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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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Replacing GB 8840-1988

Limit for exhaust smoke of marine diesel engines

船用柴油机排气烟度限值

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1 Scope

This standard specifies the limits for the exhaust smoke of marine diesel engines, together with the measurement method, the test conditions and the judgement of the results.

It applies to the diesel engines installed in ships, both as main propulsion and as auxiliary machinery.

Note on the status of this document: a new edition, GB 8840-2026, Limits and measurement methods for the exhaust smoke of ships, has been issued and takes effect on 1 July 2027. This 2009 edition remains in force until then.

4 Smoke limits and measurement

The limits are expressed as a smoke number measured on the exhaust, and they are set for the operating conditions at which a marine engine actually smokes: at full load, and during the acceleration and load acceptance transients.

The measurement is made with a smoke meter on a sample drawn from the exhaust, and Clause 6 fixes the conditions under which the reading is taken: the engine load, the speed, the state of warm-up, and the ambient conditions.

Those conditions are not administrative detail. A diesel engine smokes most when it is cold, when it is accelerating, and when it is overloaded, and a limit measured only at steady full load would describe the condition in which the engine smokes least.

Why smoke is regulated separately from the other emissions

Diesel emissions are usually regulated as mass per unit of work: grams of nitrogen oxides or of particulate per kilowatt hour, measured over a test cycle. Smoke is regulated differently, as an opacity or a smoke number, and it is worth understanding why.

Smoke is what can be seen. It is the visible part of the particulate, it appears in seconds when something is wrong, and it is the emission that a harbour authority, a port state inspector or a member of the public can observe from the quayside without instruments.

It is also the fastest indicator that an engine is faulty. A worn injector, a fouled turbocharger, a blocked air filter or an overloaded engine all show up as smoke long before they show up as a measurable change in fuel consumption, which makes a smoke limit a maintenance requirement as much as an environmental one.

For marine engines specifically it is the only emission most vessels are checked on in practice. A ship is not brought to a test cell; it is looked at, and a smoke limit is the requirement that survives that.

Why smoke is regulated on its own

Smoke is the particulate fraction of the exhaust, and it is also the one emission that can be seen. A harbour inspector can act on it without instrumentation, and a chief engineer can read the state of the combustion from it, which is why it is regulated separately from the gaseous emissions.

How the measurement is fixed

A diesel engine smokes most on acceleration and under a sudden increase of load, and hardly at all when it is steady and warm. A smoke value therefore means nothing unless the operating point is prescribed.

The standard fixes the load points at which the measurement is taken, the stabilisation and the ambient conditions, the sampling position and the instrument, and the way the individual readings are combined into the value compared with the limit. The limits themselves are set against the engine parameters, so that the same figure is not demanded of a small high speed auxiliary and of a large slow speed main engine.

A limit that is enforced by looking

Ships are not brought to emission test cells. A vessel is inspected in port, by a port state control officer with a checklist and a few hours, and most of what can be verified in that time is documentary.

Smoke is the exception. It is visible from the quay, it appears within seconds of an engine being loaded, and its absence or presence can be established without opening anything. That is what makes a smoke limit the emission requirement with real enforcement behind it on a merchant vessel.

It is also why the limits are set at the operating points where smoke actually occurs. An engine at steady full load, warm and correctly tuned, produces little; the same engine

accelerating, or manoeuvring in harbour on a cold start, produces the plume that a limit is meant to prevent.

Auxiliary engines run where people are

This standard covers the auxiliary machinery as well as the main propulsion, and in practice the auxiliaries matter more for what a port experiences.

A main engine runs at sea and is shut down alongside. The generators run continuously in port, supplying the ship's hotel load, often for days, and they run at part load, which is the condition in which a diesel smokes most readily.

So the emission a harbour actually receives comes disproportionately from the smallest engines on board, operating at the least favourable point on their curve, at the moment the ship is closest to a populated area. A smoke standard that covered propulsion alone would regulate the engine that runs where nobody is.

Smoke is the fault indicator that reaches the deck

On a ship the people who notice an engine problem first are rarely in the engine room. A change in the exhaust is visible from the bridge wing and from the quayside, and on a vessel with an unmanned machinery space at night it is one of the few symptoms that reaches a human being directly.

What produces it is almost always something specific and repairable: an injector that has stopped atomising, a fouled turbocharger delivering less air than the fuel rack assumes, a blocked air cooler, a filter nobody changed. Each of them means the engine is burning fuel it cannot burn completely.

That is why a smoke limit does double duty. It caps an emission, and it obliges an operator to keep the engine in the condition where the emission does not occur - which is the same condition in which the engine uses less fuel and lasts longer.