# Core Logic for Bolt Calculation Tool

Upgradation Manual

**Language:** Python 3

**Modules** **used:** openpyxl, tinydb, sys, pyinstaller, PyQt5

**Supporting utilities:** pip, pyuic, pyinstaller, Qt Designer, JSONEdit

# File Information:

**Active UI:** newui.py

**Active Driver:** delta.py

**Active Database:** boltdata.json

**Active Template:** bolt\_cal\_template.xlsx

# Manual:

1. Package installation for servicing
2. Install Python 3 from python.org and set Python to your PATH environment variable
3. Install PyCharm (IDE) from JetBrains
4. It is recommended to create a new virtual environment to work with a project while configuring the Project Interpreter in PyCharm
5. Run the following commands in PyCharm Terminal to setup the required packages on the computer
   1. pip install openpyxl
   2. pip install pyqt5-tools
   3. pip install pyqt5-stubs
   4. pip install tinydb
   5. pip install pyinstaller
6. GUI updation
7. The GUI skeleton is designed with the Qt Designer
8. The Qt Designer is a part of the pyqt5-tools packages installed using the pip utility
9. The Designer can be found at *“<PYTHON\_INSTALLATION\_DIRECTORY>\Python37-32\Lib\site-packages\pyqt5\_tools\designer.exe”*
10. No programming is required to setup the basic UI layout and to add widgets to the window
11. All components in the Qt GUI are called as Widgets (all components inherit the QWidget class)
12. The main window in this application is based on the QDialog class
13. Widgets can be added or removed like working with any photo editor
14. ***Note****: It is important to lay all the widgets in a proper layout, failing which will result in goofy arrangement of widgets inside the QDialog class*
15. The right side of the Qt Designer has the “Property Editor” pane where the properties of each widget can be changed
16. Use the “Edit Tab Order” from ***Edit -> Edit Tab Order*** to change the order in which the focus shifts from widget to widget on pressing the Tab key
17. Though Qt Designer has the feature to map buttons to actions (signals to slots in Qt words), it is recommended to do this manually via code for flexibility and to write custom actions
18. Once UI changes have been done, save the file in .ui format. This must be converted to .py using *pyuic* tool in Terminal

pyuic <PATH/FILE\_NAME.ui> -o <PATH/FILE\_NAME.py>

1. Find more on the Qt Documentation from <https://doc.qt.io/qt-5/qtdesigner-manual.html>

***Note:*** *The GUI is only partially built with Qt Designer for the Bolt Calculation Tool. The second tab in the tool which accepts the clamped parts data has regenerative code for the GUI which is manually written in Python; please refer the class named as* ***Generator*** *in the source code.*

1. Driver logic
2. Start
3. The application execution begins from

app = QApplication(sys.argv)

dial = UX()

dial.show()

app.exec\_()

This will create a new instance of the QApplication class. This instance is a container for the GUI to show. A new instance of the UX class is created. It is the actual window that we are intending to display to the user. The ***app.exec\_()*** is the terminal point for the application.

1. The *UX* class inherits the *Ui\_bolt\_ui* class and the QDialog class. The *Ui\_bolt\_ui* class is the result of compiling the GUI (.ui file) designed in Qt Designer to .py file. The QDialog class is the super class which refers to the main window rendered on the screen.
2. The UX class has a constructor (the \_\_init\_\_() method)

QDialog.\_\_init\_\_(self)

Ui\_bolt\_ui.\_\_init\_\_(self)

The above statements will invoke the constructor of the inherited classes namely QDialog and *Ui\_bolt\_ui*.

self.setupUi(self)

The *setupUi()* method is used to lay all the widgets on the window and render the UI.

1. Once the UI render is complete, necessary functions to fill in the widgets with data have to be called
2. The first tab is set as active with the below statement

self.tabWidget.setCurrentIndex(0)

1. TinyDB is used for database solution in this tool; it uses JSON-style formatting to contain data; A new instance of TinyDB is created inside the UX class with the below statement

self.db = TinyDB('boltdata.json')

1. Certain widgets are hidden on starting the tool; the UI is designed as a responsive one; the widgets will appear based on the need
2. Call *populateTypeList()* to fill the various standards of bolts available in the database

***Algorithm for populateTypeList():***

* 1. Initialize an empty list *l*; this will contain all the names of the bolts along with their standard numbers
  2. Open the table ‘*boltnames’* from the database with the following statement

nametable = self.db.table('boltnames')

* 1. Iterate though every item in the table and append the name and type of each item to the list l
  2. Clear all options inside the typeComboBox and add the list l as the options to the typeComboBox with the following statements

self.typeCombo.clear()

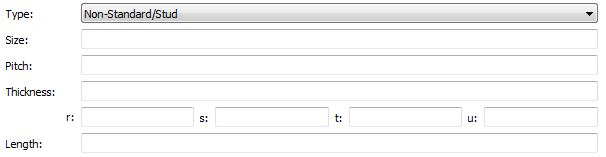
self.typeCombo.addItems(l)

* 1. Call *populateSizeList()* to fill the available sizes for each standard in the sizeComboBox

1. The method *populateSizeList()* will be called internally from the *populateTypeList()* method to fill in the sizes available in the selected standard

***Algorithm for populateSizeList():***

* 1. Check if the type is “*Non-Standard/Stud*”



Change the ‘hidden’ property of the required widgets to show them so that the dimensional data can be acquired.

* 1. Else for standard types,
     1. Initialize an empty list *l*
     2. Get the currently selected option from the *typeComboBox* by using the below statement

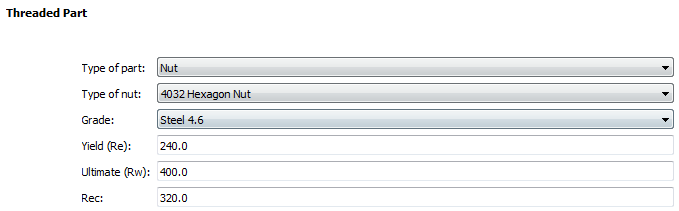
type = self.typeCombo.currentText().split()[0]

* + 1. Open the table from the database whose name is equal to the string contained in ‘*type*’
    2. Iterate through each entry in the table and append the size to the list *l*
    3. Clear all items in the *sizeComboBox* and set the options to list *l*
  1. Call *setBoltSize()* to capture the diameter of the selected bolt in the global variable *bolt\_size*

1. The *populateGradeList()* method is called to fill in the material grade in both *gradeComboBox* (for the bolt) and *gradeNutComboBox* (for the nut)
2. The *populatePartList()* method is called to add the types of threaded parts available to the *partComboBox* namely ‘Nut’ and ‘Block’; the *populatePartComponentList()* method is called internally from this method

***Algorithm for populatePartComponentList():***

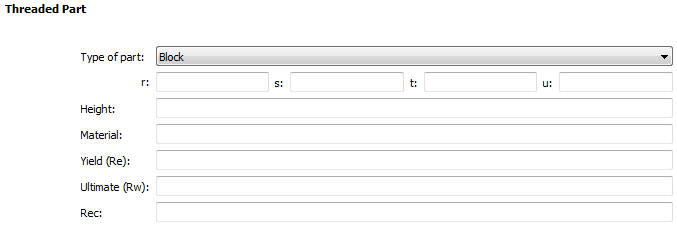
* 1. If the type of part is ‘Nut’
     1. Show only the following widgets in the GUI by hiding the other widgets in the *Threaded Part* section



* + 1. Open the table ‘*nutnames’* with the below statement

nuttab = self.db.table('nutnames')

* + 1. Initialize an empty list *l*;this list will contain the available standards of the nuts compatible with the selected bolt
    2. Iterate through each item in the table; if the standard has the selected bolt size, then append the standard to *l*
    3. Clear all options and set *l* as the options for *nutComboBox*
    4. Call *getNutMaterialData()* internally to populate the material data for the selected bolt
  1. Else hide the required widgets to show the GUI as shown below



1. By the end of the previous step, the GUI rendering must have been completed and the tool suspends itself for user response
2. The following signals are connected to their respective slots by the following statements

self.nClampedPartsText.editingFinished.connect(self.populateClampTab)  
self.typeCombo.currentTextChanged.connect(self.populateSizeList)  
self.sizeCombo.currentTextChanged.connect(self.setBoltSize)  
self.sizelineEdit.editingFinished.connect(self.setBoltSize)  
self.gradeCombo.currentTextChanged.connect(self.getMaterialData)  
self.gradeNutCombo.currentTextChanged.connect(self.getNutMaterialData)  
self.partCombo.currentTextChanged.connect(self.populatePartComponentList)  
self.saveInput.clicked.connect(self.saveInputData)  
self.resetInput.clicked.connect(self.resetInputData)  
self.saveClamp.clicked.connect(self.saveClampData)  
self.resetClamp.clicked.connect(self.resetClampData)  
self.calculateEL.clicked.connect(self.saveExtData)  
self.resetEL.clicked.connect(self.resetExtData)  
self.renutlineEdit.editingFinished.connect(self.setREC)  
self.rmnutlineEdit.editingFinished.connect(self.setREC)

1. The *nClampedPartsText* QLineEdit is connected to the *populateClampTab()* method which is used to fill in the form for the second tab to capture information about the clamped parts

***Algorithm for populateClampTab():***

* 1. Get the number of clamped parts from *nClampedPartsText* with the below statement

x = self.nClampedPartsText.text()

* 1. Check if the number of parts lies within the range 2-10
  2. New instances of the class *Generator* must be added to the *scrollLayout* to construct the form to capture the clamped parts data
  3. Clear any previous instances of the *Generator* class in the *scrollLayout* using the following loop

for i in range(self.scrollLayout.count()):

self.scrollLayout.itemAt(i).widget().close()

* 1. Populate the *scrollLayout* with new instances of *Generator* class to create a new form with the following loop

if count in range(2, 11):

for i in range(0, count):

self.scrollLayout.addRow(Generator(i))

* 1. Throw an error if the number of clamped parts doesn’t fall in range

1. Most of the other widgets are connected to the same methods/slots discussed above; this redundancy is given so that the widgets will dynamically change their data based on the inputs provided
2. The QPushButtons are connected to the slots that are used to either save or reset the forms in the application
3. The *saveInput* push button is connected to the *saveInputData()* method which will capture the information of the bolt and the threaded part from the first tab and store it in the global variables

***Algorithm for saveInputData():***

* 1. Wrap the code in a try…catch block for to handle exceptions and prevent random crashes
  2. Refer all global variables
  3. Initialize *data* and *data2* as empty lists; *data* will hold the information of the bolt whereas *data2* will hold the information of the threaded part
  4. Capture the type and size along with the dimensions of the bolt
  5. If the material is *Stainless Steel*, set the Young’s modulus to 191000
     1. Else if the material is *Steel*, set the Young’s modulus to 210000
  6. Capture Re and Rm along with the bolt length using the following statements

re = self.relineedit.text()

rm = self.rmlineedit.text()

length = self.lengthText.text()

* 1. If the type of bolt is “*Non-Standard/Stud”* capture *r, s, t* and *u* and set dw as the minimum of *r, s,* *t* and *u*
  2. Else if the bolt is “*Countersunk*”, use the following expressions to set dw

csa = math.pi \* math.sqrt(2) \*

(math.pow(float(item['dw'])/2, 2) –

math.pow(float(item['dw'])/2 - float(item['k']), 2))

dw = 8 / (3 \* math.pi) \* csa

* 1. Append all the captured data to *data* in a dictionary format
  2. Assign the global variable *bolt\_data* with a dictionary formed with the list *data* with the below statement

bolt\_data = dict(data)

* 1. Check the type of threaded part
  2. If the threaded part is a nut, capture data directly from the GUI into *data2* to construct a dictionary
  3. Else if the threaded part is a block, calculate the diameter as shown in the following expression

dia = abs(r-t) if (abs(r-t)<abs(s-u)) else abs(s-u)

* 1. Capture Re and Rm from the GUI and append it to *data2* as a tuple (key, value)
  2. Assign the global variable *threaded\_data* with a dictionary formed with the list *data2* with the below statement

threaded\_data = dict(data2)

1. The *saveClamp* method is connected to the *saveClampData()* method which will capture the information of the clamped parts and store it in a global variable

***Algorithm for saveClampData():***

* 1. Refer the required global variables
  2. Initialize *clamped\_data* as an empty list
  3. Iterate through each instance of *Generator* in the *scrollLayout*
     1. Initialize *l* as an empty list
     2. Capture each *Generator* instance with the following statement

x: Generator = self.scrollLayout.itemAt(i).widget()

* + 1. Read data from each QLineEdit and append it to *l* as a (key, value) tuple
    2. If the washer is ‘*Rectangular’*, capture *r, s, t* and *u* and set outside diameter as 2\*minimum(*r, s, t, u*)
    3. Construct a dictionary from *l* and append it to *clamped\_data*

1. The *calculate\_EL* button is connected to the *saveExtData()* slot which will capture the information from the third tab that accepts ‘External Loading’ data and performs the necessary calculations based on the requirements

***Algorithm for saveExtData():***

* 1. Refer to the global variable *extLoad\_data*
  2. Fetch numerical data from all the QLineEdits in the ‘External Loading’ tab and store it in temporary variables
  3. Construct a list of tuples named *data* with all the numerical values fetched from the form in the GUI
  4. Initialize *extLoad\_data* with a dictionary constructed from the list *data*
  5. Call the method *fillSpreadsheet()* internally

1. The method *fillSpreadsheet()* is called internally from the *saveExtData()* method which will write the captured information to the bolt calculation sheet

***Algorithm for fillSpreadsheet():***

* 1. Refer to the global variables containing the captured data
  2. Create a new instance of the Excel workbook with the following statement

wb = openpyxl.load\_workbook('calcbook2.xlsx')

* 1. Open the worksheet named as ‘calculation’ in the workbook by using the following statement

ws = wb['calculation']

* 1. Write all the information to the sheet by referring to the cell names directly
  2. Use the following loop to write the table for ‘*Bearing Pressure Check*’

ws['A44'] = 'Head/Part1'

ws['B44'] = '=MIN(O7,Q16)'

ws['D44'] = '=IF(B44>C44,"Pass","Fail")'

nClamped = int(self.nClampedPartsText.text())

for i in range(nClamped):

ws['A'+str(i+44)] = 'Part'+str(i+1)+'/Part'+str(i+2)

ws['B'+str(i+44)] = '=MIN(Q'+str(i+16)+',Q'+str(i+17)+')'

ws['D'+str(i+44)] = '=IF(B'+str(i+44)+'>C'+str(i+44)+',"Pass","Fail")'

ws['A' + str(i + 44)] = 'Part' + str(i + 1) + '/Threaded Part'

ws['B' + str(i + 44)] = '=MIN(Q' + str(i + 16) + ',O35)'

ws['D' + str(i + 44)] = '=IF(B' + str(i + 44) + '>C' + str(i + 44) + ',"Pass","Fail")'

* 1. Save the workbook with the same name

1. Generator Class

The *Generator* class is used as a model to create instances of the form used to collect the information of the clamped parts. Since the number of forms required to capture the information varies between cases – based on the number of clamped parts, going for a regenerative approach helps keep the tool dynamic and highly elastic.

Apart from the widgets used to get data from the user, the *Generator* class also have certain method to facilitate dynamism and on-the-fly swapping of widgets/data.

***The \_\_init\_\_() constructor:***

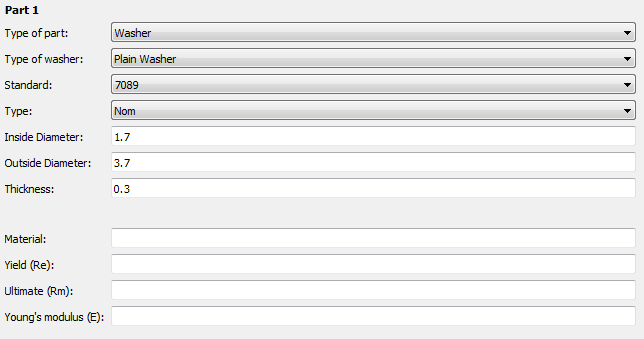
1. Create an instance of the database ‘*boltdata.json’* by passing it as an argument to the constructor of TinyDB using the following statement

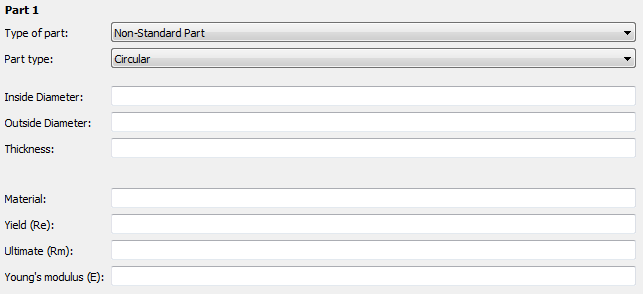
self.db = TinyDB('boltdata.json')

1. Make a rough layout of the form with Qt Designer and export the .ui file to .py; copy the code in the generated class to the *Generator* class and make necessary changes so that the form meets the requirements of the clamped part
2. Use the *setLayout()* method to render the form on the screen (here refers to the parent layout – *scrollLayout*)

self.setLayout(self.formLayout)

1. Call the *populatePartCombo()* method to fill the *partComboBox*; this ComboBox will have ‘Washer’ and ‘Non-Standard Part’ as the options
2. Call the *populateWasher()* method to change the available widgets (options) based on the type of clamped part selected





The active widgets will change dynamically based on the type of part selected.

1. The *populateWashStd()* method is called internally from *populateWasher()* method to set the available washer standards in the *washerComboBox*; it also dynamically changes the input requirements appropriately for each QLineEdit
2. The *populateWasherTypes()* method is called internally from the *populateWashStd()* method; this method adds options to the *typeComboBox* which consists of the different types of washers along with their standards
3. The *fetchWasherInfo()* method is called internally from the *populateWasherTypes()* method which will retrieve the details of the washer currently selected

***Algorithm for fetchWasherInfo():***

1. Refer global variable *bolt\_size*
2. Show QLineEdits for Oblong/Circular hole where the dimension input is manual
3. If a standard washer is chosen,
   1. Open the table from the database whose name is the same as the standard selected
   2. If the type and size match the chosen type and bolt size, get the minimum inner diameter, minimum outer diameter and the nominal thickness and set these values to their respective QLineEdit
4. Broken/incomplete features
5. **Results Tab**

The fourth tab provisioned to show the results is incomplete. In order to finish this work, build a basic layout for the output with Qt Designer and compile the .ui file to .py. Import this code into the main project’s UI. It is better to modify the .ui file in the source code of this tool.

Use a spreadsheet package to read the Excel Workbook like xlrd or openpyxl. Refer the package’s documentation for the syntaxes of the read statements. Read data from individual cells and use the QWidgets to present the data captured from the sheet.

1. **Database Upgradation**

The current JSON format used for database is not very user serviceable as one has to deal with code directly. Necessary steps must be taken to use Microsoft Access or Oracle DB (will require administrative privileges to access the ODBC drivers). A better alternative will be is to use SQLite or React DB which are standalone micro databases.

