

INTERCOMPARISONS

NAWI intercomparison carried out by the APLMF

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Intercomparisons in the field of legal metrology

An intercomparison on non-automatic weighing instruments (NAWI) carried out by the Asia-Pacific Legal Metrology Forum (APLMF)

General introduction on intercomparisons in the field of legal metrology

One important element to facilitate international trade is the acceptance of measurement results since the price of goods and services is based on a number of quantitative and qualitative parameters, many of which are determined through measurements.

Several international bodies are concerned with this matter, including the Meter Convention (which has developed a mutual acceptance agreement on the equivalence of national measurement standards and measurement certificates based on a system of inter-comparisons), ISO and the IEC (for example through the standardization of measurement methods) and the OIML (in so far as measuring instruments covered by OIML Recommendations are used in international trading operations). As a result of the role it has played, the OIML has been granted observer status by the WTO TBT Committee, within which several international organizations (ISO, IEC, OIML, etc.) cooperate closely.

Another of the OIML's responsibilities is to develop mutual acceptance of type approval certificates with a view to reducing the redundancy of national or regional legal metrology controls.

In order to reach these goals, the *OIML Action Plan* provides for the organization of intercomparisons (preferably at the regional level) concerning:

- testing standards and equipment, in order to prove their equivalence; and
- measuring instruments, in order to prove that the participating legal metrology laboratories may implement OIML requirements in a uniform manner.

In addition, the BIML has the responsibility to publish the results of such intercomparisons in order to keep other countries and regions informed.

It is not practical, especially due to the large number of pages involved, to publish intercomparison reports in the OIML Bulletin in their entirety. Current policy is therefore to publish only a summary, the complete report being accessible on the OIML web site and/or the site of the Regional Legal Metrology Organization concerned.

The APLMF intercomparison on NAWI

Below is a summary of the report published by the National Standards Commission (NSC) of Australia, Pilot Secretariat for this APLMF intercomparison, carried out between June 1996 and April 2000. The complete report, dated July 2000, is available for download on the OIML web site www.oiml.org. The summary has been compiled by the BIML and approved by the APLMF and the NSC.

1. Purpose of the intercomparison

The scope of the intercomparison of non-automatic weighing instrument testing is to provide a transparent basis for the comparability of pattern approval evaluation of weighing instruments carried out by legal metrology authorities in the Asia-Pacific region. It is expected that these results will make a significant contribution to mutual recognition agreements between participating members. Some members of WELMEC have also participated to provide a comparability with pattern evaluation testing in the Western European Region.

The OIML is responsible for providing the means for harmonization of legal metrology requirements for its Members. One such means is the *OIML Certificate System* whereby an OIML Member can (under certain

conditions) issue an OIML certificate and a test report for a particular measuring instrument and these can be accepted by other Members as a basis for their own pattern approval without further testing. This system forms the basis for mutual recognition agreements between Members. However acceptance of tests conducted by other laboratories is only likely if there is mutual confidence in the capabilities of laboratories. This intercomparison is aimed at fostering such confidence.

2. Participants

The following agreed to participate in the intercomparison: Australia, Canada, People's Republic of China, Germany, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Russia, Chinese Taipei, United Kingdom and the United States of America. Two State laboratories represented the USA.

3. Artefacts

Two non-automatic weighing instruments were circulated among the participants. These instruments were of a type intended for direct trading with the public and had tare and price computing facilities.

The instruments were of the same pattern:

Manufacturer: CAS Corporation
 Model: CAS AP-1
 Class: 3
 Maximum capacity: 15 kg
 Verification scale interval (e): 0.005 kg
 Temperature range: -10 °C to +40 °C
 Nominal voltage: 220 V

4. Instructions for the intercomparison

Detailed instructions were provided to all participants in order to eliminate deviations in the examination and testing that might result in inconsistencies in the evaluation results. These instructions mainly covered:

- a visual inspection of the equipment when received, its initial set-up and calibration;
- the preliminary tests;
- the examinations and test to be carried out (according to OIML R 76-1);
- the test report to be completed (according to OIML R 76-2); and

- the dispatch of the instrument to its next destination (including customs formalities).

