. Inadequate maintenance may reduce performance levels and increase levels of particulates and gases.

5.3 All vehicle operators are to be suitably trained and qualified especially with regard to isolation (air and fuel), performing pre-start checks on the DES, and emergency shutdown procedures.

5.4 For the determination of required Category and/or SIL levels for safety related parts of control systems, Sandvik assume the operating environment is maintained as specified by the regulatory authority with regard to coal dust suppression, mine ventilation, and explosion barriers.

5.5 Sandvik FMEA's on vehicle systems may exclude generic faults from the analyses in accordance with AS4024.1502 Section 4. The generic faults that may be excluded and conditions for exclusion are in listed in AS4024.1502 Appendices A, B, C, and D. End Users should note that if the vehicle system is modified outside the scope of the registration or design intention, or has not been tested or maintained as specified, the conditions upon which a generic fault may have been excluded will no longer be valid, and the likelihood of this fault occurring will increase.

5.6 Sandvik FMEA's and risk assessments assume that the assessed design has not been modified and has been adequately maintained. End Users should note that modification or poor maintenance practices will invalidate assessment of some risks.

5.7 Mine Transport Rules should consider the following issues:

- Prevention of operation of DES in prohibited areas.
- Rated grades for mobile plant are not exceeded

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6 Appendix A - Conditions of Use Compliance Details

6.1 The following table details the compliance to conditions of use nominated in MDR 0889003 DES.

Table A1 – Clause By Clause Conditions of Use Compliance Details

Item	Requirement	Sandvik Compliance Statement for New Supply Cat3126 DES	End User Requirements
3	**Conditions for Supply and Use**	Heading	
3.1	**General Conditions for Supply**	Heading	
1.	The plant design registration number must appear in a conspicuous place in a legible manner on each item of registered plant, unless specifically excluded.	Comply, when nameplate BD00003888 installed.	Install nameplate to existing vehicles. Remove old approval nameplate.
2.	The designer, manufacturer and/or supplier must provide any person who owns the plant, or who has control of the plant or the end use all information as required by clauses 96, 105, and 122 of the Regulation and all documents listed in section 2.1 of this registration.	Comply for new loaders supplied by Sandvik, refer to: Operator Manual Service Manual Plant Safety File (or previous approval documentation) Training Manuals Service Schedules JSEA's	Ensure the required documentation is supplied when selling or hiring out the Loader.
3.	A copy of the registration of plant design documentation must be supplied to any person who owns or who has control of the registered plant. The documentation must comprise the number of pages listed in the footer block together with all documentation and drawings as listed in the Schedule specifically nominated for the purposes of installation, inspection and maintenance of the plant design.	Comply for new DES supplied from Sandvik.	Ensure the required documentation is supplied when selling or hiring out the Loader.
4.	The manufacturer is to certify in writing that the particular plant design supplied is in accordance with the requirements of this design registration.	Refer to Section 1.2 of this Technical Statement.	
5.	There must be no variation in the materials, design or construction of the plant associated with this registration. Unauthorised alteration or substitution of registered plant will render this registration void.	Refer Notice of Inspection in Plant Safety File.	Ensure loader is maintained as per registration requirements.
6.	New plant must not be manufactured, (or supplied) to this design registration after the specified date of expiry. If no date is specified, after 10 years for the date of registration. This does not prevent ongoing use of existing plant manufactured prior to the specified date of expiry.	Not Applicable at this time.	Not Applicable
3.2	**General Conditions for Use**	End User Responsibility	Comply with requirements of Section 3.2 of MDR 087597 TBS.

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Item	Requirement	Sandvik Compliance Statement for New Supply Cat3126 DES	End User Requirements
3.3	**Specific Conditions**	Heading	
1	Design registration number MDR 089003 DES, the Suppliers name or mark and the required minimum ventilation quantity of 9.1m^3/sec must be inscribed on a durable plate fixed in a prominent position on the equipment. In addition, the design registration number must be stamped on each of the following components: a) Inlet manifold assembly b) Exhaust manifold c) Exhaust pipe assembly d) Wet exhaust conditioner e) Exhaust gas catalytic converter and oxidiser f) Exhaust particulate filter assembly g) Emergency shutdown valve	Comply, when nameplate BD00003888 installed.	Install nameplate BD0003888 or equivalent. Stamp components.
2	An individual item registration number must be allocated for each diesel engine by the Department of primary Industries Mine Safety unit. This number must be stamped on the engine block in an accessible location.	Comply, when authorised by plant owner.	Item register DES or provide authorisation to Sandvik for item registration.
3	MDG32, AS3584.3 or any relevant Australian Standard must be considered in the development of the mine's mechanical engineering management plans under Clause 20 of the Coal Mine Health and Safety Regulation 2006.	End user responsibility.	Comply with requirements of Section 3.3 (3) of MDR 087597 TBS.
4	Each installation of this engine type must be checked to ensure compliance with Australian Standard AS 3584.2-2003. These checks shall include but are not limited to: a) Protection of exposed Aluminium or light metals b) Operation of the engine and emergency shutdown systems c) All checks as identified in Clause 4.4 of AS3584.2:2003.	Refer Notice of Inspection in Plant Safety File.	Maintain DES as per requirement. Refer to Sandvik service schedules for maintenance requirements. Refer to registration drawings for listing of aluminium components and shutdown systems.
5	Diesel fuel must comply with that specified by gazettal under Clause 73 of the Coal Mines Health and Safety Regulation 2006.	End user responsibility. Fuel supplied with the vehicle is standard diesel with no additives and sourced from major fuel suppliers. Some standard diesel fuel may have a flash point >60.5°C.	Only use compliant diesel fuel for the DES.
6	The exhaust gas emissions must comply with that specified by gazettal under Clause 74 of the Coal Mines Health and Safety Regulation 2006.	Refer Diesel Exhaust Report in Plant Safety File.	Conduct in-service testing and monitor DES emission levels.

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Item	Requirement	Sandvik Compliance Statement for New Supply Cat3126 DES	End User Requirements
7	Routine testing of exhaust gas emissions must be carried out by a licensed laboratory and must not exceed those results obtained during type testing, as specified by gazettal under Clause 74 of the Coal Mine Health and Safety Regulation 2006.	Refer Diesel Exhaust Report in Plant Safety File.	Conduct in-service testing and monitor DES emission levels.
8	All emergency activations of the emergency shutdown system and failures of the normal shutdown system must be documented and reported to the Department Inspectorate.	End User responsibility.	Ensure failures are reported as required.
9	After activation of the emergency shutdown system there must be a risk assessment to determine the issues of resetting and the continued safe operation of the diesel engine system.	End User responsibility.	Ensure failures are reported as required.
10	Each diesel engine system must be inspected and maintained by people with appropriate training, qualifications, experience and knowledge of the explosion protection characteristics of the diesel engine system.	Refer Notice of Inspection in Plant Safety File.	Ensure failures are reported as required.

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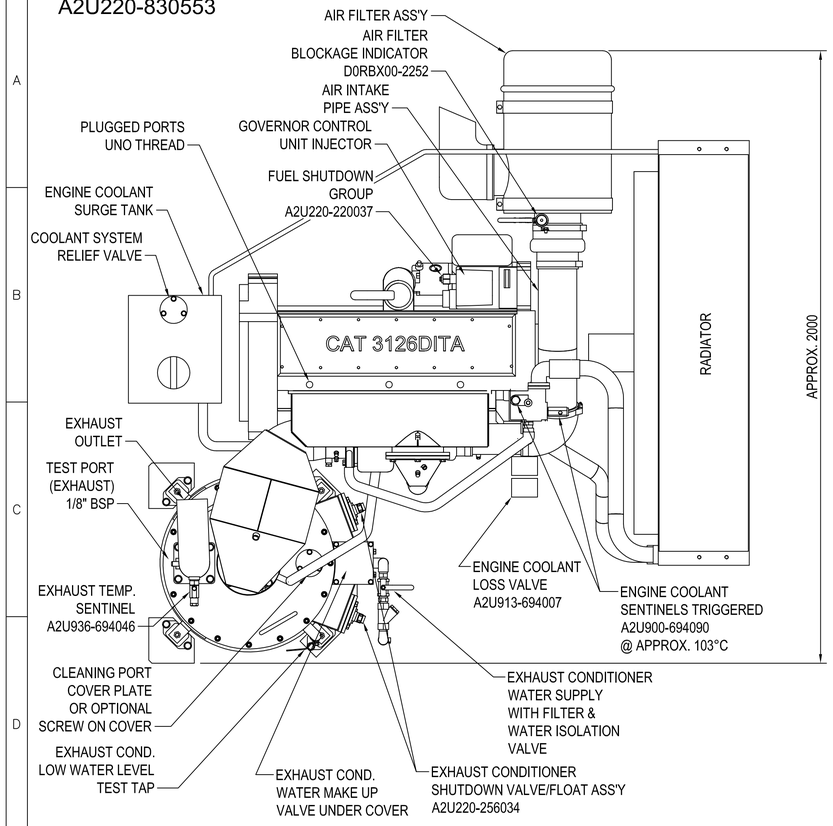
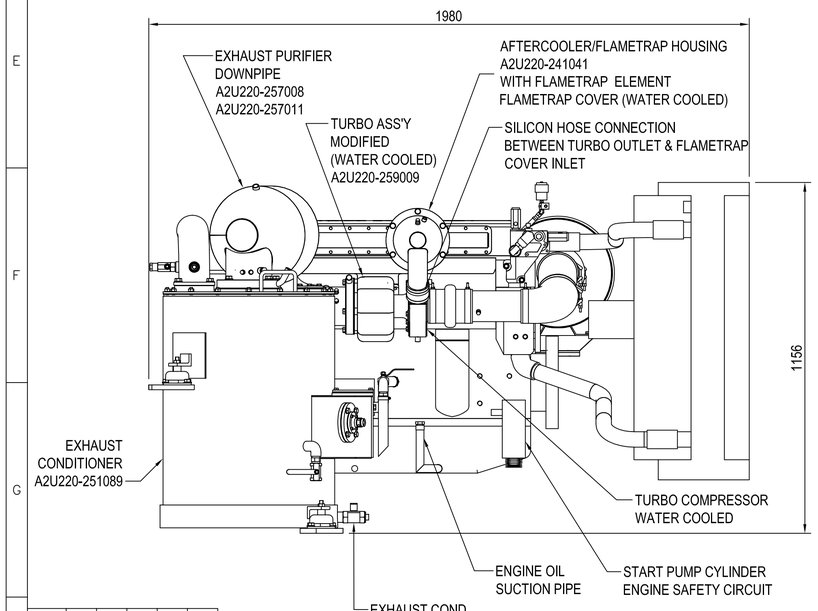
A2U220-830553



NOTE: DIESEL PARTICULATE FILTER HOUSING NOT SHOWN



NOTE: DIESEL PARTICULATE FILTER HOUSING NOT SHOWN

DIESEL ENGINE SPECIFICATIONS
CATERPILLAR MODEL - 3126DITA
SERIAL No. - 9ZR02262
ARRANGEMENT No. - 139-3317
CAPACITY - 7.2 LITRES
BORE - 110mm
STROKE - 127mm
RATED SPEED - 2300 RPM
RATED POWER @ RATED SPEED - 150 kW
RATED TORQUE SPEED - 1900 RPM
RATED TORQUE - 736 Nm
HIGH IDLE - 2600 RPM
LOW IDLE - 800 RPM
MAX. INLET VACUUM - 6.2 kPa
MAX. EXHAUST PRESSURE - 10.0 kPa
TURBO BOOST PRESSURE - 150 kPa
MIN. OPERATING OIL PRESSURE - 100 kPa
FUEL CONSUMPTION
@ RATED MAX. POWER - 36.6 kg/hr
@ RATED MAX. TORQUE - 30.1 kg/hr
FUEL SETTING - 7.79mm
FUEL TIMING - 65.34mm
GOVERNOR GRP - UNIT INJECTOR - C2A1333062
FUEL INJECTOR - C2A1278218
COOLING SYSTEM
SYSTEM IS DESIGNED FOR CONTINUOUS OPERATION IN 40°C AMBIENT CONDITIONS.
MAX. COOLANT OPERATING TEMPERATURE - 99°C
FAN AIR FLOW - 7 m^3 /s
SURGE TANK RELIEF PRESSURE - 48 kPa
COOLANT BOILING POINT @RELIEF PRESSURE - 113°C
ENGINE AUXILLARIES
GEAR PUMP - HYDRAULIC FAN DRIVE
OPTIONAL MECHANICAL DRIVE FAN COMPRESSOR
REFERENCE DRAWINGS
GENERAL SAFETY SHUTDOWN SYSTEM
GENERAL AIR SCHEMATIC - A2U220-830555
DIESEL ENGINE SYSTEM MASS
APPROX. MASS - 1100 kg
APPROX. MASS - 1200 kg (WITH PARTICULATE FILT. HSG)

