ORGANISATION INTERNATIONALE

DE MÉTROLOGIE LÉGALE

INTERNATIONAL RECOMMENDATION

Test report format for the evaluation of load cells

(Annex A to OIML R 60, 1991 edition)

Format du rapport d'essai des cellules de pesée

(Annexe A à OIML R 60, édition 1991)

OIML R 60-Annex A

Edition 1993 (E)

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FOREWORD

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

1) **International Recommendations (OIML R),** which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;

2) **International Documents (OIML D),** which are informative in nature and intended to improve the work of the metrological services.

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INTRODUCTION

The objective of the *Test report format for the evaluation of load cells,* Annex A to the OIML International Recommendation R 60 *Metrological regulation for load cells,* is to provide a standard format for the presentation of test results obtained when evaluating a load cell in conformity with the test procedures described in OIML R 60.

In the framework of the *OIML Certificate System for Measuring Instruments,* applicable to load cells in conformity with R 60 (1991 edition), use of this test report format is mandatory, in French and/or in English with translation into the national languages of the countries issuing such certificates, if appropriate.

Note concerning the numbering of pages

Some of the tests may have to be repeated several times and reported using several identical sheets; therefore, report pages must be numbered in the space provided at the top of each page, completed by the indication of the total number of pages.

CALCULATION PROCEDURES

Preliminary note concerning abbreviations

In order to facilitate a comparison of the reports established in English and in French, the same abbreviations (those of the English language) are used in both versions; the meaning of these abbreviations is given whenever appropriate.

In testing and evaluating load cells for pattern evaluation it is recognized that the test apparatus and practices used by the various laboratories will be different. OIML R 60 *Metrological regulation for load cells* allows for these variations and still provides a method for testing, recording, and calculating results that are readily understandable by other knowledgeable parties reviewing the data.

In order to achieve this ease of comparability it is necessary that those persons conducting tests use a common system for recording data and calculating results.

Thus, it is essential that the calculation procedures below be reviewed and followed closely in the completion of this test report.

Load cell errors (E_L = Error Load test)

1 Complete a Table A.1 for each test temperature, calculate the averages and record in the right hand column of Table A.1. When more than three runs are necessary, use another sheet and renumber runs 1, 2, and 3 to 4, 5, and 6, etc.

2 Determine factor (f). This factor is the number of indicated units per verification interval (v) and is used to convert all "indicated units" to "v", and is determined from the test data averages of the increasing load tests at the initial 20 °C nominal test temperature.

If a test load corresponding to 75 % of the measuring range for the load cell under test (i.e. 2 250 divisions for a 3 000 division cell, which is D_{min} plus 75 % of the difference between D_{max} and D_{min}) is not included in the test loads used in Table A.1, interpolate between the adjacent upper and lower values of the averages of all three test runs and record on Table A.2 (see OIML R 60, 6.2).

Calculate the difference between the average indication on the increasing load test runs at 75 % of the difference between D_{max} and D_{min}, and divide the result (to five significant figures) by the number of verification intervals (75 % n) for that load to obtain the factor (f) and record on tables that follow.

$f = [\text{indication at } 75\ \% \times (D_{max} - D_{min}) - \text{indication at } D_{min}] / (0.75 \times n)$

3 Enter the average test indications of the tests at the temperatures following the initial test at a nominal 20 °C, on Table A.2. In recording this data, indicate a "no test load" indication as "0". This may require subtracting the "no load indication" from the "test load indication" so that the first entry in the column is "0". These "0s" have been preprinted on the form to clarify that a dead load condition is recorded as "0".

4 Calculate the reference indication by converting the net test load in mass units to "v" units by multiplying by the factor (f) for each test load and recording in the 2nd column in Table A.2.

$R_i = [(\text{test load} - D_{min}) / (D_{max} - D_{min})] \times n \times f$

$f = \text{units/v}$

5 In Table A.2 calculate the difference between the average test indication and the reference indication for each test load at each test temperature and divide by f to obtain the error for each test load in terms of v.

$E_L = (\text{average test indication} - \text{reference indication}) / f$

6 Compare E_L with the corresponding maximum permissible error (mpe) for each test load.

Repeatability error (E_R = Error Repeatability)

1 Enter the test indications for the three test runs for each temperature from Table A.1 to Table A.3.

2 Calculate the maximum difference between the three test indications and divide by f to obtain the repeatability error in terms of v.

$E_R = (\text{maximum indication} - \text{minimum indication}) / f$

3 Compare E_R with the absolute value of the corresponding mpe for each test load.

Temperature effects on minimum dead load output (MDLO) (C_M = Change MDLO)

1 Enter on Table A.4 the average indication for the initial minimum load for each test temperature from Table A.1.

2 Calculate the difference between the average test indications for each temperature in sequence and divide by f to obtain the change in terms of v.

