

Figure 1. UML pseudo-class diagram of the logical oeit.xml structure.

# Validation Rules

Terminology follows RFC 2119 (<http://www.ietf.org/rfc/rfc2119.txt>):

MUST This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.

MUST NOT This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.

SHOULD This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.

SHOULD NOT This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.

MAY This word, or the adjective "OPTIONAL", mean that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)

A note on the rule “Must not contain text”: the rule validates only non-whitespace text since whitespace may occur to make the XML more human readable.

**xml** namespace is imported from standard xml version 1.0

**xsd** namespace is imported from <http://www.w3.org/2001/XMLSchema>

1. An OEIT file
   1. Must be a valid zip file.
   2. Should have extension *.oeit*.
   3. Must contain one *oeit.xml* file in the root directory.
   4. Should not contain any other file in the root directory.
   5. Must contain a non-empty *eit/0000* directory.
   6. May contain directories that conform to the regular expression “eit/\d{4}”.
   7. May contain files that conform to the regular expression “eit/\d{4}/\d{5}.frames”.
   8. Should not contain files with a directory the conforms to the regular expression “eit/\d{4}” but do not conform to the regular expression “eit/\d{4}/\d{5}.frames”.
   9. May contain a non-empty *oem* directory.
   10. May contain a non-empty *auxiliary* directory.
   11. May contain directories that conform to the regular express “auxiliary/\d{4}”.
   12. May contain files that conform to the regular expression “auxiliary /\d{4}/\d{5}.frames”.
   13. Should not contain files with a directory that conforms to the regular expression “auxiliary /\d{4}” but do not conform to the regular expression “auxiliary /\d{4}/\d{5}.frames”.
   14. May contain a non-empty *user* directory.
   15. May contain a non-empty *log* directory.
   16. Should contain an *info/devices.xml* file.
   17. Should contain an *info/electrodes.xml* file.
   18. Should contain an *info/frame\_types.xml* file.
   19. Should contain an *info/meas\_types.xml* file.
   20. Should contain an *info/stim\_types.xml* file.
   21. Should contain an *info/streams.xml* file.
   22. Should contain an *info/subject.xml* file.
   23. Should not contain other directories.
   24. Should not contain any empty directory.
2. An *oeit.xml* file
   1. Must be a valid XML file, containing one **<oeit>** element as the root element.
3. An **<acquisition>** element
   1. Must declare an **id** attribute of type **xml:ID**.
   2. Must not declare any other attributes.
   3. May contain one **<stim\_list>** element.
   4. Must contain one **<meas\_list>** element.
   5. May contain zero or more **<user\_data>** elements.
   6. Must not contain other elements.
   7. Must not contain text.
4. An **<age>** element
   1. Must not declare any attributes.
   2. Must contain **text** that conforms to **oeit:time**.
   3. Must not contain other elements.
5. A **<contactimpedance>** element
   1. Must not declare any attributes.
   2. Must contain **text** that conforms to **oeit:impedance**. [?? contactimpedance or contact\_impedance]
   3. Must not contain other elements.
   4. Must not contain text.
6. A **<data\_acquisition\_software>** element
   1. Must not declare any attributes.
   2. Must contain one **<name>** element.
   3. Must contain one **<version>** element.
   4. Must contain one **<manufacturer>** element.
   5. May contain zero or more **<user\_data>** elements.
   6. Must not contain other elements.
   7. Must not contain text.
7. A **<decode>** element
   1. Must declare a **frame** attribute of type **xml:IDREF** that references a valid **frame:id**.
   2. Must not declare any other attributes.
   3. Must not contain other elements.
   4. Must not contain text.
8. A **<description>** element
   1. Must not declare any attributes.
   2. Must contain **text** that conforms to xsd:string.
   3. Must not contain other elements.
9. A **<device>** element
   1. Must declare an **id** attribute of type **xml:ID**.
   2. Must not declare any other attributes.
   3. May contain one **<manufacturer>** element.
   4. May contain one **<model>** element.
   5. May contain one **<serialnumber>** element.
   6. May contain one **<firware>** element.
   7. May contain one **<data\_acquisition\_software>** element.
   8. May contain zero or more **<user\_data>** elements.
   9. Must not contain other elements.
   10. Must not contain text.
10. A **<device\_list>** element