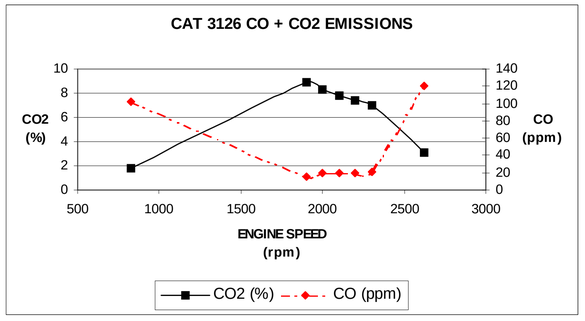
COMPONENT SPECIFICATIONS
ENGINE AIR SYSTEM
AIR CLEANER ASSEMBLY -
MINIMUM RATING - 18.5 m^3/min AT 10" W.G. PRESSURE DROP
PRIMARY AND SAFETY ELEMENTS REQUIRED

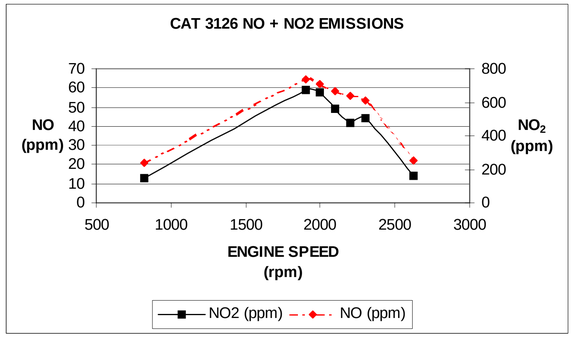
TURBO ASSEMBLY (MODIFIED) - SANDVIK P/N - A2U220-259009
AFTERCOOLER/FLAMETRAP ASSEMBLY - SANDVIK P/N - A2U220-241041
FLAMETRAP ELEMENT - SANDVIK P/N - A2U900-241033
FLAMETRAP APPROVAL - No. M77/3636
ENGINE EXHAUST SYSTEM
EXHAUST CONDITIONER - SANDVIK P/N - A2U220-251089
EXHAUST CONDITIONER MATERIAL - 316/SAF 2205 STAINLESS STEEL
EXHAUST CONDITIONER MAX. OPERATING ANGLE - +-15° FORE/AFT & SIDE TO SIDE
EXHAUST PURIFIER DOWNPIPE - SANDVIK P/N - A2U220-257008
EXHAUST PURIFIER DOWNPIPE - SANDVIK P/N - A2U220-257011
TURBO ASSEMBLY (MODIFIED) - SANDVIK P/N - A2U220-259009
EXHAUST PARTICULATE FILTER HOUSING - SANDVIK P/N A2U220-252038
NOTE: FILTER HOUSING OPTIONAL IN QLD AND OUTSIDE AUSTRALIA
ENGINE COOLING SYSTEM
RADIATOR - SANDVIK P/N - A2U220-261073
FAN - SANDVIK P/N - A2U220-267111
FAN HUB MATERIAL - ZINC OR STEEL
FAN BLADE - ANTI STATIC
VEE BELT (MECHANICAL FAN DRIVE) - SANDVIK P/N - TBA
VEE BELT (WATER PUMP DRIVE) - SANDVIK P/N - A2U220-267109
VEE BELT APPROVAL - No. MDA 860144, AS 2784 FRAS
MISCELLANEOUS
AIR COMPRESSOR HOSE - CONSTRUCTION PTFE STEEL WIRE REINFORCED BRAIDED
TURBO COMPRESSOR OUTLET HOSE - SILICON HOSE (TEMP. RATING - 230°C)
ALUMINIUM/ALLOY COMPONENTS
ROCKER COVER, AIR INLET MANIFOLD, TURBO COMPRESSOR, ENGINE TIMING CASE
FUEL PUMP/GOVERNOR CONTROL, OIL COOLER COVER, OIL FILTER HEAD, FUEL FILTER HEAD.
COOLANT LOSS VALVE, COMPRESSOR AIR GOVERNOR, TURBO SAVIOUR HOUSING ASSEMBLY
GENERAL NOTES
1. COMPLIANCE / SPECIFICATION / WARNING NAMEPLATES AS REQUIRED BY AS3584.2 TO BE FITTED IN CLOSE PROXIMITY TO THE DES.
2. BACKPRESSURE GAUGE TO BE FITTED IN A POSITION READILY VISIBLE TO THE MACHINE OPERATOR. THIS MAY BE REMOTE FROM THE DES.
3. MAXIMUM EXHAUST BACKPRESSURE IS 10 kPa (FULL THROTTLE, NO LOAD) FILTER ELEMENTS SHOULD BE CHANGED AT THIS PRESSURE.
4. ALUMINIUM ITEMS WILL BE PROTECTED BY COVERS COMPLYING WITH AS3678.2 WHEN SUPPLIED FOR USE IN UNDERGROUND COAL MINES.

FIXED JOINTS
GASKET MATERIAL
GRAFOIL GHE, GHR
NOVATEC PREMIUM
GENUINE CATEPILLAR GASKETS
AIR INLET SYSTEM
1. CYLINDER HEAD TO AIR INLET MANIFOLD.
CAT. CYLINDER HEAD GRP P/N: C2A1407370
CAT. INLET MANIFOLD GRP P/N: C2A1323527
CAT. GASKET P/N: C2A1136250
2. PORTS (3 OFF) @TOP OF AIR INLET MANIFOLD
3. AIR INLET MANIFOLD TO AFTERCOOLER/FLAMETRAP HSG
CAT. GASKET P/N: C2A7C1152
EXHAUST SYSTEM
1. CYLINDER HEAD TO EXHAUST MANIFOLD
CAT. CYLINDER HEAD GRP P/N: C2A1407370
CAT. EXHAUST MANIFOLD GRP P/N: C2A7C6373
CAT. GASKET P/N: C2A1136200
2. EXHAUST MANIFOLD TO TURBO
CAT. GASKET P/N: C2A4P7704
3. TURBO TO EXHAUST PURIFIER DOWNPIPE
4. EXHAUST PURIFIER DOWNPIPE TO EXH. CONDITIONER

OPEN JOINTS
AFTERCOOLER/FLAMETRAP HSG - 'REFER TO DETAIL - A'

CERTIFICATE / APPROVAL Nos.
NEW SOUTH WALES, AUSTRALIA MDA DES 030043





SINGLE POINT SMOKE MEASUREMENTS

SPEED	1541 rpm	1656 rpm	2047rpm	2300 rpm
BOSCH UNITS	2.4	1.75	0.45	0.35

MAXIMUM ENGINE SYSTEM SURFACE TEMPERATURES MEASURED DURING TYPE TESTING WITH & WITHOUT METHANE INJECTION

TEMP. LOCATION	TEMP.(°C) WITH METHANE	TEMP.(°C) WITHOUT METHANE
AFTERCOOLER HOUSING	146	133
TURBO CENTRAL BODY	117	116
FLANGE - DOWNPIPE TO EXH. CONDITIONER	108	103

NOTE:
ENGINE POWER WITH METHANE INJECTION WAS APPROXIMATELY 190 kW

REVISIONS					
0	EN 8001	24.12.02
1	EN 8380	26/7/2003
2	EN 8823	18/3/2005
3	EN 9113	20/11/06
E	EN 9105	26.11.08

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining and Construction Tomago Pty. Ltd.
ABN 38 070 973 330

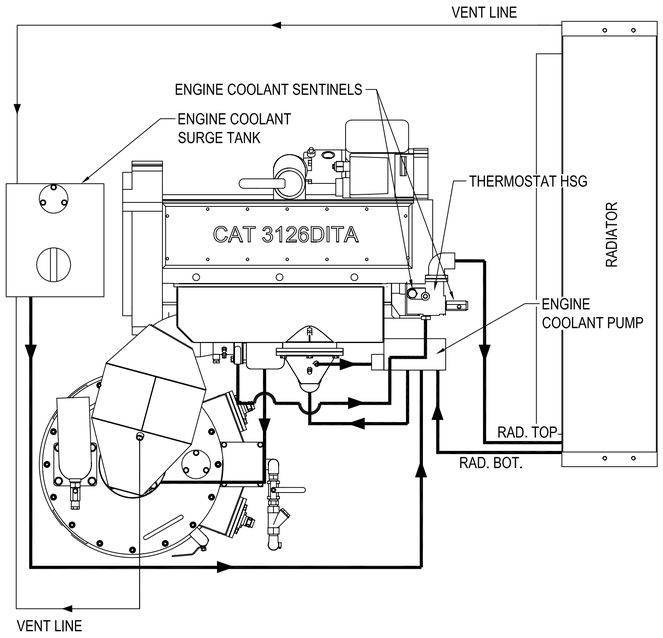
DRAWN	D.C
DATE:	24-12-02
CHECKED:	P.N.
SIGNATURE:	P.Nelthorpe
DATE:	24/12/2002

TOLERANCES O.N.O.
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

TITLE- GENERAL ARRANGEMENT DIESEL ENGINE SYSTEM
CAT 3126DITA

DWG. No. A2U220-830553
SIZE A1
DO NOT SCALE. IF IN DOUBT,ASK.
SHEET 1OF 4
SCALE: 1:10

A2U220-830553

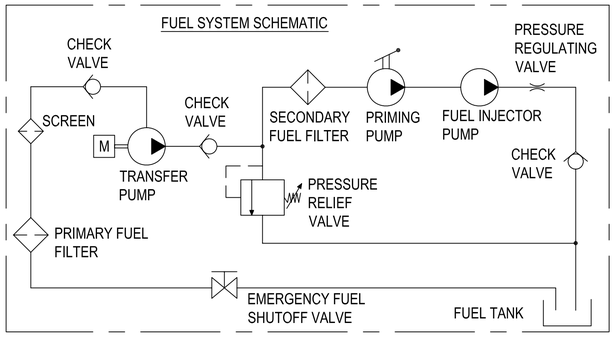


ENGINE COOLANT FLOW CIRCUIT

COOLING CIRCUIT DESCRIPTION

- MAIN COOLANT FLOW FROM PUMP IS DIRECTED INTO ENGINE OIL COOLER & ENGINE BLOCK/CYLINDER HEAD. SOME FLOW THEN PASSES THROUGH EXHAUST MANIFOLD & THEN RETURNS TO REGULATOR HOUSING.
- ADDITIONAL FLOW IS ALSO DIRECTED THROUGH TURBO & EXHAUST PURIFIER DOWNPIPE BEFORE RETURNING TO REGULATOR HOUSING.
- ADDITIONAL FLOW DIRECTLY FROM WATER PUMP IS DIRECTED THROUGH THE AFTERCOOLER & THEN RETURNED TO REGULATOR HOUSING.
- A SMALL AMOUNT OF ADDITIONAL FLOW IS ALSO DIRECTED TO TURBO COMPRESSOR HSG & AIR INLET FLAMETRAP COVER HOUSING FOR SURFACE TEMPERATURE COOLING.

VENT LINES ARE LOCATED AT TOP OF EXHAUST PURIFIER DOWNPIPE & RADIATOR & ARE DIRECTED TO SURGE TANK.



NOTES:

1. FUEL SETTING & FUEL TIMING ADJUSTMENT POINTS (FACTORY SET & LOCATED UNDER ROCKER COVER) ARE TAMPER-PROOF SEALED.
2. HIGH IDLE ADJUSTMENT POINT TO BE TAMPER-PROOF SEALED BEFORE SHIPMENT TO CUSTOMER.

REVISIONS		
0	EN 8001	24.12.02
1	EN 8380	26/7/2003
2	EN 8823	18/3/2005
3	EN 9113	20/11/06
E	EN 9105	26.11.08

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK [redacted]
Sandvik Mining & Construction Pty. Ltd.
ABN 38 070 973 330

DRAWN D.C
DATE: 24-12-02
CHECKED: P.N.
SIGNATURE: P.Nelthorpe
DATE: 24/12/2002

TOLERANCES O.N.O.
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

DO NOT SCALE. IF IN DOUBT,ASK.

