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Translation

OR

Approval procedures for diesel engines of motive power units

*Procédure d'homologation des moteurs diesel d'engins moteurs
Zulassungsverfahren für Dieselmotoren der Triebfahrzeuge*



UNION INTERNATIONALE DES CHEMINS DE FER
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The person responsible for this leaflet is named in the UIC Code

Contents

Summary	1
1 - Scope	2
2 - General.....	3
3 - Approval conditions	4
4 - Approval procedure	5
4.1 - Request for approval procedure	5
4.2 - Organisation of the test.....	5
4.3 - Monitoring of the test	7
4.4 - Report on the test carried out	8
5 - Approval.....	9
5.1 - Work to be carried out by the UIC	9
5.2 - List of approved engines.....	9
6 - Testing costs	10
6.1 - Labour costs	10
6.2 - Travel expenses	10
6.3 - UIC costs	10
Appendix A - Time schedule for a UIC approval test	11
Appendix B - List of principal documents to be provided with the test report.....	12
Appendix C - Conclusions of the test engineers concerning the approval tests of the diesel engine.....	13
C.1 - Testing schedule.....	13
C.2 - Test interruption.....	13
C.3 - Approved differences.....	14
C.4 - Proposed approval by railway representative	15

Appendix D - Engines which have successfully passed a UIC approval test.....	16
Appendix E - Measured and calculated values on an automated test rig	17
Appendix F - Approval procedure for a "derivative" engine	18
Appendix G - Proposal for approval of a "derivative" engine	19
Appendix H - List of principal documents to be provided with the test report of the "derivative" engine	21
Bibliography	22

Summary

This leaflet defines the procedure, methods and conditions applicable to the approval testing of diesel engines for tractive units.

On completion of the test procedure, the engine shall be declared approved by the UIC for use in railway tractive units without restrictions to the area of application. It shall be guaranteed, in particular, that the engine meets current exhaust requirements.

R 1 - Scope

1.1 - The purpose of these international regulations is to define general conditions and methods for the approval tests to be carried out on railway diesel traction engines.

1.2 - These regulations shall apply to railway diesel traction engines, with the exception of engines for special locomotives (e.g. refinery or mine locomotives) and traction engines with an output of less than 100 kW.

1.3 - These regulations can be used by Railway Undertakings (RUs) for their own purposes to guarantee the operating reliability of a given type of diesel traction engine.

2 - General

- R 2.1 - The approval method in question may result in a UIC recommendation for the use of an engine without any restriction on the number of items in the series.
- O 2.2 - Every engine subjected to the approval test must be produced according to the normal manufacturing method; the principal components of the engine, in particular, must not exhibit any differences which might affect the technical value of the test.

3 - Approval conditions

3.1 - The approval test shall consist of a performance test (100 hours) followed by an endurance test (360 hours), both of which shall be carried out on the test rig.

3.2 - In accordance with the provisions of *UIC Leaflet 623-2* (see Bibliography - page 22) as valid at the time of the request for the approval procedure, the tests to be carried out shall be conducted in the presence of a UIC official.

3.3 - The approval test shall be conducted under nominal service conditions if they are known. Rated speed and rated power shall be equal or superior to service conditions.

○ 4 - Approval procedure

(see Appendix A - page 11)

4.1 - Request for approval procedure

Every request for the execution of approval tests must be supported by at least one UIC member.

4.1.1 - The manufacturer shall first of all approach the RU of his own country, even if there are no immediate plans for the engine in question to be used on motive power units belonging to that RU.

In the event of the RU declining to support the request, it will be up to the manufacturer to find at least one UIC member RU who is sufficiently interested in the engine to support the application.

4.1.2 - The RU requesting the execution of approval tests or supporting the manufacturer's application, shall normally, as lead RU, assume the task of undertaking the general organisation of the approval test.

4.1.3 - The request shall be submitted to the Director of the UIC System Department by the supporting RU at least three months before the start of the envisaged test.