    1. Should be located in *info/devices.xml*.
    2. Must not declare any attributes.
    3. Must contain one or more **<device>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
11. An **<electrode>** element
    1. Must declare an **id** attribute of type **xml:ID**.
    2. Must declare a **type** attribute of type **xml:IDREF** that references a valid **electrode\_type:id**.
    3. May declare a **position** attribute of type **oeit:position\_cartesian** or **oeit:position\_cylindrical** or **oeit:position\_spherical** or **oeit:position\_gps**, but the type must match **electrode\_list:coordinate\_system**. [?? Attribute or element]
    4. May declare an **orientation** attribute of type **oeit:orientation**. [?? Attribute or element]
    5. May declare a **position\_accuracy** attribute of type **oeit:length**. [?? Attribute or element]
    6. May declare a **contact\_impedance** attribute of type **oeit:impedance**. [?? Attribute or element]
    7. Must not declare any other attributes.
    8. May contain zero or more **<user\_data>** elements.
    9. Must not contain other elements.
    10. Must not contain text.
12. An **<electrode\_list>** element
    1. May declare an **id** attribute of type **xml:ID**.
    2. May declare a **coordinate\_system** attribute of type **oeit:coordinate\_system**. [?? Attribute or element]
    3. May declare a **position\_description** attribute of type **oeit:position\_description**. [?? Attribute or element]
    4. Must not declare any other attributes.
    5. Must contain one or more **<electrode>** elements.
    6. Must not contain other elements.
    7. Must not contain text.
13. An **<electrode\_type>** element
    1. Must declare an **id** attribute of type **xml:ID**.
    2. Must not declare any other attributes.
    3. May contain one **<manufacturer>** element.
    4. May contain one **<model>** element.
    5. May contain one **<material>** element.
    6. May contain one **<diameter>** element.
    7. May contain one **<thickness>** element.
    8. May contain one **<height>** element.
    9. May contain one **<width>** element.
    10. May contain one **<contactimpedance>** element. [?? contactimpedance or contact\_impedance]
    11. May contain zero or more **<user\_data>** elements.
    12. Must not contain other elements.
    13. Must not contain text.
14. An **<electrode\_type\_list>** element
    1. Must not declare any attributes.
    2. Must contain one or more **<electrode\_type>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
15. An **<event>** element
    1. Must declare a **name** attribute of type **xml:NCName**.
    2. Must declare a **type** attribute of type **oeit:field\_type**.
    3. Must declare a **time** attribute of type **oeit:time**.
    4. May contain one **<description>** element.
    5. May contain zero or more **<user\_data>** elements.
    6. Must not contain other elements.
    7. Must not contain text.
16. An **<event\_list>** element
    1. Must not declare any attributes.
    2. May contain one or more **<log>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
17. A **<field>** element
    1. Must declare a **name** attribute of type **xml:NCName**.
    2. Must declare a **type** attribute of type **oeit:field\_type**.
    3. Must not declare any other attributes.
    4. May contain zero or more **<user\_data>** elements.
    5. Must not contain other elements.
    6. Must not contain text.
18. A **<fields>** element [?? Fields or field\_list]
    1. Must not declare any attributes.
    2. Must contain one or more **<field>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
19. A **<firmware>** element
    1. Must not declare any attributes.
    2. Must contain one **<name>** element.
    3. Must contain one **<version>** element.
    4. Must contain one **<manufacturer>** element.
    5. May contain zero or more **<user\_data>** elements.
    6. Must not contain other elements.
    7. Must not contain text.
20. A **<file>** element
    1. Must declare a **name** attribute of type **xsd: anyURI.**
    2. May declare a **start\_frame** attribute of type **xsd:integer**.
    3. May declare a **start\_frame** attribute of type **xsd:integer**.
    4. May declare an **end\_frame** attribute of type **xsd:integer**.
    5. May declare a **start\_time** attribute of type **oeit:time**.
    6. May declare an **end\_time** attribute of type **oeit:time**
    7. Must not declare any other attributes.
    8. May contain zero or more **<user\_data>** elements.
    9. Must not contain other elements.
    10. Must not contain text.
21. A **<files>** element [?? Files or file\_list]
