

THE FINAL WORD

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CALIBRATION OF LABORATORY EQUIPMENT

Calibration is process in which equipment performance is compared against better accuracy standard; essentially which should be traceable to SI unit or to primary standard of country.

The formal definition of calibration by the International Bureau of Weights and Measures(BIPM) is the following:”Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indication with associated measurement uncertainties (of the calibrated instrument or secondary standard) and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.”

For physical standards like Mass, Volume, length, temperature generally NPL (National physical laboratory) is consider as primary reference in India. NPL provide traceability to International system (SI unit).

The laboratory is maintaining at present six out of seven SI base units. These are meter, kilograms, second, kelvin, ampere candela. R&D work is under way for realizing and establishing the seventh SI base unit of mole (mol). The SI supplementary units are radian (rad) & steradian (sr).

At present seventh SI based unit mole is traceable to NIST (National institute of standard material, USA).

Results produce by laboratory may have problem due to equipment; which can be ascertain against assigned or known value by means of traceable reference standard.

NABL (National accreditation board for testing and calibration laboratories) accredits various calibration based on their technical competence and ascertain unbroken chain of traceability to SI unit. Any calibration made by NABL accredited laboratory is traceable to SI unit.

Different types of calibrations are:

- ✦ **Mass:** Weights, Weighing balance etc.
- ✦ **Thermal:** Thermometers, Thermal sensors, Hot air ovens, Water baths, Muffle furnaces, and other temperature measuring equipment.
- ✦ **Volume:** Volumetric cylinders, pipets, burettes, and other volumetric equipment.
- ✦ **Electro technical :** uv visible spectrophotometer, Flame photometer, Gas chromatography detectors, HPLC pumps, Atomic absorption spectrometers, pH meter, Electrical Conductivity meter etc.
- ✦ **Electrical:** Ampere, volts etc.

Characteristics of Calibration

- ✦ **Accuracy:** Is the closeness to true value Or ratio of error to the full scale output.
- ✦ **Tolerance:** deviation from the value specified by standard; which is accepted. For example if test method of moisture mentions that temperature of oven should be 100 ± 5 oC means the maximum error permissible in temperature is 5 oC from 100 oC and hence calibration of

oven should be done with reference thermometer having uncertainty of measurement less than $\frac{1}{4}$ of 5 °C i.e. 1.25 °C. Here tolerance is 5 °C at 100 °C.

- ✦ **Traceability:** Traceability is defined by ANSI/NCSL Z540-1-1994 (which replaced MIL-STD-45662A) as “the property of a result of a measurement whereby it can be related to appropriate standards, generally national or international standards, through an unbroken chain of comparisons.”
- ✦ **Uncertainty of measurement:** It is the process of identification and evaluation of the factors that affects the results of calibration significantly.

Standards' accuracy requirements:

- Standard used for calibration must have 10:1 accuracy or must have at least $\frac{1}{4}$ th Measurement uncertainty than Device under calibration.
- It must be traceable to SI unit.
- It should have appropriate life or stability to produce same values.

Some typical example of Chemical laboratory equipment calibration:

UV Visible spectrophotometer:

- ✦ Control of absorbance: it is performed using 0.006 % $K_2Cr_2O_7$ Solution. Absorbance of this solution at 235, 257, 313 and 350 nm wavelength is measured and from which value of A is calculated for which USP, IP and other pharmacopoeia has given limits. Healthy instrument should pass this test.
- ✦ Wavelength accuracy: It is measured using holmium oxide glass filter or Holmium perchlorate solution, Instrument should produce specific peaks when scanned in UV and visible region using one of these with + 1 nm accuracy to comply the test.
- ✦ Limit of stray light: It is done with traceable solution of 1.2 % KCl, and absorbance at 200 nm should be greater than 2.0 to comply the test.

- ✦ Resolution power: It is performed using traceable hexane.
- ✦ Carrier Gas flow: It is measured using calibrated bubble manometer
- ✦ Detector response: It is deferent for different detector e.g for FID it is done using mixture of traceable hydrocarbon.
- ✦ Oven temperature accuracy

pH meter

- ✦ pH 4, pH 7 and pH 9.2 comparison against NIST or BAM traceable buffer.

Electrical conductivity meter:

- ✦ Comparison against Traceable conductivity reference standard of different conductivity KCl solutions

Atomic absorption spectrometer:

- ✦ Absorbance of 5 ppm traceable copper solution should be more than 0.650
- ✦ Using traceable reference standard of Individual metals to prepare calibration curve.

Any calibration report must contains following as they are very essential components in calibration reports.

- Statement of Uncertainty of Measurement with + MU value.
- Status of traceability of reference standard against which calibration is made.

Bibliography

- 1 JCGM 200:2008 International vocabulary of metrology
- 2 NPL web site.