5. Circulation schedule

Due to a number of factors, the final circulation schedules for the two instruments differed from the initial schedules. Table 1 gives these final schedules, and notes explain certain delays in the circulation, resulting from technical or administrative constraints.

6. Comments on the instruments

The two instruments used for the intercomparison were purchased by the Commission from the local agent for CAS Corporation. The instruments were common, class III non-automatic weighing instruments of electronic, load cell type intended for direct trading with the public and having tare and price computing facilities.

On receipt of the instruments preliminary tests were carried out to establish whether they were suitable for the intercomparison. The tests revealed that there were some areas of non-compliance with R 76 but this was not considered to be a problem. In fact it was considered that an instrument with some points of non-compliance would be beneficial for an intercomparison, particularly if the performance was near a specified limit of error.

In particular the Commission noted that for both instruments the temperature effect on no-load indication exceeded the error limit considerably and that the temperature effect on the weighing performance was close to the limits of the maximum permissible errors at some temperatures. The latter affected other weighing performance tests such as tare and damp-heat as well. In addition the instruments were affected by radiated electromagnetic fields at some frequencies. The Commission found that the instruments showed a tendency to creep during the load tests. One laboratory also commented on a tendency for Instrument A to drift which caused errors during decreasing load tests.

However the instruments showed good repeatability and as it turned out they maintained their performance over the whole period of the intercomparison despite breakdowns and other mishaps. Both instruments, when retested by the Commission, showed similar but not quite the same results as they did on the initial tests. Both instruments were damaged once during an electrostatic discharge test with the keyboard failing when a discharge was applied to the keyboard. Both were repaired by the local CAS agent in the country where the damage was done and both continued to perform after the repair. On its return to the Commis-

sion Instrument B was found not to perform at maximum capacity. A piece of plastic was removed from the bump stop for the load cell and this fixed the problem. Instrument A did not have the piece of plastic. Instrument A lost the liquid in the level indicator but the subsequent laboratory in the schedule performed the tilt test as if there was no level indicator. The level indicator was replaced on return to the Commission. Three test reports for the temperature effect on zero indication for Instrument B showed a dramatically different performance to the others. Perhaps the instrument was re-zeroed between tests. Instrument A did show a shift in the temperature effect on span for -10 °C for the last two tests.

7. Comments on the test results

As described above, the instruments were reliable and repeatable enough to provide meaningful results on all tests included in the intercomparison. There was a fair degree of agreement in the test results by all laboratories for both instruments. The performance of both instruments was very similar. As agreed, the results for the initial tests obtained by the Commission as the Pilot Laboratory are considered to be the reference results.

A large number of graphs and tables have been prepared for both instruments showing the results obtained by each laboratory and are included in the

Table 1 Final circulation schedules for the two instruments

	Country	Organization	Import date	Export date
Instrument A serial no. 95111021	Australia	National Standards Commission		22.7.96
	New Zealand	Trade Measurement Unit	5.8.96	7.10.96
	USA	Ohio Department of Agriculture	11.10.96	23.12.96
	Canada	Measurement Canada	3.1.97	?
	USA	California Division of Measurement Standards	? ¹	27.5.97
	Japan	National Research Laboratory of Metrology	2.6.97	16.7.97
	Australia	National Standards Commission	10.8.97	19.11.99
	Canada	Measurement Canada	14.12.99 ²	16.5.00
	Australia	National Standards Commission	25.5.00	
Instrument B serial no. 95111033	Australia	National Standards Commission	—	22.7.96
	China	China State Bureau of Technical Supervision	18.8.96	12.9.96
	Germany	Physikalisch-Technische Bundesanstalt	18.10.96	2.1.97
	United Kingdom	National Weights and Measures Laboratory	6.1.97 ³	4.9.97
	Australia	National Standards Commission	28.9.97	17.3.98
	Russia	Russian Research Institute for Metrological Services	22.5.98 ⁴	29.6.98
	Korea	Korean National Institute of Technology and Quality	6.7.98	7.8.98
	Chinese Taipei	National Bureau of Standards, Electronics Testing Center	12.8.98	23.10.98
	Malaysia	SIRIM	25.8.99 ⁵	1.12.99
	Australia	National Standards Commission	3.12.99	13.1.00
	Indonesia	Directorate Metrology	20.1.00	6.3.00
	Australia	National standards Commission	12.4.00	

¹ Instrument failed and had to be repaired by a CAS agent.