    1. Must not declare any attributes.
    2. May contain one or more **<file>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
22. A **<first\_name>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
23. A **<frame\_type\_list>** element
    1. Should be located in *info/frames.xml.*
    2. Must not declare any attributes.
    3. Must contain one or more **<frame\_type>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
24. A **<height>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:length**.
    3. Must not contain other elements.
25. A **<last\_name>** element
    1. Must not declare any attributes.
    2. Must contain **xsd:string**.
    3. Must not contain other elements.
26. A **<log>** element
    1. Must declare a **name** attribute of type **xsd: anyURI.**
    2. May declare a **start\_frame** attribute of type **xsd:integer**.
    3. May declare a **start\_frame** attribute of type **xsd:integer**.
    4. May declare an **end\_frame** attribute of type **xsd:integer**.
    5. May declare a **start\_time** attribute of type **oeit:time**.
    6. May declare an **end\_time** attribute of type **oeit:time**
    7. Must not declare any other attributes.
    8. May contain zero or more **<user\_data>** elements.
    9. Must not contain other elements.
    10. Must not contain text.
27. A **<logs>** element [?? logs or log\_list]
    1. Must not declare any attributes.
    2. May contain one or more **<log>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
28. A **<manufacturer>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
29. A **<meas>** element
    1. Must declare a **type** attribute of type **xml:IDREF** that references a valid **meas\_type:id**.
    2. May contain zero or more **<elec>** elements.
    3. May contain zero or more **<user\_data>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
30. A **<meas\_list>** element
    1. Must not declare any attributes.
    2. Must include one or more **<meas>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
31. A **<meas\_type>** element
    1. Must declare an **id** attribute of type **xml:ID.**
    2. May declare a **frequency** attribute of type **oeit:frequency**. [?? Attribute or element]
    3. May declare a **physical\_property** attribute of type **oeit:physical\_property**. [?? Attribute or element][?? Is this necessary, since the amplitude has units]
    4. May declare a **multiplier** attribute of type **xsd:decimal**. [?? Attribute or element]
    5. May declare an **offset** attribute of type **xsd:decimal**. [?? Attribute or element]
    6. Must not declare other attributes.
    7. Must include one **<fields>** element. [?? Fields or field\_list]
    8. May contain zero or more **<user\_data>** elements.
    9. Must not contain other elements.
    10. Must not contain text.
32. A **<meas\_type\_list>** element
    1. Should be located in *info/meas\_types.xml*.
    2. Must not declare any attributes.
    3. Must contain one or more **<meas\_type>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
33. A **<model>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
34. A **<name>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
35. An **<oeit>** element
    1. Must reference namespace <http://open-eit/> through an **xmlns** attribute. [?? This needs an actual resource location].
    2. Should reference namespace [http://www.w3.org/2001/XInclude](http://www.w3.org/2001/XIncludet) through an **xmlns** attribute. XInclude is required to support recommended locations.
    3. Must not declare other attributes.
    4. Must contain one **<subject>** element.
    5. Must contain one **<device\_list>** element.
    6. Must contain one **<electrode\_type\_list>** element.
    7. Must contain one **<electrode\_list>** element
    8. Must contain one **<stim\_type\_list>** element.
    9. Must contain one **<meas\_type\_list>** element.
    10. Must contain one **<frame\_type\_list>** element.
    11. Must contain one **<streams>** element.
    12. Must not contain other elements.
    13. Must not contain text.
36. A **<patient>** element
    1. Must declare an **id** attribute of type **xml:ID**. . [?? Not necessary since it isn’t referenced, and only one exists]
    2. Must not declare other attributes.
    3. May contain one **<first\_name>** element.
    4. May contain one **<last\_name>** element.
    5. May contain zero or more **<user\_data>** elements.
    6. Must not contain other elements.
    7. Must not contain text.
37. A **<process>** element
    1. Must declare an **id** attribute of type **xml:ID.**
    2. Must not declare other attributes.
