

# Material entries using MatTool program

As a result of the Bellows Master II Upgrades due to specification additions and changes the material entering has become more and more critical and sometimes difficult to understand. To clarify some issues we like to point out issues, which are valid for the program:

- Material entry is critical. Mistakes results in difficult to detect errors in design calculations
- You can enter unlimited number of materials. Program comes with limited number of sample materials
- Use the short code to separate different material types. Each material must have own short code. If you try to use same code as before you get Key violation error
- If your allowable stress is different for different material thicknesses enter each thickness range as a separate material. Use codes like Grade 70 >40 mm. Remember that the database is used for not only Bellows Master but for FlangeTool, Rodmaster etc.
- In the program you have to separate materials for ASME B31.3, ASME VIII Div 1 appendix 26 and EJMA calculations. Use material short code to do this. For instance 304 2001 ed and 304 2002 ASME. Main reason are the differences in fatigue factors and sometimes allowable stresses. If you do not use correct fatigue values for each of the codes your bellows cycle calculation results are totally wrong.
- **Help file has a lot of information. Please use it. Use F1 key to activate help file!** Content page has general information to read. Each form has its own help page. Images in the help file have "Hot Spots" Use your mouse to click the image to get more information. Nobody likes help files. This time you have to look at it. Even we do so each time we enter new material.
- How to add new material is done using the General info form. On top is a set of buttons. Please use help file and attached pages to get more information.
- Back ups are important. We have had no corruptions in the last 5 years. Be safe and not sorry. Computers fail, they are stolen etc. If you are uncertain how and what to back up please ask. (We lost in one year two hard drives within 6 months! Without back ups we would have been in trouble. Hard drives were under 2 years old.)
- If you are not sure how to enter materials please ask our support. Let us know your most common material and if possible we will send you data to enter with answers to your queries.
- You have to enter all the information required. There are several different forms: General, Allowable, Yield, UTS, Poisson and E. We do not enter always all the information but we know when this can be done. We do not recommend this method as

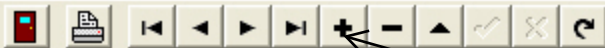
sooner or later it gives serious problems. The trick is to limit the maximum temperature on the main form.

- Each entry form Allowable, Yield, UTS, Poisson and E has to have as an absolute minimum 2 entries. Lower temperature has to be same temperature as main form Limit Temperature. For Poisson factor the lower temperature must be lowest you will ever use the material for. Highest temperature value and material entry has to be same or higher than Max Temp entry on the main form. Between these two temperatures you can enter as many values as required - entry for each value change.
- Never change material values except if you find a clear mistake. This way you can recalculate old saved designs and you will get same result. Note that sometimes customer specified material specification edition. This is common especially for ASME designs. ASME edition is decided in the beginning of the project and is used for the lifetime of the plant. Any replacement is therefore ordered to the old material values.
- Material standards change with time. ASME has major changes every 3 years. Sometimes changes are substantial in allowable stress values.
- Use note field to record where you have taken the values etc
- Never enter a material and think that "I am too busy, I will only enter some information I need now". Sooner or later you will use that material without remembering what you did. BM will most probably calculate but the results are rubbish.
- MatTool is a database program. Most users have not used this type of program before. There are couple issues, which are important. You do not "Save" or "Save as". Saving is called "Posting". There are two ways to post the entries. You can click the button Post or you can just move to an other record. Moving is automatically posting the entries. This can be very dangerous. If you for instance just look, which entries are possible for Fatigue Type and accidentally change the entry and then move to an other material the change is posted without any warning. Result is that you messed up that material totally.
- We generally recommend that the entry to MatTool program is limited to authorized people only. There are couple reasons. One is that the program requires training, untrained person can accidentally change the values. Second reason is that unfortunately there are people who will change material values to get a design acceptable. Such changes are nearly impossible to detect except if the customer makes check calculation or the bellows fails.
- Where to get values is sometimes problematic. Here are some pointers: Materials for EJMA calculations can be from any standard. Most common is ASME 2D. From this standard you can find allowable stress, UTS and Yield. Creep limit is in the allowable stress notes. Poisson values are difficult to find. Special Metals ([www.specialmetals.com](http://www.specialmetals.com)) has values for many bellows materials. Density is also

