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SCR equipment datasheet

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Revision History

Date	Revision	Status	Revised Sections	Description
02/08/2023	P01	S4 - For review / approval		
15/09/2023	P02	S4 - For review / approval		
04/10/2023	P03	S4 - For review / approval	Operating Requirements for SCR Catalysts CONTAMINANT LIMITS	Addition of reduction values of all parameters,

Comment tracker list:

Version	Submittal name	Vantage Comments	Action
P02	MXP11-ENE-DC-ZZ-DS-N-0109_P03 SCR equipment datasheet	Please provide the reduction values of all parameters, even if only NOx are considered in the first step.	Values Added

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DCL Quote#:	**Datasheet SCR system**
Date	**25/07/2023 - v3**
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I. TECHNICAL DESCRIPTION

1. ENGINE AND EXHAUST GAS DATA (TABLE 1A)

Parameter	**Unit**	**Engine System**
Engine Model		CATERPILLAR 3516E HPD
Fuel	-	Diesel
Engine Power	kW	2600 kW
Engine Speed	rpm	1500 RPM
Exhaust Gas Flow Rate (WET)	m^3/min	598,6 m^3/min (39 916 m3/h)
Exhaust Vol Flow Rate (DRY @0°C ; 101kPa)	m^3/min	195,1 m^3/min (11 706 m3/h)
Exhaust Gas Mass Flow Rate (WET)	kg/h	16 260,4 kg/hour (271 kg/min)
Exhaust Temperature	°C	492°C
Ambient Temperature	°C	Between 0°C and 40°C
NOx (as NO_2)	mg/Nm^3 (@5%O_2) g/h	1 988,1 mg/Nm^3 16 706 g/h
CO	mg/Nm^3 (@5%O_2) g/h	416,1 mg/Nm^3 3 545 g/h
HC	mg/Nm^3 (@5%O_2) g/h	16,3 mg/Nm^3 160 g/h
PM	mg/Nm^3 (@5%O_2) g/h	36,2 mg/Nm^3 370,4 g/h

2. SCR EMISSION CONTROL SYSTEM DESIGN PARAMETERS (TABLE 1B)

Parameter	**Unit**	**SCR System**
FSCR Catalyst Model		**SCR filters**
Part Number		TBD
catalyst Type Number of Elements CPSI		5 layers x 16 SCR catalyst filters (Cu-Zeolite SCR coating)

catalyst Type Number of Elements CPSI		Spare for DOC filters Spare for DPF and ASC filters
Connection Size	mm	700
Approximate Housing Dimensions	mm (LxWxH)	TBD
Approximate System Weight	kg	TBD
Housing Material		Carbon steel
Urea Solution	%	32.5
Urea Solution Consumption Rate (approximate at 100% load)	L/h	approx. 45 L/h
Total System Backpressure	mbar	~ 40 mbar

3. EMISSIONS GUARANTEE & WARRANTY (TABLE 1C)

Emission	**Unit**	**% Reduction**
NOx (as NO_2)	mg/Nm^3 @5 % O_2	**95 % efficiency** Target Emissions 100mg/Nm^3 *(Estimated at 840 g/h)*
CO	mg/Nm^3 @5 % O_2	*NC - Provision for future upgrade*
Total Hydrocarbon	mg/Nm^3 @5 % O_2	*NC - Provision for future upgrade*
PM	Efficiency	*NC - Provision for future upgrade*
NH3 Slip	mg/Nm^3 @5% O_2	Ammonia slip up to 40 mg/Nm^3 *(Estimated at 336 g/h)*
Warranty		Warranty Document: X0000-0000-K2 Minimum shelf life of one (1) year or 8,000 operating hours, whichever occurs first

This guarantee is subject to certain maintenance practices and engine operating conditions, as defined in the Terms & Conditions.

B) <u>Urea Control Unit: XIOS controller Heinzmann.:</u>

XIOS^{SCR} control unit (Version X20-00-027-00)

Power supply:	24 V DC
Current consumption:	0,5 A nominal 25 A max. (depending on peripheral components) 20 bar max.
Operating temperature:	-40…70°C
Analogue/temperature/digital inputs:	up to 20 (configurable)
Analogue/digital outputs:	up to 4 (configurable)
Injector outputs:	up to 2
Data logger:	up to 10 data sets (max. 10 values each)
CAN Bus:	up to 2
Ethernet:	up to 2

Urea pump 36 kg/h

Power supply:	24 V DC
Current consumption:	2 A nominal 7 A Start
Flow rate:	36 kg/h max.
Pressure:	7 bar nominal 20 bar max.
Operating temperature:	-20…65°C
Suction lift:	1 m
Transfer length (to injector):	6 m
Transfer height (to injector):	1,5 m