# Appendix A:

Main UI Design

*# -\*- coding: utf-8 -\*-  
  
# Form implementation generated from reading ui file '\boltcalc\production\_ui.ui'***from** PyQt5 **import** QtCore, QtGui, QtWidgets  
  
  
**class** Ui\_bolt\_ui(object):  
 **def** setupUi(self, bolt\_ui):  
 bolt\_ui.setObjectName(**"bolt\_ui"**)  
 bolt\_ui.resize(714, 707)  
 sizePolicy = QtWidgets.QSizePolicy(QtWidgets.QSizePolicy.Expanding, QtWidgets.QSizePolicy.Expanding)  
 sizePolicy.setHorizontalStretch(0)  
 sizePolicy.setVerticalStretch(0)  
 sizePolicy.setHeightForWidth(bolt\_ui.sizePolicy().hasHeightForWidth())  
 bolt\_ui.setSizePolicy(sizePolicy)  
 bolt\_ui.setSizeGripEnabled(**True**)  
 bolt\_ui.setModal(**False**)  
 self.gridLayout\_4 = QtWidgets.QGridLayout(bolt\_ui)  
 self.gridLayout\_4.setObjectName(**"gridLayout\_4"**)  
 self.tabWidget = QtWidgets.QTabWidget(bolt\_ui)  
 sizePolicy = QtWidgets.QSizePolicy(QtWidgets.QSizePolicy.Preferred, QtWidgets.QSizePolicy.Preferred)  
 sizePolicy.setHorizontalStretch(0)  
 sizePolicy.setVerticalStretch(0)  
 sizePolicy.setHeightForWidth(self.tabWidget.sizePolicy().hasHeightForWidth())  
 self.tabWidget.setSizePolicy(sizePolicy)  
 self.tabWidget.setTabShape(QtWidgets.QTabWidget.Triangular)  
 self.tabWidget.setObjectName(**"tabWidget"**)  
 self.tab = QtWidgets.QWidget()  
 self.tab.setObjectName(**"tab"**)  
 self.gridLayout = QtWidgets.QGridLayout(self.tab)  
 self.gridLayout.setObjectName(**"gridLayout"**)  
 self.pitchlabel = QtWidgets.QLabel(self.tab)  
 self.pitchlabel.setObjectName(**"pitchlabel"**)  
 self.gridLayout.addWidget(self.pitchlabel, 5, 1, 1, 1)  
 self.thicklineEdit = QtWidgets.QLineEdit(self.tab)  
 self.thicklineEdit.setObjectName(**"thicklineEdit"**)  
 self.gridLayout.addWidget(self.thicklineEdit, 6, 2, 1, 7)  
 self.nutCombo = QtWidgets.QComboBox(self.tab)  
 self.nutCombo.setObjectName(**"nutCombo"**)  
 self.gridLayout.addWidget(self.nutCombo, 20, 2, 1, 7)  
 self.renutlineEdit = QtWidgets.QLineEdit(self.tab)  
 self.renutlineEdit.setObjectName(**"renutlineEdit"**)  
 self.gridLayout.addWidget(self.renutlineEdit, 25, 2, 1, 7)  
 self.rmnutlineEdit = QtWidgets.QLineEdit(self.tab)  
 self.rmnutlineEdit.setObjectName(**"rmnutlineEdit"**)  
 self.gridLayout.addWidget(self.rmnutlineEdit, 26, 2, 1, 7)  
 self.label\_9 = QtWidgets.QLabel(self.tab)  
 self.label\_9.setObjectName(**"label\_9"**)  
 self.gridLayout.addWidget(self.label\_9, 20, 1, 1, 1)  
 self.label\_10 = QtWidgets.QLabel(self.tab)  
 self.label\_10.setObjectName(**"label\_10"**)  
 self.gridLayout.addWidget(self.label\_10, 23, 1, 1, 1)  
 self.label\_14 = QtWidgets.QLabel(self.tab)  
 self.label\_14.setObjectName(**"label\_14"**)  
 self.gridLayout.addWidget(self.label\_14, 25, 1, 1, 1)  
 self.gradeNutCombo = QtWidgets.QComboBox(self.tab)  
 self.gradeNutCombo.setObjectName(**"gradeNutCombo"**)  
 self.gridLayout.addWidget(self.gradeNutCombo, 23, 2, 1, 7)  
 self.tBlock = QtWidgets.QLineEdit(self.tab)  
 self.tBlock.setObjectName(**"tBlock"**)  
 self.gridLayout.addWidget(self.tBlock, 21, 6, 1, 1)  
 self.label\_15 = QtWidgets.QLabel(self.tab)  
 self.label\_15.setObjectName(**"label\_15"**)  
 self.gridLayout.addWidget(self.label\_15, 26, 1, 1, 1)  
 self.resetInput = QtWidgets.QPushButton(self.tab)  
 self.resetInput.setMinimumSize(QtCore.QSize(0, 40))  
 self.resetInput.setObjectName(**"resetInput"**)  
 self.gridLayout.addWidget(self.resetInput, 28, 6, 1, 1)  
 self.label\_36 = QtWidgets.QLabel(self.tab)  
 self.label\_36.setObjectName(**"label\_36"**)  
 self.gridLayout.addWidget(self.label\_36, 24, 1, 1, 1)  
 self.label\_3 = QtWidgets.QLabel(self.tab)  
 self.label\_3.setObjectName(**"label\_3"**)  
 self.gridLayout.addWidget(self.label\_3, 8, 1, 1, 1)  
 self.label = QtWidgets.QLabel(self.tab)  
 self.label.setObjectName(**"label"**)  
 self.gridLayout.addWidget(self.label, 0, 0, 1, 2)  
 self.label\_16 = QtWidgets.QLabel(self.tab)  
 self.label\_16.setObjectName(**"label\_16"**)  
 self.gridLayout.addWidget(self.label\_16, 27, 1, 1, 1)  
 self.uBlock = QtWidgets.QLineEdit(self.tab)  
 self.uBlock.setObjectName(**"uBlock"**)  
 self.gridLayout.addWidget(self.uBlock, 21, 8, 1, 1)  
 self.recnutlineEdit = QtWidgets.QLineEdit(self.tab)  
 self.recnutlineEdit.setObjectName(**"recnutlineEdit"**)  
 self.gridLayout.addWidget(self.recnutlineEdit, 27, 2, 1, 7)  
 self.label\_4 = QtWidgets.QLabel(self.tab)  
 self.label\_4.setObjectName(**"label\_4"**)  
 self.gridLayout.addWidget(self.label\_4, 11, 1, 1, 1)  
 self.label\_13 = QtWidgets.QLabel(self.tab)  
 self.label\_13.setObjectName(**"label\_13"**)  
 self.gridLayout.addWidget(self.label\_13, 15, 1, 1, 1)  
 self.label\_11 = QtWidgets.QLabel(self.tab)  
 self.label\_11.setObjectName(**"label\_11"**)  
 self.gridLayout.addWidget(self.label\_11, 13, 1, 1, 1)  
 self.label\_32 = QtWidgets.QLabel(self.tab)  
 self.label\_32.setObjectName(**"label\_32"**)  
 self.gridLayout.addWidget(self.label\_32, 21, 1, 1, 1)  
 self.label\_37 = QtWidgets.QLabel(self.tab)  
 self.label\_37.setObjectName(**"label\_37"**)  
 self.gridLayout.addWidget(self.label\_37, 22, 1, 1, 1)  
 self.nutHeight = QtWidgets.QLineEdit(self.tab)  
 self.nutHeight.setObjectName(**"nutHeight"**)  
 self.gridLayout.addWidget(self.nutHeight, 22, 2, 1, 7)  
 self.label\_12 = QtWidgets.QLabel(self.tab)  
 self.label\_12.setObjectName(**"label\_12"**)  
 self.gridLayout.addWidget(self.label\_12, 14, 1, 1, 1)  
 self.relineedit = QtWidgets.QLineEdit(self.tab)  
 self.relineedit.setEnabled(**True**)  
 self.relineedit.setReadOnly(**True**)  
 self.relineedit.setObjectName(**"relineedit"**)  
 self.gridLayout.addWidget(self.relineedit, 13, 2, 1, 7)  
 self.lengthText = QtWidgets.QLineEdit(self.tab)  
 self.lengthText.setObjectName(**"lengthText"**)  
 self.gridLayout.addWidget(self.lengthText, 8, 2, 1, 7)  
 self.nClampedPartsText = QtWidgets.QLineEdit(self.tab)  
 self.nClampedPartsText.setObjectName(**"nClampedPartsText"**)  
 self.gridLayout.addWidget(self.nClampedPartsText, 0, 2, 1, 7)  
 self.label\_6 = QtWidgets.QLabel(self.tab)  
 self.label\_6.setObjectName(**"label\_6"**)  
 self.gridLayout.addWidget(self.label\_6, 2, 1, 1, 1)  
 self.gradeCombo = QtWidgets.QComboBox(self.tab)  
 self.gradeCombo.setObjectName(**"gradeCombo"**)  
 self.gridLayout.addWidget(self.gradeCombo, 11, 2, 1, 7)  
 self.label\_33 = QtWidgets.QLabel(self.tab)  
 self.label\_33.setObjectName(**"label\_33"**)  
 self.gridLayout.addWidget(self.label\_33, 21, 3, 1, 1)  
 self.saveInput = QtWidgets.QPushButton(self.tab)  
 sizePolicy = QtWidgets.QSizePolicy(QtWidgets.QSizePolicy.Minimum, QtWidgets.QSizePolicy.Minimum)  
 sizePolicy.setHorizontalStretch(0)  
 sizePolicy.setVerticalStretch(0)  
 sizePolicy.setHeightForWidth(self.saveInput.sizePolicy().hasHeightForWidth())  
 self.saveInput.setSizePolicy(sizePolicy)  
 self.saveInput.setMinimumSize(QtCore.QSize(0, 40))  
 self.saveInput.setObjectName(**"saveInput"**)  
 self.gridLayout.addWidget(self.saveInput, 28, 8, 1, 1)  
 self.label\_34 = QtWidgets.QLabel(self.tab)  
 self.label\_34.setObjectName(**"label\_34"**)  
 self.gridLayout.addWidget(self.label\_34, 21, 5, 1, 1)  
 self.rBlock = QtWidgets.QLineEdit(self.tab)  
 self.rBlock.setObjectName(**"rBlock"**)  
 self.gridLayout.addWidget(self.rBlock, 21, 2, 1, 1)  
 self.label\_35 = QtWidgets.QLabel(self.tab)  
 self.label\_35.setObjectName(**"label\_35"**)  
 self.gridLayout.addWidget(self.label\_35, 21, 7, 1, 1)  
 self.sBlock = QtWidgets.QLineEdit(self.tab)  
 self.sBlock.setObjectName(**"sBlock"**)  
 self.gridLayout.addWidget(self.sBlock, 21, 4, 1, 1)  
 self.sizeCombo = QtWidgets.QComboBox(self.tab)  
 self.sizeCombo.setObjectName(**"sizeCombo"**)  
 self.gridLayout.addWidget(self.sizeCombo, 3, 2, 1, 7)  
 self.rmlineedit = QtWidgets.QLineEdit(self.tab)  
 self.rmlineedit.setEnabled(**True**)  
 self.rmlineedit.setReadOnly(**True**)  
 self.rmlineedit.setObjectName(**"rmlineedit"**)  
 self.gridLayout.addWidget(self.rmlineedit, 14, 2, 1, 7)  
 self.reclineedit = QtWidgets.QLineEdit(self.tab)  
 self.reclineedit.setEnabled(**True**)  
 self.reclineedit.setReadOnly(**True**)  
 self.reclineedit.setObjectName(**"reclineedit"**)  
 self.gridLayout.addWidget(self.reclineedit, 15, 2, 1, 7)  
 self.partCombo = QtWidgets.QComboBox(self.tab)  
 self.partCombo.setObjectName(**"partCombo"**)  
 self.gridLayout.addWidget(self.partCombo, 19, 2, 1, 7)  
 self.matBlock = QtWidgets.QLineEdit(self.tab)  
 self.matBlock.setObjectName(**"matBlock"**)  
 self.gridLayout.addWidget(self.matBlock, 24, 2, 1, 7)  
 self.typeCombo = QtWidgets.QComboBox(self.tab)  
 self.typeCombo.setObjectName(**"typeCombo"**)  
 self.gridLayout.addWidget(self.typeCombo, 2, 2, 1, 7)  
 self.label\_5 = QtWidgets.QLabel(self.tab)  
 self.label\_5.setObjectName(**"label\_5"**)  
 self.gridLayout.addWidget(self.label\_5, 3, 1, 1, 1)  
 self.label\_2 = QtWidgets.QLabel(self.tab)  
 self.label\_2.setObjectName(**"label\_2"**)  
 self.gridLayout.addWidget(self.label\_2, 1, 0, 1, 1)  
 self.label\_8 = QtWidgets.QLabel(self.tab)  
 self.label\_8.setObjectName(**"label\_8"**)  
 self.gridLayout.addWidget(self.label\_8, 19, 1, 1, 1)  
 self.label\_7 = QtWidgets.QLabel(self.tab)  
 self.label\_7.setObjectName(**"label\_7"**)  
 self.gridLayout.addWidget(self.label\_7, 18, 0, 1, 2)  
 self.pitchlineEdit = QtWidgets.QLineEdit(self.tab)  
 self.pitchlineEdit.setObjectName(**"pitchlineEdit"**)  
 self.gridLayout.addWidget(self.pitchlineEdit, 5, 2, 1, 7)  
 self.thicklabel = QtWidgets.QLabel(self.tab)  
 self.thicklabel.setObjectName(**"thicklabel"**)  
 self.gridLayout.addWidget(self.thicklabel, 6, 1, 1, 1)  
 self.sizeLabel = QtWidgets.QLabel(self.tab)  
 self.sizeLabel.setObjectName(**"sizeLabel"**)  
 self.gridLayout.addWidget(self.sizeLabel, 4, 1, 1, 1)  
 self.sizelineEdit = QtWidgets.QLineEdit(self.tab)  
 self.sizelineEdit.setObjectName(**"sizelineEdit"**)  
 self.gridLayout.addWidget(self.sizelineEdit, 4, 2, 1, 7)  
 self.label\_42 = QtWidgets.QLabel(self.tab)  
 self.label\_42.setObjectName(**"label\_42"**)  
 self.gridLayout.addWidget(self.label\_42, 7, 3, 1, 1)  
 self.sBlock\_2 = QtWidgets.QLineEdit(self.tab)  
 self.sBlock\_2.setObjectName(**"sBlock\_2"**)  
 self.gridLayout.addWidget(self.sBlock\_2, 7, 4, 1, 1)  
 self.label\_41 = QtWidgets.QLabel(self.tab)  
 self.label\_41.setObjectName(**"label\_41"**)  
 self.gridLayout.addWidget(self.label\_41, 7, 1, 1, 1)  
 self.rBlock\_2 = QtWidgets.QLineEdit(self.tab)  
 self.rBlock\_2.setObjectName(**"rBlock\_2"**)  
 self.gridLayout.addWidget(self.rBlock\_2, 7, 2, 1, 1)  
 self.label\_43 = QtWidgets.QLabel(self.tab)  
 self.label\_43.setObjectName(**"label\_43"**)  
 self.gridLayout.addWidget(self.label\_43, 7, 5, 1, 1)  
 self.tBlock\_2 = QtWidgets.QLineEdit(self.tab)  
 self.tBlock\_2.setObjectName(**"tBlock\_2"**)  
 self.gridLayout.addWidget(self.tBlock\_2, 7, 6, 1, 1)  
 self.label\_44 = QtWidgets.QLabel(self.tab)  
 self.label\_44.setObjectName(**"label\_44"**)  
 self.gridLayout.addWidget(self.label\_44, 7, 7, 1, 1)  
 self.uBlock\_2 = QtWidgets.QLineEdit(self.tab)  
 self.uBlock\_2.setObjectName(**"uBlock\_2"**)  
 self.gridLayout.addWidget(self.uBlock\_2, 7, 8, 1, 1)  
 self.tabWidget.addTab(self.tab, **""**)  
 self.tab\_2 = QtWidgets.QWidget()  
 self.tab\_2.setObjectName(**"tab\_2"**)  
 self.layoutWidget = QtWidgets.QWidget(self.tab\_2)  
 self.layoutWidget.setGeometry(QtCore.QRect(10, 500, 158, 25))  
 self.layoutWidget.setObjectName(**"layoutWidget"**)  
 self.horizontalLayout = QtWidgets.QHBoxLayout()  
 self.horizontalLayout.setContentsMargins(0, 0, 0, 0)  
 self.horizontalLayout.setObjectName(**"horizontalLayout"**)  
 self.resetClamp = QtWidgets.QPushButton(self.layoutWidget)  
 self.resetClamp.setObjectName(**"resetClamp"**)  
 self.horizontalLayout.addWidget(self.resetClamp)  
 self.saveClamp = QtWidgets.QPushButton(self.layoutWidget)  
 self.saveClamp.setObjectName(**"saveClamp"**)  
 self.horizontalLayout.addWidget(self.saveClamp)  
 self.tabWidget.addTab(self.tab\_2, **""**)  
 self.tab\_3 = QtWidgets.QWidget()  
 self.tab\_3.setObjectName(**"tab\_3"**)  
 self.gridLayout\_3 = QtWidgets.QGridLayout(self.tab\_3)  
 self.gridLayout\_3.setObjectName(**"gridLayout\_3"**)  
 self.ublineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.ublineEdit.setObjectName(**"ublineEdit"**)  
 self.gridLayout\_3.addWidget(self.ublineEdit, 7, 1, 1, 1)  
 self.label\_26 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_26.setObjectName(**"label\_26"**)  
 self.gridLayout\_3.addWidget(self.label\_26, 7, 2, 1, 1)  
 self.delublineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.delublineEdit.setObjectName(**"delublineEdit"**)  
 self.gridLayout\_3.addWidget(self.delublineEdit, 7, 3, 1, 1)  
 self.label\_27 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_27.setObjectName(**"label\_27"**)  
 self.gridLayout\_3.addWidget(self.label\_27, 8, 0, 1, 1)  
 self.yelineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.yelineEdit.setObjectName(**"yelineEdit"**)  
 self.gridLayout\_3.addWidget(self.yelineEdit, 8, 1, 1, 2)  
 self.calculateEL = QtWidgets.QPushButton(self.tab\_3)  
 self.calculateEL.setObjectName(**"calculateEL"**)  
 self.gridLayout\_3.addWidget(self.calculateEL, 11, 3, 1, 1)  
 self.label\_17 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_17.setObjectName(**"label\_17"**)  
 self.gridLayout\_3.addWidget(self.label\_17, 0, 0, 1, 1)  
 self.axialForcelineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.axialForcelineEdit.setObjectName(**"axialForcelineEdit"**)  
 self.gridLayout\_3.addWidget(self.axialForcelineEdit, 0, 1, 1, 2)  
 self.label\_18 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_18.setObjectName(**"label\_18"**)  
 self.gridLayout\_3.addWidget(self.label\_18, 1, 0, 1, 1)  
 self.shearForcelineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.shearForcelineEdit.setObjectName(**"shearForcelineEdit"**)  
 self.gridLayout\_3.addWidget(self.shearForcelineEdit, 1, 1, 1, 2)  
 self.label\_19 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_19.setObjectName(**"label\_19"**)  
 self.gridLayout\_3.addWidget(self.label\_19, 2, 0, 1, 1)  
 self.betalineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.betalineEdit.setObjectName(**"betalineEdit"**)  
 self.gridLayout\_3.addWidget(self.betalineEdit, 2, 1, 1, 2)  
 self.label\_20 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_20.setObjectName(**"label\_20"**)  
 self.gridLayout\_3.addWidget(self.label\_20, 3, 0, 1, 1)  
 self.uminlineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.uminlineEdit.setObjectName(**"uminlineEdit"**)  
 self.gridLayout\_3.addWidget(self.uminlineEdit, 3, 1, 1, 2)  
 self.label\_28 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_28.setObjectName(**"label\_28"**)  
 self.gridLayout\_3.addWidget(self.label\_28, 0, 3, 1, 1)  
 self.label\_29 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_29.setObjectName(**"label\_29"**)  
 self.gridLayout\_3.addWidget(self.label\_29, 1, 3, 1, 1)  
 self.label\_30 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_30.setObjectName(**"label\_30"**)  
 self.gridLayout\_3.addWidget(self.label\_30, 4, 3, 1, 1)  
 self.label\_31 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_31.setObjectName(**"label\_31"**)  
 self.gridLayout\_3.addWidget(self.label\_31, 8, 3, 1, 1)  
 self.label\_21 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_21.setObjectName(**"label\_21"**)  
 self.gridLayout\_3.addWidget(self.label\_21, 4, 0, 1, 1)  
 self.torquelineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.torquelineEdit.setObjectName(**"torquelineEdit"**)  
 self.gridLayout\_3.addWidget(self.torquelineEdit, 4, 1, 1, 2)  
 self.label\_22 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_22.setObjectName(**"label\_22"**)  
 self.gridLayout\_3.addWidget(self.label\_22, 5, 0, 1, 1)  
 self.tightAccuracylineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.tightAccuracylineEdit.setObjectName(**"tightAccuracylineEdit"**)  
 self.gridLayout\_3.addWidget(self.tightAccuracylineEdit, 5, 1, 1, 2)  
 self.label\_23 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_23.setObjectName(**"label\_23"**)  
 self.gridLayout\_3.addWidget(self.label\_23, 6, 0, 1, 1)  
 self.utlineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.utlineEdit.setObjectName(**"utlineEdit"**)  
 self.gridLayout\_3.addWidget(self.utlineEdit, 6, 1, 1, 1)  
 self.label\_24 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_24.setObjectName(**"label\_24"**)  
 self.gridLayout\_3.addWidget(self.label\_24, 6, 2, 1, 1)  
 self.resetEL = QtWidgets.QPushButton(self.tab\_3)  
 self.resetEL.setObjectName(**"resetEL"**)  
 self.gridLayout\_3.addWidget(self.resetEL, 11, 1, 1, 1)  
 self.label\_38 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_38.setObjectName(**"label\_38"**)  
 self.gridLayout\_3.addWidget(self.label\_38, 5, 3, 1, 1)  
 self.delutlineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.delutlineEdit.setObjectName(**"delutlineEdit"**)  
 self.gridLayout\_3.addWidget(self.delutlineEdit, 6, 3, 1, 1)  
 self.label\_25 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_25.setObjectName(**"label\_25"**)  
 self.gridLayout\_3.addWidget(self.label\_25, 7, 0, 1, 1)  
 self.thetalineEdit = QtWidgets.QLineEdit(self.tab\_3)  
 self.thetalineEdit.setObjectName(**"thetalineEdit"**)  
 self.gridLayout\_3.addWidget(self.thetalineEdit, 9, 1, 1, 1)  
 self.label\_39 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_39.setObjectName(**"label\_39"**)  
 self.gridLayout\_3.addWidget(self.label\_39, 9, 0, 1, 1)  
 self.label\_40 = QtWidgets.QLabel(self.tab\_3)  
 self.label\_40.setObjectName(**"label\_40"**)  
 self.gridLayout\_3.addWidget(self.label\_40, 9, 3, 1, 1)  
 self.tabWidget.addTab(self.tab\_3, **""**)  
 self.tab\_4 = QtWidgets.QWidget()  
 self.tab\_4.setObjectName(**"tab\_4"**)  
 self.gridLayout\_5 = QtWidgets.QVBoxLayout(self.tab\_4)  
 self.gridLayout\_5.setObjectName(**"gridLayout\_5"**)  
 self.table = QtWidgets.QTableWidget(self.tab\_4)  
 self.table.setObjectName(**"table"**)  
 self.table.setRowCount(60)  
 self.table.setColumnCount(5)  
 self.exportPDF = QtWidgets.QPushButton(self.tab\_4)  
 self.exportPDF.setObjectName(**"exportPDF"**)  
 self.gridLayout\_5.addWidget(self.table)  
 self.gridLayout\_5.addWidget(self.exportPDF)  
 self.tabWidget.addTab(self.tab\_4, **""**)  
 self.gridLayout\_4.addWidget(self.tabWidget, 0, 1, 1, 1)  
  