Details of Summer Inplant Training of M.Sc Industrial Chemistry Second Semester Students (May 2018)

NO.	Name of Student	Name of Company
1	ABHISHEK JAYESHKUMAR RAVAL	Kusha Chemicals Pvt. Ltd., Godhra
2	ARPAN AJAYKUMAR SHAH	Lupin Ltd., Dabhaha
3	ARPITKUMAR SURESHBHAI PATEL	Gujarat Fluorochemicals Ltd., Panchmahal
4	ASHISHKUMAR FULABHAI PONKIYA	Aalidhra Pharma Pvt. Ltd., Nandesari
5	ASHUTOSH PANKAJBHAI PATEL	Centurion Laboratories Pvt. Ltd., Savli
6	BHAUMIK SURESH PATEL	Pharmanza Herbal Pvt., Ltd. Kaniya
7	BHAVESHKUMAR RAJNIKANT MODI	Zydus Pharma Ltd., Ankleshwar
8	BHAVIN ARJAN NANDANIA	Zydus Pharma Ltd., Ankleshwar
9	CHARULKUMAR NANDABHAI KATHIRIYA	Ambuja Cement Ltd., Kodinar
10	DARSHAK PRAVINBHAI PANSURIYA	CLR Industries, Vidhyanagar
11	DAYABHAI ARJANBHAI KAMALIYA	Aditya Birla Nuvo Ltd., Veraval
12	DEVENDRA AMARSINH JADAV	Lupin Ltd., Ankleshwar
13	DHARMESH BHIKHABHAI RATHOD	Aditya Birla Nuvo Ltd., Veraval
14	DHAVAL NITINBHAI SHAH	Lupin Ltd., Ankleshwar
15	DHRUVKUMAR SANJAYBHAI PATEL	Zydus Pharma Ltd., Ankleshwar
16	DIVYANGKUMAR VIJAYBHAI PATEL	Gujarat Fluorochemicals Ltd., Panchmahal
17	DVIJENDRASINH DILIPSINH RATHOD	Gujarat Fluorochemicals Ltd., Panchmahal
18	FAIJAN AIYUB KIDI	Lupin Ltd., Ankleshwar
19	HARISHCHANDRA RUPSINH BARIA	Zydus Pharma Ltd., Ankleshwar
20	HARSHIT RAJENDRAKUMAR GANATRA	Gujarat State Fertilizers & Chemicals Ltd., Vadodara
21	HEMANTKUMAR MALI	Sanofi- Aventis Ltd., Ankleshwar
22	HIMANK TRIVEDI	Hindustan Zinc Ltd., Rajasthan
23	HIMANSHU SUTHAR	CLR Industries, Vidhyanagar
24	HIREN SOLANKI	Farmson Pharmaceutical Ltd., Nandesari
25	HIRENKUMAR MINESHBHAI PATEL	Amul Dairy, Anand
26	JAIMIN VIPULCHANDRA PATEL	Link Pharma Chem. Ltd., Nandesari
27	JAGRAT SEVAK	Farmson Pharmaceutical Ltd., Nandesari
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29	JANAK RAMANBHAI PATEL	Zydus Pharma Ltd., Ankleshwar
30	JANKIBEN NARESHKUMAR PANCHOLI	Zydus Pharma Ltd., Ankleshwar
31	JAPILBHAI MAHESHBHAI BHAGAT	Lupin Ltd., Ankleshwar
32	JAYDEEP JAYANTIBHAI VADARIYA	Lupin Ltd., Dabhaha
33	JITENDRAKUMAR RAMESHBHAI SHUDRA	Ambuja Cement Ltd., Kodinar
34	JITESH PALABHAI KARANGIYA	Zydus Pharma Ltd., Ankleshwar
35	KALPINKUMAR KANUBHAI PATEL	Apothecon Pharma. Ltd., Vadodara
36	KASHYAP RAMESHBHAI GOHIL	Gujarat Heavy Chemicals Ltd., Veraval
37	KEYURKUMAR KAMLESHBHAI MACHHI	Jay Chemical Ltd., Khambhat
38	KIRANSINH MAHENDRASINH SINDHA	Zydus Pharma Ltd., Dabhaha
39	KISHAN SUNILKUMAR RANA	Zydus Pharma Ltd., Ankleshwar
40	MOHAMMADSAHIL S DALAL	Bombay Tablet Mfg. Pvt., Ltd., Gandhinagar
41	MUBINSHA SAJIDHUSEN DIWAN	Lupin Ltd., Ankleshwar
42	MITESHKUMAR DHYABHAI PATEL	Jay chemical Ltd., Khambhat
43	MIHIRKUMAR SHAILESHKUMAR JOSHI	Mayur Chemicals Pvt. Ltd., Halol
44	NEEL ASHOKBHAI PATEL	Arvalli Castor Derivatives Pvt. Ltd., Vadodara
45	NIKUNJKUMAR SURENDRABHAI BARIA	Zydus Pharma Ltd., Ankleshwar
46	NIRMIT RAMESHBHAI ZALA	Ambuja Cement Ltd., Kodinar
47	NISHITKUMAR RAMANBHAI PATEL	Jay Chemical Ltd., Khambhat
48	NIKUNJKUMAR ATULBHAI PATEL	Jay Chemical Ltd., Khambhat
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53	PRINCYBEN RAKESHBHAI PATEL	Lupin Ltd., Dabhaha
54	RAHULKUMAR RADHAKISHAN	Arvalli Castor Derivatives Pvt. Ltd., Vadodara
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57	RUSHI JITENDRAKUMAR MAKATI	Vrunda Vitthal Polynet Pvt. Ltd., Vapi
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63	SIDHDHARAJINSINH HARSURBHAI SISODIYA	Disman pharmaceutical, Ahmedabad
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