TITLE- GENERAL ARRANGEMENT DIESEL ENGINE SYSTEM CAT 3126DITA

DWG. No. A2U220-830553

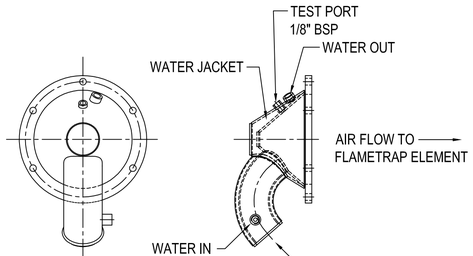
SIZE A1

SHEET 2OF 4

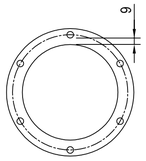
SCALE: 1:10

A2U220-830553

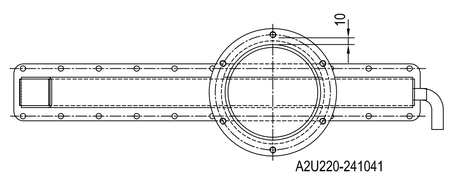
ENGINE AIR INLET SYSTEM

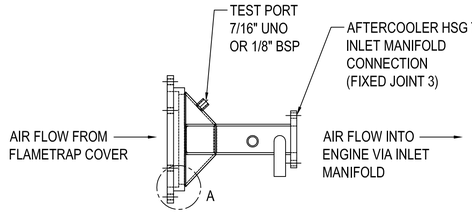


A2U220-241042
FLAMETRAP COVER (WATER COOLED)
SCALE 1:5
MATERIAL SPECS.
MILD/STAINLESS STEEL

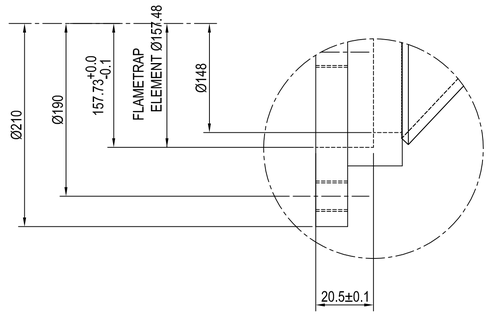


A2U900-243007
GASKET - FLAMETRAP COVER TO
AFTERCOOLER/FLAMETRAP ASSEMBLY



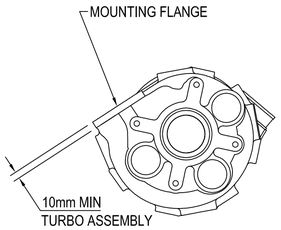


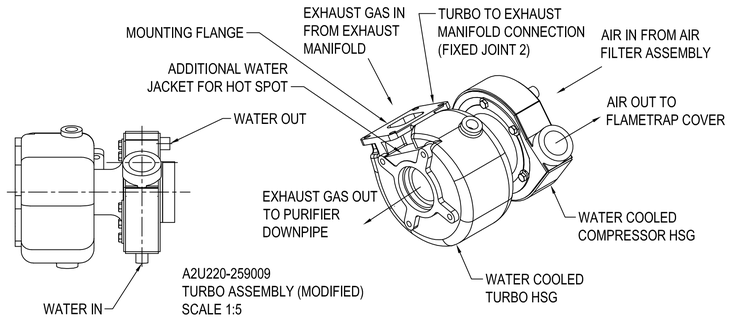
A2U220-241041
AFTERCOOLER/FLAMETRAP ASSEMBLY
SCALE 1:5
MATERIAL SPECS.
MILD/STAINLESS STEEL
CONE SECT. - 3mm PL.
FASTENER DETAILS
FIXED JOINT 3 - M8 x 40 LG. BOLT GRD 8.8 (CAT. P/N - 6V5219)



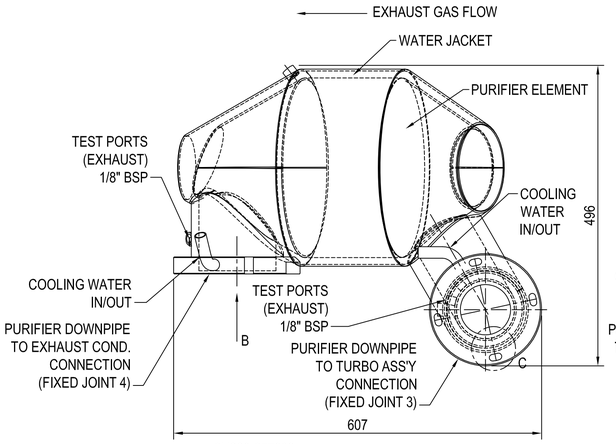
DETAIL ' A ' (OPEN JOINT)
SCALE 1:1

ENGINE EXHAUST SYSTEM

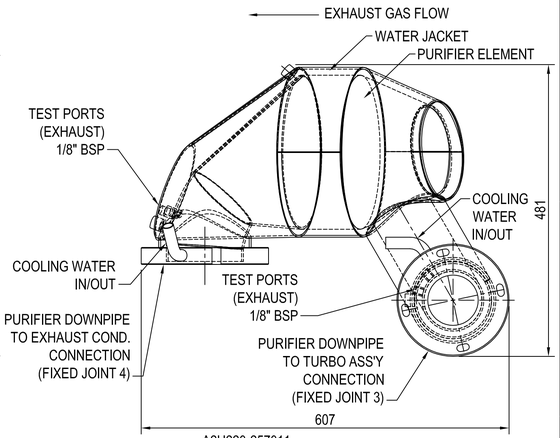




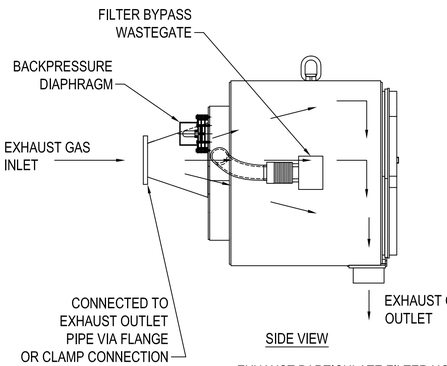
A2U220-259009
TURBO ASSEMBLY (MODIFIED)
SCALE 1:5
MATERIAL SPECS.
MILD STEEL, CAST IRON, ALUMINIUM
3mm PL.
FASTENER DETAILS
FIXED JOINT 2 - M10 STUD (CAT. P/N - 8T-7044)



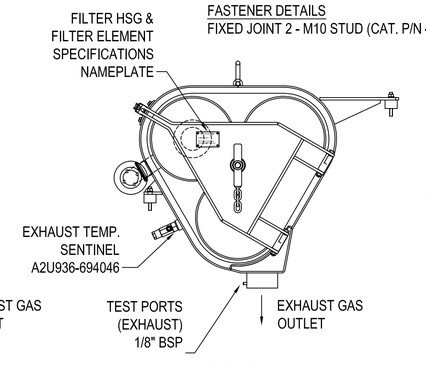
A2U220-257008
PURIFIER DOWNPIPE (WATER COOLED)
SCALE 1:5
MATERIAL SPECS.
MILD/STAINLESS STEEL
PIPE/CONE SECT. - 3mm PL.
FASTENER DETAILS
FIXED JOINT 3 - M10 x 45LG. BOLT / M10 STUD (GRD 8.8)
FIXED JOINT 4 - M12 x 45LG. BOLT (GRD 8.8)



A2U220-257011
PURIFIER DOWNPIPE (WATER COOLED)
SCALE 1:5
MATERIAL SPECS.
MILD/STAINLESS STEEL
PIPE/CONE SECT. - 3mm PL.
FASTENER DETAILS
FIXED JOINT 3 - M10 x 45LG. BOLT / M10 STUD (GRD 8.8)
FIXED JOINT 4 - M12 x 45LG. BOLT (GRD 8.8)

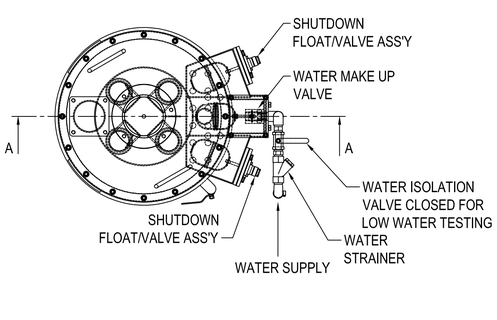


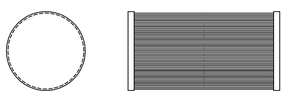
SIDE VIEW



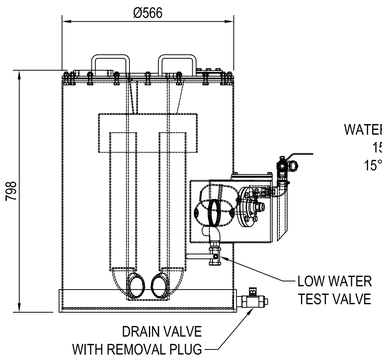
END VIEW

EXHAUST PARTICULATE FILTER HOUSING - A2U220-252038
MANDATORY FOR NSW. OPTIONAL FOR QLD AND OUTSIDE AUSTRALIA.

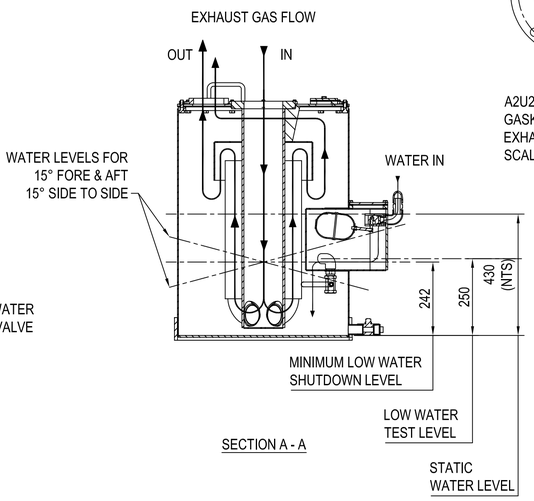




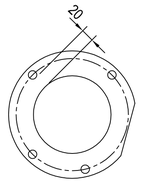
EXHAUST PARTICULATE FILTER ELEMENT
A2U900-292008
SPECIFICATIONS
1. MAX. OPERATING TEMPERATURE - 175°C
2. FILTER MEDIA - FILTRETE, GRD SP4055F
2.1 APPROX. IGNITION TEMP. (NEW FILTER) - 960°C
2.2 APPROX. IGNITION TEMP. (DIRTY FILTER) - 650°C



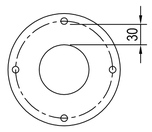
EXHAUST CONDITIONER
A2U220-251089



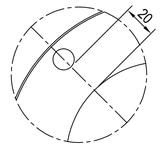
SECTION A - A



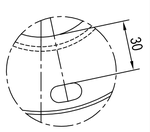
A2U220-254091
GASKET - PURIFIER DOWNPIPE TO
EXHAUST CONDITIONER
SCALE 1:5



A2U220-254092
GASKET - TURBO TO
PURIFIER DOWNPIPE
SCALE 1:5



PART VIEW DETAIL 'B'
TYPICAL FOR
A2U220-257008 &
A2U220-257011



DETAIL 'C'
TYPICAL FOR
A2U220-257008 &
A2U220-257011

REVISIONS						
0	EN 8001	24.12.02				
1	EN 8380	26/7/2003				
2	EN 8823	18/3/2005				
3	EN 9113	20/11/06				
E	EN 9105	26.11.08				

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining and Construction Tomago Pty. Ltd.
ABN 38 070 973 330

DRAWN D.C	TOLERANCES O.N.O.
DATE: 24-12-02	DECIMAL ±
CHECKED: P.N.	FRACTIONAL ±
SIGNATURE: P.Nelthorpe	ANGULAR ±
DATE: 24/12/2002	
DO NOT SCALE. IF IN DOUBT,ASK.	