 self.scrollLayout = QtWidgets.QFormLayout()  
 self.scrollWidget = QtWidgets.QWidget()  
 self.scrollWidget.setLayout(self.scrollLayout)  
  
 self.scrollArea = QtWidgets.QScrollArea()  
 self.scrollArea.setWidgetResizable(**True**)  
 self.scrollArea.setWidget(self.scrollWidget)  
  
 self.mainLayout = QtWidgets.QVBoxLayout(self.tab\_2)  
  
 self.mainLayout.addWidget(self.scrollArea)  
 self.mainLayout.addLayout(self.horizontalLayout)  
  
  
 self.retranslateUi(bolt\_ui)  
 self.tabWidget.setCurrentIndex(0)  
 QtCore.QMetaObject.connectSlotsByName(bolt\_ui)  
 bolt\_ui.setTabOrder(self.tabWidget, self.nClampedPartsText)  
 bolt\_ui.setTabOrder(self.nClampedPartsText, self.typeCombo)  
 bolt\_ui.setTabOrder(self.typeCombo, self.sizeCombo)  
 bolt\_ui.setTabOrder(self.sizeCombo, self.sizelineEdit)  
 bolt\_ui.setTabOrder(self.sizelineEdit, self.pitchlineEdit)  
 bolt\_ui.setTabOrder(self.pitchlineEdit, self.thicklineEdit)  
 bolt\_ui.setTabOrder(self.thicklineEdit, self.rBlock\_2)  
 bolt\_ui.setTabOrder(self.rBlock\_2, self.sBlock\_2)  
 bolt\_ui.setTabOrder(self.sBlock\_2, self.tBlock\_2)  
 bolt\_ui.setTabOrder(self.tBlock\_2, self.uBlock\_2)  
 bolt\_ui.setTabOrder(self.uBlock\_2, self.lengthText)  
 bolt\_ui.setTabOrder(self.lengthText, self.gradeCombo)  
 bolt\_ui.setTabOrder(self.gradeCombo, self.relineedit)  
 bolt\_ui.setTabOrder(self.relineedit, self.rmlineedit)  
 bolt\_ui.setTabOrder(self.rmlineedit, self.reclineedit)  
 bolt\_ui.setTabOrder(self.reclineedit, self.partCombo)  
 bolt\_ui.setTabOrder(self.partCombo, self.nutCombo)  
 bolt\_ui.setTabOrder(self.nutCombo, self.rBlock)  
 bolt\_ui.setTabOrder(self.rBlock, self.sBlock)  
 bolt\_ui.setTabOrder(self.sBlock, self.tBlock)  
 bolt\_ui.setTabOrder(self.tBlock, self.uBlock)  
 bolt\_ui.setTabOrder(self.uBlock, self.nutHeight)  
 bolt\_ui.setTabOrder(self.nutHeight, self.gradeNutCombo)  
 bolt\_ui.setTabOrder(self.gradeNutCombo, self.matBlock)  
 bolt\_ui.setTabOrder(self.matBlock, self.renutlineEdit)  
 bolt\_ui.setTabOrder(self.renutlineEdit, self.rmnutlineEdit)  
 bolt\_ui.setTabOrder(self.rmnutlineEdit, self.recnutlineEdit)  
 bolt\_ui.setTabOrder(self.recnutlineEdit, self.saveInput)  
 bolt\_ui.setTabOrder(self.saveInput, self.resetInput)  
 bolt\_ui.setTabOrder(self.resetInput, self.saveClamp)  
 bolt\_ui.setTabOrder(self.saveClamp, self.resetClamp)  
 bolt\_ui.setTabOrder(self.resetClamp, self.axialForcelineEdit)  
 bolt\_ui.setTabOrder(self.axialForcelineEdit, self.shearForcelineEdit)  
 bolt\_ui.setTabOrder(self.shearForcelineEdit, self.betalineEdit)  
 bolt\_ui.setTabOrder(self.betalineEdit, self.uminlineEdit)  
 bolt\_ui.setTabOrder(self.uminlineEdit, self.torquelineEdit)  
 bolt\_ui.setTabOrder(self.torquelineEdit, self.tightAccuracylineEdit)  
 bolt\_ui.setTabOrder(self.tightAccuracylineEdit, self.utlineEdit)  
 bolt\_ui.setTabOrder(self.utlineEdit, self.delutlineEdit)  
 bolt\_ui.setTabOrder(self.delutlineEdit, self.ublineEdit)  
 bolt\_ui.setTabOrder(self.ublineEdit, self.delublineEdit)  
 bolt\_ui.setTabOrder(self.delublineEdit, self.yelineEdit)  
 bolt\_ui.setTabOrder(self.yelineEdit, self.thetalineEdit)  
 bolt\_ui.setTabOrder(self.thetalineEdit, self.calculateEL)  
 bolt\_ui.setTabOrder(self.calculateEL, self.resetEL)  
 bolt\_ui.setTabOrder(self.resetEL, self.exportPDF)  
  
 **def** retranslateUi(self, bolt\_ui):  
 \_translate = QtCore.QCoreApplication.translate  
 bolt\_ui.setWindowTitle(\_translate(**"bolt\_ui"**, **"Bolt Calculation UX"**))  
 self.pitchlabel.setText(\_translate(**"bolt\_ui"**, **"Pitch:"**))  
 self.label\_9.setText(\_translate(**"bolt\_ui"**, **"Type of nut:"**))  
 self.label\_10.setText(\_translate(**"bolt\_ui"**, **"Grade:"**))  
 self.label\_14.setText(\_translate(**"bolt\_ui"**, **"Yield (Re):"**))  
 self.label\_15.setText(\_translate(**"bolt\_ui"**, **"Ultimate (Rw):"**))  
 self.resetInput.setText(\_translate(**"bolt\_ui"**, **"Reset"**))  
 self.label\_36.setText(\_translate(**"bolt\_ui"**, **"Material:"**))  
 self.label\_3.setText(\_translate(**"bolt\_ui"**, **"Length:"**))  
 self.label.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p><span style=\" font-weight:600;\">Number of clamped parts:</span></p></body></html>"**))  
 self.label\_16.setText(\_translate(**"bolt\_ui"**, **"Rec:"**))  
 self.label\_4.setText(\_translate(**"bolt\_ui"**, **"Grade:"**))  
 self.label\_13.setText(\_translate(**"bolt\_ui"**, **"Rec:"**))  
 self.label\_11.setText(\_translate(**"bolt\_ui"**, **"Yield (Re):"**))  
 self.label\_32.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p align=\"right\">r:</p></body></html>"**))  
 self.label\_37.setText(\_translate(**"bolt\_ui"**, **"Height:"**))  
 self.label\_12.setText(\_translate(**"bolt\_ui"**, **"Ultimate (Rw):"**))  
 self.nClampedPartsText.setPlaceholderText(\_translate(**"bolt\_ui"**, **"Enter values between 2-10"**))  
 self.label\_6.setText(\_translate(**"bolt\_ui"**, **"Type:"**))  
 self.label\_33.setText(\_translate(**"bolt\_ui"**, **"s:"**))  
 self.saveInput.setText(\_translate(**"bolt\_ui"**, **"Save"**))  
 self.label\_34.setText(\_translate(**"bolt\_ui"**, **"t:"**))  
 self.label\_35.setText(\_translate(**"bolt\_ui"**, **"u:"**))  
 self.label\_5.setText(\_translate(**"bolt\_ui"**, **"Size:"**))  
 self.label\_2.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p><span style=\" font-weight:600;\">Bolt</span></p></body></html>"**))  
 self.label\_8.setText(\_translate(**"bolt\_ui"**, **"Type of part:"**))  
 self.label\_7.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p><span style=\" font-weight:600;\">Threaded Part</span></p></body></html>"**))  
 self.thicklabel.setText(\_translate(**"bolt\_ui"**, **"Thickness:"**))  
 self.sizeLabel.setText(\_translate(**"bolt\_ui"**, **"Size:"**))  
 self.label\_42.setText(\_translate(**"bolt\_ui"**, **"s:"**))  
 self.label\_41.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p align=\"right\">r:</p></body></html>"**))  
 self.label\_43.setText(\_translate(**"bolt\_ui"**, **"t:"**))  
 self.label\_44.setText(\_translate(**"bolt\_ui"**, **"u:"**))  
 self.tabWidget.setTabText(self.tabWidget.indexOf(self.tab), \_translate(**"bolt\_ui"**, **"Inputs"**))  
 self.resetClamp.setText(\_translate(**"bolt\_ui"**, **"Reset"**))  
 self.saveClamp.setText(\_translate(**"bolt\_ui"**, **"Save"**))  
 self.tabWidget.setTabText(self.tabWidget.indexOf(self.tab\_2), \_translate(**"bolt\_ui"**, **"Clamped Parts"**))  
 self.ublineEdit.setPlaceholderText(\_translate(**"bolt\_ui"**, **"µb"**))  
 self.label\_26.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p align=\"center\">±</p></body></html>"**))  
 self.delublineEdit.setPlaceholderText(\_translate(**"bolt\_ui"**, **"Δµb"**))  
 self.label\_27.setText(\_translate(**"bolt\_ui"**, **"Equivalent stress tightening ratio (γE):"**))  
 self.calculateEL.setText(\_translate(**"bolt\_ui"**, **"Calculate"**))  
 self.label\_17.setText(\_translate(**"bolt\_ui"**, **"Axial Force (Fa):"**))  
 self.label\_18.setText(\_translate(**"bolt\_ui"**, **"Shear Force (Ft):"**))  
 self.label\_19.setText(\_translate(**"bolt\_ui"**, **"Load Introduction Factor(β):"**))  
 self.label\_20.setText(\_translate(**"bolt\_ui"**, **"Co-efficient of friction (sliding faces) (µmin):"**))  
 self.label\_28.setText(\_translate(**"bolt\_ui"**, **"N"**))  
 self.label\_29.setText(\_translate(**"bolt\_ui"**, **"N"**))  
 self.label\_30.setText(\_translate(**"bolt\_ui"**, **"Nm"**))  
 self.label\_31.setText(\_translate(**"bolt\_ui"**, **"% Re"**))  
 self.label\_21.setText(\_translate(**"bolt\_ui"**, **"Applied torque (T):"**))  
 self.label\_22.setText(\_translate(**"bolt\_ui"**, **"Tightening torque accuracy (ΔT/T):"**))  
 self.label\_23.setText(\_translate(**"bolt\_ui"**, **"Thread coefficient of friction (µt ± Δµt):"**))  
 self.utlineEdit.setPlaceholderText(\_translate(**"bolt\_ui"**, **"µt"**))  
 self.label\_24.setText(\_translate(**"bolt\_ui"**, **"<html><head/><body><p align=\"center\">±</p></body></html>"**))  
 self.resetEL.setText(\_translate(**"bolt\_ui"**, **"Reset"**))  
 self.label\_38.setText(\_translate(**"bolt\_ui"**, **"%"**))  
 self.delutlineEdit.setPlaceholderText(\_translate(**"bolt\_ui"**, **"Δµt"**))  
 self.label\_25.setText(\_translate(**"bolt\_ui"**, **"Friction co-efficient under the driven element (µb ± Δµb):"**))  
 self.thetalineEdit.setPlaceholderText(\_translate(**"bolt\_ui"**, **"for oblong hole calculation only"**))  
 self.label\_39.setText(\_translate(**"bolt\_ui"**, **"Cone Angle (Ɵ):"**))  
 self.label\_40.setText(\_translate(**"bolt\_ui"**, **"degrees"**))  
 self.tabWidget.setTabText(self.tabWidget.indexOf(self.tab\_3), \_translate(**"bolt\_ui"**, **"External Loading"**))  
 self.exportPDF.setText(\_translate(**"bolt\_ui"**, **"Export to PDF"**))  
 self.tabWidget.setTabText(self.tabWidget.indexOf(self.tab\_4), \_translate(**"bolt\_ui"**, **"Results"**))

# Appendix B:

## Driver Logic

**import** sys, openpyxl, math  
**from** PyQt5.QtWidgets **import** \*  
**from** tinydb **import** TinyDB  
**import** newui  
  
bolt\_size = 1.6 *# diameter of bolt  
  
# global content collectors*bolt\_data = {}  
clamped\_data = []  
threaded\_data = {}  
extLoad\_data = {}  
  
  
**class** UX(QDialog, newui.Ui\_bolt\_ui):  
 **def** \_\_init\_\_(self):  
 QDialog.\_\_init\_\_(self)  
 newui.Ui\_bolt\_ui.\_\_init\_\_(self)  
 self.setupUi(self)  
 self.tabWidget.setCurrentIndex(0)  
 self.db = TinyDB(**'boltdata.json'**)  
 self.old\_clamp\_count = 0  
  
 self.nutCombo.hide()  
 self.gradeNutCombo.hide()  
 self.renutlineEdit.hide()  
 self.rmnutlineEdit.hide()  
 self.recnutlineEdit.hide()  
  
 self.sizeLabel.hide()  
 self.pitchlabel.hide()  
 self.thicklabel.hide()  
 self.label\_41.hide()  
 self.label\_42.hide()  
 self.label\_43.hide()  
 self.label\_44.hide()  
 self.sizelineEdit.hide()  
 self.pitchlineEdit.hide()  
 self.thicklineEdit.hide()  
 self.rBlock\_2.hide()  
 self.sBlock\_2.hide()  
 self.tBlock\_2.hide()  
 self.uBlock\_2.hide()  
  
  
 self.populateTypeList()  
 self.populateGradeList()  
 self.populatePartList()  
 self.getMaterialData()  
 self.getNutMaterialData()  
  
 self.nClampedPartsText.editingFinished.connect(self.populateClampTab)  
 self.typeCombo.currentTextChanged.connect(self.populateSizeList)  
 self.sizeCombo.currentTextChanged.connect(self.setBoltSize)  
 self.sizelineEdit.editingFinished.connect(self.setBoltSize)  
 self.gradeCombo.currentTextChanged.connect(self.getMaterialData)  
 self.gradeNutCombo.currentTextChanged.connect(self.getNutMaterialData)  
 self.partCombo.currentTextChanged.connect(self.populatePartComponentList)  
 self.saveInput.clicked.connect(self.saveInputData)  
 self.resetInput.clicked.connect(self.resetInputData)  
 self.saveClamp.clicked.connect(self.saveClampData)  
 self.resetClamp.clicked.connect(self.resetClampData)  
 self.calculateEL.clicked.connect(self.saveExtData)  
 self.resetEL.clicked.connect(self.resetExtData)  
 self.renutlineEdit.editingFinished.connect(self.setREC)  
 self.rmnutlineEdit.editingFinished.connect(self.setREC)  
  