    3. Must contain one or more of any combination of **<repeat>** and **<decode>** elements.
    4. Must contain declare any **<repeat>** or **<decode>** elements after a **<repeat>** with no **repeat:number**.
    5. Must not contain other elements.
    6. Must not contain text.
38. A **<radius>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:length**.
    3. Must not contain other elements.
39. A **<repeat>** element
    1. May declare an **number** attribute of type **xsd:integer.**
    2. Must not declare other attributes.
    3. Must contain one or more of any combination of **<repeat>** and **<decode>** elements.
    4. Must not contain any **<repeat>** or **<decode>** elements after a **<repeat>** with no **repeat:number**.
    5. Must not contain other elements.
    6. Must not contain text.
40. A **<serialnumber>** element [?? serialnumber or serial\_number]
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
41. A **<stim>** element
    1. Must declare a **type** attribute of type **xml:IDREF** that references a valid **stim\_type:id**.
    2. May contain zero or more **<elec>** elements.
    3. May contain zero or more **<user\_data>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
42. A **<stim\_list>** element
    1. Must not declare any attributes.
    2. Must include one or more **<stim>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
43. A **<stim\_type >** element
    1. Must declare an **id** attribute of type **xml:ID.**
    2. May declare an **amplitude** attribute of type **oeit:current** or **oeit:voltage**. [?? Attribute or element][?? Other properties than amplitude, frequency, wave]
    3. May declare a **frequency** attribute of type **oeit:frequency**. [?? Attribute or element]
    4. May declare a **wave** attribute of type **oeit:wave**. [?? Attribute or element]
    5. May declare a **physical\_property** attribute of type **oeit:physical\_property**. [?? Attribute or element][?? Is this necessary, since the amplitude has units]
    6. Must not declare other attributes.
    7. May contain zero or more **<user\_data>** elements.
    8. Must not contain other elements.
    9. Must not contain text.
44. A **<stim\_type\_list>** element
    1. Should be located in *info/stim\_types.xml*.
    2. Must not declare any attributes.
    3. Must contain one or more **<stim\_type>** elements.
    4. Must not contain other elements.
    5. Must not contain text.
45. A **<stream>** element
    1. Must declare an **id** attribute of type **xml:ID.**
    2. May declare a **device** attribute of type **xml:IDREF** that references a valid **device:id**.
    3. Must not declare other attributes.
    4. Must contain one **<process>** element.
    5. Must contain one **<files>** element.
    6. Must contain one **<logs>** element.
    7. May contain zero or more **<user\_data>** elements.
    8. Must not contain other elements.
    9. Must not contain text.
46. A **<streams>** element
    1. Must not contain any attributes.
    2. Must contain one or more **<stream>** elements.
    3. Must not contain other elements.
    4. Must not contain text.
47. A **<subject>** element
    1. Should be located in *info/subject.xml*.
    2. Must declare an **id** attribute of type **xml:ID**. [?? Not necessary since it isn’t referenced, and only one exists]
    3. Must declare a **type** attribute of type **oeit:subject\_type**.
    4. Must not declare any other attributes.
    5. Must not contain text.
    6. If the **type** is “Person”, a **<subject>** element
       1. May contain one **<patient>** element.
       2. May contain one **<age>** element.
       3. May contain one **<weight>** element.
       4. May contain one **<height>** element.
       5. May contain one **<radius>** element.
       6. May contain one **<waterlevel>** element. [?? waterlevel or water\_level]
       7. May contain one **<waterconductivity>** element. [?? waterconductivity or water\_conductivity]
       8. May contain one **<manufacturer>** element.
       9. May contain zero or more **<user\_data>** elements.
       10. Must not contain other elements.
    7. If the **type** is “Tank”, a **<subject>** element
       1. May contain one **<patient>** element.
       2. May contain one **<age>** element.
       3. May contain one **<weight>** element.
       4. May contain one **<height>** element.
       5. May contain one **<radius>** element.
       6. May contain one **<waterlevel>** element. [?? waterlevel or water\_level]
       7. May contain one **<waterconductivity>** element. [?? waterconductivity or water\_conductivity]
       8. May contain one **<manufacturer>** element.