TITLE- GENERAL ARRANGEMENT DIESEL ENGINE SYSTEM
CAT 3126DITA

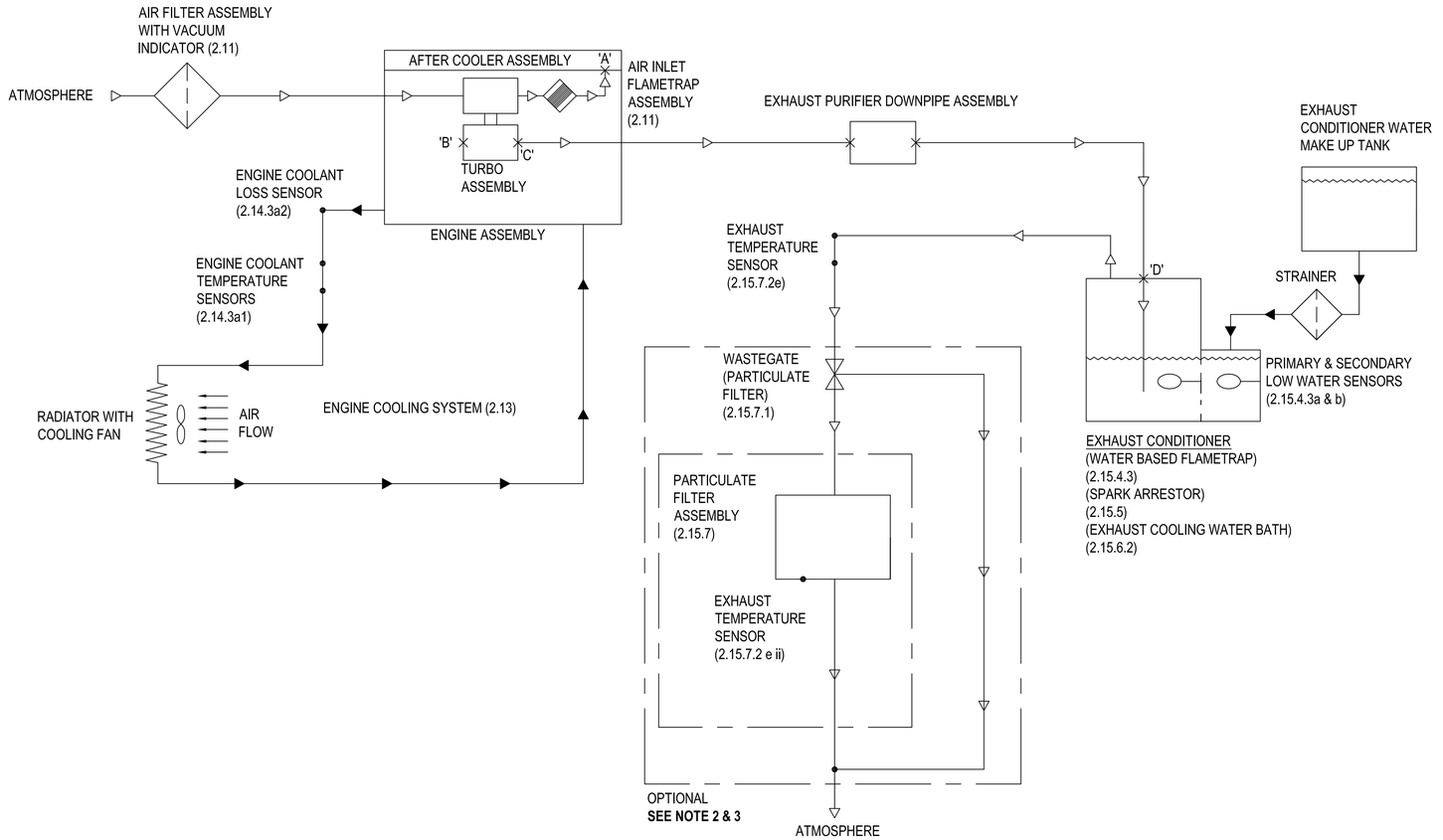
DWG. No. A2U220-830553

SIZE A1

SHEET 3OF 4 | SCALE: 1:10

A2U220-830553

DES BLOCK DIAGRAM



EXPLOSION PROTECTED JOINTS
AIR INLET SYSTEM
FIXED JOINTS
A. -CYLINDER HEAD TO AIR INLET MANIFOLD
-PORTS (3 OFF) AT TOP OF AIR INLET MANIFOLD
-AIR INLET MANIFOLD TO AFTERCOOLER/FLAMETRAP HSG
OPEN JOINT
A. -AFTERCOOLER/FLAMETRAP HSG

EXPLOSION PROTECTED JOINTS
EXHAUST SYSTEM
FIXED JOINTS
B. -CYLINDER HEAD TO EXHAUST MANIFOLD
-EXHAUST MANIFOLD TO TURBO
C. -TURBO TO EXHAUST PURIFIER DOWNPIPE
D. -EXHAUST PURIFIER DOWNPIPE TO EXHAUST CONDITIONER

NOTE
EXHAUST FILTER ASSEMBLY MANDATORY IN NSW
OPTIONAL IN QUEENSLAND AND OUTSIDE AUSTRALIA

REVISIONS		
0	EN 8001	24.12.02
1	EN 8380	26/7/2003
2	EN 8823	18/3/2005
3	EN 9113	20/11/06
E	EN 9105	26.11.08

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining and Construction Tomago Pty. Ltd.
ABN 38 070 973 330

DRAWN D.C	TOLERANCES O.N.O.
DATE: 24-12-02	DECIMAL ±
CHECKED: P.N.	FRACTIONAL ±
SIGNATURE: P.Nelthorpe	ANGULAR ±
DATE: 24/12/2002	
DO NOT SCALE. IF IN DOUBT,ASK.	

TITLE- GENERAL ARRANGEMENT DIESEL ENGINE SYSTEM
CAT 3126DITA

DWG. No. A2U220-830553

SIZE A1

SHEET 4OF 4 SCALE: 1:10

A2U220-830555

SAFETY SYSTEM DESCRIPTION

The safety system was developed to preserve the integrity of the safety system by preventing the accidental or purposeful override of important safety functions such as engine over temperature, exhaust over temperature, low engine oil, low exhaust conditioner water and coolant loss.

Features of the system include :

* Inability to start the engine for any of the following functions.

1. Low engine oil (below bottom level of dipstick).
2. Over temperature (+103 Celsius).
3. Low scrubber water.(double float type)
4. Machine not in neutral.
5. Park brake not applied.

* Engine coolant is overridden at start up but the engine will shut-down after starting within 6-30 secs (depending on the engine oil temperature). This will not allow the operator to start more than 3-5 times before the air receiver losses its charge.
* There is an additional "Start Button Override Valve" which is fitted to prevent the engine low water valve being overriden by holding in the start button.
* Only a single start button is used which will only engage the starter if all of the safety functions are correct.
* A single direct mounted oil operated shutdown cylinder is mounted into the governor/fuel control unit which cannot be externally manually operated.

SYSTEM DESCRIPTION

AIR SYSTEM

Air is supplied from the air receiver and passes through the "ON-OFF" valve which controls both :

1. The air supply to the start system.
2. The pilot pressure to the "ON-OFF PILOT" valve which dumps the oil to the shutdown cylinder and thereby shutdown the engine.

Further down the system the air passes through the "START" valve which controls the following functions :

1. The air supply to the start system.
2. A pilot signal is sent to the "LOW ENGINE WATER OVERRIDE" valve which by-passes the "COOLANT LOSS" valve at start (this is necessary as there is no engine water pressure at start).
3. Air is supplied to the "START PUMP/CYLINDER" to allow for the pressurisation of the oil system.

If all of the above valves have been activated the air will pass onto the "SAFE START" valve which will not pilot across until it senses a minimum of 20 PSI in the oil "SHUT-DOWN CYLINDER". This feature isolates the "STARTER MOTOR" if there is any disfunction in the oil based shutdown cylinder.

ENGINE OIL SYSTEM

The safety shutdown system is supplied by oil from two places :

1. The standard oil pressure pick-up at the fuel pump side of the engine block.
2. A suction tube mounted into the sump on the turbo side of the engine.

Before start, a spring return "START PUMP/CYLINDER" draws oil from the suction tube supply on the engine sump via a "CHECK" valve. This charge of oil is ready to start the engine, should there be no oil in the engine,the cylinder will not charge and the engine will not start.

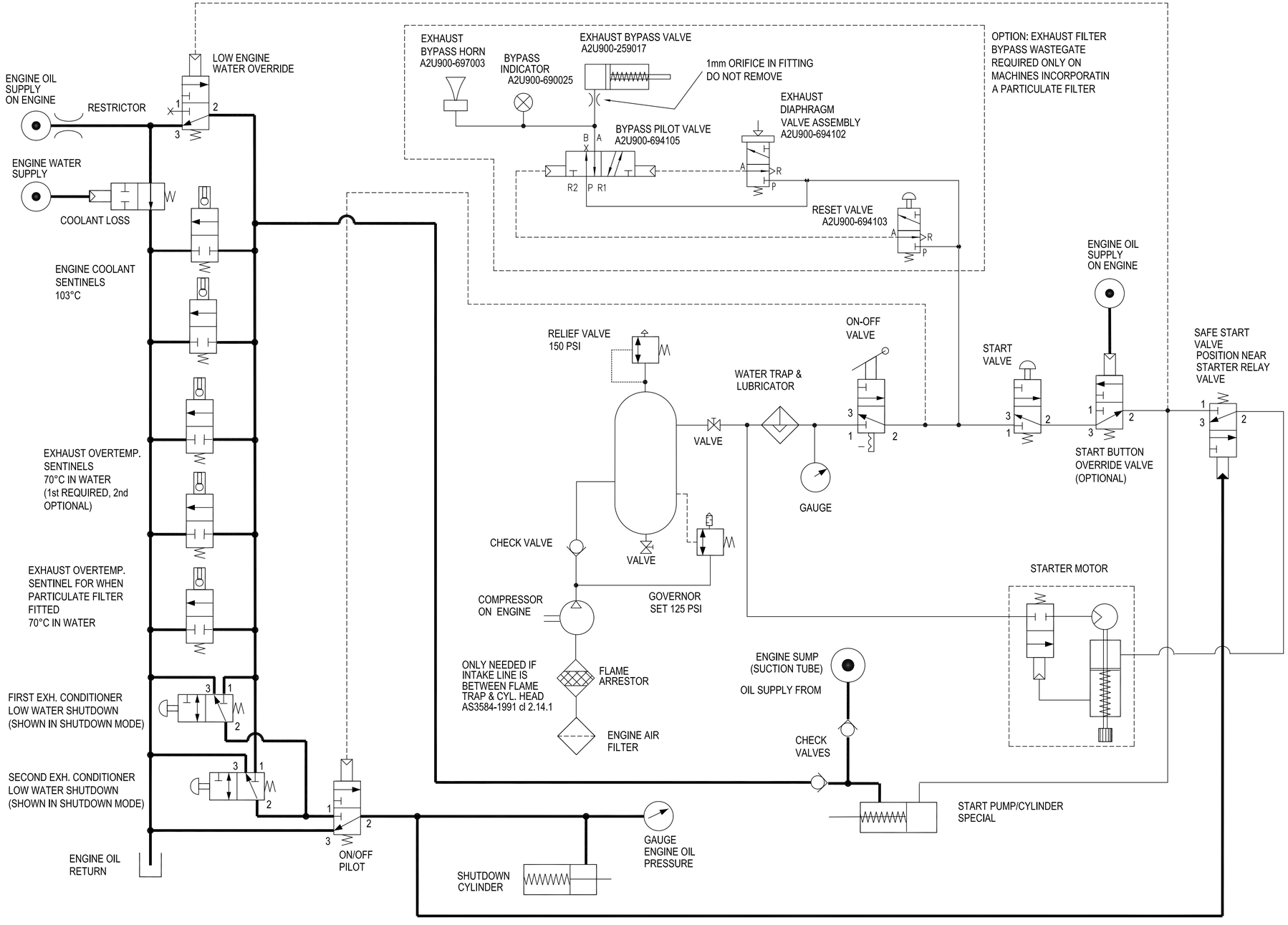
At start the operator depresses the "START" valve (mounted in the dash) and if all of the above requirements are met a charge of air is supplied to the oil filled "START PUMP/CYLINDER". This then strokes and supplies a charge of oil via a "CHECK" valve to the safety system.

Oil must pass the "SENTINEL" valves and through the "LOW WATER SHUT-DOWN" and the "ON-OFF PILOT" valves to reach the "SHUT-DOWN CYLINDER" and override the internal compression spring. If any of these valves are in the dump mode the shutdown cylinder will not build up oil pressure and a signal will not be sent to the "SAFE START" valve which will not engage the "STARTER MOTOR".

Whilst the engine is running the safety system will dump the oil from the "SHUT-DOWN CYLINDER" and stop the engine for the following reasons:

1. Low engine coolant pressure (less than 2 PSI).
2. Engine coolant over temperature (two sensors set at 103 deg Celsius).
3. Low engine oil pressure (below 10 PSI).
4. Low scrubber water level (two sensors).
5. Engine exhaust over temperature (one sensor set at 70°C in water).
6. Engine shutdown by the operator.