Urea injector 36 kg/h

Power supply:	1 A nominal 5 A max.
Dosing rate:	36 kg/h max.
Pressure:	5…7 bar nominal
Sensor cable temp. range:	0…125°C
Max. height of tank to injector:	2,5 m
Integrated pressure sensor :	0…10 bar

NOx Sensor

Power supply:	24 V DC
Current consumption:	1,0 A nominal 22 A max.
NO_x measuring range:	0…1500 ppm
O_2 measuring range:	0…20,9 %
Exhaust temperature range:	-40…800°C
Sensor control unit temperature range:	-40…100°C

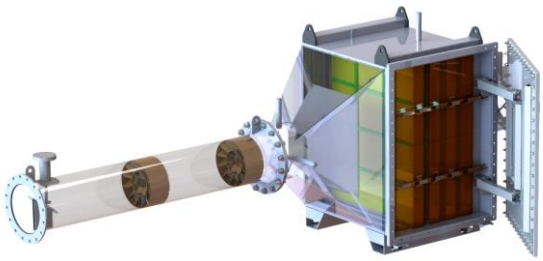
Exhaust temperature sensor

Sensor type:	Pt200
Sensor length:	110 mm
Exhaust temperature range:	-40…700°C
Sensor cable temperature range:	-40…260°C

C) 1 x SCR Reactor

An example of the full exhaust aftertreatment system is shown and consists of:

- Oxidation catalyst incl. housing
- Mixing pipe, with urea injector / urea injector mount and mixer
- SCR housing for DPF (SCR coated) and SCR catalyst



Design figures:

- compact design
- total length of around (see drawing)
- DN600
- NOx sensor pre-SCR injection and post-SCR catalyst
- Differential pressure monitoring over SCR coated DPF and SCR catalyst

Key Differences in SCR Catalysts

Spec	Code 62 + Code 73	Code 66 + Code 73
Material Type	Stabilized Vanadia on Titania	Copper Zeolite
Temperature range for achieving design NOx conversion	350 °C to 460 °C 662 °F to 860 °F	350 °C to 510 °C 662 °F to 950 °F
Maximum peak temperature	525 °C 977 °F	600 °C 1112 °F
Allowable Sulfur in Fuel (Natural Gas and Biogas) ○ Total Sulfur (all sulfur compounds)	< 750 mg/Nm^3 and < 500 ppm	< 30 mg/Nm3 and <20 ppm
Allowable Sulfur in Fuel (Diesel and other liquid fuels) ○ Total Sulfur	< 500 ppm	< 15 ppm

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Operating Requirements for SCR Catalysts

Variable	Operating Requirement
Exhaust Flowrate	○ As indicated in quote.
Exhaust Temperature	○ Code 62 catalyst: To meet design conversion efficiency, temperature at inlet to converter shall not exceed 860 °F (460 °C), and shall be no lower than 662 °F (350 °C). ○ Code 66 catalyst: To meet design conversion efficiency, temperature at inlet to converter shall not exceed 950 °F (510 °C), and shall be no lower than 662 °F (350 °C). ○ To avoid permanent damage, at inlet and outlet of the converter the temperature must never exceed a maximum 525°C for Code 62 SCR catalyst, or 600°C for Code 66 SCR catalyst.
Engine Power	○ As indicated in quote.
Engine Speed	○ As indicated in quote.
Lube Oil Specification	○ Sulfated ash <0.6 wt% (Spark ignited engines). ○ Sulfated ash <1.0 wt% (Compression ignited engines). ○ Zinc < 700 ppm. ○ Phosphorus < 300 ppm.
Lube Oil Consumption Rate	○ Manufacturer's normal lube oil consumption rate or 0.2 g/bhp-hr (0.27 g/kW-h), whichever is lower.
Crank case ventilation	○ Crank case ventilation should be routed either back to the air intake or downstream of the converter.
Fuel Quality for Gaseous Fuels	○ Pipeline quality natural gas or commercial grade LPG or gasoline is preferred but not required. ○ Unprocessed wellhead gas is acceptable if all other specifications are maintained and measures are taken to ensure the engine can run on the fuel without misfires. ○ Biogas, landfill gas and digester gas are acceptable if all other specifications are maintained. ○ Total Sulfur (all sulfur compounds) < 750 mg/Nm^3 and < 500 ppm (Code 62). ○ Total Sulfur (all sulfur compounds) < 30 mg/Nm^3 and <20 ppm (Code 66). ○ Chlorinated compounds < 10 ppm. ○ Siloxane compounds < 40 ppb (Scrubbing of the fuel is normally required to achieve this level for landfill gas).
Fuel Quality for Diesel, LFO, or Biodiesel Blends	○ Fuel must conform to ASTM D975, ASTM D6751, EN590 or EN14214 standards, plus the following additional standards: ○ Chlorinated compounds – must be zero. ○ Siloxane compounds – must be zero. ○ Phosphorus – must be zero. ○ Sulfur < 500 ppm (when Code 62 SCR is used). ○ Sulfur < 15 ppm (when Code 66 SCR is used).
Oxygen	○ > 2% at inlet to converter.
Exhaust System	○ Ensure the exhaust system is free of leaks, particularly before the converter.
Fuel System (Spark Ignited Engines)	○ Ensure the fuel system is properly maintained and functioning according to manufacturer's specifications. ○ Ensure a stable fuel supply, proper fuel pressures and balanced regulators and carburetors.