4.1.4 - The request, made out in 5 copies, must contain:

- an explanation to the effect that the RU is supporting the application of the firm in question and is prepared to provide a test engineer to monitor the various tests, at the same time indicating the name of the officer appointed;
- the manufacturer's description of the engine as required by *UIC Leaflet 623-2, point 3*;
- a description indicating in particular the special features of the engine;
- full details of the test rig;
- references, where available.

The declaration to support the application commits the RU to the task of supervising the organisation of the tests and representing the UIC vis-a-vis the manufacturer.

4.1.5 - The UIC shall check to ensure that all necessary documents and technical data are supplied.

4.2 - Organisation of the test

4.2.1 - The organisation of the test between the time of the application for approval and the preparatory meeting shall not take more than 60 days.

4.2.2 - The UIC must be informed of the application for approval and, before the start of approval tests, of the testing schedule.

4.2.3 - The UIC shall, in agreement with the lead railway, arrange a meeting at the premises of the manufacturer in order to discuss the methodology of the test and to agree on which UIC language should be used during the tests and for the test report.

4.2.4 - Nomination of test engineers

4.2.4.1 - The UIC shall nominate, in addition to the lead railway organising the test, two further RUs for the purpose of monitoring the approval test on the test rig.

4.2.4.2 - Each of the two additionally nominated railways shall designate one test engineer.

4.2.4.3 - All test engineers shall be experts in diesel engines.

4.2.5 - Work to be carried out on the rig and on the engine to be tested

4.2.5.1 - The test engineer provided by the lead railway shall ascertain test rig conformity.

4.2.5.2 - The following operations shall be carried out in the presence of the test engineer of the lead railway (see *UIC Leaflet 623-2*):

- checking of the dimensions of the principal wear parts of the engine,
- measurement of pollutant levels (in the event of the test not being carried out by a laboratory approved by the lead railway),
- measurement of the smoke density values,
- definition of the characteristic curves of the engine.

4.2.6 - Preparatory meeting for test

4.2.6.1 - At least one month before the planned date of commencement of the test UIC, the lead railway and the manufacturer shall arrange a preparatory meeting including a visit to inspect the test rig. The test engineers of the two other RUs shall all participate at this meeting. In the course of the meeting the final preparations are to be made and technical (e.g. method of measuring the oil consumption) and administrative questions answered.

4.2.6.2 - No later than one week before the commencement of the test, the manufacturer must submit details of all the arrangements he has made for the approval of the test engineer responsible for the general organisation of the test.

4.3 - Monitoring of the test

4.3.1 - For monitoring the rig tests:

- the manufacturer must be present during the performance test, and throughout the test there must always be at least one test engineer at an agreed schedule to be identified during the preliminary meeting;
- the manufacturer must be present during the continuous rating test and at least one test engineer, at his convenience, at least once during each section. All the necessary steps must be taken to maintain constant contact between the manufacturer and the test engineers.

The test engineers shall decide among themselves at the preparatory meeting which of them shall be present at the various phases of the test.

4.3.2 - The manufacturer is solely responsible for the running of the test. The essential tasks of the test engineers nominated by the UIC shall be:

- to verify the progress of the test,
- to record the necessary findings.

The test engineers shall enter all the findings made during the test in a record book.

4.3.3 - UIC shall inform all parties about any interruption to the approval test.

4.3.4 - The engine shall be dismantled and its dimensions shall be checked in the presence of the manufacturer and of at least the test engineer of the lead railway.

4.3.5 - The expert appraisal of the engine to be made after completion of the test shall be carried out in the presence of the UIC test engineers and of the manufacturer within 60 days of completion of the continuous rating test.

4.3.6 - Upon completion of this expert appraisal, the test engineers and the UIC representative must:

- compile the documents for the test report (see Appendix B - page 12),
- complete and sign the "conclusions" form (see Appendix C - page 13).

4.4 - Report on the test carried out

4.4.1 - Within thirty days of the expert appraisal of the engine components, the test engineer of the lead railway, the manufacturer and the UIC representative shall jointly prepare a concluding report in the UIC language chosen.

4.4.2 - The test report shall remain first of all with UIC, and will be sent to the participating railways for appraisal.

UIC shall arrange for the test report to be translated into the two other UIC languages.