 **def** saveInputData(self):  
 **try**:  
 **global** bolt\_data, threaded\_data, bolt\_size  
 data = []  
 data2 = []  
 type = self.typeCombo.currentText().split()[0]  
 **if** self.typeCombo.currentText() == **'Non-Standard/Stud '**:  
 size = self.sizelineEdit.text()  
 **else**:  
 size = self.sizeCombo.currentText()  
 material = self.gradeCombo.currentText().split()[0]  
 **if** material == **'Stainless'**:  
 e = 191000  
 **else**:  
 e = 210000  
 re = self.relineedit.text()  
 rm = self.rmlineedit.text()  
 length = self.lengthText.text()  
  
 **if** self.typeCombo.currentText() == **'Non-Standard/Stud '**:  
 data.append((**'height'**, float(self.thicklineEdit.text())))  
  
 dimen = [float(self.rBlock\_2.text()),  
 float(self.sBlock\_2.text()),  
 float(self.tBlock\_2.text()),  
 float(self.uBlock\_2.text())]  
  
 data.append((**'dw'**, 2 \* min(dimen)))  
 data.append((**'pitch'**, float(self.pitchlineEdit.text())))  
 data.append((**'re'**, float(re)))  
 data.append((**'rm'**, float(rm)))  
 data.append((**'length'**, float(length)))  
 data.append((**'e'**, e))  
 **else**:  
 bolttab = self.db.table(type)  
  
 **for** item **in** bolttab:  
 **if** str(item[**'size'**]) == str(size):  
 data.append((**'height'**, item[**'k'**]))  
  
 print(self.typeCombo.currentText().split())  
  
 **if 'Countersunk' in** self.typeCombo.currentText().split():  
 csa = math.pi \* math.sqrt(2) \* (math.pow(float(item[**'dw'**])/2, 2) -  
 math.pow(float(item[**'dw'**])/2 - float(item[**'k'**]), 2))  
 dw = 8 / (3 \* math.pi) \* csa  
 data.append((**'dw'**, dw))  
 **else**:  
 data.append((**'dw'**, item[**'dw'**]))  
 data.append((**'pitch'**, item[**'pitch'**]))  
 data.append((**'re'**, float(re)))  
 data.append((**'rm'**, float(rm)))  
 data.append((**'length'**, float(length)))  
 data.append((**'e'**, e))  
 **break** print(data)  
 bolt\_data = dict(data)  
  
 thread\_type = self.partCombo.currentText()  
 **if**(thread\_type == **'Nut'**):  
 nutStd = self.nutCombo.currentText().split()[0]  
 nuttab = self.db.table(nutStd)  
 **for** item **in** nuttab:  
 **if** float(item[**'size'**]) == float(bolt\_size):  
 dia = float(item[**'dw'**])  
 h = float(item[**'m'**])  
 data2.append((**'dia'**,dia))  
 data2.append((**'height'**, h))  
 **break  
 else**:  
 r = float(self.rBlock.text())  
 s = float(self.sBlock.text())  
 t = float(self.tBlock.text())  
 u = float(self.uBlock.text())  
 dia = abs(r-t) **if** (abs(r-t)<abs(s-u)) **else** abs(s-u)  
 data2.append((**'dia'**, dia))  
 h = float(self.nutHeight.text())  
 data2.append((**'height'**, h))  
 re = self.renutlineEdit.text()  
 rm = self.rmnutlineEdit.text()  
 data2.append((**'re'**, float(re)))  
 data2.append((**'rm'**, float(rm)))  
  
 print(data2)  
 threaded\_data = dict(data2)  
 **except**:  
 print(**'Missing data!'**)  
  
 **def** resetInputData(self):  
 **pass  
  
 def** saveClampData(self):  
 **global** clamped\_data, bolt\_data, threaded\_data, bolt\_size  
 clamped\_data.clear()  
  
 **try**:  
 **for** i **in** range(self.scrollLayout.count()):  
 l = []  
 x: Generator = self.scrollLayout.itemAt(i).widget()  
 l.append((**'re'**, float(x.yieldWasher.text())))  
 l.append((**'rm'**, float(x.ultiWasher.text())))  
 l.append((**'e'**, float(x.eModulus.text())))  
 l.append((**'material'**, x.materialWasher.text()))  
 print(x.washerComboBox.currentText())  
 **if** x.washerComboBox.currentText() == **'Rectangular'**:  
 dimen = [float(x.insdialineEdit.text()),  
 float(x.outdialineEdit.text()),  
 float(x.thicklineEdit.text()),  
 float(x.uEdit.text())]  
  
 outdia = 2\*min(dimen)  
 print(outdia)  
 print(dimen)  
 l.append((**'outdia'**, outdia))  
 l.append((**'thick'**, float(x.rectThickness.text())))  
 l.append((**'insdia'**, float(x.holeDia.text())))  
 **else**:  
 l.append((**'insdia'**, float(x.insdialineEdit.text())))  
 l.append((**'outdia'**, float(x.outdialineEdit.text())))  
 l.append((**'thick'**, float(x.thicklineEdit.text())))  
 clamped\_data.append(dict(l))  
 print(clamped\_data)  
 **except**:  
 print(**'Enter all data!'**)  
  
 **def** resetClampData(self):  
 **pass  
  
 def** saveExtData(self):  
 **try**:  
 **global** extLoad\_data  
 fa = float(self.axialForcelineEdit.text())  
 ft = float(self.shearForcelineEdit.text())  
 beta = float(self.betalineEdit.text())  
 umin = float(self.uminlineEdit.text())  
 torque = float(self.torquelineEdit.text())  
 ttAcc = float(self.tightAccuracylineEdit.text())  
 ut = float(self.utlineEdit.text())  
 delut = float(self.delutlineEdit.text())  
 ub = float(self.ublineEdit.text())  
 delub = float(self.delublineEdit.text())  
 ye = float(self.yelineEdit.text())  
  
 data = [  
 (**'axialForce'**, fa),  
 (**'shearForce'**, ft),  
 (**'beta'**, beta),  
 (**'fricCoeff'**, umin),  
 (**'torque'**, torque),  
 (**'tightTorqAcc'**, ttAcc),  
 (**'ut'**, ut),  
 (**'delut'**, delut),  
 (**'ub'**, ub),  
 (**'delub'**, delub),  
 (**'eqStressTightRatio'**, ye)  
 ]  
  
 extLoad\_data = dict(data)  
 print(extLoad\_data)  
  
 self.fillSpreadsheet()  
 **except**:  
 print(**'Empty or invalid fields!'**)  
  
 **def** resetExtData(self):  
 **pass  
  
 def** populateTypeList(self):  
 l = []  
 nametable = self.db.table(**'boltnames'**)  
 **for** item **in** nametable:  
 item = str(item[**'name'**]+**' '**+item[**'type'**])  
 l.append(str(item))  
 self.typeCombo.clear()  
 self.typeCombo.addItems(l)  
 self.populateSizeList()  
  
 **def** populateSizeList(self):  
 print(self.typeCombo.currentText())  
 **if** self.typeCombo.currentText() == **'Non-Standard/Stud '**:  
 self.sizeLabel.show()  
 self.pitchlabel.show()  
 self.thicklabel.show()  
 self.label\_41.show()  
 self.label\_42.show()  
 self.label\_43.show()  
 self.label\_44.show()  
 self.sizelineEdit.show()  
 self.pitchlineEdit.show()  
 self.thicklineEdit.show()  
 self.rBlock\_2.show()  
 self.sBlock\_2.show()  
 self.tBlock\_2.show()  
 self.uBlock\_2.show()  
  
 self.label\_5.hide()  
 self.sizeCombo.hide()  
  
 self.setBoltSize()  
  
 **else**:  
 self.label\_5.show()  
 self.sizeCombo.show()  
  
 self.sizeLabel.hide()  
 self.pitchlabel.hide()  
 self.thicklabel.hide()  
 self.label\_41.hide()  
 self.label\_42.hide()  
 self.label\_43.hide()  
 self.label\_44.hide()  
 self.sizelineEdit.hide()  
 self.pitchlineEdit.hide()  
 self.thicklineEdit.hide()  
 self.rBlock\_2.hide()  
 self.sBlock\_2.hide()  
 self.tBlock\_2.hide()  
 self.uBlock\_2.hide()  
  
 type = self.typeCombo.currentText().split()[0]  
 sizetab = self.db.table(type)  
 l = []  
 **for** item **in** sizetab:  
 l.append(str(item[**'size'**]))  
 self.sizeCombo.clear()  
 self.sizeCombo.addItems(l)  
 self.setBoltSize()  
  
 **def** setBoltSize(self):  
 **global** bolt\_size  
 **if not** (self.sizeCombo.currentText() == **''**):  
 **if** (self.typeCombo.currentText() == **'Non-Standard/Stud '**):  
 **if not** (self.sizelineEdit.text() == **''**):  
 bolt\_size = float(self.sizelineEdit.text().lstrip(**'M'**))  
 **else**:  
 bolt\_size = float(self.sizeCombo.currentText().lstrip(**'M'**))  
 print(bolt\_size)  
 self.populatePartComponentList()  
  
 **def** populateGradeList(self):  
 gradetab = self.db.table(**'boltnutmaterial'**)  
 l = []  
 **for** item **in** gradetab:  
 l.append(str(item[**'material'**]+**" "**+str(item[**'size'**])))  
 self.gradeCombo.clear()  
 self.gradeCombo.addItems(l)  
 self.gradeNutCombo.clear()  
 self.gradeNutCombo.addItems(l)  
  
 **def** getMaterialData(self):  
 size = self.gradeCombo.currentText().split()[-1]  
 gradetab = self.db.table(**'boltnutmaterial'**)  
 **for** item **in** gradetab:  
 **if**(str(item[**'size'**])==size):  
 re = item[**'Re'**]  
 rm = item[**'Rm'**]  
 rec = (item[**'Re'**]+item[**'Rm'**])/2  
 self.relineedit.setText(str(re))  
 self.rmlineedit.setText(str(rm))  
 self.reclineedit.setText(str(rec))  
  
 **def** getNutMaterialData(self):  
 size = self.gradeNutCombo.currentText().split()[-1]  
 gradetab = self.db.table(**'boltnutmaterial'**)  
 **for** item **in** gradetab:  
 **if**(str(item[**'size'**])==size):  
 re = item[**'Re'**]  
 rm = item[**'Rm'**]  
 rec = (item[**'Re'**]+item[**'Rm'**])/2  
 self.renutlineEdit.setText(str(re))  
 self.rmnutlineEdit.setText(str(rm))  
 self.recnutlineEdit.setText(str(rec))  
  
 **def** populatePartList(self):  
 self.partCombo.clear()  
 self.partCombo.addItems([**'Nut'**, **'Block'**])  
 self.populatePartComponentList()  
  
 **def** populatePartComponentList(self):  
 **global** bolt\_size  
 **if** self.partCombo.currentText() == **'Nut'**:  
 self.label\_32.hide()  
 self.label\_33.hide()  
 self.label\_34.hide()  
 self.label\_35.hide()  
 self.label\_36.hide()  
 self.label\_37.hide()  
 self.rBlock.hide()  
 self.sBlock.hide()  
 self.tBlock.hide()  
 self.uBlock.hide()  
 self.matBlock.hide()  
 self.nutHeight.hide()  
 self.recnutlineEdit.setReadOnly(**True**)  
 self.renutlineEdit.setReadOnly(**True**)  
 self.rmnutlineEdit.setReadOnly(**True**)  
 self.label\_9.show()  
 self.label\_10.show()  
 self.nutCombo.show()  
 self.gradeNutCombo.show()  
 self.renutlineEdit.show()  
 self.rmnutlineEdit.show()  
 self.recnutlineEdit.show()  
  
 nuttab = self.db.table(**'nutnames'**)  
 l = []  
 **for** item **in** nuttab:  
 stdtab = self.db.table(str(item[**'std'**]))  
 **for** x **in** stdtab:  
 **if** str(x[**'size'**]).lstrip(**'M'**).split(**'x'**)[0] == str(bolt\_size):  
 l.append(str(item[**'std'**]) + **' '** + item[**'type'**])  
 **break** self.nutCombo.clear()  
 self.nutCombo.addItems(l)  
 self.getNutMaterialData()  
 **else**:  
 self.nutCombo.hide()  
 self.gradeNutCombo.hide()  
 self.label\_9.hide()  
 self.label\_10.hide()  
 self.label\_32.show()  
 self.label\_33.show()  
 self.label\_34.show()  
 self.label\_35.show()  
 self.label\_36.show()  
 self.label\_37.show()  
 self.rBlock.show()  
 self.sBlock.show()  
 self.tBlock.show()  
 self.uBlock.show()  
 self.matBlock.show()  
 self.nutHeight.show()  
 self.renutlineEdit.setReadOnly(**False**)  
 self.rmnutlineEdit.setReadOnly(**False**)  
 self.recnutlineEdit.clear()  
 self.renutlineEdit.clear()  
 self.rmnutlineEdit.clear()  
  
 **def** setREC(self):  
 re = self.renutlineEdit.text()  
 rm = self.rmnutlineEdit.text()  
 **try**:  
 **if**(re == **'' or** rm == **''**):  
 **pass  
 else**:  
 rec = (float(re) + float(rm)) / 2  
 self.recnutlineEdit.setText(str(rec))  
 **except**:  
 print(**'Enter numerical values only!'**)  
  
 **def** populateClampTab(self):  
 x = self.nClampedPartsText.text()  
 **if**(x == **'' or** x.isalpha()):  
 self.scrollLayout.addRow(QLabel(**'Enter valid number of clamps.'**))  
 **return** count = int(x)  
 **if not**(self.old\_clamp\_count == count):  
 **for** i **in** range(self.scrollLayout.count()):  
 self.scrollLayout.itemAt(i).widget().close()  
 **try**:  
 **if** count **in** range(2, 11):  
 **for** i **in** range(0, count):  
 self.scrollLayout.addRow(Generator(i))  
 **else**:  
 self.scrollLayout.addRow(QLabel(**'Number of clamps should be between 2 and 10.'**))  
 self.old\_clamp\_count = count  
 **except** Exception:  
 self.scrollLayout.addRow(QLabel(**'Unhandled Exception.'**))  
  
 **def** fillSpreadsheet(self):  
 **try**:  
 **global** bolt\_data, bolt\_size, threaded\_data, extLoad\_data, clamped\_data  
  
 wb = openpyxl.load\_workbook(**'bolt\_cal\_template.xlsx'**)  
 ws = wb[**'calculation'**]  
  
 *# write bolt data to sheet* ws[**'L2'**] = bolt\_data[**'height'**]  
 ws[**'L3'**] = bolt\_data[**'e'**]  
 ws[**'L4'**] = bolt\_data[**'dw'**]  
 ws[**'L5'**] = bolt\_size  
 ws[**'L6'**] = bolt\_data[**'pitch'**]  
 ws[**'L7'**] = bolt\_data[**'re'**]  
 ws[**'L8'**] = bolt\_data[**'rm'**]  
 ws[**'L9'**] = bolt\_data[**'length'**]  
  
 *# write thread data to sheet* ws[**'L32'**] = threaded\_data[**'height'**]  
 ws[**'L33'**] = threaded\_data[**'dia'**]  
 ws[**'L35'**] = threaded\_data[**'re'**]  
 ws[**'L36'**] = threaded\_data[**'rm'**]  
  
 *# write ext data to sheet* ws[**'L40'**] = extLoad\_data[**'axialForce'**]  
 ws[**'L41'**] = extLoad\_data[**'shearForce'**]  
 ws[**'L42'**] = extLoad\_data[**'beta'**]  
 ws[**'L43'**] = extLoad\_data[**'fricCoeff'**]  
 ws[**'L44'**] = extLoad\_data[**'torque'**]  
 ws[**'L45'**] = extLoad\_data[**'tightTorqAcc'**]  
 ws[**'L47'**] = extLoad\_data[**'ut'**]  
 ws[**'M47'**] = extLoad\_data[**'delut'**]  
 ws[**'L48'**] = extLoad\_data[**'ub'**]  
 ws[**'M48'**] = extLoad\_data[**'delub'**]  
 ws[**'L49'**] = extLoad\_data[**'eqStressTightRatio'**]  
  
 *# write clamp data to sheet* i = 16  
 **for** item **in** clamped\_data:  
 ws[**'K'**+str(i)] = item[**'thick'**]  
 ws[**'L'**+str(i)] = item[**'insdia'**]  
 ws[**'M'**+str(i)] = item[**'outdia'**]  
 ws[**'N'**+str(i)] = item[**'material'**]  
 ws[**'O'**+str(i)] = item[**'re'**]  
 ws[**'P'**+str(i)] = item[**'rm'**]  
 ws[**'R'**+str(i)] = item[**'e'**]  
 i += 1  
 **while** i < 26:  
 ws[**'K'**+str(i)] = 0  
 ws[**'L'** + str(i)] = 0  
 ws[**'M'** + str(i)] = 0  
 ws[**'N'** + str(i)] = 0  
 ws[**'O'** + str(i)] = 0  
 ws[**'P'** + str(i)] = 0  
 ws[**'R'** + str(i)] = 1  
 i += 1  
  
 *# write part nature to sheet* **if 'Non-Standard/Stud' in** self.typeCombo.currentText():  
 ws[**'H6'**] = **'non standard'  
 else**:  
 ws[**'H6'**] = **'standard'  
 if 'Block' in** self.partCombo.currentText():  
 ws[**'H7'**] = **'non standard'  
 else**:  
 ws[**'H7'**] = **'standard'** *# pressure table* ws[**'A44'**] = **'Head/Part1'** ws[**'B44'**] = **'=MIN(O7,Q16)'** ws[**'D44'**] = **'=IF(B44>C44,"Pass","Fail")'** nClamped = int(self.nClampedPartsText.text())  
  
