Reconsideration of the Requirement for Odor Assessment for JAXA Space Station Program

JAXA S&MA Sachie Eguchi

Background

- From the begining of JEM development to 2007, JAXA imposed odor requirement.
- As the response to the situation shown in below, JAXA reconsidered the requirement for odor assessment.

Most of components and materials are judged acceptable if those safeness were confirmed, even if these failed in Test 6 of NASA-STD-6001.

The maintenance cost of the system of conducting Test 6 such as keeping up certification of panellists is expensive.

Odor Spreading

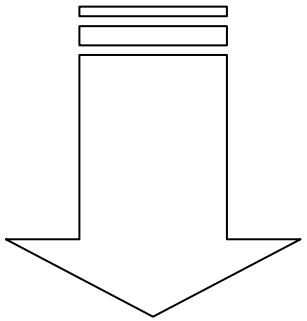
- When JEM is docked to the ISS,
  internal air of JEM will be circulated with air of the ISS and odor will be uniformly distributed.

  - Odor would not be actual concern in module level
    even if there is concern about odor on a component or a material.

Impact of Odor for Safety

Odor requirement is not safety requirement.

*Safety is assured by offgas requirement.



No impact for safety

JAXA'S New Odor Requirement

Basically, JAXA does not required odor assessment.
But...

for keeping crew's comfort

Odor Requirement applies only to the items used close to Crew.

Example: Cloth, Sleeping Bag etc...

It means...

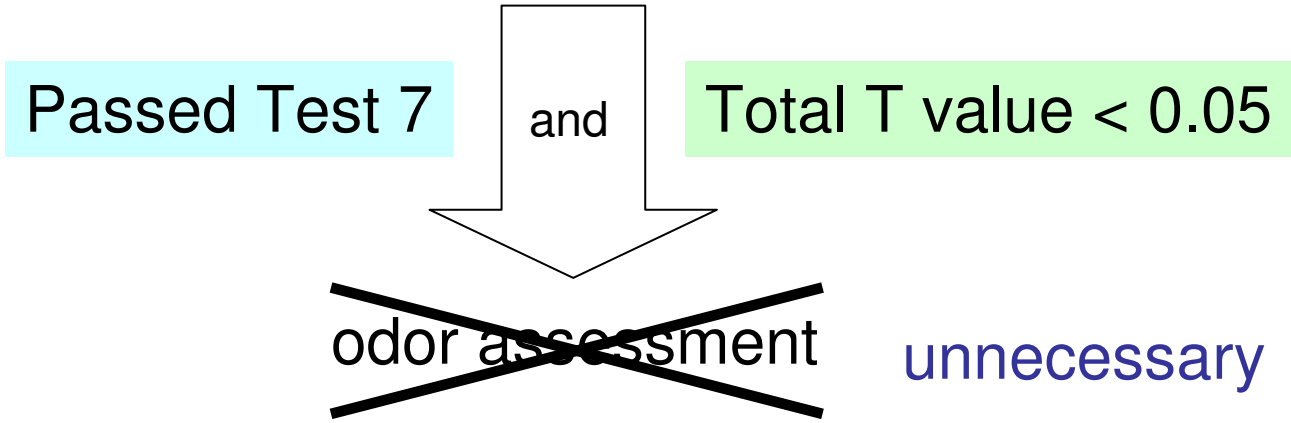
JAXA will carry out Test 6 if necessary.

How to Judge the Necessity

How does JAXA judge the necessity of conducting Test 6?

SSP30233 saids...

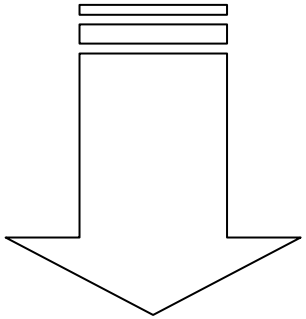
Components and non-metallic materials



In the case **total T value > 0.05**
Test 6 will be required based on the process described next.

Odor Intensity Estimation from Offgas Test Result

In JAXA, Offgas test is carried out on
Almost All Components and
Rating-Unknown Non-Metallic Materials.



Odor intensity could be predicted
from the compounds and these concentrations
which are detected by offgas test.