It is important to note that this system cannot be overridden for any function other than coolant loss and this function will only override for a maximum of 30 seconds. To move a malfunctioning machine the shutdown fault must be rectified (i.e. fill the exhaust cond. with water) or a fitter is required to bypass any faulty valve or subsystem.



SAFETY ENGINE SHUTDOWN

GENERAL AIR AND SUPPLY

START SYSTEM

AIR LINES

ENGINE OIL LINES

NOTE:
THE ABOVE CIRCUIT IS FOR THE SHUTDOWN/START SYSTEM ONLY.
THERE MAY BE OTHER AIR FUNCTIONS NOT SHOWN ON THIS SCHEMATIC.
FOR FULL INFORMATION REFER TO THE FULL AIR SCHEMATIC OR PARTS MANUAL FOR THE PARTICULAR MACHINE.

REVISIONS		
0	EN 8001	03-01-03
1	EN 8380	17/7/2003
2	EN 8823	18/3/2005
3	EN 9113	20/11/06

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining & Construction Pty. Ltd.
ABN 38 070 973 330

DRAWN D.C	TOLERANCES O.N.O.
DATE: 14-11-02	DECIMAL ±
CHECKED:	FRACTIONAL ±
SIGNATURE:	ANGULAR ±
DATE:	
DO NOT SCALE. IF IN DOUBT,ASK.	

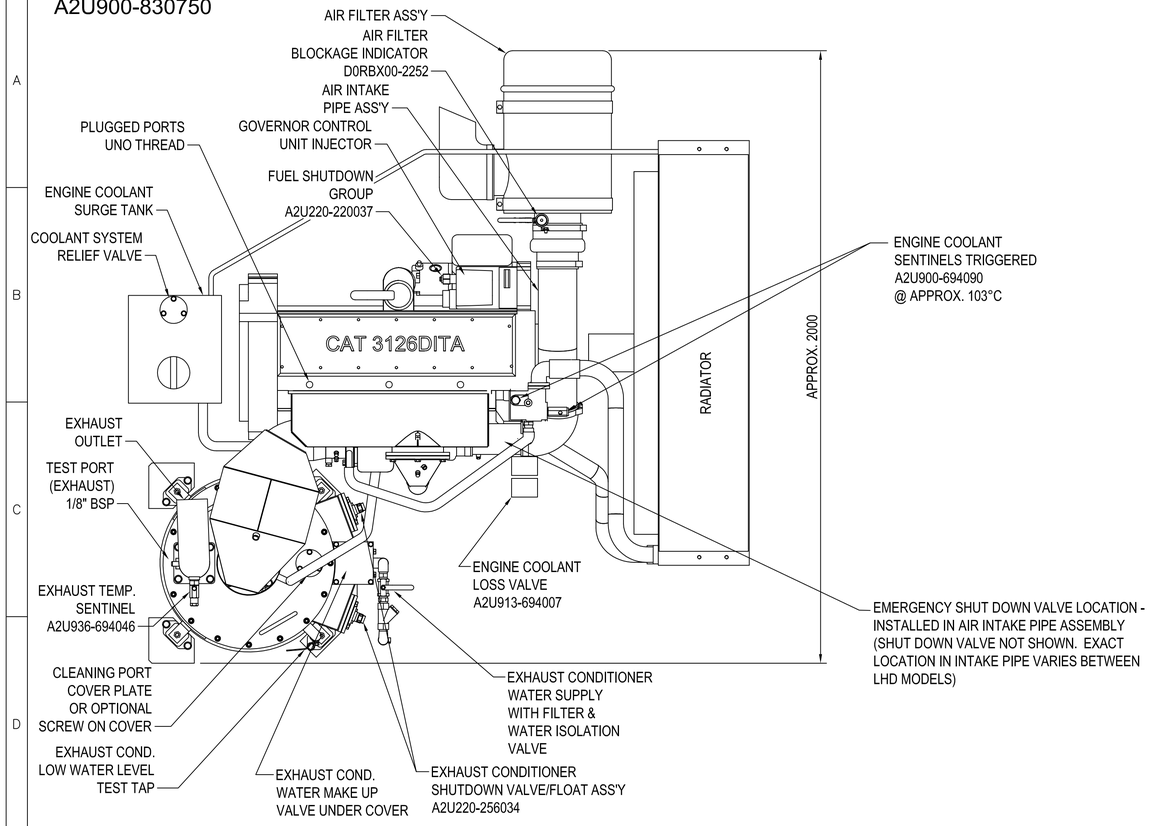
TITLE- SAFETY CIRCUIT
CAT 3126DITA DES
220 LHD

DWG. No. A2U220-830555

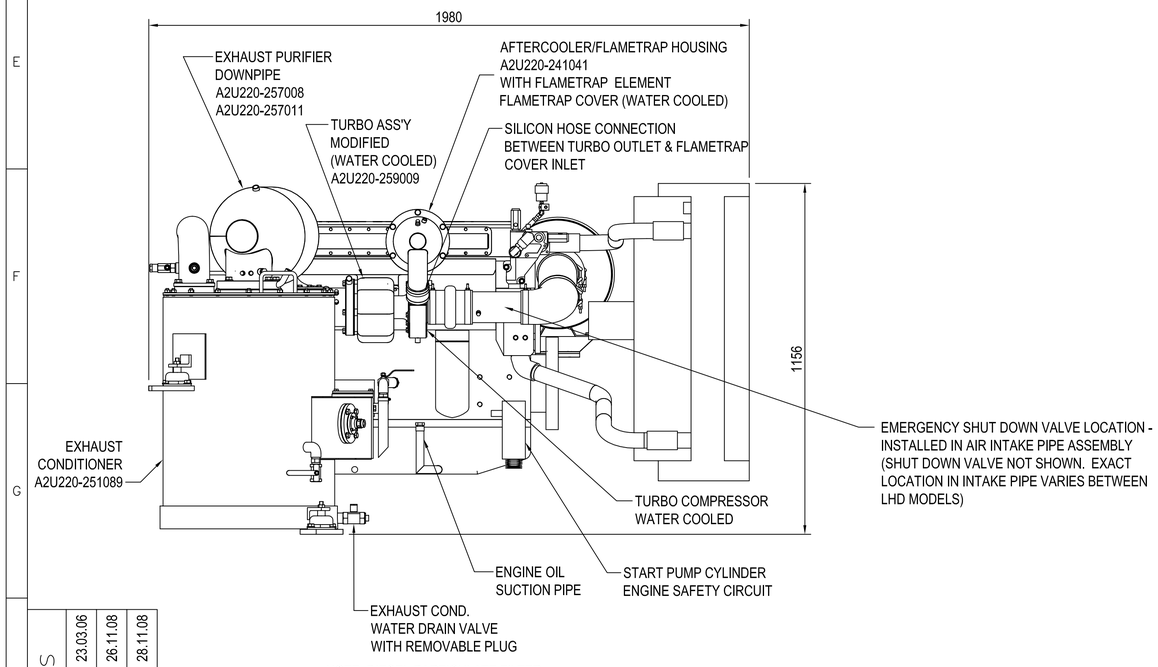
SIZE A1

SHEET 1OF 1 SCALE: NTS

A2U900-830750



NOTE: DIESEL PARTICULATE FILTER HOUSING NOT SHOWN



NOTE: DIESEL PARTICULATE FILTER HOUSING NOT SHOWN

EMERGENCY SHUT DOWN ASSEMBLY

1. TYPICAL CONNECTION TO PIPE FROM AIR FILTER
CONNECTOR SLEEVE - EPDM RUBBER - 100°C RATING SECURED WITH BOLT T-CLAMP
INLET ADAPTOR (OPTIONAL DEPENDING ON LHD MODEL) - MIN. 1.6mm
GRADE 304 STAINLESS STEEL.
GASKET - NOVATEC PREMIUM, GRAFOIL GHE
INLET HOUSING - AS3678-250
2. EMERGENCY SHUT DOWN VALVE
BUTTERFLY VALVE - BRASS
3. TYPICAL CONNECTION TO PIPE TO AFTER-COOLER
OUTLET HOUSING - AS3678-250
GASKET - NOVATEC PREMIUM, GRAFOIL GHE
OUTLET ADAPTOR (OPTIONAL DEPENDING ON LHD MODEL) - MIN. 1.6mm
GRADE 304 STAINLESS STEEL
CONNECTOR SLEEVE - SILICONE RUBBER - 230°C RATING SECURED WITH BOLT T-CLAMP

REFERENCE DOCUMENTS

1. SANDVIK DRAWING A2U220-830553 - GENERAL ARRANGEMENT - DIESEL ENGINE SYSTEM - CAT3126 DITA.
2. SANDVIK DRAWING A2U220-830555 - SAFETY CIRCUIT - CAT3126DITA DES - 220 LHD.

REVISIONS			
0	EN 8875	23.03.06	
B	EN 8875	26.11.08	
C	EN 9105	28.11.08	

TECHNICAL INFORMATION
Please Check For Latest Revision

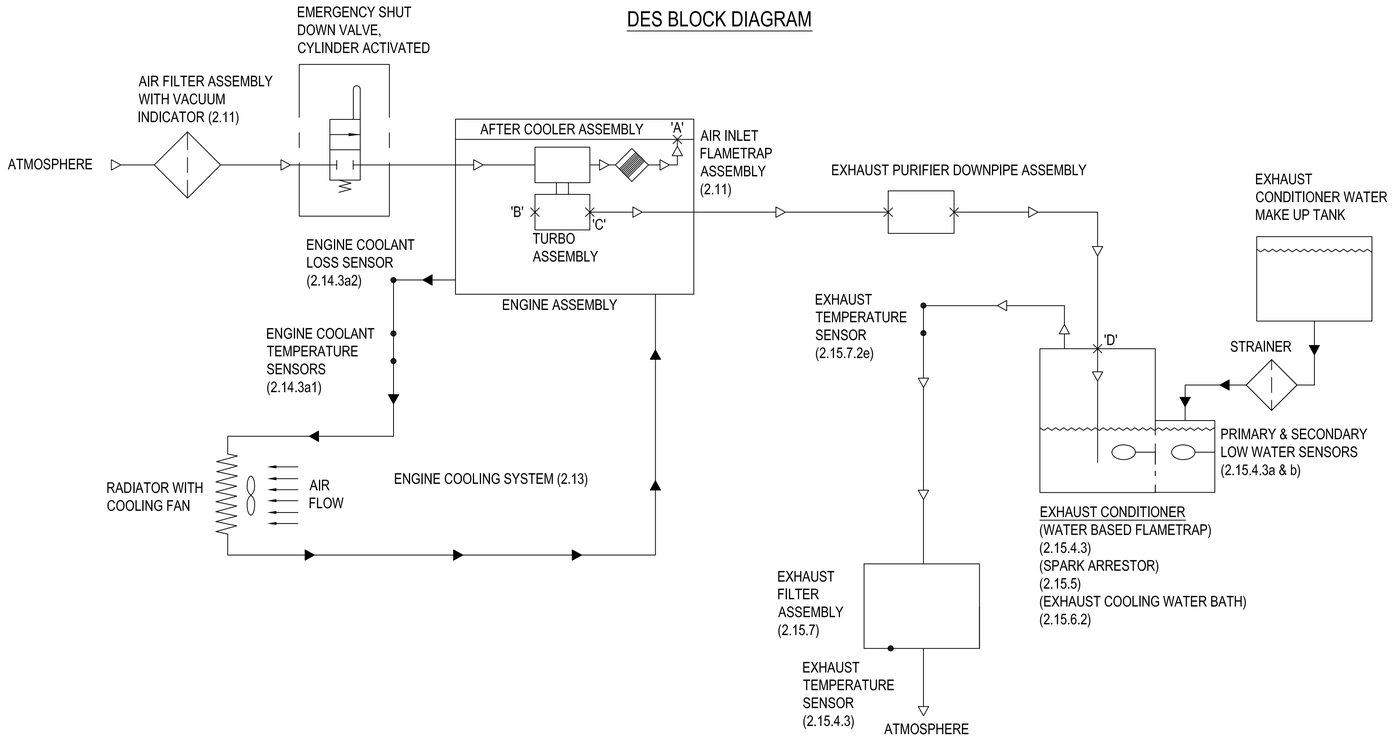
ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining and Construction Tomago Pty. Ltd.
ABN 38 070 973 330

DRAWN M.P.	TOLERANCES O.N.O.	
DATE: 23-03-06	DECIMAL ±	TITLE- EMERGENCY SHUT DOWN DIESEL ENGINE SYSTEM CAT 3126DITA
CHECKED: P.N.	FRACTIONAL ±	
SIGNATURE: P.Nelthorpe	ANGULAR ±	DWG. No. A2U900-830750 SIZE A1
DATE: 12-04-2006		
DO NOT SCALE. IF IN DOUBT,ASK.		SHEET 1 OF 3 SCALE: 1:10

A2U900-830750

DES BLOCK DIAGRAM



EXPLOSION PROTECTED JOINTS
AIR INLET SYSTEM
FIXED JOINTS
A. -CYLINDER HEAD TO AIR INLET MANIFOLD
-PORTS (3 OFF) AT TOP OF AIR INLET MANIFOLD
-AIR INLET MANIFOLD TO AFTERCOOLER/FLAMETRAP HSG
OPEN JOINT
A. -AFTERCOOLER/FLAMETRAP HSG

EXPLOSION PROTECTED JOINTS
EXHAUST SYSTEM
FIXED JOINTS
B. -CYLINDER HEAD TO EXHAUST MANIFOLD
-EXHAUST MANIFOLD TO TURBO
C. -TURBO TO EXHAUST PURIFIER DOWNPIPE
D. -EXHAUST PURIFIER DOWNPIPE TO EXHAUST CONDITIONER

NOTE
EXHAUST FILTER ASSEMBLY MANDATORY IN NSW
REFER APPLICABLE REGULATORY AUTHORITY REQUIREMENTS OUTSIDE NSW.