 **for** i **in** range(1, nClamped + 1):  
 ws[**'A'**+str(i+44)] = **'Part'**+str(i+1)+**'/Part'**+str(i+2)  
 ws[**'B'**+str(i+44)] = **'=MIN(Q'**+str(i+16)+**',Q'**+str(i+17)+**')'** ws[**'D'**+str(i+44)] = **'=IF(B'**+str(i+44)+**'>C'**+str(i+44)+**',"Pass","Fail")'** ws[**'A'** + str(i + 44)] = **'Part'** + str(i + 1) + **'/Threaded Part'** ws[**'B'** + str(i + 44)] = **'=MIN(Q'** + str(i + 16) + **',O35)'** ws[**'D'** + str(i + 44)] = **'=IF(B'** + str(i + 44) + **'>C'** + str(i + 44) + **',"Pass","Fail")'** wb.save(**'results.xlsx'**)  
 self.exportResults()  
  
 **except** Exception **as** e:  
 print(**'Error in spreadblock!'**)  
 print(e)  
  
 **def** exportResults(self):  
 wb = openpyxl.load\_workbook(**'results.xlsx'**)  
 ws = wb[**'calculation'**]  
 **for** i **in** range(0, 60):  
 **if** i==41:  
 **continue  
 for** j **in** range(0, 5):  
 item = QTableWidgetItem(str(ws.cell(**None**, i, j).value))  
 self.table.setItem(i, j, item)  
  
**class** Generator(QWidget):  
 **def** \_\_init\_\_(self, i, parent=**None**):  
 super(Generator, self).\_\_init\_\_(parent)  
 self.db = TinyDB(**'boltdata.json'**)  
 self.formLayout = QFormLayout()  
 self.formLayout.setContentsMargins(0, 0, 0, 0)  
 self.label = QLabel(**'<b>Part '**+str(i+1)+**"</b>"**)  
 self.formLayout.setWidget(0, QFormLayout.LabelRole, self.label)  
 self.label\_2 = QLabel(**'Type of part:'**)  
 self.formLayout.setWidget(1, QFormLayout.LabelRole, self.label\_2)  
 self.partComboBox = QComboBox()  
 self.formLayout.setWidget(1, QFormLayout.FieldRole, self.partComboBox)  
 self.label\_3 = QLabel(**'Type of washer:'**)  
 self.formLayout.setWidget(2, QFormLayout.LabelRole, self.label\_3)  
 self.washerComboBox = QComboBox()  
 self.formLayout.setWidget(2, QFormLayout.FieldRole, self.washerComboBox)  
 self.label\_4 = QLabel(**'Standard:'**)  
 self.formLayout.setWidget(3, QFormLayout.LabelRole, self.label\_4)  
 self.standardComboBox = QComboBox()  
 self.formLayout.setWidget(3, QFormLayout.FieldRole, self.standardComboBox)  
  
 self.label\_5 = QLabel(**'Type:'**)  
 self.formLayout.setWidget(4, QFormLayout.LabelRole, self.label\_5)  
 self.typeComboBox = QComboBox()  
 self.formLayout.setWidget(4, QFormLayout.FieldRole, self.typeComboBox)  
  
 self.label\_6 = QLabel(**'Inside Diameter:'**)  
 self.formLayout.setWidget(5, QFormLayout.LabelRole, self.label\_6)  
 self.insdialineEdit = QLineEdit()  
 self.insdialineEdit.setReadOnly(**True**)  
 self.formLayout.setWidget(5, QFormLayout.FieldRole, self.insdialineEdit)  
 self.label\_7 = QLabel(**'Outside Diameter:'**)  
 self.formLayout.setWidget(6, QFormLayout.LabelRole, self.label\_7)  
 self.outdialineEdit = QLineEdit()  
 self.outdialineEdit.setReadOnly(**True**)  
 self.formLayout.setWidget(6, QFormLayout.FieldRole, self.outdialineEdit)  
 self.label\_8 = QLabel(**'Thickness:'**)  
 self.formLayout.setWidget(7, QFormLayout.LabelRole, self.label\_8)  
 self.thicklineEdit = QLineEdit()  
 self.thicklineEdit.setReadOnly(**True**)  
 self.formLayout.setWidget(7, QFormLayout.FieldRole, self.thicklineEdit)  
  
 self.label\_9 = QLabel(**'u:'**)  
 self.formLayout.setWidget(8, QFormLayout.LabelRole, self.label\_9)  
 self.uEdit = QLineEdit()  
 self.uEdit.setReadOnly(**False**)  
 self.formLayout.setWidget(8, QFormLayout.FieldRole, self.uEdit)  
  
 self.label\_15 = QLabel(**'Hole length (L):'**)  
 self.formLayout.setWidget(9, QFormLayout.LabelRole, self.label\_15)  
 self.holeLength = QLineEdit()  
 self.holeLength.setReadOnly(**False**)  
 self.formLayout.setWidget(9, QFormLayout.FieldRole, self.holeLength)  
  
 self.label\_16 = QLabel(**'Hole height (d):'**)  
 self.formLayout.setWidget(10, QFormLayout.LabelRole, self.label\_16)  
 self.holeDia = QLineEdit()  
 self.holeDia.setReadOnly(**False**)  
 self.formLayout.setWidget(10, QFormLayout.FieldRole, self.holeDia)  
  
 self.label\_10 = QLabel(**'Thickness:'**)  
 self.formLayout.setWidget(11, QFormLayout.LabelRole, self.label\_10)  
 self.rectThickness = QLineEdit()  
 self.rectThickness.setReadOnly(**False**)  
 self.formLayout.setWidget(11, QFormLayout.FieldRole, self.rectThickness)  
  
 self.label\_14 = QLabel(**'Material:'**)  
 self.formLayout.setWidget(12, QFormLayout.LabelRole, self.label\_14)  
 self.materialWasher = QLineEdit()  
 self.materialWasher.setReadOnly(**False**)  
 self.formLayout.setWidget(12, QFormLayout.FieldRole, self.materialWasher)  
  
 self.label\_11 = QLabel(**'Yield (Re):'**)  
 self.formLayout.setWidget(13, QFormLayout.LabelRole, self.label\_11)  
 self.yieldWasher = QLineEdit()  
 self.yieldWasher.setReadOnly(**False**)  
 self.formLayout.setWidget(13, QFormLayout.FieldRole, self.yieldWasher)  
  
 self.label\_12 = QLabel(**'Ultimate (Rm):'**)  
 self.formLayout.setWidget(14, QFormLayout.LabelRole, self.label\_12)  
 self.ultiWasher = QLineEdit()  
 self.ultiWasher.setReadOnly(**False**)  
 self.formLayout.setWidget(14, QFormLayout.FieldRole, self.ultiWasher)  
  
 self.label\_13 = QLabel(**"Young's modulus (E):"**)  
 self.formLayout.setWidget(15, QFormLayout.LabelRole, self.label\_13)  
 self.eModulus = QLineEdit()  
 self.eModulus.setReadOnly(**False**)  
 self.formLayout.setWidget(15, QFormLayout.FieldRole, self.eModulus)  
  
 self.label\_9.hide()  
 self.uEdit.hide()  
 self.label\_10.hide()  
 self.rectThickness.hide()  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
  
 self.formLayout.setWidget(16, QFormLayout.FieldRole, QLabel(**" "**))  
 self.setLayout(self.formLayout)  
  
 self.populatePartCombo()  
 self.populateWasher()  
 self.partComboBox.currentTextChanged.connect(self.populateWasher)  
 self.washerComboBox.currentTextChanged.connect(self.populateWashStd)  
 self.typeComboBox.currentTextChanged.connect(self.fetchWasherInfo)  
  
 **def** populatePartCombo(self):  
 self.partComboBox.clear()  
 self.partComboBox.addItems([**'Washer'**, **'Non-Standard Part'**])  
  
 **def** populateWasher(self):  
 self.washerComboBox.clear()  
 **if**(self.partComboBox.currentText()==**'Washer'**):  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
 self.uEdit.hide()  
 self.label\_9.hide()  
 self.label\_4.show()  
 self.label\_5.show()  
 self.standardComboBox.show()  
 self.typeComboBox.show()  
 self.label\_6.setText(**'Inside Diameter:'**)  
 self.label\_7.setText(**'Outside Diameter:'**)  
 self.label\_8.setText(**'Thickness:'**)  
 self.insdialineEdit.setReadOnly(**True**)  
 self.outdialineEdit.setReadOnly(**True**)  
 self.thicklineEdit.setReadOnly(**True**)  
 washertable = self.db.table(**'washernames'**)  
 l = []  
 **for** i **in** washertable:  
 type = str(i[**'type'**])  
 **if not**(type **in** l):  
 l.append(type)  
 self.washerComboBox.addItems(l)  
 self.populateWashStd()  
  
 **else**:  
 self.label\_3.setText(**'Part type:'**)  
 self.washerComboBox.addItems([**'Circular'**, **'Rectangular'**])  
 self.label\_4.hide()  
 self.label\_5.hide()  
 self.standardComboBox.hide()  
 self.typeComboBox.hide()  
 self.label\_6.setText(**'Inside Diameter:'**)  
 self.label\_7.setText(**'Outside Diameter:'**)  
 self.label\_8.setText(**'Thickness:'**)  
 self.populateWashStd()  
  
 **def** populateWashStd(self):  
 **global** bolt\_size  
 self.standardComboBox.clear()  
 **if** self.partComboBox.currentText() == **'Washer'**:  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
 self.label\_9.hide()  
 self.label\_10.hide()  
 self.uEdit.hide()  
 self.rectThickness.hide()  
 type = self.washerComboBox.currentText()  
 l = []  
 y = []  
 washertable = self.db.table(**'washernames'**)  
  
 **for** i **in** washertable:  
 **if**(str(i[**'type'**]) == type):  
 l.append(str(i[**'std'**]))  
  
 **for** item **in** l:  
 x = self.db.table(str(item))  
 sizeList = []  
 **for** size **in** x:  
 sizeList.append(size[**'size'**])  
 **if** float(bolt\_size) **in** sizeList:  
 y.append(item)  
 self.standardComboBox.addItems(y)  
 self.populateWasherTypes()  
 **else**:  
 self.typeComboBox.hide()  
 self.label\_5.hide()  
 self.label\_9.hide()  
 self.uEdit.hide()  
 self.rectThickness.hide()  
 self.label\_10.hide()  
 self.insdialineEdit.setReadOnly(**False**)  
 self.outdialineEdit.setReadOnly(**False**)  
 self.thicklineEdit.setReadOnly(**False**)  
 **if** self.washerComboBox.currentText() == **'Circular'**:  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
 self.label\_6.setText(**'Inside Diameter:'**)  
 self.label\_7.setText(**'Outside Diameter:'**)  
 self.label\_8.setText(**'Thickness:'**)  
 **else**:  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
 self.typeComboBox.show()  
 self.populateWasherTypes()  
 self.label\_5.show()  
 self.uEdit.show()  
 self.uEdit.setText(**''**)  
 self.label\_9.show()  
 self.label\_10.show()  
 self.rectThickness.show()  
 self.rectThickness.clear()  
 self.label\_6.setText(**'r:'**)  
 self.label\_7.setText(**'s:'**)  
 self.label\_8.setText(**'t:'**)  
 self.label\_9.setText(**'u:'**)  
 self.thicklineEdit.setText(**''**)  
 self.insdialineEdit.setText(**''**)  
 self.outdialineEdit.setText(**''**)  
  
 **def** populateWasherTypes(self):  
 self.typeComboBox.clear()  
 l = []  
 **if**(self.partComboBox.currentText() == **'Washer'**):  
 **global** bolt\_size  
 std = self.standardComboBox.currentText()  
 washertab = self.db.table(std)  
 **for** item **in** washertab:  
 **if**(item[**'type'**] **not in** l **and** item[**'size'**] == float(bolt\_size)):  
 l.append(item[**'type'**])  
 self.typeComboBox.addItems(l)  
 self.fetchWasherInfo()  
  
 **else**:  
 l = [**'Circular hole'**, **'Oblong hole'**]  
 self.typeComboBox.addItems(l)  
  
 **def** fetchWasherInfo(self):  
 **global** bolt\_size  
 **if** self.typeComboBox.currentText() == **'Oblong hole'**:  
 self.label\_15.hide()  
 self.label\_16.show()  
 self.holeLength.hide()  
 self.holeDia.show()  
 self.label\_16.setText(**'Hole Diameter (d):'**)  
 **elif** self.typeComboBox.currentText()==**'Circular hole'**:  
 self.label\_15.hide()  
 self.label\_16.show()  
 self.holeLength.hide()  
 self.holeDia.show()  
 self.label\_16.setText(**'Hole Diameter (d):'**)  
 **else**:  
 self.label\_15.hide()  
 self.label\_16.hide()  
 self.holeLength.hide()  
 self.holeDia.hide()  
 std = self.standardComboBox.currentText()  
 type = self.typeComboBox.currentText()  
 washertab = self.db.table(std)  
 **for** item **in** washertab:  
 print(item)  
 **if**(item[**'type'**] == type **and** item[**'size'**] == float(bolt\_size)):  
 self.insdialineEdit.setText(str(item[**'dimin'**]))  
 self.outdialineEdit.setText(str(item[**'domin'**]))  
 self.thicklineEdit.setText(str(item[**'thnom'**]))  
  
  
app = QApplication(sys.argv)  
dial = UX()  
dial.show()  
app.exec\_()