Comparison of Definition of Odor Intensity

Six Level Odor Intensity System*		NASA-STD-6001 Test 6	
Characteristic	Intensity	Intensity	Characteristic
Undetectable	0	0	Undetectable
Detection Threshold	1	1	Barely Detectable
Perception Threshold	2		
Easily Detectable	3	2	Easily Detectable
Objectionable	4	3	Objectionable
Revolting	5	4	Revolting

*Commonly used system in JAPAN to indicate odor intensity

How to Estimate the Odor Intensity

Test 6 of NASA-STD-6001

Odor Intensity < **2.5** ⇒ Acceptable

Estimation from Offgas Test

Odor Intensity < **1.5** ⇒ Acceptable

How to Estimate the Odor Intensity

For 22 compounds that have strong odor,

Concentration (A) are known.

Concentration (A) is identified as odor intensity 2 of Six Level Odor Intensity System.

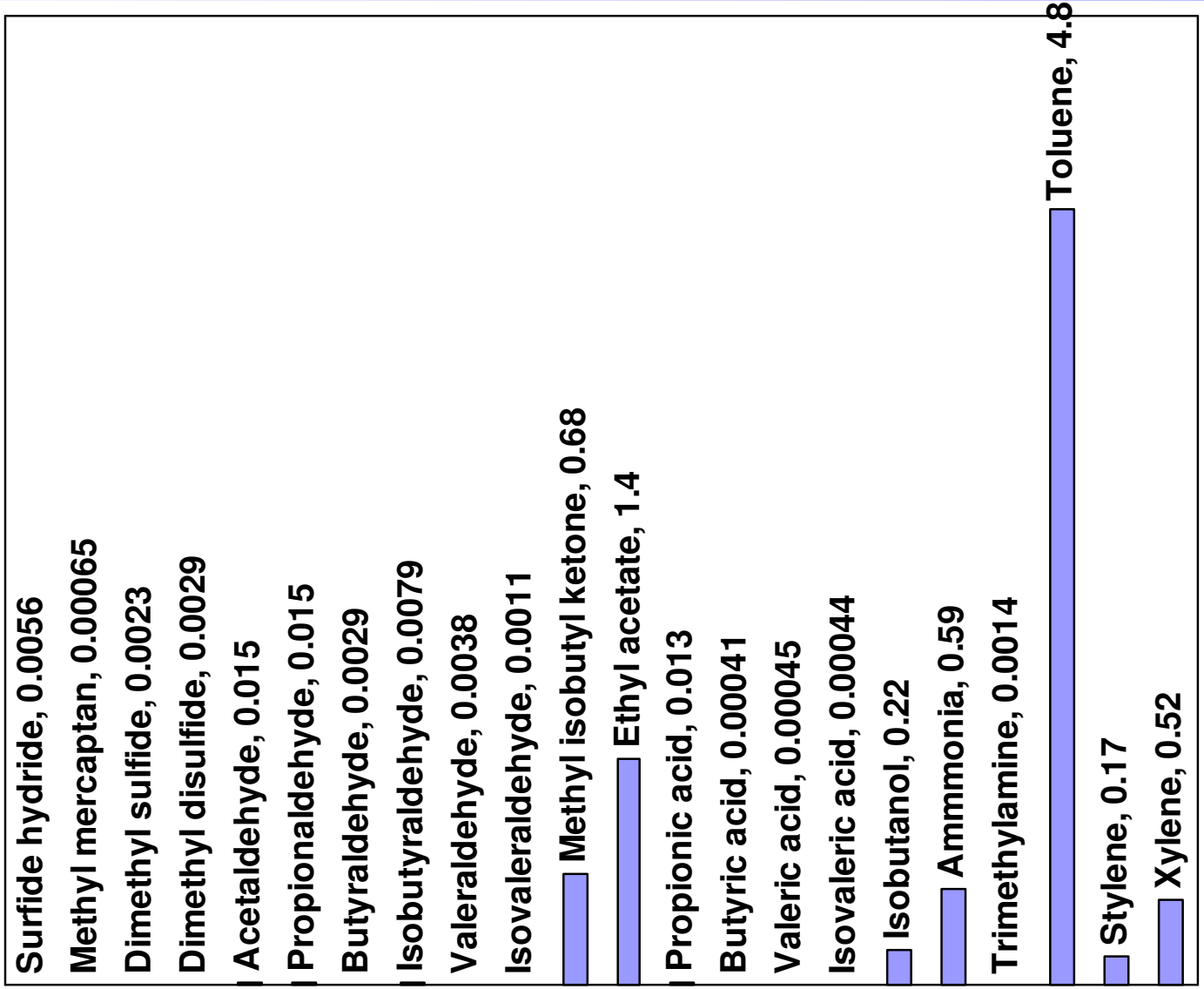
These are defined in offensive odor control law of Japan.