REVISIONS			
0	EN 8875	23.03.06	
B	EN 9105	26.11.08	
C	EN 9105	28.11.08	

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK
Sandvik Mining and Construction Tomago Pty. Ltd.
ABN 38 070 973 330

DRAWN	M.P.
DATE:	23-03-06
CHECKED:	P.N.
SIGNATURE:	P.Nelthorpe
DATE:	12-04-06

TOLERANCES O.N.O.
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

TITLE- EMERGENCY SHUT DOWN DIESEL ENGINE SYSTEM
CAT 3126DITA

DWG. No. A2U900-830750

SIZE A1

DO NOT SCALE. IF IN DOUBT,ASK.

SHEET 2OF 3

SCALE: 1:10

A2U900-830750

SAFETY SYSTEM DESCRIPTION

The safety system was developed to preserve the integrity of the safety system by preventing the accidental or purposeful override of important safety functions such as engine over temperature, exhaust over temperature, low engine oil, low exhaust conditioner water and coolant loss.

Features of the system include :

* Inability to start the engine for any of the following functions.

1. Low engine oil (below bottom level of dipstick).
2. Over temperature (+103 Celsius).
3. Low scrubber water.(double float type)
4. Machine not in neutral,
5. Park brake not applied.
6. Emergency shut down valve closed (cylinder retracted)

* Engine coolant is overridden at start up but the engine will shut-down after starting within 6-30 secs (depending on the engine oil temperature). This will not allow the operator to start more than 3-5 times before the air receiver losses its charge.
* There is an additional "Start Button Override Valve" which is fitted to prevent the engine low water valve being overriden by holding in the start button.
* Only a single start button is used which will only engage the starter if all of the safety functions are correct.
* A single direct mounted oil operated shutdown cylinder is mounted into the governor/fuel control unit which cannot be externally manually operated.
* An emergency shut down that cuts off airflow, to stop the engine when shutting off the fuel supply doesn't stop the engine.
* An optional strangler interlock valve will prevent the DES from being started when the strangler valve has no air supply (i.e. closed position) and applies shutdown cylinder in safety circuit when strangler is activated.

SYSTEM DESCRIPTION

AIR SYSTEM

Air is supplied from the air receiver and passes through to the Emergency Stop Valve, and ON/OFF valve. The Emergency Shut Down Valve controls:

1. The air supply to the Emergency Shut Down Cylinder.

If the Emergency Shut Down button is depressed, air vents from the cylinder and airflow to the engine is blocked. If the Emergency Shut Down button is released, the cylinder extends and the airflow path to the engine is open.

Air then passes through the "ON-OFF" valve which controls both:

1. The air supply to the start system.
2. The pilot pressure to the "ON-OFF PILOT" valve which dumps the oil to the shutdown cylinder and thereby shutdown the engine.

Further down the system the air passes through the "START" valve which controls the following functions :

1. The air supply to the start system.
2. A pilot signal is sent to the "LOW ENGINE WATER OVERRIDE" valve which by-passes the "COOLANT LOSS" valve at start (this is necessary as there is no engine water pressure at start).
3. Air is supplied to the "START PUMP/CYLINDER" to allow for the pressurisation of the oil system.

If all of the above valves have been activated the air will pass onto the "SAFE START" valve which will not pilot across until it senses a minimum of 20 PSI in the oil "SHUT-DOWN CYLINDER". This feature isolates the "STARTER MOTOR" if there is any disfunction in the oil based shutdown cylinder.

ENGINE OIL SYSTEM

The safety shutdown system is supplied by oil from two places :

1. The standard oil pressure pick-up at the fuel pump side of the engine block.
2. A suction tube mounted into the sump on the turbo side of the engine.

Before start, a spring return "START PUMP/CYLINDER" draws oil from the suction tube supply on the engine sump via a "CHECK" valve. This charge of oil is ready to start the engine, should there be no oil in the engine,the cylinder will not charge and the engine will not start.

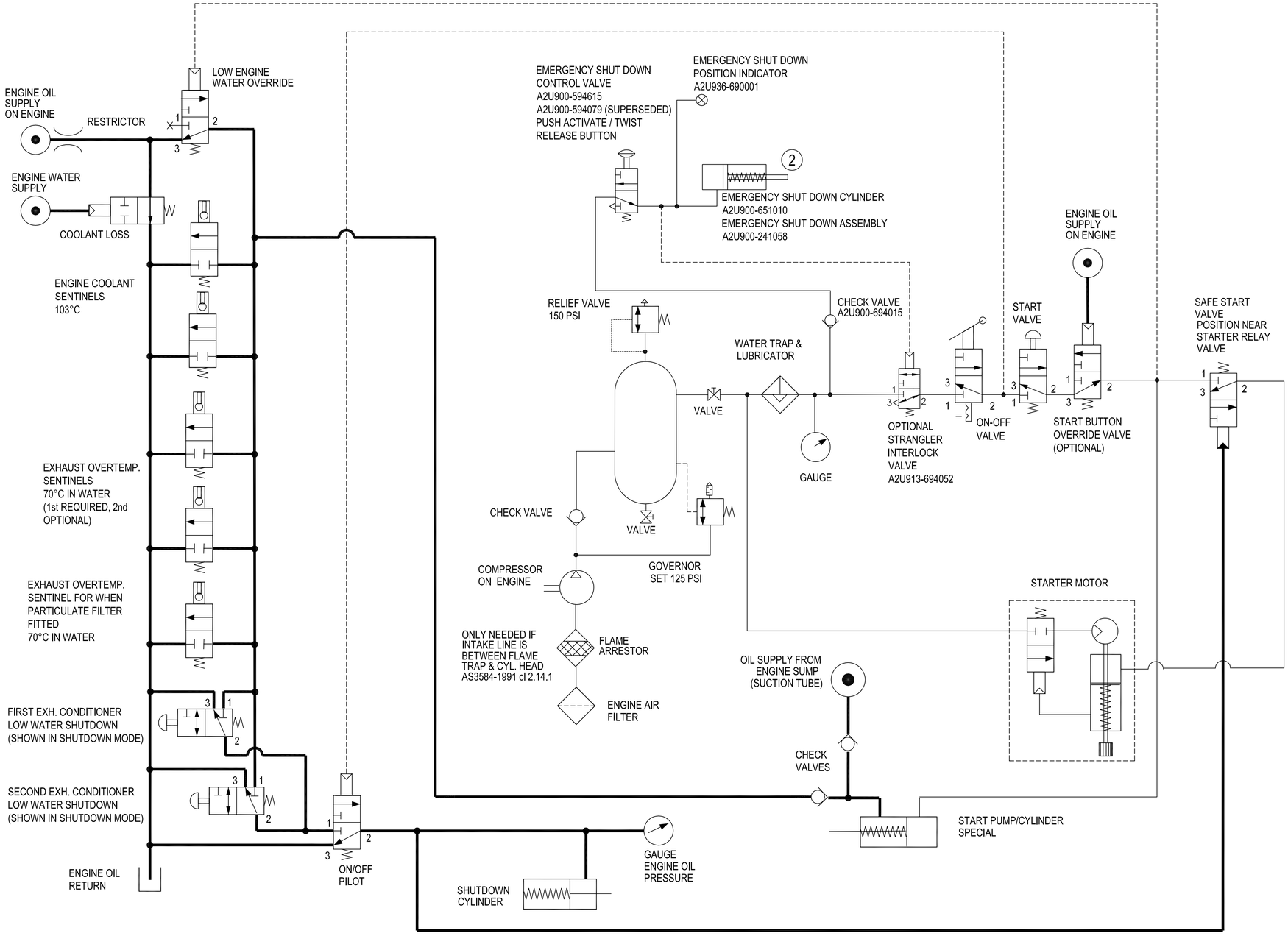
At start the operator depresses the "START" valve (mounted in the dash) and if all of the above requirements are met a charge of air is supplied to the oil filled "START PUMP/CYLINDER". This then strokes and supplies a charge of oil via a "CHECK" valve to the safety system.

Oil must pass the "SENTINEL" valves and through the "LOW WATER SHUT-DOWN" and the "ON-OFF PILOT" valves to reach the "SHUT-DOWN CYLINDER" and override the internal compression spring. If any of these valves are in the dump mode the shutdown cylinder will not build up oil pressure and a signal will not be sent to the "SAFE START" valve which will not engage the "STARTER MOTOR".

Whilst the engine is running the safety system will dump the oil from the "SHUT-DOWN CYLINDER" and stop the engine for the following reasons:

1. Low engine coolant pressure (less than 2 PSI).
2. Engine coolant over temperature (two sensors set at 103 deg Celsius).
3. Low engine oil pressure (below 10 PSI).
4. Low scrubber water level (two sensors).
5. Engine exhaust over temperature (one sensor set at 70°C in water).
6. Engine shutdown by the operator.

It is important to note that this system cannot be overridden for any function other than coolant loss and this function will only override for a maximum of 30 seconds. To move a malfunctioning machine the shutdown fault must be rectified (i.e. fill the exhaust cond. with water) or a fitter is required to bypass any faulty valve or subsystem.



SAFETY ENGINE SHUTDOWN

GENERAL AIR AND SUPPLY

START SYSTEM

AIR LINES

ENGINE OIL LINES

NOTES:
1. THE ABOVE CIRCUIT IS FOR THE SHUTDOWN/START SYSTEM ONLY. THERE MAY BE OTHER AIR FUNCTIONS NOT SHOWN ON THIS SCHEMATIC. FOR FULL INFORMATION REFER TO THE FULL AIR SCHEMATIC OR PARTS MANUAL FOR THE PARTICULAR MACHINE.
2. CYLINDER EXTENDED - EMERGENCY SHUT DOWN VALVE OPEN (ENGINE RUN CONDITION)
CYLINDER RETRACTED - EMERGENCY SHUT DOWN VALVE CLOSED (ENGINE STOP CONDITION)

REVISIONS		
0	EN 8875	23-03-06
B	EN 9105	26.11.08
C	EN 9105	28.11.08

TECHNICAL INFORMATION
Please Check For Latest Revision

ITEM	PART No.	DESCRIPTION	MATERIAL	QTY	WT

SANDVIK — Sandvik Mining and Construction Tomago Pty. Ltd. ABN 38 070 973 330

DRAWN M.P.	TOLERANCES O.N.O.
DATE: 23-03-06	DECIMAL ±
CHECKED: P.N.	FRACTIONAL ±
SIGNATURE: P. NELTHORPE	ANGULAR ±
DATE: 12-04-2006	
DO NOT SCALE. IF IN DOUBT,ASK.	

TITLE- EMERGENCY SHUT DOWN DIESEL ENGINE SYSTEM
CAT 3126DITA

DWG. No. A2U900-830750

SIZE A1

SHEET 3OF 3 SCALE: NTS

RISK ASSESSMENT REPORT

REPORT NO.:	RA0023
JOB NO.:	EN 9105
MACHINE:	Sandvik CAT3126 DITA Diesel Engine System
PROJECT:	Non-conformance Risk Assessment for Cat3126DITA Diesel Engine System against AS/NZS3584.2:2008
ASSESSMENT DATE:	25/11/08
PREPARED FOR:	NSW Department of Primary Industries

REVISION	DATE	REVISIONS
A	25/11/08	Initial Release

.....