       9. May contain zero or more **<user\_data>** elements.
       10. Must not contain other elements.
    8. If the **type** is “Volcano”, a **<subject>** element
       1. May contain one **<patient>** element.
       2. May contain one **<age>** element.
       3. May contain one **<weight>** element.
       4. May contain one **<height>** element.
       5. May contain one **<radius>** element.
       6. May contain one **<waterlevel>** element. [?? waterlevel or water\_level]
       7. May contain one **<waterconductivity>** element. [?? waterconductivity or water\_conductivity]
       8. May contain one **<manufacturer>** element.
       9. May contain zero or more **<user\_data>** elements.
       10. Must not contain other elements.
    9. If the **type** is “Field”, a **<subject>** element
       1. May contain one **<patient>** element.
       2. May contain one **<age>** element.
       3. May contain one **<weight>** element.
       4. May contain one **<height>** element.
       5. May contain one **<radius>** element.
       6. May contain one **<waterlevel>** element. [?? waterlevel or water\_level]
       7. May contain one **<waterconductivity>** element. [?? waterconductivity or water\_conductivity]
       8. May contain one **<manufacturer>** element.
       9. May contain zero or more **<user\_data>** elements.
       10. Must not contain other elements.
48. A **<thickness>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:length**.
49. A **<user\_data>** element
    1. May contain a **key** attribute of type **xml:NCName**.
    2. Must not declare any other attributes.
    3. Must contain data of type **xsd:any** that will not be used or validated by the validator.
50. A **<version>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **xsd:string**.
    3. Must not contain other elements.
51. A **<waterlevel>** element [?? waterlevel or water\_level]
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:length**.
    3. Must not contain other elements.
52. A **<waterconductivity>** element [?? waterconductivity or water\_conductivity]
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:conductivity**.
    3. Must not contain other elements.
53. A **<width>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:length**.
    3. Must not contain other elements.
54. A **<weight>** element
    1. Must not declare any attributes.
    2. Must contain **text** that conforms to **oeit:mass** or **oeit:force**.
    3. Must not contain other elements.
55. An **oeit:conductance** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?(S|Mho(s)?)”.
56. An **oeit:conductivity** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?S/([YZEPTGMkdcmuµnpfazy]|da)?m”.
57. An **oeit:coordinate\_system** must be a value from the enumeration of {“Cartesian”, “Cylindrical”, “GPS”, “Spherical”}.
58. An **oeit:current** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?A”.
59. An **oeit:field\_type** must be a value from the enumeration of {“byte”, “uint16”, “uint32”, “uint64”, “int16”, “int32”, “int64”, “float”, “double”, “timestamp”, “datetime”}. [?? Throw away timestamp and datetime for other base types][?? Capability to handle strings or arrays]
60. An **oeit:force** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?N”.
61. An **oeit:length** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?m”.
62. An **oeit:mass** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?g”.
63. An **oeit:position\_cartesian** must conform to the regular expression pattern: “\[\w\*\d+(\.\d+)?\w\*(,\w\*\d+(\.\d+)?\w){1,2}\]”
64. An **oeit:position\_cylindrical** must conform to the regular expression pattern: “\[\w\*\d+(\.\d+)?\w\*(,\w\*\d+(\.\d+)?\w){2}\]”
65. An **oeit:position\_description** must be a value from the enumeration of {“Absolute”, “Illustrative”, “Relative”}.
66. An **oeit:position\_gps** must conform to the regular expression pattern: “\[\w\*\d+(\.\d+)?\w\*(,\w\*\d+(\.\d+)?\w){2}\]” [?? This is wrong].
67. An **oeit:position\_spherical** must conform to the regular expression pattern: “\[\w\*\d+(\.\d+)?\w\*(,\w\*\d+(\.\d+)?\w){2}\]”
68. An **oeit:pressure** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?Pa”.
69. An **oeit:resistance** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?(Ω|Ohm(s)?)”.
70. An **oeit:subject\_type** must be a value from the enumeration of {“Person”, “Tank”, “Volcano”, “Field”}.
71. An **oeit:time** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*(([YZEPTGMkdcmuµnpfazy]|da)?s|minute(s)?|hour(s)?|day(s)?|week(s)?|year(s)?)”.
72. An **oeit:voltage** must conform to the regular expression pattern: “\d+(\.\d+)?\w\*([YZEPTGMkdcmuµnpfazy]|da)?V”.