$C_M = (\text{indication at } T_2 - \text{indication at } T_1) / f$

Divide C_M by $(T_2 - T_1)$ and multiply the result by 5 to determine the change in v per 5 °C.

Multiply the result by the number of v_{min} per v in terms of mass $[(D_{max} - D_{min})/n] / v_{min}$ (as stated by the manufacturer).

This result must not exceed 0.7.

Creep and minimum dead load output return (MDLOR) (C_C = Change Creep, C_{MDLOR} = Change MDLOR)

1 From the test indications recorded on Table A.5, calculate the greatest difference between the initial indication obtained at the test load after the stabilization period and any indication obtained over the 30 minute test period and divide by f (f must be recalculated if D_{max} and D_{min} for this test differ from those in the load test) to obtain the creep error in terms of v.

$C_C = (\text{indication} - \text{initial indication}) / f$

2 C_C must not exceed 0.7 times the absolute value of the mpe for the test load.

3 Calculate the difference between the test indications obtained at 20 minutes and 30 minutes after the initial load application and divide by f to obtain the creep error in terms of v.

$C_C\ (30 - 20) = (\text{test indication at 30 minutes} - \text{test indication at 20 minutes}) / f$

4 C_C (30 – 20) must not exceed 0.15 times the absolute value of the mpe for the test load.

5 Calculate the difference between the test indication at minimum load before and after the creep test and divide by f to obtain the minimum dead load output return error in terms of v.

C_{MDLOR} = (minimum load indication$_2$ – minimum load indication$_1$) / f

6 C_{MDLOR} must not exceed 0.5 v.

Barometric pressure effects(*) (C_P = Change Barometric Pressure)

1 From the test indications recorded on Table A.6, calculate the difference between the indications for each pressure and divide by f to obtain the change in terms of v.

C_P = (indication$_{P2}$ – indication$_{P1}$) / f

Divide by ($P_2 - P_1$) to determine change in v per kPa.

Multiply the result by v in terms of mass [($D_{max} - D_{min}$) / n] / v_{min} (as stated by the manufacturer) to obtain the result in terms of v_{min} per kPa.

The result must not exceed 1.

Humidity effects(**) (C_{Hmin} = Change Humidity effects min)

1 From the test indications recorded on Table A.7, calculate the difference between the initial indications for minimum load before and after the damp heat test and divide by f (f must be recalculated if D_{max} and D_{min} for this test differ from those in the load test) to obtain the change in terms of v.

C_{Hmin} = (minimum load indication$_{after}$ – minimum load indication$_{before}$) / f

2 C_{Hmin} must not exceed 0.04 n.

3 Calculate the average indications at minimum load and D_{max} (see R 60, 15.5.5) for the required number of test indications, before and after the damp heat test. Subtract the average minimum load indication from the average D_{max} indication for each test and then calculate the difference between the results before and after the damp heat test. Divide the difference by f to obtain the change in terms of v.

C_{Hmax} = [(indication at D_{max} – indication at $D_{min})_{after}$ – (indication at D_{max} – indication at $D_{min})_{before}$] / f

4 C_{Hmax} must not exceed 1 v.

General notes

The calculations made do not include the application of R 60, 6.1. To ensure that these requirements are met, the calculations should be carried out using lower n values than the n_{max} specified.

It should be sufficient to carry out the calculations with:
$n = n_{max} - 500$ and $n = n_{max} - 1\,000$ (provided $500 \leq n$).

Performing this check should not be difficult as the calculations will in all probability be automated.

Check to make certain that $v_{min} \leq v$
$v_{min} \leq (D_{max} - D_{min}) / n$

(*) This test may not be necessary depending on the design of the load cell.

(**) This test is not necessary if the load cell is marked NH.

TEST REPORT FORMAT for the EVALUATION of LOAD CELLS

Annex A to OIML International Recommendation R 60
Metrological regulation for load cells

Note: This Annex is informative with regard to implementation of Recommendation R 60 in national regulations; however, use of the test report format is mandatory for the application of the Recommendation within the OIML Certificate System.

Information concerning the pattern (provided by the manufacturer)

Application N°: .....

Application date: .....

Model designation: .....

Manufacturer: .....

Address: .....

.....

Applicant: .....

Address: .....

.....

Representative: .....
(name, telephone)
.....

Instrument category: Load cell

Accuracy class: [ ] A [ ] B [ ] C [ ] D

Maximum number of load cell intervals (n_{max}): .....