Mark Peristy
Design Engineer
Sandvik Mining & Construction – Tomago Pty Ltd

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2.1 BACKGROUND 4
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1 EXECUTIVE SUMMARY

1.1 In order to minimise risk due to partial and non-compliances of the CAT3126DES to AS/NZS3584.2-2008, Sandvik and End Users should perform the following actions. Refer to Section 4 for hazard identifications and specific actions required for each risk.

1.2 Sandvik Actions as an outcome of the Risk Assessment. These actions are nominally due for completion January 2009:

- 1.2.1 Design revised DES nameplate (not related to any non-compliance, but required due to new registration numbers)
- 1.2.2 Engineer retrofit. for radiator cap and issue technical bulletin.
- 1.2.3 Issue technical bulletin recommending belt tensioner and tension indicator tool.
- 1.2.4 Engineer fuel shutoff label and issue technical bulletin.
- 1.2.5 Issue technical bulletin regarding movement of fuel shutoff valve.

1.3 End User Actions as an outcome of the Risk Assessment:

- 1.3.1 Install revised DES nameplate.
- 1.3.2 Ensure operators are adequately trained prior to use of vehicle, specifically in the location of the fuel shutoff valve.
- 1.3.3 Consider fittingfuel shutoff valve label, and move valve to downstream of fuel/water separator.
- 1.3.4 Ensure fuel shut off valve is shut-off routinely to ensure it does not sieze.
- 1.3.5 Ensure nominated particulate filter elements are used.
- 1.3.6 Ensure Operators and maintainers are aware of pinch point hazard of engine belts and pulleys and all guards and covers are fitted.
- 1.3.7 Consider fitting mesh to ED7/LS170 as per TB0719
- 1.3.8 Consider fitment of belt tensioner and use of tension indicator tool.
- 1.3.9 Ensure Operators and maintainers are aware of radiator scalding hazard
- 1.3.10 Consider fitting retrofit. radiator cap.
- 1.3.11 Consider fitment of radiator expansion tank.

2 INTRODUCTION

2.1 BACKGROUND

In order to apply for Design Registration for the Cat3126 diesel engine systems, a gap analysis and risk assessment are required to be performed and issued to the regulating authority. The gap analysis has been performed in Sandvik Compliance report CR0326. The partial and non-compliances identified by this compliance report have been risk assessed in this Risk Assessment Report to identify the criticality their non-compliances present to the use of the machine.

2.2 REFERENCES

Australian / New Zealand Standard 4360-1999, Risk Management
MDG 1010 - Risk Management Handbook
MDG 1014 - Guide to Reviewing a Risk Assessment
AS/NZS3584.2-2008 - Diesel engine systems for underground coal mines Part 2: Explosion Protected.
CR0326 - Cat3126 DES compliance to AS/NZS3584.2-2008

2.3 DEFINITIONS

Hazard	A source of potential harm or a situation with a potential to cause loss.
Principle Hazard	A source of potential harm or a situation with a potential to result in multiple fatalities.
Likelihood	Used as a qualitative description of probability and frequency.
Probability	The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes.
Consequence	The outcome of an event or situation expressed qualitatively or quantitatively, being loss, injury disadvantage or gain.
Risk	The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood.
Risk Analysis	A systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences.
Risk Assessment	The overall process of risk analysis and risk evaluation.
Risk Management	The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk.
Risk Control	That part of risk management, which involves the provision of, polices, standards and procedures to eliminate, avoid or minimise adverse risks facing an enterprise.
Monitor	To check, supervise, observe critically, or record the progress of an activity, action or system on a regular basis in order to identify change.
FMEA	A procedure by which potential failures are analysed and each failure mode identified is ranked according to the combined influence of its likelihood of occurrence and the severity of its consequences.

2.4 RISK ASSESSMENT OBJECTIVE

The objective of the risk assessment is to identify and then resolve or minimise any hazards which could impact on the health or safety of workers operating the equipment due to it's non-conformances with the current standard for Underground Coal Mines. The resolution or minimisation of risks may be achieved via design changes, additional signage, or modifications to operating and maintenance procedures. Engineering changes that eliminate the risk are preferred where practical.

2.5 RISK ASSESSMENT SCOPE

The Risk Assessment scope is limited to the the Sandvik Cat3126 DES. Risk areas have been identified as areas of non-conformance with the current Australian Standard AS/NZS3584.2-2008.

2.6 RISK ASSESSMENT TEAM MEMBERS

NAME	ORGANISATION	POSITION
Phil Nelthorpe	Sandvik Mining & Construction – Tomago Pty Ltd.	Engineering Manager - RTV
Mark Peristy	Sandvik Mining & Construction – Tomago Pty Ltd.	Design Engineer
Wayne Scrivens	Sandvik Mining & Construction – Tomago Pty Ltd.	Product Engineer

3 METHODOLOGY

3.1 RISK ASSESSMENT PROCEDURE

The risk assessment was carried out by following the following four defined stages:

Stage 1
Determine an objective and a scope.

- The objective was to identify non-compliances with MDG39 incorporating Amendment No.1, and then perform a risk assessment on these non-compliances.
- The scope was limited to the braking systems on the 130HD LHD, specifically the non-compliances to MDG39 incorporating Amendment No.1.

Stage 2
Identification of non-conformances of the 130HD LHD braking systems to MDG39 incorporating Amendment No.1. These have been recorded in Sandvik Compliance Report CR0348.

Stage 3
The formal risk review was undertaken at Sandvik Mining & Construction – Tomago Pty Ltd, Hexham offices on 31.10.08.

This risk review nominated the expected criticality of the risks and suggested new barriers where applicable

Stage 4
Following the completion of the risk assessment, the report was written and a list of recommendations developed for implementation.

Stage 5
Additional actions are required subsequent to the risk assessment and these are as follows:

- Engineering and Management review of Risk Assessment recommendations to determine suitability, requirements, practicality and approval of each suggested new barrier.
- Engineering of approved suggested new barriers and recommendations.
- Update of vehicle training, operating and maintenance documentation to reflect approved recommendations.
- Communication of new barriers to industry via Technical Bulletin.
- Ongoing audit of Risk Assessment actions until all items closed out.
- Re-assessment of risks in response to changes to requirements, or vehicle design for the life of the machines.

3.2 RISK ASSESSMENT PROCESS

The risk assessment process utilised is outlined on the following flowchart 2.3 to clearly define each step.

3.3 RISK ASSESSMENT FLOWCHART

- 3.3.1 SET ASSESSMENT OBJECTIVES
- 3.3.2 DEVELOP OPERATIONAL PROCESS
- 3.3.3 IDENTIFY HAZARDS
- 3.3.4 NOMINATE EXISTING BARRIERS
- 3.3.5 ESTIMATE PROBABILITY
- 3.3.6 ESTIMATE CONSEQUENCES
- 3.3.7 ESTIMATE RISK USING MATRIX
- 3.3.8 RECOMMEND POTENTIAL NEW BARRIERS
- 3.3.9 IMPLEMENT NEW BARRIERS
- 3.3.10 PREPARE REPORT

3.4 SET ASSESSMENT OBJECTIVES

Set an objective to aim at throughout the process. It is important that all parties agree on the objective of the process and that it is strictly adhered to throughout the discussions.

3.5 DEVELOP OPERATIONAL PROCESS

Analyse the operation of the equipment and to lay it out in a flow chart form so that a step by step approach to the use of the equipment can be evaluated.

3.6 IDENTIFY HAZARDS

Examine each operation along the flow chart created in step 2 to identify hazards or loss scenarios associated with those operations.
In line with the previously decided limitations of the exercise, only the operations relating to the objectives and scope were examined for possible hazards and loss scenarios.

3.7 NOMINATE EXISTING BARRIERS

Nominate, where possible, any existing barriers presently in the design of the machine, system or procedure, which may prevent identified hazards from occurring.

3.8 ESTIMATE FREQUENCY

Determine the probability of a hazard, as identified in step 3, occurring. The rating of the probability is decided by team consensus or statistics where available.
The basis of the rating is shown on the table below for a WRAC SYSTEM TO MDG 1010 APPENDIX A7.

FREQUENCY OF THE EVENT

A	Almost certain to happen, more once per month
B	Likely to happen at some point, more than once per year
C	Possible, it might happen, more than once per 5 years
D	Not likely to happen, less than once per 5 years
E	Practically impossible, unlikely to ever occur

3.9 ESTIMATE SEVERITY

Determine the severity of the identified failure should they occur. The consequence rating is determined by team consensus or statistical information where available. The basis of the severity rating is shown on the following table.

SEVERITY OF THE EVENT

	PERSONNEL INJURY	FINANCIAL COST	LOSS OF PRODUCTION
1	FATALITY OR PERMANENT DISABILITY	> $500K	> 1 DAY
2	SERIOUS LOST TIME INJURY OR ILLNESS	$100K - $500K	> 1 SHIFT
3	MODERATE LOST TIME INJURY OR ILLNESS	$50K - $100K	> 1 HOUR
4	MINOR LOST TIME INJURY OR ILLNESS	$5K - $50K	1 HOUR
5	NO LOST TIME (POSSIBLE FIRST AID)	<$5K	INSIGNIFICANT

3.10 ESTABLISH RISK FROM RISK MATRIX

The risk ranking can be determined by checking the frequency and severity rating for each hazard against the Risk Matrix below. The Risk Matrix has been sourced from Sandvik's "Sandvik Safety Take 5 Personal Risk Assessment Handbook".

RISK MATRIX

	FREQUENCY				
SEVERITY	**A**	**B**	**C**	**D**	**E**
1	**1**	**2**	**4**	**7**	**11**
2	**3**	**5**	**8**	**12**	**16**
3	**6**	**9**	**13**	**17**	**20**
4	**10**	**14**	**18**	**21**	**23**
5	**15**	**19**	**22**	**24**	**25**

3.11 RECOMMEND POTENTIAL NEW BARRIERS

Recommend through group discussion, drawing from the team members' experience, means of reducing or eliminating the risk through appropriate barriers or controls.

3.12 IMPLEMENT NEW BARRIERS

3.12.1 The implementation of the potential new barriers that have been selected by the manufacturer and/or end-user of the equipment or system of use.

3.12.2 A written explanation as to the reasoning behind selection or rejection of the suggested new barriers is required for each of the identified hazards.

3.12.3 As a guide to ensure each identified hazard is sufficiently addressed, the table below may be used as a guide for the minimum expected controls or barriers for each risk ranking.

RISK	NECESSARY CONTROLS AND BARRIERS
LOW	**Risk may or may not have barriers set but in the interest of the manufacturer/end-user those barriers that are relatively easy or cost effective to implement should be implemented.**
MEDIUM	**Controls or barriers should be implemented.**
HIGH	**Identified risks in this category shall have barriers or controls in place.**

3.12.4 Hard barriers or mechanical forms of protection should be used in preference to soft barriers (training and procedures) where practical. This is especially true when implementing barriers and controls for High risk ranked hazards.

3.13 PREPARE REPORT

3.13.1 Step 10 is to prepare the report; this report should have included the following as a minimum.

- 3.13.1.1 A list of the risk assessment team including the person's name, company and position.
- 3.13.1.2 A list of the new or revised items being assessed on the equipment.
- 3.13.1.3 Clear drawings, diagrams and photos where available to validate the affected equipment.
- 3.13.1.4 Any available injury and safety statistics should be documented in the appendix.
- 3.13.1.5 All processes, hazards, probabilities, consequences, risks and barriers nominated in the exercise are to be listed.
- 3.13.1.6 A final recommendation list of selected barriers and the hazards they minimise or eliminate must be listed.
- 3.13.1.7 Statements as to the reasons why potential new barriers have not been implemented must be supplied by the manufacturer/end-user.

4 RISK IDENTIFICATION AND HAZARD MANAGEMENT

4.1 The partial compliances and non-compliances to the specified standard have been assessed for design risk in this section. The information is contained in the following 3 tables:

- Table 1 – Listing of all hazards requiring Sandvik or End User Action, sorted highest risk to lowest risk
- Table 2 – Listing of all hazards requiring Sandvik action and delegation of responsibilities.
- Table 3 – Listing of all risks pertaining to gap analysis between the design and nominated standard.