4.4.3 - The test report shall remain the property of the manufacturer and may not be released to third parties without the specific approval of the manufacturer. UIC shall retain a copy of the test report in its files.

5 - Approval

o 5.1 - Work to be carried out by the UIC

5.1.1 - UIC shall provide all the members of the UIC body dealing with the question of official approval as well as each of the test engineers with a copy of the final test report.

5.1.2 - Within three months of receipt of the report, the UIC body shall decide whether the engine in question can be approved, and shall inform:

- the manufacturer of the engine,
- the test engineers present at the approval tests.

The UIC shall also update the list of approved engines.

R 5.2 - List of approved engines

The approved diesel engines are entered by the UIC on a list as shown in Appendix D - page 16.

Similar engines may also be included in the list of approved engines (the procedure is described in Appendix F - page 18) without the need for a complete approval test to be undertaken. The UIC body dealing with the question of official approval shall decide on whether such engines can be included.

R 6 - Testing costs

All costs incurred in the acceptance tests monitored by UIC will normally be payable by the manufacturer of the engine unless any special agreement has been reached.

6.1 - Labour costs

The labour costs relating to the test engineers and payable by the manufacturer shall be settled by direct arrangement between the railways in question and the manufacturer.

6.2 - Travel expenses

6.2.1 - Accommodation costs

Accommodation costs shall be standardised by UIC for all the test engineers. They shall be paid out direct to the inspectors by UIC, and upon completion of the tests they shall then be invoiced to the manufacturer.

The number of days invoiced shall include all the days spent in the manufacturer's workshops and also the travelling time involved. Weekends and public holidays shall also be included should it not be feasible for the test engineer to travel home at such times.

6.2.2 - Travel expenses

Travel expenses shall be calculated on the basis of journeys by rail. If in special cases or at the request of the manufacturer, additional costs are involved, these additional costs shall also be borne by the manufacturer. All travel expenses shall be settled by direct arrangement between the RUs in question and the manufacturer.

6.3 - UIC costs

The costs incurred by UIC in the organisation and monitoring of the tests, and in the compilation, printing and translation of the test report shall also be borne by the manufacturer who may choose whether to pay a lump sum or to pay itemised amounts as required.

There is also the possibility of concluding a blanket contract (covering all the work completed by the RUs and UIC) between UIC and the manufacturer. In this case, UIC shall conclude sub-contracts with the lead railway and the other two RUs to cover their work.

Appendix A - Time schedule for a UIC approval test

A	Time	> D-90 days			60 days (point 4.2.1 - page 5)			> D-30 days	> D-8 days	D	100 hours	360 hours		< 60 days			30 days		< 30 days	< 90 days			
	Work	Request for test together with all relevant documentation			Meting and inspection of the test rig		Nomina-tion of test engi-neers (E) and (F)	Install-a-tion of en-gine, heat balance + pollutant level results (1)	Prepar-atory meeting and inspection of test rig		Approval	Perfor-mance test	Continuous rating test		Appraisal			Report			Approval		
c		Phase 1	Phase 2	Phase 3	Phase 1	Phase 2					Duration	Duration	End	Disman- tling of engine	Parts	Com-ments	Prepara- tion	Des- patch	Des- patch	Decision	Des- patch	Updat- ing of Leaflet	
d	Engine manufacturer (A)	* → (O)				x		x	x	* → (O)	x	x	x		x		x						
e	UIC (B)			* → (B)	(A) * → (O)	x	(E) * → B (F)		x		x				x	x	* → B	(D) → (E) (F)	* → (H)				
f	Lead railway	Railway (O)	* → B														x	* → (B)					
g		Test engineer (D)				x	x		x	x		x (2)	x (2)	x	x	x							
h	Other railway	Test engineer (E)							x		x (2)	x (2)			x	x							
i		Test engineer (F)							x		x (2)	x (2)			x	x							
j	UIC body with delegation of powers (H)																			(H)	* → (A) (B) (O) (E) (F)	(H)	
k	UIC Leaflet 623-1	4.1.1	4.1.3	4.2.2	4.2.3		4.2.4.1	4.2.5.2	4.2.6.1	4.2.6.2	4.3.1		4.3.4	4.3.5	4.3.6	4.4.1	4.4.2	5.1.1	5.1.2				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

