

Upper Thorax Qualification V1.3

This document describes the requirements for the data set preparation for the Upper Thorax Qualification according to THOR-50M Qualification Procedures and Requirements April 2023, NHTSA.

1 Data Organization

The data set has to be delivered in ISO MME 1.6 format given by ISO/TS 13499 (respectively ISO MME). The data set must contain the *.mme file and a directory named "CHANNEL", which contains the *.chn file and the channel files. Reports in common file formats (*.pdf, *.emf) may be included in a directory "REPORT" next to the directory "CHANNEL".

2 Data Preparation

2.1 Channels

2.1.1 Required Measurement Channels

The measurement channels shown in the following table must be included in the data set.

| Channel Description / Proposed Longname | Channel Code |
|---|-------------------------------|
| Chest MTRAC Rotation Left Upper Y | D0CHSTLEUPTHANYP |
| Chest MTRAC Rotation Left Upper Z | D0CHSTLEUPTHANZP |
| Chest MTRAC Length Left Upper 0 | D0CHSTLEUPTHDC0P ¹ |
| Chest MTRAC Rotation Right Upper Y | D0CHSTRIUPTHANYP |
| Chest MTRAC Rotation Right Upper Z | D0CHSTRIUPTHANZP |
| Chest MTRAC Length Right Upper 0 | D0CHSTRIUPTHDC0P ¹ |
| Impactor Acceleration X | T0IMPA000000ACXP ² |

2.1.2 Optional Channels

- All measurement channels taken on the dummy in this full body test shall be included in the data set, if available.
- Calculated channels can be included in the data set.

2.1.3 Further Channel Requirements

- No filtering is applied to the channels.

¹ Despite the documentation of NHTSA, the MTRAC length information is usually not provided and exchanged as voltage channel (VO), but as distance channel (DC). For the conversion of VO to DC sensor specific parameters are required.

² In the NHTSA document THOR-50M Qualification Procedures and Requirements April 2023, the code used for the impactor is 'SENSMI'. Here, the recommendation of the ISO MME working group is followed by using the code 'IMPA' (T0SENSMI0000ACXP → T0IMPA000000AXCP).

- A time range of at least 200 ms before contact (expected T0) and 300 ms after contact (expected T0) has to be included in each channel.
- For further processing a conversion to coordinate axes will be performed. The conversion formula often requires lever arms (delta value). For the standard design, the absolute value of this lever arm is 15.65 mm. When a special design with a different lever arm was used, this value has to be given in the DC0 channel as additional descriptor '.MTRAC_leverarm'. If such a descriptor is not given, the standard values will be assumed.

2.1.4 Physical Units

All dynamic measurements have to be given in SI units.

Static tilt sensors should be given in the unit "deg" (degrees).

The SI units must be written as shown in the following table (from **ISO/TS 13499 Database**):

| Physical Dimension | ISO Code | Unit |
|----------------------|----------|-----------|
| Acceleration | AC | m/(s*s) |
| Angle | AN | rad |
| Angular Acceleration | AA | rad/(s*s) |
| Angular Velocity | AV | rad/s |
| Distance | DC | m |
| Displacement | DS | m |
| Energy | EN | J |
| Event | EV | 1 |
| Force | FO | N |
| Humidity | HU | % |
| Lever Arm | LE | m |
| Mass | MA | kg |
| Moment | MO | Nm |
| Temperature | TE | K |
| Velocity | VE | m/s |
| Voltage | VO | V |

2.1.5 Channel Sorting

The channels have to be sorted in the following order:

- Dummy channels
- Pendulum/test rig channels
- Other channels

The channel sorting given for dummy channels by the document **ISO/TS 13499 – RED B : 2021 E** has to be respected.

2.1.6 Sign Convention

All measurement channels should be delivered in their own local coordinate systems with respect to SAE J1733 November 2018. This reference system has to be specified as “Instrumentation standard” in the channel information file (*.chn).

In the channel T0IMPA000000ACXP, the acceleration of the impactor should become negative as the impactor contacts the dummy.

2.1.7 Offset Correction and T0 (Time Zero) Definition

The following sequence of steps has to be applied:

- **Pre-Shift:**
Set T0 to the time when the pendulum first contacts the dummy. Perform bias removal of the channel T0IMPA000000ACXP by subtracting the average value of the data samples over the period between (-0.05 s) to (-0.01 s) prior to T0.
- **Shift:**
Set T0 to the first data sample, where the bias removed channel T0IMPA000000ACXP filtered by CFC180 exceeds the 5 g level (= 49.03325 m/s²)³.
- **Final Shift:**
Shift the time by 3 ms for all channels (shift samples forward in time).
- **Offset Correction:**
Perform bias removal of the remaining measured (unfiltered) channels by subtracting the average value of the data samples over the period between (-0.05 s) to (-0.01 s) prior to T0. Do not perform bias removal for absolute channels (e. g. angle, voltage, constant channels) or MTRAC channels.

| Subtype of the test | Filter Class | Search level | Final Shift |
|---------------------|--------------|--------------|-------------|
| THHS | CFC180 | 5 g | 3 ms |

³ A sampling rate of at least 10 kHz is assumed.

3 ISO MME Test Descriptor File (*.mme)

3.1 General Information

The following information must be included:

| | |
|-----------------------------|--|
| Type of the test | Dummy Certification TH |
| Subtype of the test | THHS |
| Regulation | NHTSA 2023-04 |
| Laboratory test ref. number | <i>A unique test ref. number must be provided here.</i> |
| Customer test ref. number | <i>A unique test ref. number must be provided here (must comply to the test name).</i> |
| Date of the test | <i>The date of the test must be provided here in the format YYYY-MM-DD. Time information is not necessary.</i> |
| Data format edition number | 1.6 |
| Reference temperature | <i>The reference temperature in Kelvin must be provided here.</i> |
| Relative air humidity | <i>The relative air humidity must be provided here.</i> |

3.2 Test Objects

- The test objects must have the following order: Dummy, Pendulum/Test Rig
- For the dummy, the following information must be included:

| | |
|------------------------------|---|
| Name of test object 1 | Dummy |
| Driver position object 1 | 0 |
| Impact side test object 1 | FR |
| Type of test object 1 | D |
| Ref. number of test object 1 | <i>The pure dummy ID must be provided here or 'NOVALUE' for a component test without dummy reference.</i> |
| Code of test object 1 | <i>The part number must be provided here or 'NOVALUE' if unknown.</i> |

- For the pendulum/test rig, the following information must be included:

| | |
|---------------------------|---|
| Name of test object 2 | Pendulum/Test Rig |
| Velocity test object 2 | <i>The pendulum/test rig velocity in m/s must be provided here.</i> |
| Mass test object 2 | <i>The pendulum/test rig mass in kg must be provided here.</i> |
| Driver position object 2 | 0 |
| Impact side test object 2 | FR |
| Type of test object 2 | T |