Table 1 – Listing of all hazards requiring Sandvik or End User Action, sorted highest risk to lowest risk

Rev	Clause No.	Hazard & Effects	Risk Rank	Suggested new Barriers	Risk Rank	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
A	2.14.4	Explosion due to DES not being able to be shutdown	11	Recommend fuel shut off valve label.	11	Engineer nameplate and issue Tech Bulletin.	Ensure operators are adequately trained prior to use of vehicle. Consider fitting nameplate.
A	2.14.4	Explosion due to delayed shutdown	11	Recommend movement of fuel shut-off valve to downstream of fuel/water separator, to ensure shut-down time is reduced, but access to valve is easy.	11	Issue Tech Bulletin regarding movement of valve.	End user to move valve. End User ensure ball valve is shut-off routinely to ensure it does not sieze.
A	F6.3.6	Undetected filter fire	11				End user to ensure nominated filter elements are used.
A	2.13 (d)	Pinch points and impact injuries due to rotating equipment	13	Recommend belt tensioner arrangement and belt tension indicator tool.	17	Write TB recommending belt tensioner and tension indicator tool.	Fit mesh to ED7/LS170. Ensure Operators and maintainers are aware of hazard and all guards and covers are fitted. Consider fitment of belt tensioner and use of tension indicator tool.
A	2.13 (b)	Scalding due to uncontrolled release of hot fluids.	13	Recommend retrofit of fill point with safety cap and fastened cover.	20	Engineer retrofit. for radiator cap. Write technical bulletin.	Fit retrofit. Ensure Operators and maintainers are aware of hazard. Consider fitment of expansion tank.

Table 2 – Listing of all hazards requiring Sandvik action and delegation of responsibilities.

Rev	ITEM	SUGGESTED CONTROLS	ACTION	RESPONSIBLE	APPROVED[1] (YES/NO)	DATE REQUIRED
A	2.13 (b)	Recommend retrofit of fill point with safety cap and fastened cover.	Engineer retrofit. for radiator cap. Write technical bulletin.	M Peristy W Scrivens	Yes	01/2009
A	2.13 (d)	Recommend belt tensioner arrangement and belt tension indicator tool.	Write TB recommending belt tensioner and tension indicator tool.	M Peristy	Yes	01/2009
A	2.14.4	Recommend fuel shut off valve label.	Engineer nameplate and issue Tech Bulletin.	M Peristy	Yes	01/2009
A	2.14.4	Recommend movement of fuel shut-off valve to downstream of fuel/water separator, to ensure shut-down time is reduced, but access to valve is easy.	Issue Tech Bulletin regarding movement of valve.	M Peristy	Yes	01/2009

1. Approval may be determined subsequent to initial issue of this Risk Assessment.

Table 3 – Listing of all risks pertaining to gap analysis between the Sandvik Cat3126DITA and AS/NZS3584.2-2008.

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
Compliance Report CR0326																	
A	2.13 (b)	Each radiator filler and radiator cap shall be so arranged or interlocked so that coolant pressure behind the fill point cap or radiator cap is safely released prior to the cap being able to be removed.	Do Not Comply	Cap may be removed whilst under pressure. Operator's Manual specifies safe working procedure for cap removal.	Scalding due to uncontrolled release of hot fluids.	JSEA for filling of radiator. Operator training. Optional expansion tank on some vehicles.	P	C	3	13	Recommend retrofit of fill point with safety cap and fastened cover.	E	3	20	In some instances uncontrolled release of ghigh temperature liquid can occur up to 30 seconds after removal of radiator cap.	Engineer retrofit. for radiator cap. Write technical bulletin.	Fit retrofit. Ensure Operators and maintainers are aware of hazard. Consider fitment of expansion tank.
A	2.13 (d)	Cooling fans and rotating parts shall be guarded in accordance with AS 4024.1601.	Partial	Cooling fan guarded, pulleys are not guarded on older model machines utilising the CAT3126 DITA.	Pinch points and impact injuries due to rotating equipment	Mesh guard on newer ED7/LS170's as per TB0719. JSEA on machine isolation. Vehicle covers. Limited items requiring maintenance in fan belt area. Engine to be shut-off when tensioning belts.	P	C	3	13	Recommend belt tensioner arrangement and belt tension indicator tool.	D	3	17		Write TB recommending belt tensioner and tension indicator tool.	Fit mesh to ED7/LS170. Ensure Operators and maintainers are aware of hazard and all guards and covers are fitted. Consider fitment of belt tensioner and use of tension indicator tool.
A	2.14.4	The manual fuel shut-off valve shall be clearly identified and labelled including operating instructions. The label shall be as close as practicable to the valve.	Do Not Comply	Manual fuel shut-off valve not labelled, but clearly identified in Operator's Manual.	Explosion due to DES not being able to be shutdown	Operator training. Strangler valve. Safety shutdown system. Operator Manual. Vehicle won't start if operator doesn't open fuel switch.	P	E	1	11	Recommend fuel shutoff valve label.	E	1	11		Engineer nameplate and issue Tech Bulletin.	Ensure operators are adequately trained prior to use of vehicle. Consider fitting nameplate.
A	2.14.4	In addition, the physical location of the valve shall be clearly indicated by a second label readily visible to the operator (driver) of any vehicle to which an explosion-protected engine system is fitted.	Do Not Comply	Operator's manual clearly identifies manual fuel isolation valve.	Explosion due to DES not being able to be shutdown	Operator training. Strangler valve. Safety shutdown system. Operator Manual. Vehicle won't start if operator doesn't open fuel switch.	P	E	1	11							

RISK ASSESSMENT REPORT

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
A	2.14.4	The manual fuel shut-off valve should be connected into the fuel system after all supply (lift) pumps and filters, to minimize the time required to shut down the engine system after operation of the valve.	Do Not Comply	Manual fuel shut-off valve mounted before filter and pump. Tests conducted at Hexham workshop on 26.11.08 indicated that moving fuel shutoff to just before engine fuel pump reduced shut-off time at idle by 0 to 60 seconds (150, 210, 210 seconds in original position and 150, 165, 150 seconds in test position), however position is difficult to access.	Explosion due to delayed shutdown	Strangler valve. Safety shutdown system. Tested by Test Safe. Ball valve to be closed at 50 hr service to drain water from fuel/water separator (ensures ball valve has not siezed)	P	E	1	11	Recommend movement of fuel shut-off valve to downstream of fuel/water separator, to ensure shut-down time is reduced, but access to valve is easy.	E	1	11		Issue Tech Bulletin regarding movement of valve.	End user to move valve. End User ensure ball valve is shut-off routinely to ensure it does not sieze.
A	F6.3.7 (b)	The operation of the manual fuel shut-off valve shall be tested at – (b) rated power, and	Do Not Comply	Manual fuel shut-off tested to the requirements of AS3584.2-2003. Low idle is worst case in terms of shutdown times.	Explosion due to failue of ball valve to cut off fuel.	Idle is worst case for time to shut down. Strangler valve. Safety shutdown system. Tested by Test Safe. Ball valve to be closed at 50 hr service to drain water from fuel/water separator (ensures ball valve has not siezed)	P	E	1	11							
A	F6.3.8 (b)	The operation of the emergency stop system shall be tested at – (b) rated power, and			Explosion due to DES not being able to be shutdown	Safety shutdown system. Balanced valve (air flow does not exert a net force/torque on valve). Tested at high free idle. Rated power unlikley under methance conditions (requires correct fuel mix and load on engine)	P	E	1	11							
Report RE0082																	

RISK ASSESSMENT REPORT

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
23/07/03	2.14.3 (b)	Engine oil pressure	Do Not Comply	Shutdown pressure at 10 psi.	Explosion due to failure of safety system	Eimco have always had the shutdown pressure on their 3306 and 3304 engine systems lower than the Caterpillar recommended minimum oil pressure. This is to ensure that nuisance shutdowns don't occur when the oil pump is worn. No incidents have been reported that were considered to have occurred because the shutdown pressure is below the recommended minimum. Note that there are at least 350 installations of this type of shutdown system, with the system being in operation for at least 12 years.	E	D	4	21							
23/07/03	5.2 (d)	The location and principal dimensions of the exhaust system, …	Partial	For details of the catalytic converter refer Eimco drawings specified as reference only in approval application.	None												
Compliance Report CR0037																	
2	2.2	Suitable sampling points shall be provided to allow monitoring of the following (b) engine speed	Do Not Comply	No point available on engine		Refer 2.2 above.											
2	2.14.3 (b)	*Engine oil pressure* A sensor to measure low engine oil pressure, which shall be set to operate at a pressure of not less than the engine manufacturer's minimum recommended pressure	Do Not Comply	Shutdown cylinder operates on low engine oil pressure, shutdown @ 70 kPa (10 psi) but min recommended pressure is 100kPa (14.5 psi)		Refer 2.14.3 (b) above.											

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
2	2.15.2 (d)	*Monitoring and shutdown devices*	Do Not Comply	Refer 2.14.3 (b) above		Refer 2.14.3 (b) above											
2	5.2	GENERAL ARRANGEMENT DRAWING The general arrangement drawing shall be numbered and shall include its current revision, with date. The location and principle dimensions of the exhaust system, including … (ii) overall lengths (iii) Pipe sizes and wall thicknesses (iv) Bend geometry and overall dimensions of exhaust gas stream pipework, from cylinder head to exhaust flametrap	Do Not Comply	(ii) overall lengths meaningless for this design (iii) pipe sizes vary, would require manufacturing drawing to adequately specify (iv) requires manufacturing drawing to adequately specify	No associated risk.												
2	B7.1.2	*Test procedure* The following test procedure shall be followed:	Do Not Comply	(b) only single reading below maximum torque taken. Note test report identifies max torque point.	No associated risk.												

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
2	F6.3.6	*Particulate filter* Tests shall be undertaken by: … For each of the tests, the engine shall stop before the temperature of the exhaust gas stream immediately before the filter reaches the lesser of 50°C below the auto-ignition temperature of the filter element or 25°C below the rated temperature.	Do Not Comply	Downstream sensor not tested in location shown. However sensor is the same as fitted for exhaust gas temperature. Rated temperature of filter media 29°C above shutdown temperature. Refer Appendix E.	Undetected filter fire	2 x shutdown floats. Temp.sensor fitted to conditioner outlet. Filter element melts and does not catch fire. Rating of filter element media is 25°C above the maximum allowable exhaust gas temperature when no filter fitted. Hence sensors fitted for exhaust gas temperature shutdown are adequate for filter element protection. Downstream sensor mounted in straight pipe, same insertion depth as upstream sensor. No reason to expect different performance.	P	E	1	11								End user to ensure nominated filter elements are used.

RISK ASSESSMENT REPORT

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
2	F6.3.10	*Low engine-oil pressure* Operate the diesel engine system at rated power. …	Do Not Comply	Oil pressure on shutdown lower than Caterpillar min recommended oil pressure	Engine damage due to running with low oil pressure	Eimco have always had the shutdown pressure on their 3306 and 3304 engine systems lower than the Caterpillar recommended minimum oil pressure. This is to ensure that nuisance shutdowns don't occur when the oil pump is worn. No incidents have been reported that were considered to have occurred because the shutdown pressure is below the recommended minimum. Note that there are at least 350 installations of this type of shutdown system, with the system being in operation for at least 12 years.	E	D	4	21							
2	F6.3.11	*Fail-to-safety system tests* The manufacturer shall nominate all credible system failure modes. The testing authority shall confirm that each nominated single failure mode will cause the system to fail to safety.	Do Not Comply	Failure modes nominated - refer VA Eimco report 0028, dated 3/1/2003. Testing authority hasn't confirmed fail to safety of failure modes.	No associated risk.												
Compliance Report CR0207																	
0				There are no non-compliances listed in this report.													

Rev	Clause No.	Clause	Comply	Comments/Justification	Hazard & Effect	Existing Barriers	Personnel, or Equipment	Probability	Consequence	Risk Rank	Suggested new Barriers	Probability	Consequence	Risk Rank	Risk Notes	Sandvik Action Required to Implement New Barrier	End User Action Required to Implement New Barrier
Compliance Statement A2U900-860004																	
2	F6.3.6	*Particulate filter* Tests shall be undertaken by: … For each of the tests, the engine shall stop before the temperature of the exhaust gas stream immediately before the filter reaches the lesser of 50°C below the auto-ignition temperature of the filter element or 25°C below the rated temperature.	Do Not Comply	Exhaust gas temperature sensor downstream of particulate filter element not tested during type testing.		Refer F6.3.6 above											
2	2.14.3(b), 2.15.2(d), F6.3.10	*Low engine-oil pressure* Operate the diesel engine system at rated power. …	Do Not Comply	Shutdown pressure (10 psi) is below Caterpillar minimum recommended oil pressure (14.5 psi)		Refer F6.3.10 above											