* : Write

x : Presence

(1) : Heat balance: may be undertaken during the week preceding the test
Harmful substances: Recognised laboratory of the lead railway or presence of an inspector

(2) : Distribution decided upon jointly by agreement between the test engineers

Appendix B - List of principal documents to be provided with the test report

	<i>UIC Leaflet 623</i>	
	<i>UIC Leaflet 623-1</i>	<i>UIC Leaflet 623-2</i>
"Conclusions" file	Appendix C - page 13	
Summary		
Documents to be submitted		point 3
Full details of the test rig		point 4.1 and Appendix B
Minutes of the preliminary meeting	point 4.2.6 - page 6	
Running of the test: - performance test - continuous rating test		point 4
Expert appraisal of the engine		point 6
Appendices: - Fuel analysis - Analysis of lubricants - Output and torque curves - Fuel consumption curves - Heat balance - Pollutant diagrams CO NOx HC PM - Noise emission - Distribution diagram - Characteristic curves, water pump		point 4.2.9 point 4.2.9 point 3.4 point 3.4 Appendix D point 3.5.1 and Appendix A point 3.5.2 point 3.3 point 3.3
Print-outs: - performance test - continuous rating test - parts before and after approval test		point 4.5 point 4.5 point 6

Appendix C - Conclusions of the test engineers concerning the approval tests of the diesel engine

« Designation of firm »

with « number » cylinders

Design model *type of engine*

with a nominal rating of « » kW

at a speed of « » r.p.m.

« 2:4 » stroke

C.1 - Testing schedule

The 100-hour performance test was carried out from: « date » to « date »

The 360-hour continuous rating test was carried out from: « date » to « date »

C.2 - Test interruption

	Time of stoppages	Performance test ^a	Continuous rating test ^a	Reasons	Consequences
Engine					
Test rig					

a. Place a cross where applicable.

C.3 - Approved differences

Parameter	Value indicated by manufacturer	Tolerance	Permissible limit	Value measured during the test (at nominal rating)
Rating		± 1%		
r.p.m.		± 1%		
Temperature of high-temperature cooling water on exit from the engine	normal:	± 3°C		
Low pressure at air induction		≥ 80%		
Induction-system temperature	maximum:	0 - 5°C		
Induction-system pressure	normal:	± 5%		
Exhaust gas temperature	normal:	+ 80°C 0		
Exhaust gas back pressure		≥ 80%		
Fuel temperature		≥ 20°C	≥ 20°C	
Oil consumption		≤ 1,2 X		

C.3.1 - Pollutant emission

Pollutants	Permissible limits (at the time of the request for the approval procedure) (g/kWh)	Specific emissions measured (g/kWh)
CO		
NO _x		
HC		
Particulate matter		
Bosch index		

C.3.2 - Expert appraisal

- Production defects:
- Design deficiencies:

All the measurements taken on the components, before and after the test, and the result of the visual inspection of the dismantled components, together with miscellaneous information (concerning pollution, the heat balance, noise, etc.) are to be provided as an appendix to the test report.

C.4 - Proposed approval by railway representative

« favourable - unfavourable - undecided »

« Place », « date »

For « railway »

For « »

For « »

For « UIC »

« signature »

« signature »

« signature »

« signature »

« typed name »

« name »

« name »

« name »

This document is the property of « firm's name ».

It may not be released to third parties without the permission of that firm.

Appendix D - Engines which have successfully passed a UIC approval test

The list of approved engines can be found on the UIC Website : <http://www.uic.asso.fr/catalog>.