Odor intensity "**2**" based on Six Level Odor Intensity System

≒

Odor intensity "**1.5**" based on NASA-STD-6001 Test 6

Concentration (A) for 22 compounds

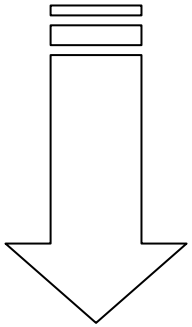


How to Estimate the Odor Intensity

Calculate the **Concentration (B)** of each compound.

Conc. (B) is the concentration of
each offgassing compounds for the JEM volume,118m^3.

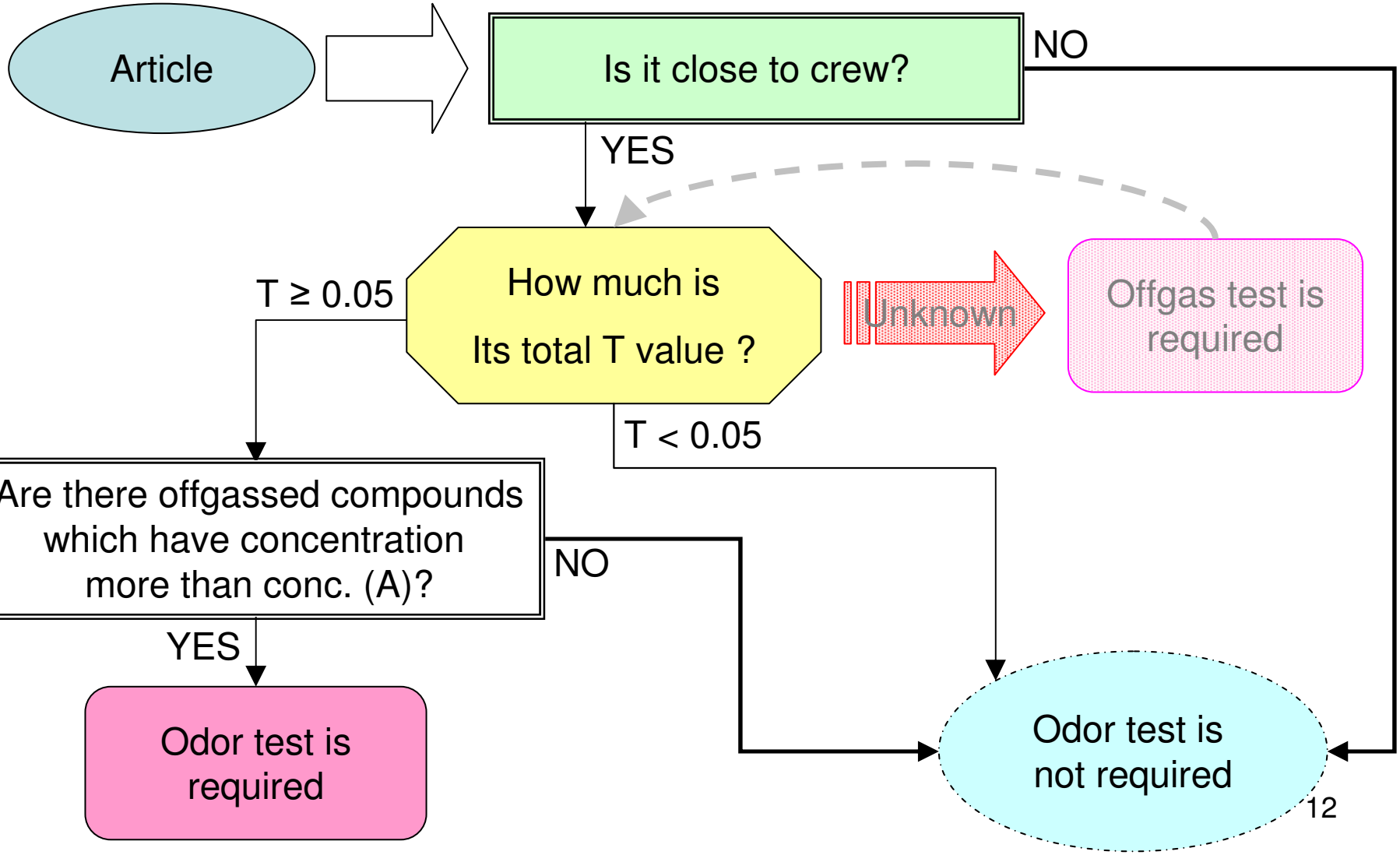
Then if... Conc.B < Conc. A



Odor Intensity → 1,5

Odor intensity could be judged under “2,5” of NASA-STD-6001.