² Canada requested to retest the instrument, as results from the first test were not available.

³ Instrument had to be repaired which caused considerable delay. The instrument was returned to the Pilot Secretary for retesting.

⁴ Instrument held up in Russian Customs.

⁵ Instrument misplaced at the wrong address in Malaysia for nearly a year.

Annexes of the complete text of the report. These have been drawn up to show the difference in results between laboratories as well as the comparison with the maximum permissible errors specified. A comparison has also been made between the conclusions reached by each laboratory for the checklist.

As a measure of the degree of concurrence between laboratories, the maximum difference between the reference results and all other results are shown on the graphs and can be compared with the applicable maximum permissible error. However no matter how small this may be, if one result is just inside the maximum permissible errors and one is just outside, then the final decision of whether the instrument passes or fails will be different.

A comparison has also been made of the test facilities and standards used by each laboratory for the tests.

The complete text of the report contains detailed comments on each test for each instrument.

8. Comments on the checklist

The checklist forms the second major part of the OIML R 76-2 test report. It has to be completed to show whether or not the pattern complies with the functional requirements of OIML R 76. The report requires the laboratory to mark either the 'passed' or 'failed' columns against each item with an 'X' depending on the result of the examination. If the item is not applicable to that pattern both columns should be marked with a '/'.

Figures A.12 and B.12 of the Annexes to the complete text of the report compare laboratories and for each instrument show how the checklist was completed. Some laboratories also recorded remarks in the appropriate column.

Some of the laboratories:

- made up their own copy of the checklist which was not identical with OIML R 76-2, e.g. it had different page numbers, items were on a different page and some items were missing;
- did not use the correct symbols to complete the columns for 'passed', 'failed' or 'not applicable';
- did not enter symbols for all requirements.

For the purpose of accepting reports from other laboratories as part of the *OIML Certificate System*, it is important for the reports to be uniform in all respects.

When looking at the results specific to Instruments A and B, one may notice that although there was considerable agreement between laboratories, there were some disagreements.

Overall most laboratories failed the checklist in the Summary of Pattern Evaluation. However one laboratory (Instrument A) and two laboratories (Instrument B) recorded 'passed' while, in both cases, one laboratory recorded neither 'passed' nor 'failed'. The Pilot Laboratory did not repeat the checklist on the return of the instrument.

Figures A.12 and B.12 compare the results for each item given by each laboratory for Instruments A and B respectively. As the two instruments are the same, the charts for each instrument can also be compared. All participants can therefore see the differences and compare their results with other laboratories. The items for which significantly different results were obtained are listed and commented in the complete text of the report.

9. Test facilities and standards

Figures A.13 and B.13 of the annexes to the complete text of the report compare the test facilities and standards used by the laboratories in the inter-comparison tests of Instruments A and B respectively.

10. Conclusions and recommendations

Despite a number of problems which developed during the intercomparison and the extra time required to complete the circuit of test laboratories, the intercomparison can be considered a success as it has provided meaningful results on the capability of the laboratories to test non-automatic weighing instruments to the requirements of OIML R 76.

Although the results show general agreement on the performance of the instruments, there are enough differences to require consideration by the APLMF to determine the conclusions and recommendations of the intercomparison. Some of the differences are explainable and can be overcome. However others are not. In particular the varying interpretations of the requirements in the checklist need some consideration.

The Pilot Laboratory, Australia tested the two instruments three times, i.e. at the beginning and end of the circuit as well as in between. The results are not exactly the same for each test but there is reasonable agreement for the tests for Instrument B showing that its performance remained stable. However the results for Instrument A indicate that its performance did change by a small amount but the results are still comparable. ■