available from the same place. Max elongation you should enter the specified minimum elongation from the applicable material standard. Moduli of elasticity values are available from EJMA standard. Note that they were changed at least one time - use EJMA 7 or later. Max fatigue temperature is either from the applicable design code or from your fatigue tests. ASME B31.3 allowable values are from that code. Other values as for EJMA. ASME VIII Div 1 Appendix 26 values are from ASME 2D and other values as per EJMA. Fatigue factors are from each code and your fatigue tests. **Make sure you do not mix these up!**

- See attachment pages for more information.

# General Properties



Material code

304 2001ASME

Bellows material

To add material click this button. Pls see help file for other buttons.

Material description

ASME SA-240 Grade 304 2001 ed

Note the coding. 304 gives grade, 2001 edition and ASME identifies this material for ASME

General | Fatigue

Max temp

1500

Limit temp E

-325

Yield cold

30

Max stress temp

1000

E cold

30.4

Limit temp Yield

100

Creep limit temp

800

E room temp

28.3

Limit temp Allow

200

Max Elongation

43

Limit temp UTS

100

Allow stress cold

20

Density

8000

UTS cold

75

Max fatigue temp

800

Cm Annealed

1.5

Cm not Annealed

3

Fatigue type

ASME

This entry is critical for which code material can be used. Press F1 key and in the help file image click this entry to get more information

It is critical to understand how entries are "saved". In a database program like MatTool you Post the entries. This is done in 2 ways. Either clicking Post button OR moving to another entry. This can be extremely dangerous. If you by accident change some entry and then move to another material your changed entry is automatically saved without any warning! Therefore if you just "look" what entry is possible for Fatigue type and then select wrong type you have a serious problem.

Notes:

Yield and UTS are calculated above 1000 F. Yield  $1.2 * \text{allowable}$  and UTS  $3.5 * \text{Yield}$

# General Properties



Material code

304 2001ASME

Be

Material description

ASME SA-240 Grade 304 2001 ed

All these factors are different in various codes. They are the reason why you need different materials for different codes.

General Fatigue

Base and low values - EN as formed

Unreinforced

Fatigue A	Fatigue B	Fatigue C	Fatigue D	Fatigue cycles
2	30600	6700000	1	100000

Reinforced

Fatigue A	Fatigue B	Fatigue C	Fatigue D	Fatigue cycles
2	38800	8500000	1	100000

ANSI/ASME Fatigue high values. EN as formed high values

Unreinforced

High limit	Fatigue A	Fatigue B	Fatigue C	Fatigue D
65000	2	38300	5200000	1

Reinforced

High limit	Fatigue A	Fatigue B	Fatigue C	Fatigue D
82200	2	48500	6600000	1

EN annealed unreinforced

Low end values

Fatigue A	Fatigue B	Fatigue C	Fatigue D	Fatigue cycles
1	1	1		1

High end values

Stress limit	Fatigue A	Fatigue B	Fatigue C	Fatigue D
1	1	1	1	1

Notes:

Yield and UTS are calculated above 1000 F. Yield  $1.2 \times$  allowable and UTS  $3.5 \times$  Yield

This area is used to make notes about the material

# Allowable Stress



Material code

304 2001ASME



Material description

ASME SA-240 Grade 304 2001 ed

Temperature in F	Allowable stress in ksi
200	20
300	18.9
400	18.3
500	17.5
600	16.6
650	16.2
700	15.8
750	15.5
800	15.2
850	14.9
900	14.6
950	14.3
1000	14
1050	12.4
1100	9.8
1150	7.7
1200	6.1

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