The Flow of Odor Assessment



Example of Odor Intensity Estimation

TRITON(R) X-100

Offgassed Compound	Result of Test 7		Conc. (A) [ppm]
	Amount [μg/g]	Conc. (B) [ppm]	
Acetaldehyde	**0.046**	**0.0009670**	**0.015**
Xylene	**0.015**	**0.0001309**	**0.52**
3-Methylpentane	0.009	-	-
C10 alkane	0.009	-	-
Methane	0.156	-	-
Acetone	0.026	-	-
Carbon monoxide	0.050	-	-

Conc. (B) < Conc. (A)

Odor Intensity Estimation from Offgas Test Result → **Acceptable**

Odor Intensity Determined by Test 6: **0.4** → **Acceptable**

Example of Odor Intensity Estimation

TOWEL

Offgassed Compound	Result of Test 7		Conc. (A) [ppm]
	Amount [μg/g]	Conc. (B) [ppm]	
Acetaldehyde	**0.109**	**0.0022913**	**0.015**
Propionaldehyde	**0.023**	**0.0003661**	**0.015**
Acetone	0.031	-	-
Carbon monoxide	0.109	-	-

Conc. (B) < Conc. (A)

Odor Intensity Estimation from Offgas Test Result → **Acceptable**

Odor Intensity Determined by Test 6: **0.8** → **Acceptable**

Example of Odor Intensity Estimation

CLAY [LA DOLL]

Offgassed Compound	Result of Test 7		Conc. (A) [ppm]
	Amount [μg/g]	Conc. (B) [ppm]	
Ethyl alcohol	0.03	-	-
Isopropyl alcohol	0.759	-	-
Methyl alcohol	0.191	-	-
n-Propyl alcohol	0.908	-	-
Acetaldehyde	**0.055**	**0.0011562**	**0.015**
Propionaldehyde	**0.048**	**0.0007641**	**0.015**
Methane	0.0074	-	-
2-Butanone	0.018	-	-
Acetone	0.051	-	-
Carbon monoxide	0.06	-	-

Conc. (B) > Conc. (A)

Odor Intensity Estimation from Offgas Test Result → **Acceptable**

Odor Intensity Determined by Test 6: **1.2** → **Acceptable**

Example of Odor Intensity Estimation

SUNPELCA L-2500NN

Offgassed Compound	Result of Test 7		Conc. (A) [ppm]
	Amount [μg/g]	Conc. (B) [ppm]	
Methyl Styrene	0.0148	-	-
alpha,alpha-Dimethyl benzenemethanol	0.0736	-	-
2-Methoxy-2-phenylpropane	0.0259	-	-
Methane	0.359	-	-
Acetone	0.0677	-	-
Acetylbenzene	0.195	-	-
Trimethylsilanol	0.181	-	-
Carbon monoxide	115	-	-
Ammonia	**18.1**	**0.9830423**	**0.59**
Hydrogen cyanide	0.371	-	-

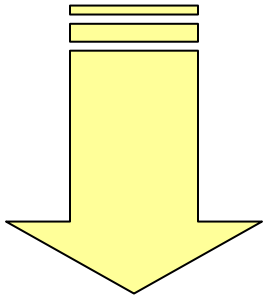
Conc. (B) < Conc. (A)

Odor Intensity Estimation from Offgas Test Result → **Unacceptable**

Odor Intensity Determined by Test 6: **2.6** → **Unacceptable**

Conclusion

All Examples are matched with
Estimations from the Flow of JAXA's Odor Assessment.



Offgas Test Result will be AVAILABLE
for Odor Intensity Prediction.

We confirmed that Estimations from the Flow of JAXA's Odor Assessment were effective.
Odor could be assessed from offgas test result without increasing odor risk.

Appendix

JAXA is now advancing development of electronic nose (E-nose).

E-nose could use as odor sensor alternative to human nose.