Direction of loading: [ ] Tension [ ] Beam (shear)
[ ] Compression
[ ] Universal [ ] Beam (bending)

Safe load limit (Lim): .....

Limits of working temperature:
Upper: [ ] + 40 °C [ ] Other: ..... °C
Lower: [ ] – 10 °C [ ] Other: ..... °C

Non-humidity Classification (NH): [ ] Yes [ ] No

Load cell excitation: Max: ..... V ac[ ] dc[ ]. Recommended: ..... V ac[ ] dc[ ].

Information concerning the pattern (cont.)

Application N°: .....

Other conditions that must be observed to obtain the specified performance (for example, electrical characteristics of the load cell).
Specify:

. .

. .

. .

Load cell(s) submitted:

Model designation	Serial number	E_{max}

Various designs within model range:

Maximum capacity (E_{max}) - Minimum load cell interval (v_{min}) - Minimum dead load (E_{min}):

Maximum capacity (kg or t)	v_{min} (kg or t)	E_{min} (kg or t)	n_{max}

Secondary equipment (specify load adapters, etc.):

. .

. .

Remarks:

. .

. .

General information concerning test conditions (R 60, 14)

Application N°: .....

Load cell model: ..... E_{max}: ..... Serial N°: .....

Force generating system - Description(*): .....

. .

. .

. . Minimum load for test: .....

Readout instrument - Description(*): .....

. .

. .

. .

Environmental equipment - Description(*): .....

. .

. .

. .

Temperature: .....

. .

Humidity: .....

..

Barometric pressure: .....

..

Test location: .....

..

Acceleration of gravity at test location: .....

Date: .....

Evaluator: .....

(*) Include information concerning accuracy traceability (for example, accredited laboratory).

Summary of the test

Application N°: .....

Load cell model: ..... E_{max}: ..... Serial N°: .....

N°	Test description	+	–	Remarks
A.2	Load cell errors (E_L)			
A.3	Repeatability error (E_R)			
A.4	Temperature effects on MDLO (C_M)			
A.5	Creep test (C_C)			
A.5	MDLOR test (C_{MDLOR})			(*)
A.6	Barometric pressure effects (C_P)			
A.7	Humidity effects (C_{Hmin})			
A.8	Marking requirements			

Notes:
+ The load cell has passed the test
– The load cell has failed the test
/ The test is not applicable
(*) Record error to accommodate OIML R 76

Remarks: .....

. .

. .

. .

Date: .....

Evaluator: .....

A.1 **Load test data** (R 60, 15.1 - establish one sheet for each test temperature)
Ref. to R 60: 15.1.2, 15.1.4, and 15.1.5 through 15.1.10

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Temperature: ..... °C Humidity: ..... %RH Bar. pres.(start): ..... kPa
(end): ..... kPa

Table A.1

Test load (kg)	Run n° 1		Run n° 2		Run n° 3		Average indication runs 1, 2 and 3
	Indication (units)	Time	Indication (units)	Time	Indication (units)	Time	
0			x	x	x	x	x
			x	x	x	x	x
0			x	x	x	x	x
			x	x	x	x	x
0			x	x	x	x	x
			x	x	x	x	x
0			x	x	x	x	x
0							

Test date: .....

Evaluator: .....

A.2 **Load cell errors** (E_L) calculation (R 60, 5.1)
Ref. to R 60: 15.1.4, and 15.1.5 through 15.1.10

Application N°: .....

Model:..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine:..... Instrument: .....

Temperature: .XXX.°C Humidity: .XXX.%RH factor (f): .....

Table A.2

Test load (kg)	Reference indicat. (units)	. . . . °C (20 °C)		. . . . °C		. . . . °C		. . . . °C (20 °C)		mpe (v)
		Indicat. (units)	Error (v)	Indicat. (units)	Error (v)	Indicat. (units)	Error (v)	Indicat. (units)	Error (v)	
0	0	0		0		0		0		

Minimum load (D_{min}): .....

Notes:

1 Load/Reference indications: if a 75 % load point was not obtained, a straight line interpolation between the adjacent higher and lower load point indications is used. (See R 60, 6.2 and calculation procedures in this Annex.)

2 Error: the difference between the test indication (units) and the reference indication (units) divided by the factor (f).

Date: .....

Evaluator: .....

A.3 **Repeatability error** (E_R) calculation (R 60, 9.0 - establish one sheet for each test temperature)
Ref. to R60: 15.1.4, 15.1.5 through 15.1.10, and 15.1.14

Application N°: .....

Model:..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Temperature:..... °C Humidity: ..... %RH factor (f): .....