# Appendix C:

Database JSON

{  
 **"\_default"** : {},  
 **"boltnames"** : {  
 **"1"** : {  
 **"type"** : **"Hexagon socket set screw with cone point (Stud)"**,  
 **"name"** : **"4027"** },  
 **"2"** : {  
 **"type"** : **"Hexagon socket set screw with cone point (Stud)"**,  
 **"name"** : **"4029"** },  
 **"3"** : {  
 **"type"** : **"Countersunk raised head screws"**,  
 **"name"** : **"14584"** },  
 **"4"** : {  
 **"type"** : **"Countersunk raised head screws"**,  
 **"name"** : **"7047"** },  
 **"5"** : {  
 **"type"** : **"Countersunk flat head screws"**,  
 **"name"** : **"7046-2"** },  
 **"6"** : {  
 **"type"** : **"Button Head Screw"**,  
 **"name"** : **"7380"** },  
 **"7"** : {  
 **"type"** : **"Countersunk flat head screws"**,  
 **"name"** : **"10642"** },  
 **"8"** : {  
 **"type"** : **"Countersunk raised head screws"**,  
 **"name"** : **"14581"** },  
 **"9"** : {  
 **"type"** : **"Cup head screw low head"**,  
 **"name"** : **"7984"** },  
 **"10"** : {  
 **"type"** : **"Cup head screws"**,  
 **"name"** : **"4762"** },  
 **"11"** : {  
 **"type"** : **"Hexagon Head Bolts"**,  
 **"name"** : **"4014"** },  
 **"12"** : {  
 **"type"** : **"Cup head square neck bolts"**,  
 **"name"** : **"603"** },  
 **"13"** : {  
 **"type"** : **"Hexagon Head Screws"**,  
 **"name"** : **"4017"** },  
 **"14"** : {  
 **"type"** : **""**,  
 **"name"** : **"Non-Standard/Stud"** }  
 },  
 **"washernames"** : {  
 **"1"** : {  
 **"std"** : 7089,  
 **"type"** : **"Plain Washer"** },  
 **"2"** : {  
 **"std"** : 7092,  
 **"type"** : **"Plain Washer"** },  
 **"3"** : {  
 **"std"** : **"7093-1"**,  
 **"type"** : **"Plain Washer"** },  
 **"4"** : {  
 **"std"** : **"7093-2"**,  
 **"type"** : **"Plain Washer"** },  
 **"5"** : {  
 **"std"** : 7349,  
 **"type"** : **"Plain Washer"** },  
 **"6"** : {  
 **"std"** : 6796,  
 **"type"** : **"CS Washer"** },  
 **"7"** : {  
 **"std"** : **"25-510"**,  
 **"type"** : **"CS Washer"** },  
 **"8"** : {  
 **"std"** : **"25-511"**,  
 **"type"** : **"Nord Lock Washer"** }  
 },  
 **"boltnutmaterial"** : {  
 **"1"** : {  
 **"material"** : **"Steel"**,  
 **"size"** : 4.6,  
 **"Re"** : 240.0,  
 **"Rm"** : 400.0,  
 **"E"** : 210000.0  
 },  
 **"2"** : {  
 **"material"** : **"Steel"**,  
 **"size"** : 8.8,  
 **"Re"** : 640.0,  
 **"Rm"** : 800.0,  
 **"E"** : 210000.0  
 },  
 **"3"** : {  
 **"material"** : **"Steel"**,  
 **"size"** : 10.9,  
 **"Re"** : 900.0,  
 **"Rm"** : 1000.0,  
 **"E"** : 210000.0  
 },  
 **"4"** : {  
 **"material"** : **"Steel"**,  
 **"size"** : 12.9,  
 **"Re"** : 1080.0,  
 **"Rm"** : 1200.0,  
 **"E"** : 210000.0  
 },  
 **"5"** : {  
 **"material"** : **"Stainless Steel"**,  
 **"size"** : **"A2-70"**,  
 **"Re"** : 450.0,  
 **"Rm"** : 700.0,  
 **"E"** : 191000.0  
 },  
 **"6"** : {  
 **"material"** : **"Stainless Steel"**,  
 **"size"** : **"A4-80"**,  
 **"Re"** : 600.0,  
 **"Rm"** : 800.0,  
 **"E"** : 191000.0  
 }  
 },  
 **"nutnames"** : {  
 **"1"** : {  
 **"std"** : 4032,  
 **"type"** : **"Hexagon Nut"** },  
 **"2"** : {  
 **"std"** : 4035,  
 **"type"** : **"Hexagon Thin Nut"** },  
 **"3"** : {  
 **"std"** : 7040,  
 **"type"** : **"Prevailing Torque type Hex nut. Non Metallic insert."** },  
 **"4"** : {  
 **"std"** : 7042,  
 **"type"** : **"Prevailing Torque type. All metal Hex nut."** },  
 **"5"** : {  
 **"std"** : 1587,  
 **"type"** : **"Cap Nut high type"** }  
 },  
 **"7089"** : {  
 **"1"** : {  
 **"size"** : 1.6,  
 **"dimin"** : 1.7,  
 **"dimax"** : 1.84,  
 **"domin"** : 3.7,  
 **"domax"** : 4.0,  
 **"thnom"** : 0.3,  
 **"thmin"** : 0.35,  
 **"thmax"** : 0.25,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 2.0,  
 **"dimin"** : 2.2,  
 **"dimax"** : 2.34,  
 **"domin"** : 4.7,  
 **"domax"** : 5.0,  
 **"thnom"** : 0.3,  
 **"thmin"** : 0.35,  
 **"thmax"** : 0.25,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 2.5,  
 **"dimin"** : 2.7,  
 **"dimax"** : 2.84,  
 **"domin"** : 5.7,  
 **"domax"** : 6.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.55,  
 **"thmax"** : 0.45,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.2,  
 **"dimax"** : 3.38,  
 **"domin"** : 6.64,  
 **"domax"** : 7.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.55,  
 **"thmax"** : 0.45,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.3,  
 **"dimax"** : 4.48,  
 **"domin"** : 8.64,  
 **"domax"** : 9.0,  
 **"thnom"** : 0.8,  
 **"thmin"** : 0.9,  
 **"thmax"** : 0.7,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 5.48,  
 **"domin"** : 9.64,  
 **"domax"** : 10.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.1,  
 **"thmax"** : 0.9,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.62,  
 **"domin"** : 11.57,  
 **"domax"** : 12.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.62,  
 **"domin"** : 15.57,  
 **"domax"** : 16.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.77,  
 **"domin"** : 19.48,  
 **"domax"** : 20.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 2.2,  
 **"thmax"** : 1.8,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 13.27,  
 **"domin"** : 23.48,  
 **"domax"** : 24.0,  
 **"thnom"** : 2.5,  
 **"thmin"** : 2.7,  
 **"thmax"** : 2.3,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 17.27,  
 **"domin"** : 29.48,  
 **"domax"** : 30.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.3,  
 **"thmax"** : 2.7,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 21.33,  
 **"domin"** : 36.38,  
 **"domax"** : 37.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.3,  
 **"thmax"** : 2.7,  
 **"type"** : **"Nom"** },  
 **"13"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 25.0,  
 **"dimax"** : 25.33,  
 **"domin"** : 43.38,  
 **"domax"** : 44.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.3,  
 **"thmax"** : 3.7,  
 **"type"** : **"Nom"** },  
 **"14"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 31.0,  
 **"dimax"** : 31.39,  
 **"domin"** : 55.26,  
 **"domax"** : 56.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.3,  
 **"thmax"** : 3.7,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 36.0,  
 **"dimin"** : 37.0,  
 **"dimax"** : 37.62,  
 **"domin"** : 64.8,  
 **"domax"** : 66.0,  
 **"thnom"** : 5.0,  
 **"thmin"** : 5.6,  
 **"thmax"** : 4.4,  
 **"type"** : **"Nom"** },  
 **"16"** : {  
 **"size"** : 42.0,  
 **"dimin"** : 45.0,  
 **"dimax"** : 45.62,  
 **"domin"** : 76.8,  
 **"domax"** : 78.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 9.0,  
 **"thmax"** : 7.0,  
 **"type"** : **"Nom"** },  
 **"17"** : {  
 **"size"** : 48.0,  
 **"dimin"** : 52.0,  
 **"dimax"** : 52.74,  
 **"domin"** : 90.6,  
 **"domax"** : 92.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 9.0,  
 **"thmax"** : 7.0,  
 **"type"** : **"Nom"** },  
 **"18"** : {  
 **"size"** : 56.0,  
 **"dimin"** : 62.0,  
 **"dimax"** : 62.74,  
 **"domin"** : 103.6,  
 **"domax"** : 105.0,  
 **"thnom"** : 10.0,  
 **"thmin"** : 11.0,  
 **"thmax"** : 9.0,  
 **"type"** : **"Nom"** },  
 **"19"** : {  
 **"size"** : 64.0,  
 **"dimin"** : 70.0,  
 **"dimax"** : 70.74,  
 **"domin"** : 113.6,  
 **"domax"** : 115.0,  
 **"thnom"** : 10.0,  
 **"thmin"** : 11.0,  
 **"thmax"** : 9.0,  
 **"type"** : **"Nom"** }  
 },  
 **"7092"** : {  
 **"1"** : {  
 **"size"** : 1.6,  
 **"dimin"** : 1.7,  
 **"dimax"** : 1.84,  
 **"domin"** : 3.2,  
 **"domax"** : 3.5,  
 **"thnom"** : 0.3,  
 **"thmin"** : 0.35,  
 **"thmax"** : 0.25,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 2.0,  
 **"dimin"** : 2.2,  
 **"dimax"** : 2.34,  
 **"domin"** : 4.2,  
 **"domax"** : 4.5,  
 **"thnom"** : 0.3,  
 **"thmin"** : 0.35,  
 **"thmax"** : 0.25,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 2.5,  
 **"dimin"** : 2.7,  
 **"dimax"** : 2.84,  
 **"domin"** : 4.7,  
 **"domax"** : 5.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.55,  
 **"thmax"** : 0.45,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.2,  
 **"dimax"** : 3.38,  
 **"domin"** : 5.7,  
 **"domax"** : 6.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.55,  
 **"thmax"** : 0.45,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.3,  
 **"dimax"** : 4.48,  
 **"domin"** : 7.64,  
 **"domax"** : 8.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.55,  
 **"thmax"** : 0.45,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 5.48,  
 **"domin"** : 8.64,  
 **"domax"** : 9.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.1,  
 **"thmax"** : 0.9,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.62,  
 **"domin"** : 10.57,  
 **"domax"** : 11.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.62,  
 **"domin"** : 14.57,  
 **"domax"** : 15.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.77,  
 **"domin"** : 17.57,  
 **"domax"** : 18.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 13.27,  
 **"domin"** : 19.48,  
 **"domax"** : 20.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 2.2,  
 **"thmax"** : 1.8,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 17.27,  
 **"domin"** : 27.48,  
 **"domax"** : 28.0,  
 **"thnom"** : 2.5,  
 **"thmin"** : 2.7,  
 **"thmax"** : 2.3,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 21.33,  
 **"domin"** : 33.38,  
 **"domax"** : 34.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.3,  
 **"thmax"** : 2.7,  
 **"type"** : **"Nom"** },  
 **"13"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 25.0,  
 **"dimax"** : 25.33,  
 **"domin"** : 38.38,  
 **"domax"** : 39.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.3,  
 **"thmax"** : 3.7,  
 **"type"** : **"Nom"** },  
 **"14"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 31.0,  
 **"dimax"** : 31.39,  
 **"domin"** : 49.38,  
 **"domax"** : 50.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.3,  
 **"thmax"** : 3.7,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 36.0,  
 **"dimin"** : 37.0,  
 **"dimax"** : 37.62,  
 **"domin"** : 58.8,  
 **"domax"** : 60.0,  
 **"thnom"** : 5.0,  
 **"thmin"** : 5.6,  
 **"thmax"** : 4.4,  
 **"type"** : **"Nom"** }  
 },  
 **"7093-1"** : {  
 **"1"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.2,  
 **"dimax"** : 3.38,  
 **"domin"** : 8.64,  
 **"domax"** : 9.0,  
 **"thnom"** : 0.8,  
 **"thmin"** : 0.9,  
 **"thmax"** : 0.7,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.3,  
 **"dimax"** : 4.48,  
 **"domin"** : 11.57,  
 **"domax"** : 12.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.1,  
 **"thmax"** : 0.9,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 5.48,  
 **"domin"** : 14.57,  
 **"domax"** : 15.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.1,  
 **"thmax"** : 0.9,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.62,  
 **"domin"** : 17.57,  
 **"domax"** : 18.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.8,  
 **"thmax"** : 1.4,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.62,  
 **"domin"** : 23.48,  
 **"domax"** : 24.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 2.2,  
 **"thmax"** : 1.8,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.77,  
 **"domin"** : 29.48,  
 **"domax"** : 30.0,  
 **"thnom"** : 2.5,  
 **"thmin"** : 2.7,  
 **"thmax"** : 2.3,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 13.27,  
 **"domin"** : 36.38,  
 **"domax"** : 37.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.3,  
 **"thmax"** : 2.7,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 17.27,  
 **"domin"** : 49.38,  
 **"domax"** : 50.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.3,  
 **"thmax"** : 2.7,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 21.33,  
 **"domin"** : 59.26,  
 **"domax"** : 60.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.3,  
 **"thmax"** : 3.7,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 25.0,  
 **"dimax"** : 25.52,  
 **"domin"** : 70.8,  
 **"domax"** : 72.0,  
 **"thnom"** : 5.0,  
 **"thmin"** : 5.6,  
 **"thmax"** : 4.4,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 33.0,  
 **"dimax"** : 33.62,  
 **"domin"** : 90.6,  
 **"domax"** : 92.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 6.6,  
 **"thmax"** : 5.4,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 36.0,  
 **"dimin"** : 39.0,  
 **"dimax"** : 39.62,  
 **"domin"** : 108.6,  
 **"domax"** : 110.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 9.0,  
 **"thmax"** : 7.0,  
 **"type"** : **"Nom"** }  
 },  
 **"7093-2"** : {  
 **"1"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.4,  
 **"dimax"** : 3.7,  
 **"domin"** : 8.1,  
 **"domax"** : 9.0,  
 **"thnom"** : 0.8,  
 **"thmin"** : 1.0,  
 **"thmax"** : 0.6,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.5,  
 **"dimax"** : 4.8,  
 **"domin"** : 10.9,  
 **"domax"** : 12.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.2,  
 **"thmax"** : 0.8,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.5,  
 **"dimax"** : 5.8,  
 **"domin"** : 13.9,  
 **"domax"** : 15.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 1.2,  
 **"thmax"** : 0.8,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.6,  
 **"dimax"** : 6.96,  
 **"domin"** : 16.9,  
 **"domax"** : 18.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.9,  
 **"thmax"** : 1.3,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 9.0,  
 **"dimax"** : 9.36,  
 **"domin"** : 22.7,  
 **"domax"** : 24.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 2.3,  
 **"thmax"** : 1.7,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 11.0,  
 **"dimax"** : 11.43,  
 **"domin"** : 28.7,  
 **"domax"** : 30.0,  
 **"thnom"** : 2.5,  
 **"thmin"** : 2.8,  
 **"thmax"** : 2.2,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.5,  
 **"dimax"** : 13.93,  
 **"domin"** : 35.4,  
 **"domax"** : 37.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.6,  
 **"thmax"** : 2.4,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.5,  
 **"dimax"** : 17.93,  
 **"domin"** : 48.4,  
 **"domax"** : 50.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 3.6,  
 **"thmax"** : 2.4,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 22.0,  
 **"dimax"** : 22.52,  
 **"domin"** : 58.1,  
 **"domax"** : 60.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 4.6,  
 **"thmax"** : 3.4,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 26.0,  
 **"dimax"** : 26.84,  
 **"domin"** : 70.1,  
 **"domax"** : 72.0,  
 **"thnom"** : 5.0,  
 **"thmin"** : 6.0,  
 **"thmax"** : 4.0,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 33.0,  
 **"dimax"** : 34.0,  
 **"domin"** : 89.8,  
 **"domax"** : 92.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 7.0,  
 **"thmax"** : 5.0,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 36.0,  
 **"dimin"** : 39.0,  
 **"dimax"** : 40.0,  
 **"domin"** : 107.8,  
 **"domax"** : 110.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 9.2,  
 **"thmax"** : 6.8,  
 **"type"** : **"Nom"** }  
 },  
 **"7349"** : {  
 **"1"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.2,  
 **"dimax"** : 0.0,  
 **"domin"** : 9.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.3,  
 **"dimax"** : 0.0,  
 **"domin"** : 12.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.6,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 0.0,  
 **"domin"** : 15.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 0.0,  
 **"domin"** : 17.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 0.0,  
 **"domin"** : 21.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 0.0,  
 **"domin"** : 25.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 30.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 14.0,  
 **"dimin"** : 15.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 36.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 40.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 18.0,  
 **"dimin"** : 19.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 44.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 44.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 22.0,  
 **"dimin"** : 23.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 50.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 8.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"13"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 25.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 50.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 10.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"14"** : {  
 **"size"** : 27.0,  
 **"dimin"** : 28.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 60.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 10.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 31.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 68.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 10.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** }  
 },  
 **"6796"** : {  
 **"1"** : {  
 **"size"** : 2.0,  
 **"dimin"** : 2.2,  
 **"dimax"** : 0.0,  
 **"domin"** : 5.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 0.4,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"2"** : {  
 **"size"** : 2.5,  
 **"dimin"** : 2.7,  
 **"dimax"** : 0.0,  
 **"domin"** : 6.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.2,  
 **"dimax"** : 0.0,  
 **"domin"** : 7.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 0.6,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"4"** : {  
 **"size"** : 3.5,  
 **"dimin"** : 3.7,  
 **"dimax"** : 0.0,  
 **"domin"** : 8.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 0.8,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.3,  
 **"dimax"** : 0.0,  
 **"domin"** : 9.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 0.0,  
 **"domin"** : 11.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.2,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"7"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 0.0,  
 **"domin"** : 14.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 7.0,  
 **"dimin"** : 7.4,  
 **"dimax"** : 0.0,  
 **"domin"** : 17.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 1.75,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 0.0,  
 **"domin"** : 18.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 2.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"10"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 0.0,  
 **"domin"** : 23.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 2.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 29.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 3.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 14.0,  
 **"dimin"** : 15.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 35.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 3.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"13"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 39.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 4.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"14"** : {  
 **"size"** : 18.0,  
 **"dimin"** : 19.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 42.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 4.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 45.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 5.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"16"** : {  
 **"size"** : 22.0,  
 **"dimin"** : 23.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 49.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 5.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"17"** : {  
 **"size"** : 24.0,  
 **"dimin"** : 24.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 56.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 6.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"18"** : {  
 **"size"** : 27.0,  
 **"dimin"** : 28.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 60.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 6.5,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** },  
 **"19"** : {  
 **"size"** : 30.0,  
 **"dimin"** : 31.0,  
 **"dimax"** : 0.0,  
 **"domin"** : 70.0,  
 **"domax"** : 0.0,  
 **"thnom"** : 7.0,  
 **"thmin"** : 0.0,  
 **"thmax"** : 0.0,  
 **"type"** : **"Nom"** }  
 },  