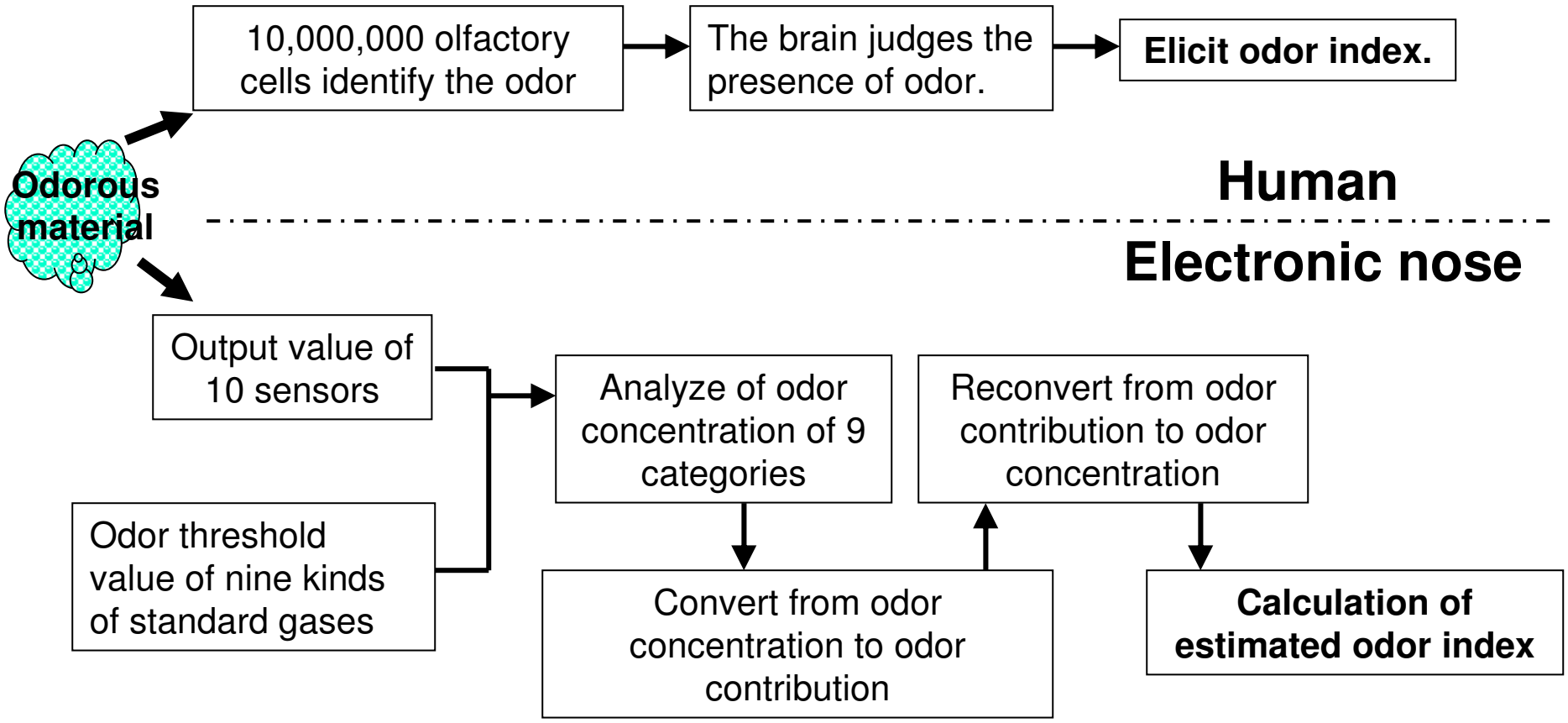
Specification of E-nose (FF-2A)

Manufacturer	**SHIMADZU Corp. (Japan)**
Type of Sensors	**Metal Oxide Semiconductor**
Number of Sensors	**10**
Instrumental time	**About 30minutes**
Necessary amount of the sample gas	**About half-liter**
Estimated odor index Repeatability	**About +/- 8**

Important

It can not test samples that contain volatile siloxane elements.
Over 0.1ppm, it decreases sensitivity of MOS sensor.

Odor Analytical Flowchart of Human and E-nose



Correlation

- E-nose is using different definition of odor intensity. Odor intensity estimated by E-nose is called Odor Index.

- JAXA is analyzing the correlation between Odor Index and Odor Intensity by comparing odor intensities with odor index on same samples.

Availability of E-nose

- For keeping panellists health, odor test by panellists can not be conducted when few Carcinogenic Compound is found in offgassed products.

- If E-nose could be used for actual odor test,
  odor test could be conducted even in these cases.