Appendix E - Measured and calculated values on an automated test rig

Manufacturer:

Type:

Computer supplier:

Type:

Designation	No. of measuring points ^a	Sensors		Channels			Output		Observations ^b
		Type	Spec. ^c	No.	Charac-teristics	Freq. ^d	Screen ^e	Printer	
1) Water					(mV/°C)				
Temperature	22 23 etc.								
Throughput	18 19								
Pressure	15 20 21								
2) Oil									
Temperature	16 17								
Throughput									
Pressure	14								
3) Air									
Temperature	42 47 48								
Throughput Hygrometry	43								
Pressure	41 44 45 46								
4) Gas									
Temperature	28 29 30 etc.								
Throughput									
Pressure	37 38 39								
5) Fuel									Min. cal. value: ^f
Temperature Consumption per unit time	10								
6) Mechanical parameters									
r.p.m. of engine	5								
turbo r.p.m.	40								
engine torque	6								
7) Calculated values									
Mechanical engine power		Mathematical expression:							
Mechanical engine output		Mathematical expression:							
Specific consumption		Mathematical expression: ^g							

- a. The reference number used to identify the devices listed at Appendix E. Use the reference numbers shown on the manufacturer's drawing.
- b. Indicate "manual data logging" against the values entered at the calculator keyboard.
- c. Spec: specification according to ISO 3046-3.
- d. Freq indicates the scanning frequency of the different channels and the updating frequency of the calculated values when these appear on the screen.
- e. Output shows whether a value is displayed on the screen and/or the printer.
- f. Indicate the minimum calorific value actually employed.
- g. Indicate the minimum calorific value according to UIC Leaflet 623-2, point 3.4.

Appendix F - Approval procedure for a "derivative" engine

The engine can only be a derivative of an already approved engine which has undergone the full UIC test.

1. The engine manufacturer shall submit his request and send the description of the engine to the "lead railway".
2. The engine manufacturer shall send five copies of the following documents to UIC following the agreement of the lead railway :
 - the request according to points 4.1.1 and 4.1.3 - page 5,
 - the completed Appendix G - page 19,
 - the description of the engine (see *UIC Leaflet 623-2*).
3. UIC shall distribute these documents to the body responsible for the approval. If a meeting of this body seems necessary then it will be organised at the premises of the engine manufacturer. All expenses resulting from that meeting shall be borne by the manufacturer.
4. If a performance test (100 hours) is requested, then this shall be carried out according to *UIC Leaflet 623-2*, or according to another test schedule to be defined by the test engineers with the exception of the pre-test and post-test measurements of the components.
5. UIC shall draft a report drawing on the documents and the test results and forward it to UIC for a decision.
6. If an engine does not entirely fulfill the requirements for a derivative engine but the application of an entire approval procedure seems to lack additional informative value, the Manufacturer may request to have the case discussed by the UIC body responsible for engine certification and to take a decision upon the case.

Appendix G - Proposal for approval of a "derivative" engine

The manufacturer shall be informed that the arrangement and angle of cylinders as well as the indications mentioned in *UIC Leaflet 623-2, point 3.3, numbers 6, 7 (1st and 3rd paragraphs), 8 (1st paragraph), 24 to 25* have to be identical in all engines. The number of cylinders must not be increased, a reduction to 60 % of the number of the approved engine is admitted. Additionally the derivative engine has to comply fully with the requirements of *UIC Leaflet 624 (see Bibliography - page 22)*.

Characteristics	Diesel engine		Difference from approved engine	
	approved (H)	proposed (P)		
Type				
Injection				
Supercharging				
Charge air cooling				
Cylinder bore				
Piston stroke				
Liners				
Complete pistons				
Complete cylinder head				
Connecting rods				
Rated speed (n) ^a				
Mean effective pressure (pme) ^a				
Pollutants (g/kWh) ^b			UIC limit value	
	CO			
	NOx			
	HC			
	Bosch index			
Particulate matter				