 **"25-510"** : {  
 **"1"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 5.6,  
 **"domin"** : 11.0,  
 **"domax"** : 10.57,  
 **"thnom"** : 1.2,  
 **"thmin"** : 1.16,  
 **"thmax"** : 1.24,  
 **"type"** : **"A"** },  
 **"2"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.3,  
 **"dimax"** : 5.6,  
 **"domin"** : 15.0,  
 **"domax"** : 14.57,  
 **"thnom"** : 1.4,  
 **"thmin"** : 1.3599999999999999,  
 **"thmax"** : 1.44,  
 **"type"** : **"B"** },  
 **"3"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.76,  
 **"domin"** : 12.0,  
 **"domax"** : 11.57,  
 **"thnom"** : 1.4,  
 **"thmin"** : 1.3599999999999999,  
 **"thmax"** : 1.44,  
 **"type"** : **"Min"** },  
 **"4"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.76,  
 **"domin"** : 14.0,  
 **"domax"** : 13.57,  
 **"thnom"** : 1.5,  
 **"thmin"** : 1.45,  
 **"thmax"** : 1.55,  
 **"type"** : **"Nom"** },  
 **"5"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.4,  
 **"dimax"** : 6.76,  
 **"domin"** : 18.0,  
 **"domax"** : 17.57,  
 **"thnom"** : 1.7,  
 **"thmin"** : 1.65,  
 **"thmax"** : 1.75,  
 **"type"** : **"Max"** },  
 **"6"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.76,  
 **"domin"** : 16.0,  
 **"domax"** : 15.57,  
 **"thnom"** : 1.9,  
 **"thmin"** : 1.8499999999999999,  
 **"thmax"** : 1.95,  
 **"type"** : **"Min"** },  
 **"7"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.76,  
 **"domin"** : 18.0,  
 **"domax"** : 17.57,  
 **"thnom"** : 2.0,  
 **"thmin"** : 1.95,  
 **"thmax"** : 2.05,  
 **"type"** : **"Nom"** },  
 **"8"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.4,  
 **"dimax"** : 8.76,  
 **"domin"** : 22.0,  
 **"domax"** : 21.48,  
 **"thnom"** : 2.2,  
 **"thmin"** : 2.1500000000000004,  
 **"thmax"** : 2.25,  
 **"type"** : **"Max"** },  
 **"9"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.93,  
 **"domin"** : 20.0,  
 **"domax"** : 19.48,  
 **"thnom"** : 2.2,  
 **"thmin"** : 2.1500000000000004,  
 **"thmax"** : 2.25,  
 **"type"** : **"Min"** },  
 **"10"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.93,  
 **"domin"** : 22.0,  
 **"domax"** : 21.48,  
 **"thnom"** : 2.4,  
 **"thmin"** : 2.35,  
 **"thmax"** : 2.4499999999999997,  
 **"type"** : **"Nom"** },  
 **"11"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.5,  
 **"dimax"** : 10.93,  
 **"domin"** : 27.0,  
 **"domax"** : 26.48,  
 **"thnom"** : 2.8,  
 **"thmin"** : 2.7399999999999998,  
 **"thmax"** : 2.86,  
 **"type"** : **"Max"** },  
 **"12"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 13.43,  
 **"domin"** : 24.0,  
 **"domax"** : 23.48,  
 **"thnom"** : 2.8,  
 **"thmin"** : 2.7399999999999998,  
 **"thmax"** : 2.86,  
 **"type"** : **"A"** },  
 **"13"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 13.0,  
 **"dimax"** : 13.43,  
 **"domin"** : 30.0,  
 **"domax"** : 29.48,  
 **"thnom"** : 3.2,  
 **"thmin"** : 3.14,  
 **"thmax"** : 3.2600000000000002,  
 **"type"** : **"B"** },  
 **"14"** : {  
 **"size"** : 14.0,  
 **"dimin"** : 15.0,  
 **"dimax"** : 15.43,  
 **"domin"** : 28.0,  
 **"domax"** : 27.48,  
 **"thnom"** : 3.0,  
 **"thmin"** : 2.94,  
 **"thmax"** : 3.06,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 17.43,  
 **"domin"** : 32.0,  
 **"domax"** : 31.5,  
 **"thnom"** : 3.4,  
 **"thmin"** : 3.33,  
 **"thmax"** : 3.4699999999999998,  
 **"type"** : **"A"** },  
 **"16"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 17.0,  
 **"dimax"** : 17.43,  
 **"domin"** : 39.0,  
 **"domax"** : 38.5,  
 **"thnom"** : 3.6,  
 **"thmin"** : 3.5300000000000002,  
 **"thmax"** : 3.67,  
 **"type"** : **"B"** },  
 **"17"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 21.52,  
 **"domin"** : 38.0,  
 **"domax"** : 37.5,  
 **"thnom"** : 4.0,  
 **"thmin"** : 3.93,  
 **"thmax"** : 4.07,  
 **"type"** : **"A"** },  
 **"18"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 21.0,  
 **"dimax"** : 21.52,  
 **"domin"** : 45.0,  
 **"domax"** : 44.5,  
 **"thnom"** : 4.4,  
 **"thmin"** : 4.33,  
 **"thmax"** : 4.470000000000001,  
 **"type"** : **"B"** }  
 },  
 **"25-511"** : {  
 **"1"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.1,  
 **"dimax"** : 3.35,  
 **"domin"** : 6.24,  
 **"domax"** : 5.76,  
 **"thnom"** : 0.5,  
 **"thmin"** : 0.47,  
 **"thmax"** : 0.53,  
 **"type"** : **"Min"** },  
 **"2"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.1,  
 **"dimax"** : 3.35,  
 **"domin"** : 8.29,  
 **"domax"** : 7.71,  
 **"thnom"** : 0.6,  
 **"thmin"** : 0.57,  
 **"thmax"** : 0.63,  
 **"type"** : **"Nom"** },  
 **"3"** : {  
 **"size"** : 3.0,  
 **"dimin"** : 3.1,  
 **"dimax"** : 3.35,  
 **"domin"** : 10.29,  
 **"domax"** : 9.71,  
 **"thnom"** : 0.6,  
 **"thmin"** : 0.57,  
 **"thmax"** : 0.63,  
 **"type"** : **"Max"** },  
 **"4"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.1,  
 **"dimax"** : 4.4,  
 **"domin"** : 8.29,  
 **"domax"** : 7.71,  
 **"thnom"** : 0.8,  
 **"thmin"** : 0.77,  
 **"thmax"** : 0.8300000000000001,  
 **"type"** : **"Min"** },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.1,  
 **"dimax"** : 4.4,  
 **"domin"** : 10.29,  
 **"domax"** : 9.71,  
 **"thnom"** : 0.9,  
 **"thmin"** : 0.86,  
 **"thmax"** : 0.9400000000000001,  
 **"type"** : **"Nom"** },  
 **"6"** : {  
 **"size"** : 4.0,  
 **"dimin"** : 4.1,  
 **"dimax"** : 4.4,  
 **"domin"** : 14.35,  
 **"domax"** : 13.65,  
 **"thnom"** : 1.0,  
 **"thmin"** : 0.96,  
 **"thmax"** : 1.04,  
 **"type"** : **"Max"** },  
 **"7"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.1,  
 **"dimax"** : 5.4,  
 **"domin"** : 10.29,  
 **"domax"** : 9.71,  
 **"thnom"** : 1.0,  
 **"thmin"** : 0.96,  
 **"thmax"** : 1.04,  
 **"type"** : **"Min"** },  
 **"8"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.1,  
 **"dimax"** : 5.4,  
 **"domin"** : 12.35,  
 **"domax"** : 11.65,  
 **"thnom"** : 1.1,  
 **"thmin"** : 1.06,  
 **"thmax"** : 1.1400000000000001,  
 **"type"** : **"Nom"** },  
 **"9"** : {  
 **"size"** : 5.0,  
 **"dimin"** : 5.1,  
 **"dimax"** : 5.4,  
 **"domin"** : 16.35,  
 **"domax"** : 15.65,  
 **"thnom"** : 1.2,  
 **"thmin"** : 1.16,  
 **"thmax"** : 1.24,  
 **"type"** : **"Max"** },  
 **"10"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.1,  
 **"dimax"** : 6.4,  
 **"domin"** : 12.35,  
 **"domax"** : 11.65,  
 **"thnom"** : 1.2,  
 **"thmin"** : 1.16,  
 **"thmax"** : 1.24,  
 **"type"** : **"Min"** },  
 **"11"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.1,  
 **"dimax"** : 6.4,  
 **"domin"** : 14.35,  
 **"domax"** : 13.65,  
 **"thnom"** : 1.3,  
 **"thmin"** : 1.26,  
 **"thmax"** : 1.34,  
 **"type"** : **"Nom"** },  
 **"12"** : {  
 **"size"** : 6.0,  
 **"dimin"** : 6.1,  
 **"dimax"** : 6.4,  
 **"domin"** : 18.35,  
 **"domax"** : 17.65,  
 **"thnom"** : 1.4,  
 **"thmin"** : 1.3599999999999999,  
 **"thmax"** : 1.44,  
 **"type"** : **"Max"** },  
 **"13"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.2,  
 **"dimax"** : 8.56,  
 **"domin"** : 16.35,  
 **"domax"** : 15.65,  
 **"thnom"** : 1.4,  
 **"thmin"** : 1.3599999999999999,  
 **"thmax"** : 1.44,  
 **"type"** : **"Min"** },  
 **"14"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.2,  
 **"dimax"** : 8.56,  
 **"domin"** : 18.35,  
 **"domax"** : 17.65,  
 **"thnom"** : 1.4,  
 **"thmin"** : 1.3599999999999999,  
 **"thmax"** : 1.44,  
 **"type"** : **"Nom"** },  
 **"15"** : {  
 **"size"** : 8.0,  
 **"dimin"** : 8.2,  
 **"dimax"** : 8.56,  
 **"domin"** : 22.42,  
 **"domax"** : 21.58,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.55,  
 **"thmax"** : 1.6500000000000001,  
 **"type"** : **"Max"** },  
 **"16"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.2,  
 **"dimax"** : 10.56,  
 **"domin"** : 20.42,  
 **"domax"** : 19.58,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.55,  
 **"thmax"** : 1.6500000000000001,  
 **"type"** : **"Min"** },  
 **"17"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.2,  
 **"dimax"** : 10.56,  
 **"domin"** : 22.42,  
 **"domax"** : 21.58,  
 **"thnom"** : 1.6,  
 **"thmin"** : 1.55,  
 **"thmax"** : 1.6500000000000001,  
 **"type"** : **"Nom"** },  
 **"18"** : {  
 **"size"** : 10.0,  
 **"dimin"** : 10.2,  
 **"dimax"** : 10.56,  
 **"domin"** : 27.42,  
 **"domax"** : 26.58,  
 **"thnom"** : 1.8,  
 **"thmin"** : 1.75,  
 **"thmax"** : 1.85,  
 **"type"** : **"Max"** },  
 **"19"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 12.4,  
 **"dimax"** : 12.83,  
 **"domin"** : 24.42,  
 **"domax"** : 23.58,  
 **"thnom"** : 1.8,  
 **"thmin"** : 1.75,  
 **"thmax"** : 1.85,  
 **"type"** : **"Min"** },  
 **"20"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 12.4,  
 **"dimax"** : 12.83,  
 **"domin"** : 27.42,  
 **"domax"** : 26.58,  
 **"thnom"** : 1.8,  
 **"thmin"** : 1.75,  
 **"thmax"** : 1.85,  
 **"type"** : **"Nom"** },  
 **"21"** : {  
 **"size"** : 12.0,  
 **"dimin"** : 12.4,  
 **"dimax"** : 12.83,  
 **"domin"** : 32.5,  
 **"domax"** : 31.5,  
 **"thnom"** : 2.0,  
 **"thmin"** : 1.95,  
 **"thmax"** : 2.05,  
 **"type"** : **"Max"** },  
 **"22"** : {  
 **"size"** : 14.0,  
 **"dimin"** : 14.4,  
 **"dimax"** : 14.83,  
 **"domin"** : 30.42,  
 **"domax"** : 29.58,  
 **"thnom"** : 2.4,  
 **"thmin"** : 2.34,  
 **"thmax"** : 2.46,  
 **"type"** : **"Nom"** },  
 **"23"** : {  
 **"size"** : 16.0,  
 **"dimin"** : 16.4,  
 **"dimax"** : 16.83,  
 **"domin"** : 32.5,  
 **"domax"** : 31.5,  
 **"thnom"** : 2.8,  
 **"thmin"** : 2.7399999999999998,  
 **"thmax"** : 2.86,  
 **"type"** : **"Nom"** },  
 **"24"** : {  
 **"size"** : 20.0,  
 **"dimin"** : 20.5,  
 **"dimax"** : 21.02,  
 **"domin"** : 40.5,  
 **"domax"** : 39.5,  
 **"thnom"** : 3.2,  
 **"thmin"** : 3.14,  
 **"thmax"** : 3.2600000000000002,  
 **"type"** : **"Nom"** }  
 },  
 **"4027"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 0.4,  
 **"k"** : 0.0  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 0.5,  
 **"k"** : 0.0  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 0.65,  
 **"k"** : 0.0  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 0.75,  
 **"k"** : 0.0  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 1.0,  
 **"k"** : 0.0  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 1.25,  
 **"k"** : 0.0  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 1.5,  
 **"k"** : 0.0  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 2.0,  
 **"k"** : 0.0  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 2.5,  
 **"k"** : 0.0  
 },  
 **"10"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 3.0,  
 **"k"** : 0.0  
 },  
 **"11"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 4.0,  
 **"k"** : 0.0  
 },  
 **"12"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 5.0,  
 **"k"** : 0.0  
 },  
 **"13"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 6.0,  
 **"k"** : 0.0  
 }  
 },  
 **"4029"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 0.55,  
 **"k"** : 0.0  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 0.75,  
 **"k"** : 0.0  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 0.95,  
 **"k"** : 0.0  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 1.15,  
 **"k"** : 0.0  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 1.75,  
 **"k"** : 0.0  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 2.25,  
 **"k"** : 0.0  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 2.75,  
 **"k"** : 0.0  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 4.7,  
 **"k"** : 0.0  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 5.7,  
 **"k"** : 0.0  
 },  
 **"10"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 7.64,  
 **"k"** : 0.0  
 },  
 **"11"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 9.64,  
 **"k"** : 0.0  
 },  
 **"12"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 13.57,  
 **"k"** : 0.0  
 },  
 **"13"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 15.57,  
 **"k"** : 0.0  
 }  
 },  
 **"14584"** : {  
 **"1"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.5,  
 **"k"** : 0.5  
 },  
 **"2"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.4,  
 **"k"** : 0.6  
 },  
 **"3"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.2,  
 **"k"** : 0.8  
 },  
 **"4"** : {  
 **"size"** : **"M3.5"**,  
 **"dia"** : 3.5,  
 **"pitch"** : 0.6,  
 **"dw"** : 6.94,  
 **"k"** : 0.9  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 8.04,  
 **"k"** : 1.0  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.94,  
 **"k"** : 1.3  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 10.87,  
 **"k"** : 1.5  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 15.37,  
 **"k"** : 2.0  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 17.78,  
 **"k"** : 2.5  
 }  
 },  
 **"7047"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 2.7,  
 **"k"** : 1.0  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.5,  
 **"k"** : 1.2  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.4,  
 **"k"** : 1.5  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.2,  
 **"k"** : 1.65  
 },  
 **"5"** : {  
 **"size"** : **"M3.5"**,  
 **"dia"** : 3.5,  
 **"pitch"** : 0.6,  
 **"dw"** : 6.94,  
 **"k"** : 2.35  
 },  
 **"6"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 8.04,  
 **"k"** : 2.7  
 },  
 **"7"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.94,  
 **"k"** : 2.7  
 },  
 **"8"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 10.87,  
 **"k"** : 3.3  
 },  
 **"9"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 15.37,  
 **"k"** : 4.65  
 },  
 **"10"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 17.78,  
 **"k"** : 5.0  
 }  
 },  
 **"7046-2"** : {  
 **"1"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.5,  
 **"k"** : 1.2  
 },  
 **"2"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.4,  
 **"k"** : 1.5  
 },  
 **"3"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.2,  
 **"k"** : 1.65  
 },  
 **"4"** : {  
 **"size"** : **"M3.5"**,  
 **"dia"** : 3.5,  
 **"pitch"** : 0.6,  
 **"dw"** : 6.9,  
 **"k"** : 2.35  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 8.0,  
 **"k"** : 2.7  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.9,  
 **"k"** : 2.7  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 10.9,  
 **"k"** : 3.3  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 15.4,  
 **"k"** : 4.65  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 17.8,  
 **"k"** : 5.0  
 }  
 },  
 **"7380"** : {  
 **"1"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.0,  
 **"k"** : 1.4  
 },  
 **"2"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 6.84,  
 **"k"** : 1.95  
 },  
 **"3"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.74,  
 **"k"** : 2.5  
 },  
 **"4"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 9.57,  
 **"k"** : 3.0  
 },  
 **"5"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 13.07,  
 **"k"** : 4.1  
 },  
 **"6"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 16.57,  
 **"k"** : 5.2  
 },  
 **"7"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 19.68,  
 **"k"** : 6.24  
 },  
 **"8"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 26.68,  
 **"k"** : 8.44  
 }  
 },  
 **"10642"** : {  
 **"1"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.54,  
 **"k"** : 1.86  
 },  
 **"2"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 7.53,  
 **"k"** : 2.48  
 },  
 **"3"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 9.43,  
 **"k"** : 3.1  
 },  
 **"4"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 11.34,  
 **"k"** : 3.72  
 },  
 **"5"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 15.24,  
 **"k"** : 4.96  
 },  
 **"6"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 19.22,  
 **"k"** : 6.2  
 },  
 **"7"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 23.12,  
 **"k"** : 7.44  
 },  
 **"8"** : {  
 **"size"** : **"M14"**,  
 **"dia"** : 14.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 26.52,  
 **"k"** : 8.4  
 },  
 **"9"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 29.01,  
 **"k"** : 8.8  
 },  
 **"10"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 35.4,  
 **"k"** : 10.16  
 }  
 },  
 **"14581"** : {  
 **"1"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.5,  
 **"k"** : 1.2  
 },  
 **"2"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.4,  
 **"k"** : 1.5  
 },  
 **"3"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.2,  
 **"k"** : 1.65  
 },  
 **"4"** : {  
 **"size"** : **"M3.5"**,  
 **"dia"** : 3.5,  
 **"pitch"** : 0.6,  
 **"dw"** : 6.94,  
 **"k"** : 2.35  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 8.04,  
 **"k"** : 2.7  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.94,  
 **"k"** : 2.7  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 10.87,  
 **"k"** : 3.3  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 15.37,  
 **"k"** : 4.65  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 17.78,  
 **"k"** : 5.0  
 }  
 },  
 **"7984"** : {  
 **"1"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 4.84,  
 **"k"** : 1.86  
 },  
 **"2"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 6.2,  
 **"k"** : 2.66  
 },  
 **"3"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 7.7,  
 **"k"** : 3.32  
 },  
 **"4"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 9.2,  
 **"k"** : 3.82  
 },  
 **"5"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 12.03,  
 **"k"** : 4.82  
 },  
 **"6"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 15.03,  
 **"k"** : 5.82  
 },  
 **"7"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 17.03,  
 **"k"** : 6.78  
 },  