Table A.3

Test load (kg)	Run n° 1	Run n° 2	Run n° 3	Error (v)	mpe (v)
	Indication (units)	Indication (units)	Indication (units)		

Note:

Error: the maximum difference between the three test indications (units) divided by the factor (f).

Date: .....

Evaluator: .....

A.4 **Temperature effects on MDLO** (C_M) calculation (R 60, 10.1.3)
Ref. to R 60: 15.1.4, 15.1.5 through 15.1.10, and 15.1.15

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Temperature: .XXX.°C Humidity: .XXX.%RH factor (f): .....

Table A.4

Temperature °C	Indication (units)	Change (v)	Change (v_{min}/5 °C)	mpc (v_{min}/5 °C)
		- - -	- - -	- - -
				0.7
				0.7
				0.7

Notes:

1 MDLO: minimum dead load output.

2 Indication (units): the average initial minimum load indication obtained from Table A.1.

3 mpc (maximum permissible change): (v_{min}/5 °C) for classes B, C, and D; (v_{min}/2 °C) for class A.

4 Change (v): the difference between the observed indication (units) and the indication (units) at the prior temperature divided by the factor (f).

Date: .....

Evaluator: .....

A.5 **Creep test** (C_C) (R 60, 15.2 and 7.1) and **MDLOR test** (C_{MDLOR}) (R 60, 15.3 and 7.2) (establish one sheet for each test temperature)

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Temperature: ..... °C Humidity: ..... %RH factor (f): .....

Table A.5

Test load (kg)	Indication (units)	Barometric pressure	Time	Change (v)	mpc (v)
0					
0					
0					
0					
0					
0				C_{MDLOR}	
Difference	20 - 30 minutes				

Notes:

1 MDLOR: minimum dead load output return.

2 mpc (maximum permissible change) for creep: the observed indication minus the initial "load" indication divided by the factor (f).

3 Determine the difference of the indication between 20 and 30 minutes (see R 60, 7.1).

4 mpc (maximum permissible change) for MDLOR: the initial indication minus the initial "no load" indication divided by the factor (f).

Test date: .....

Evaluator: .....

A.6 **Barometric pressure effects** (C_p) (R 60, 15.4 and 10.2)

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Temperature: ..... °C Humidity: ..... %RH factor (f): .....

Table A.6

Pressure (kPa)	Indication (units)	Time	Change (v)	Change (v_{min}/kPa)	mpc (v_{min}/kPa)
			0	0	0
					1.000
					1.000
					1.000
					1.000

Notes:

1 mpc (maximum permissible change): the difference between the observed indication (units) and the initial indication (units) divided by the factor (f).

2 Although subclause 15.4 of R 60 specifies a change of only 1 kPa for this test, additional measurements may be taken.

Test date: .....

Evaluator: .....

A.7 **Humidity effects** (C_{Hmin})* (R 60, 15.5 and 7.3)

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: ..... n_{max}: .....

Test machine: ..... Instrument: .....

Chmbr.Temp.(high): ..... °C Humidity: ..... %RH factor (f): ..... Date before: .....

Chmbr.Temp. (low): ..... °C Humidity: ..... %RH Date after: .....

Table A.7

Test load (kg)	Before humidity test (DHT)		After humidity test (DHT)		Change (v)	mpc (v)
	Indication (units)	Time	Indication (units)	Time		
0						
0						
0						
0						
0						
0						
0						
0						
Average (*)						1.00

(*) Average: see R 60, 7.3.2

Notes:

1 This test is not necessary if the load cell is marked NH.

2 mpc (maximum permissible change): the difference between the after indication (units) and the before indication (units) divided by the factor (f).

Date: .....

Evaluator: .....

A.8 **Marking requirements** (R 60, 4.7)

Application N°: .....

Model: ..... Serial N°: ..... E_{max}: .....

Table A.8

R 60 clause	Information to be marked	On cell	On document
4.6.1	Accuracy class		
4.6.2	Maximum number of intervals		
4.6.3	Direction of loading		
4.6.4	Special limits of temperature		
4.6.5	Symbol "NH"		
4.6.6 4.7	Manufacturer's name and address or trademark		
4.6.6	Manufacturer's designation (model)		
4.6.6	Serial number	(*)	(*)
4.6.6	Year of manufacture		
4.6.6	Minimum dead load		
4.6.6	Maximum capacity		
4.6.6	Safe load limit		
4.6.6	Minimum verification interval		
4.6.6	Other pertinent conditions		
4.6.7	Classification symbol		
4.6.8	Multiple classifications		

(*) Required on both

Notes:

Indicate by + that the marking is present
" " – " " " is not present
" " / when not applicable

Remarks: .....

. .

. .

Date: .....

Evaluator: .....