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Fuel System (Compression Ignited Engines)	○ Repair and replace at fuel injectors at intervals required by the engine manufacturer's maintenance schedule. ○ Fix worn hydraulic injectors to stop lube oil leaks into the fuel.
High Temperature Shutdown	○ For spark ignited engines a functioning high temperature shut-down system is required to prevent the catalyst element from over-heating due to misfires. ○ The thermocouple located on an outlet port of the converter should be set to 150°F (83°C) above the normal outlet temperature of the converter but should never exceed 1112°F (600°C).
Ash Deposits	○ Ash deposits on the catalyst should not be allowed to accumulate to the point where they result in plugging, higher pressure restrictions or reduce the conversion efficiency. ○ Cleaning procedures are available from DCL upon request. ○ It is recommended that an authorized cleaning facility is contacted if cleaning of the catalyst element is necessary.
Back-Pressure	○ Back-pressure that is higher than normal operating conditions may indicate excessive build-up of ash deposits. ○ When the catalyst bed is new, measure pressure before and after the converter during full load operation. The difference in before and after pressure is the baseline back-pressure for the converter. ○ Re-measure the converter back-pressure under the same operating conditions periodically. ○ Should the converter back-pressure increase by more than 2" wc (0.5 kPa) over the baseline back-pressure, the catalyst element should be removed for cleaning. ○ Should the converter back-pressure decrease from baseline back-pressure, the catalyst element should be removed and inspected for damage.
Catalyst Poisons	○ In like manner to ash deposits, catalyst poisons build up on the catalyst element over time, due to their presence in the fuel or lube oil. The presence of certain contaminants may also indicate excessive engine wear or a coolant breach. ○ If there is a suspected problem, the catalyst element may be returned to DCL, where a small amount of washcoat is removed and analyzed for contaminants and activity. ○ To meet design conversion efficiency, catalyst poisons as a percentage of washcoat or as an amount per catalyst volume shall not exceed limits indicated in **Contaminant Limits** below.

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CONTAMINANT LIMITS

Contaminants	SCR (Code 66)	SCR (Code 62)	SCR (Code 66)	SCR (Code 62)
	DCL (%washcoat)	DCL (%washcoat)	*DCL (g/ft3 volume)*	*DCL (g/ft3 volume)*
Phosphorus (P)	0.5%	1%	21	42
Zinc (Zn)	1%	0.5%	42	21
Sulfur (S)	2%	2%	85	85
Sulfur + Phosphorus + Zinc (collectively)	2%	2%	85	85
Lead (Pb)	100 ppm	100 ppm	0.425	0.425
Mercury (Hg)	100 ppm	100 ppm	0.425	0.425
Arsenic (As)	100 ppm	100 ppm	0.425	0.425
Antimony (Sb)	100 ppm	100 ppm	0.425	0.425
Tin (Sn)	100 ppm	100 ppm	0.425	0.425
Chromium (Cr)	0.1%	0.1%	4	4
Nickel (Ni)	0.1%	0.1%	4	4
Copper (Cu)	-	500 ppm	2	2
Lead + Mercury + Arsenic + Antimony + Tin + Chromium + Nickel (collectively)	0.1%	0.1%	4	4
Sodium (Na)	0.5%	0.5%	21	21
Potassium (K)	0.5%	0.5%	21	21
Alkali Metals (all collectively)	0.5%	0.5%	21	21
Magnesium (Mg) Calcium (Ca)	1%	1%	42	42
Alkaline Earth Metals (all collectively)	1%	1%	42	42
Iron (Fe)	1%	1%	42	42
Silicon (Si)	N/A	0.3%	N/A	13
Collective Limit			194 g/ft3 6.9 g/l	194 g/ft3 6.9 g/l

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