 **"8"** : {  
 **"size"** : **"M14"**,  
 **"dia"** : 14.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 19.83,  
 **"k"** : 7.78  
 },  
 **"9"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 22.83,  
 **"k"** : 8.78  
 },  
 **"10"** : {  
 **"size"** : **"M18"**,  
 **"dia"** : 18.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 25.83,  
 **"k"** : 9.78  
 },  
 **"11"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 28.83,  
 **"k"** : 10.73  
 },  
 **"12"** : {  
 **"size"** : **"M22"**,  
 **"dia"** : 22.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 31.61,  
 **"k"** : 11.73  
 },  
 **"13"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 34.61,  
 **"k"** : 12.73  
 }  
 },  
 **"4762"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 2.72,  
 **"k"** : 1.46  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.48,  
 **"k"** : 1.86  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.18,  
 **"k"** : 2.36  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 5.07,  
 **"k"** : 2.86  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 6.53,  
 **"k"** : 3.82  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 8.3,  
 **"k"** : 4.82  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 9.38,  
 **"k"** : 5.7  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 12.33,  
 **"k"** : 7.64  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 15.33,  
 **"k"** : 9.64  
 },  
 **"10"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 17.23,  
 **"k"** : 11.57  
 },  
 **"11"** : {  
 **"size"** : **"M14"**,  
 **"dia"** : 14.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 20.17,  
 **"k"** : 13.57  
 },  
 **"12"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 23.17,  
 **"k"** : 15.57  
 },  
 **"13"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 28.87,  
 **"k"** : 19.48  
 },  
 **"14"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 34.81,  
 **"k"** : 23.48  
 },  
 **"15"** : {  
 **"size"** : **"M30"**,  
 **"dia"** : 30.0,  
 **"pitch"** : 3.5,  
 **"dw"** : 43.61,  
 **"k"** : 29.48  
 },  
 **"16"** : {  
 **"size"** : **"M36"**,  
 **"dia"** : 36.0,  
 **"pitch"** : 4.0,  
 **"dw"** : 52.54,  
 **"k"** : 35.38  
 },  
 **"17"** : {  
 **"size"** : **"M42"**,  
 **"dia"** : 42.0,  
 **"pitch"** : 4.5,  
 **"dw"** : 61.34,  
 **"k"** : 41.38  
 },  
 **"18"** : {  
 **"size"** : **"M48"**,  
 **"dia"** : 48.0,  
 **"pitch"** : 5.0,  
 **"dw"** : 70.34,  
 **"k"** : 47.38  
 },  
 **"19"** : {  
 **"size"** : **"M56"**,  
 **"dia"** : 56.0,  
 **"pitch"** : 5.5,  
 **"dw"** : 82.26,  
 **"k"** : 55.26  
 },  
 **"20"** : {  
 **"size"** : **"M64"**,  
 **"dia"** : 64.0,  
 **"pitch"** : 6.0,  
 **"dw"** : 94.26,  
 **"k"** : 63.26  
 }  
 },  
 **"4014"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 2.27,  
 **"k"** : 0.975  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.07,  
 **"k"** : 1.275  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.07,  
 **"k"** : 1.575  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 4.57,  
 **"k"** : 1.875  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 5.88,  
 **"k"** : 2.675  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 6.88,  
 **"k"** : 3.35  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 8.88,  
 **"k"** : 3.85  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 11.63,  
 **"k"** : 5.15  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 14.63,  
 **"k"** : 6.22  
 },  
 **"10"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 16.63,  
 **"k"** : 7.32  
 },  
 **"11"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 22.49,  
 **"k"** : 9.82  
 },  
 **"12"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 28.19,  
 **"k"** : 12.285  
 },  
 **"13"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 33.61,  
 **"k"** : 14.785  
 },  
 **"14"** : {  
 **"size"** : **"M30"**,  
 **"dia"** : 30.0,  
 **"pitch"** : 3.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"15"** : {  
 **"size"** : **"M36"**,  
 **"dia"** : 36.0,  
 **"pitch"** : 4.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"16"** : {  
 **"size"** : **"M42"**,  
 **"dia"** : 42.0,  
 **"pitch"** : 4.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"17"** : {  
 **"size"** : **"M48"**,  
 **"dia"** : 48.0,  
 **"pitch"** : 5.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"18"** : {  
 **"size"** : **"M56"**,  
 **"dia"** : 56.0,  
 **"pitch"** : 5.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"19"** : {  
 **"size"** : **"M64"**,  
 **"dia"** : 64.0,  
 **"pitch"** : 6.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** }  
 },  
 **"603"** : {  
 **"1"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 12.45,  
 **"k"** : 2.7  
 },  
 **"2"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 15.45,  
 **"k"** : 3.12  
 },  
 **"3"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 19.35,  
 **"k"** : 4.12  
 },  
 **"4"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 23.35,  
 **"k"** : 4.62  
 },  
 **"5"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 29.35,  
 **"k"** : 6.05  
 },  
 **"6"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 37.2,  
 **"k"** : 8.05  
 },  
 **"7"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 45.2,  
 **"k"** : 9.95  
 }  
 },  
 **"4017"** : {  
 **"1"** : {  
 **"size"** : **"M1.6"**,  
 **"dia"** : 1.6,  
 **"pitch"** : 0.35,  
 **"dw"** : 2.27,  
 **"k"** : 0.975  
 },  
 **"2"** : {  
 **"size"** : **"M2"**,  
 **"dia"** : 2.0,  
 **"pitch"** : 0.4,  
 **"dw"** : 3.07,  
 **"k"** : 1.275  
 },  
 **"3"** : {  
 **"size"** : **"M2.5"**,  
 **"dia"** : 2.5,  
 **"pitch"** : 0.45,  
 **"dw"** : 4.07,  
 **"k"** : 1.575  
 },  
 **"4"** : {  
 **"size"** : **"M3"**,  
 **"dia"** : 3.0,  
 **"pitch"** : 0.5,  
 **"dw"** : 4.57,  
 **"k"** : 1.875  
 },  
 **"5"** : {  
 **"size"** : **"M4"**,  
 **"dia"** : 4.0,  
 **"pitch"** : 0.7,  
 **"dw"** : 5.88,  
 **"k"** : 2.675  
 },  
 **"6"** : {  
 **"size"** : **"M5"**,  
 **"dia"** : 5.0,  
 **"pitch"** : 0.8,  
 **"dw"** : 6.88,  
 **"k"** : 3.35  
 },  
 **"7"** : {  
 **"size"** : **"M6"**,  
 **"dia"** : 6.0,  
 **"pitch"** : 1.0,  
 **"dw"** : 8.88,  
 **"k"** : 3.85  
 },  
 **"8"** : {  
 **"size"** : **"M8"**,  
 **"dia"** : 8.0,  
 **"pitch"** : 1.25,  
 **"dw"** : 11.63,  
 **"k"** : 5.15  
 },  
 **"9"** : {  
 **"size"** : **"M10"**,  
 **"dia"** : 10.0,  
 **"pitch"** : 1.5,  
 **"dw"** : 14.63,  
 **"k"** : 6.22  
 },  
 **"10"** : {  
 **"size"** : **"M12"**,  
 **"dia"** : 12.0,  
 **"pitch"** : 1.75,  
 **"dw"** : 16.63,  
 **"k"** : 7.32  
 },  
 **"11"** : {  
 **"size"** : **"M16"**,  
 **"dia"** : 16.0,  
 **"pitch"** : 2.0,  
 **"dw"** : 22.49,  
 **"k"** : 9.82  
 },  
 **"12"** : {  
 **"size"** : **"M20"**,  
 **"dia"** : 20.0,  
 **"pitch"** : 2.5,  
 **"dw"** : 28.19,  
 **"k"** : 12.285  
 },  
 **"13"** : {  
 **"size"** : **"M24"**,  
 **"dia"** : 24.0,  
 **"pitch"** : 3.0,  
 **"dw"** : 33.61,  
 **"k"** : 14.785  
 },  
 **"14"** : {  
 **"size"** : **"M30"**,  
 **"dia"** : 30.0,  
 **"pitch"** : 3.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"15"** : {  
 **"size"** : **"M36"**,  
 **"dia"** : 36.0,  
 **"pitch"** : 4.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"16"** : {  
 **"size"** : **"M42"**,  
 **"dia"** : 42.0,  
 **"pitch"** : 4.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"17"** : {  
 **"size"** : **"M48"**,  
 **"dia"** : 48.0,  
 **"pitch"** : 5.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"18"** : {  
 **"size"** : **"M56"**,  
 **"dia"** : 56.0,  
 **"pitch"** : 5.5,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** },  
 **"19"** : {  
 **"size"** : **"M64"**,  
 **"dia"** : 64.0,  
 **"pitch"** : 6.0,  
 **"dw"** : **"NA"**,  
 **"k"** : **"NA"** }  
 },  
 **"4032"** : {  
 **"1"** : {  
 **"size"** : 1.6,  
 **"damax"** : 1.84,  
 **"damin"** : 1.6,  
 **"dw"** : 2.4,  
 **"m"** : 1.05  
 },  
 **"2"** : {  
 **"size"** : 2.0,  
 **"damax"** : 2.3,  
 **"damin"** : 2.0,  
 **"dw"** : 3.1,  
 **"m"** : 1.35  
 },  
 **"3"** : {  
 **"size"** : 2.5,  
 **"damax"** : 2.9,  
 **"damin"** : 2.5,  
 **"dw"** : 4.1,  
 **"m"** : 1.75  
 },  
 **"4"** : {  
 **"size"** : 3.0,  
 **"damax"** : 3.45,  
 **"damin"** : 3.0,  
 **"dw"** : 4.6,  
 **"m"** : 2.15  
 },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"damax"** : 4.6,  
 **"damin"** : 4.0,  
 **"dw"** : 5.9,  
 **"m"** : 2.9  
 },  
 **"6"** : {  
 **"size"** : 5.0,  
 **"damax"** : 5.75,  
 **"damin"** : 5.0,  
 **"dw"** : 6.9,  
 **"m"** : 4.4  
 },  
 **"7"** : {  
 **"size"** : 6.0,  
 **"damax"** : 6.75,  
 **"damin"** : 6.0,  
 **"dw"** : 8.9,  
 **"m"** : 4.9  
 },  
 **"8"** : {  
 **"size"** : 8.0,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.6,  
 **"m"** : 6.44  
 },  
 **"9"** : {  
 **"size"** : 10.0,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.6,  
 **"m"** : 8.04  
 },  
 **"10"** : {  
 **"size"** : 12.0,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.6,  
 **"m"** : 10.37  
 },  
 **"11"** : {  
 **"size"** : 16.0,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.5,  
 **"m"** : 14.1  
 },  
 **"12"** : {  
 **"size"** : 20.0,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 16.9  
 },  
 **"13"** : {  
 **"size"** : 24.0,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.3,  
 **"m"** : 20.2  
 },  
 **"14"** : {  
 **"size"** : 30.0,  
 **"damax"** : 32.4,  
 **"damin"** : 30.0,  
 **"dw"** : 42.8,  
 **"m"** : 24.3  
 },  
 **"15"** : {  
 **"size"** : 36.0,  
 **"damax"** : 38.9,  
 **"damin"** : 36.0,  
 **"dw"** : 51.1,  
 **"m"** : 29.4  
 },  
 **"16"** : {  
 **"size"** : 42.0,  
 **"damax"** : 45.4,  
 **"damin"** : 42.0,  
 **"dw"** : 60.0,  
 **"m"** : 32.4  
 },  
 **"17"** : {  
 **"size"** : 48.0,  
 **"damax"** : 51.8,  
 **"damin"** : 48.0,  
 **"dw"** : 69.5,  
 **"m"** : 36.4  
 },  
 **"18"** : {  
 **"size"** : 56.0,  
 **"damax"** : 60.5,  
 **"damin"** : 56.0,  
 **"dw"** : 78.7,  
 **"m"** : 43.4  
 },  
 **"19"** : {  
 **"size"** : 64.0,  
 **"damax"** : 69.1,  
 **"damin"** : 64.0,  
 **"dw"** : 88.2,  
 **"m"** : 49.1  
 }  
 },  
 **"4035"** : {  
 **"1"** : {  
 **"size"** : 1.6,  
 **"damax"** : 1.84,  
 **"damin"** : 1.6,  
 **"dw"** : 2.4,  
 **"m"** : 0.75  
 },  
 **"2"** : {  
 **"size"** : 2.0,  
 **"damax"** : 2.3,  
 **"damin"** : 2.0,  
 **"dw"** : 3.1,  
 **"m"** : 0.95  
 },  
 **"3"** : {  
 **"size"** : 2.5,  
 **"damax"** : 2.9,  
 **"damin"** : 2.5,  
 **"dw"** : 4.1,  
 **"m"** : 1.35  
 },  
 **"4"** : {  
 **"size"** : 3.0,  
 **"damax"** : 3.45,  
 **"damin"** : 3.0,  
 **"dw"** : 4.6,  
 **"m"** : 1.55  
 },  
 **"5"** : {  
 **"size"** : 4.0,  
 **"damax"** : 4.6,  
 **"damin"** : 4.0,  
 **"dw"** : 5.9,  
 **"m"** : 1.95  
 },  
 **"6"** : {  
 **"size"** : 5.0,  
 **"damax"** : 5.75,  
 **"damin"** : 5.0,  
 **"dw"** : 6.9,  
 **"m"** : 2.45  
 },  
 **"7"** : {  
 **"size"** : 6.0,  
 **"damax"** : 6.75,  
 **"damin"** : 6.0,  
 **"dw"** : 8.9,  
 **"m"** : 2.9  
 },  
 **"8"** : {  
 **"size"** : 8.0,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.6,  
 **"m"** : 3.7  
 },  
 **"9"** : {  
 **"size"** : 10.0,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.6,  
 **"m"** : 4.7  
 },  
 **"10"** : {  
 **"size"** : 12.0,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.6,  
 **"m"** : 5.7  
 },  
 **"11"** : {  
 **"size"** : 16.0,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.5,  
 **"m"** : 7.42  
 },  
 **"12"** : {  
 **"size"** : 20.0,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 9.1  
 },  
 **"13"** : {  
 **"size"** : 24.0,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.2,  
 **"m"** : 10.9  
 },  
 **"14"** : {  
 **"size"** : 30.0,  
 **"damax"** : 32.4,  
 **"damin"** : 30.0,  
 **"dw"** : 42.8,  
 **"m"** : 13.9  
 },  
 **"15"** : {  
 **"size"** : 36.0,  
 **"damax"** : 38.9,  
 **"damin"** : 36.0,  
 **"dw"** : 51.1,  
 **"m"** : 16.9  
 },  
 **"16"** : {  
 **"size"** : 42.0,  
 **"damax"** : 45.4,  
 **"damin"** : 42.0,  
 **"dw"** : 60.0,  
 **"m"** : 19.7  
 },  
 **"17"** : {  
 **"size"** : 48.0,  
 **"damax"** : 51.8,  
 **"damin"** : 48.0,  
 **"dw"** : 69.5,  
 **"m"** : 22.7  
 },  
 **"18"** : {  
 **"size"** : 56.0,  
 **"damax"** : 60.5,  
 **"damin"** : 56.0,  
 **"dw"** : 78.7,  
 **"m"** : 26.7  
 },  
 **"19"** : {  
 **"size"** : 64.0,  
 **"damax"** : 69.1,  
 **"damin"** : 64.0,  
 **"dw"** : 88.2,  
 **"m"** : 30.4  
 }  
 },  
 **"7040"** : {  
 **"1"** : {  
 **"size"** : 3.0,  
 **"damax"** : 3.45,  
 **"damin"** : 3.0,  
 **"dw"** : 4.57,  
 **"m"** : 2.15  
 },  
 **"2"** : {  
 **"size"** : 4.0,  
 **"damax"** : 4.6,  
 **"damin"** : 4.0,  
 **"dw"** : 5.88,  
 **"m"** : 2.9  
 },  
 **"3"** : {  
 **"size"** : 5.0,  
 **"damax"** : 5.75,  
 **"damin"** : 5.0,  
 **"dw"** : 6.88,  
 **"m"** : 4.4  
 },  
 **"4"** : {  
 **"size"** : 6.0,  
 **"damax"** : 6.75,  
 **"damin"** : 6.0,  
 **"dw"** : 8.88,  
 **"m"** : 4.9  
 },  
 **"5"** : {  
 **"size"** : 8.0,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.63,  
 **"m"** : 6.44  
 },  
 **"6"** : {  
 **"size"** : 10.0,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.63,  
 **"m"** : 8.04  
 },  
 **"7"** : {  
 **"size"** : 12.0,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.63,  
 **"m"** : 10.37  
 },  
 **"8"** : {  
 **"size"** : 14.0,  
 **"damax"** : 15.1,  
 **"damin"** : 14.0,  
 **"dw"** : 19.64,  
 **"m"** : 12.1  
 },  
 **"9"** : {  
 **"size"** : 16.0,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.49,  
 **"m"** : 14.1  
 },  
 **"10"** : {  
 **"size"** : 20.0,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 16.9  
 },  
 **"11"** : {  
 **"size"** : 24.0,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.25,  
 **"m"** : 20.2  
 },  
 **"12"** : {  
 **"size"** : 30.0,  
 **"damax"** : 32.4,  
 **"damin"** : 30.0,  
 **"dw"** : 42.75,  
 **"m"** : 24.3  
 },  
 **"13"** : {  
 **"size"** : 36.0,  
 **"damax"** : 38.9,  
 **"damin"** : 36.0,  
 **"dw"** : 51.11,  
 **"m"** : 29.4  
 }  
 },  
 **"7042"** : {  
 **"1"** : {  
 **"size"** : 5.0,  
 **"damax"** : 5.75,  
 **"damin"** : 5.0,  
 **"dw"** : 6.88,  
 **"m"** : 3.52  
 },  
 **"2"** : {  
 **"size"** : 6.0,  
 **"damax"** : 6.75,  
 **"damin"** : 6.0,  
 **"dw"** : 8.88,  
 **"m"** : 3.92  
 },  
 **"3"** : {  
 **"size"** : 8.0,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.63,  
 **"m"** : 5.15  
 },  
 **"4"** : {  
 **"size"** : 10.0,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.63,  
 **"m"** : 6.43  
 },  
 **"5"** : {  
 **"size"** : 12.0,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.63,  
 **"m"** : 8.3  
 },  
 **"6"** : {  
 **"size"** : 14.0,  
 **"damax"** : 15.1,  
 **"damin"** : 14.0,  
 **"dw"** : 19.64,  
 **"m"** : 9.68  
 },  
 **"7"** : {  
 **"size"** : 16.0,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.49,  
 **"m"** : 11.28  
 },  
 **"8"** : {  
 **"size"** : 20.0,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 13.52  
 },  
 **"9"** : {  
 **"size"** : 24.0,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.25,  
 **"m"** : 16.16  
 },  
 **"10"** : {  
 **"size"** : 30.0,  
 **"damax"** : 32.4,  
 **"damin"** : 30.0,  
 **"dw"** : 42.75,  
 **"m"** : 19.44  
 },  
 **"11"** : {  
 **"size"** : 36.0,  
 **"damax"** : 38.9,  
 **"damin"** : 36.0,  
 **"dw"** : 51.11,  
 **"m"** : 23.52  
 }  
 },  
 **"1587"** : {  
 **"1"** : {  
 **"size"** : **"M4"**,  
 **"damax"** : 4.6,  
 **"damin"** : 4.0,  
 **"dw"** : 5.9,  
 **"m"** : 2.9  
 },  
 **"2"** : {  
 **"size"** : **"M5"**,  
 **"damax"** : 5.75,  
 **"damin"** : 5.0,  
 **"dw"** : 6.9,  
 **"m"** : 3.7  
 },  
 **"3"** : {  
 **"size"** : **"M6"**,  
 **"damax"** : 6.75,  
 **"damin"** : 6.0,  
 **"dw"** : 8.9,  
 **"m"** : 4.7  
 },  
 **"4"** : {  
 **"size"** : **"M8"**,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.6,  
 **"m"** : 6.14  
 },  
 **"5"** : {  
 **"size"** : **"M10"**,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.6,  
 **"m"** : 7.64  
 },  
 **"6"** : {  
 **"size"** : **"M12"**,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.6,  
 **"m"** : 9.64  
 },  
 **"7"** : {  
 **"size"** : **"M14"**,  
 **"damax"** : 15.1,  
 **"damin"** : 14.0,  
 **"dw"** : 19.6,  
 **"m"** : 10.3  
 },  
 **"8"** : {  
 **"size"** : **"M16"**,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.5,  
 **"m"** : 12.3  
 },  
 **"9"** : {  
 **"size"** : **"M18"**,  
 **"damax"** : 19.5,  
 **"damin"** : 18.0,  
 **"dw"** : 24.9,  
 **"m"** : 14.3  
 },  
 **"10"** : {  
 **"size"** : **"M20"**,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 14.9  
 },  
 **"11"** : {  
 **"size"** : **"M22"**,  
 **"damax"** : 23.7,  
 **"damin"** : 22.0,  
 **"dw"** : 31.4,  
 **"m"** : 16.9  
 },  
 **"12"** : {  
 **"size"** : **"M24"**,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.3,  
 **"m"** : 17.7  
 },  
 **"13"** : {  
 **"size"** : **"M8x1"**,  
 **"damax"** : 8.75,  
 **"damin"** : 8.0,  
 **"dw"** : 11.6,  
 **"m"** : 6.14  
 },  
 **"14"** : {  
 **"size"** : **"M10x1.25"**,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.6,  
 **"m"** : 7.64  
 },  
 **"15"** : {  
 **"size"** : **"M10x1.25"**,  
 **"damax"** : 10.8,  
 **"damin"** : 10.0,  
 **"dw"** : 14.6,  
 **"m"** : 7.64  
 },  
 **"16"** : {  
 **"size"** : **"M12x1.5"**,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.6,  
 **"m"** : 9.64  
 },  
 **"17"** : {  
 **"size"** : **"M12x1.25"**,  
 **"damax"** : 13.0,  
 **"damin"** : 12.0,  
 **"dw"** : 16.6,  
 **"m"** : 9.64  
 },  
 **"18"** : {  
 **"size"** : **"M14x1.5"**,  
 **"damax"** : 15.1,  
 **"damin"** : 14.0,  
 **"dw"** : 19.6,  
 **"m"** : 10.3  
 },  
 **"19"** : {  
 **"size"** : **"M16x1.5"**,  
 **"damax"** : 17.3,  
 **"damin"** : 16.0,  
 **"dw"** : 22.5,  
 **"m"** : 12.3  
 },  
 **"20"** : {  
 **"size"** : **"M18x2"**,  
 **"damax"** : 19.5,  
 **"damin"** : 18.0,  
 **"dw"** : 24.9,  
 **"m"** : 14.3  
 },  
 **"21"** : {  
 **"size"** : **"M18x1.5"**,  
 **"damax"** : 19.5,  
 **"damin"** : 18.0,  
 **"dw"** : 24.9,  
 **"m"** : 14.3  
 },  
 **"22"** : {  
 **"size"** : **"M20x2"**,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 14.9  
 },  
 **"23"** : {  
 **"size"** : **"M20x1.5"**,  
 **"damax"** : 21.6,  
 **"damin"** : 20.0,  
 **"dw"** : 27.7,  
 **"m"** : 14.9  
 },  
 **"24"** : {  
 **"size"** : **"M22x2"**,  
 **"damax"** : 23.7,  
 **"damin"** : 22.0,  
 **"dw"** : 31.4,  
 **"m"** : 16.9  
 },  
 **"25"** : {  
 **"size"** : **"M22x1.5"**,  
 **"damax"** : 23.7,  
 **"damin"** : 22.0,  
 **"dw"** : 31.4,  
 **"m"** : 16.9  
 },  
 **"26"** : {  
 **"size"** : **"M24x2"**,  
 **"damax"** : 25.9,  
 **"damin"** : 24.0,  
 **"dw"** : 33.3,  
 **"m"** : 17.7  
 }  
 },  
 **"Non-Standard/Stud"** : {},  
 **""** : {}  
}