- a) The engine is to be classified as derivative, if the following conditions concerning rated speed (n) mean effective pressure (pme), cylinder bore (A) and piston stroke (C) are met:
1. The engine is derivative if
 - $pme (P) \leq 1,05 pme (H)$ and
 - $n (P) \leq 1,05 n (H)$ and
 - $0,975 A (H) \leq A (P) \leq 1,025 A (H)$ (where $A (P) = A (H) \pm 2,5 \%$) and
 - $0,950 C (H) \leq C (P) \leq 1,050 C (H)$ (where $C (P) = C (H) \pm 5 \%$)
 2. The engine is to be subjected to a 100 hour run in order to be classified as a derivative engine if
 - $1,05 pme (H) < pme (P) \leq 1,1 pme (H)$ and
 - $1,05 n (H) < n (P) \leq 1,1 n (H)$ and
 - $A (P) = A (H) +2,5 \text{ to } +5 \%$ or $A (P) = A (H) -2,5 \text{ to } -5 \%$ and
 - $C (P) = C (H) +5 \text{ to } 10 \%$ or $C (P) = C (H) -5 \text{ to } -10 \%$

Where "H" stands for the already approved engine and "P" for the proposed derivative engine.

All engines outside this range must be subjected to the full approval test run.

- b) Pollutant values shall be less than or equal to the limit values in force at the time of the request for the approval procedure.

Proposal of the representative of the lead railway:

(Place a cross where applicable)

The engine is a "derivative" of the approved engine	
The engine must undergo a performance test	
The engine is not a "derivative" and must undergo the full test	

Place:
Date:
For (railway):
Name (in block letters):
Signature:

Appendix H - List of principal documents to be provided with the test report of the "derivative" engine

	<i>UIC Leaflet 623</i>		<i>UIC Leaflet 624</i>
	<i>UIC Leaflet 623-1</i>	<i>UIC Leaflet 623-2</i>	
Summary	Appendix G - page 19		
Presentation file of the derivative engine		point 3	
Detailed description of the differences between the approved and the derivative engine	Appendix G		
"Conclusions" file			point 5
Running of the test: - characteristic curves - emission test		point 4	point 4.3
Appendices: - Proposal for approval of a derivative engine - Minutes of the preliminary meeting - Fuel analysis - Analysis of lubricants - Power and torque curves - Fuel consumption curves - Thermal balance - Pollutants: diagrams CO NOx HC - Particulates in the measuring points ^a	Appendix G point 4.2.6 - page 6	point 4.2.9 point 3.4 point 3.4 Annexe D	point 4.3.3 point 4.4.1 and Appendix B
Measurement sheet: - Exhaust emission test			Appendix B

a. Mandatory from 1.1.2003.

Bibliography

1. UIC leaflets

International Union of Railways (UIC)

UIC Leaflet 623-2 : Approval tests for diesel engines of motive power units, 5th edition, January 2008

UIC Leaflet 623-3 : Series test and acceptance conditions for diesel engines of motive power units, 3rd edition, December 2003

UIC Leaflet 624 : Exhaust emission tests for diesel traction engines, 3rd edition, February 2006

2. International standards

International Organization for Standardization (ISO)

ISO 8178-1:1996: Reciprocating internal combustion engines - Exhaust emission measurement - Part 1: Test-bed measurement of gaseous and particulate exhaust emissions, 1996

ISO 8178-2:1996: Reciprocating internal combustion engines - Exhaust emission measurement - Part 2: Measurement of gaseous and particulate exhaust emissions at site, 1996

ISO 8178-3:1994: Reciprocating internal combustion engines - Exhaust emission measurement - Part 3: Definitions and methods of measurement of exhaust gas smoke under steady-state conditions, 1994

ISO 8178-4:1996: Reciprocating internal combustion engines - Exhaust emission measurement - Part 4: Test cycles for different engine applications, 1996

ISO 8178-5:1997: Reciprocating internal combustion engines - Exhaust emission measurement - Part 5: Test fuels, 1997

ISO 8178-6:2000: Reciprocating internal combustion engines - Exhaust emission measurement - Part 6: Report of measuring results and test, 2000

ISO 8178-7:1996 : Reciprocating internal combustion engines - Exhaust emission measurement - Part 7: Engine family determination, 1996

ISO 8178-8:1996: Reciprocating internal combustion engines - Exhaust emission measurement - Part 8: Engine group determination, 1996

ISO 8178-9:2000: Reciprocating internal combustion engines - Exhaust emission measurement - Part 9: Test cycles and test procedures for test bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions, 2000

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