**REASON FOR UPDATE:** Content updated to reflect current files, file locations and example screenshots.

**ASSOCIATED DOCUMENTS:** N/A

## 1. PURPOSE

**1.1** This procedure covers updating the CTP with changes to existing material entries and the characterisation of new materials to allow their addition to the CTP Source Data Microsoft Excel spreadsheet and CTP Calculator Microsoft Access database.

## 2. SCOPE

**2.1** This document applies to the addition of new materials and editing of current material entries in the Cure Time Predictor (CTP).

## 3. RESPONSIBILITY

**3.1** The Materials Engineering Department are responsible for updating and communicating the details within this procedure.

## 4. PROCEDURE

**4.1** The CTP Source Data is a Microsoft Excel spreadsheet located in Lionshare / Docushare. The current file is named **CTP Version 15 Source Data**. The collection containing the CTP Source Data spreadsheet can be opened with the link Cure Time Predictor Collection.

**4.2** The CTP Source Data can be updated by checking out the file to allow edits and checking in to upload any changes to Lionshare / Docushare.

**4.3** The CTP Calculator is a Microsoft Access database located on the public network drive in the Cure Time Predictor folder. The current file is named **Cure Time Predictor Version 15**. The Cure Time Predictor folder can be opened with the link Cure Time Predictor Folder.

**4.4** Before any changes to the CTP Calculator can be made a backup copy of the current file **Cure Time Predictor Version 15 MUST BE CREATED**. This must be saved in the Archived Files folder linked here CTP Archived Files Folder with the file name format as “Cure Time Predictor Version 15 Backup DD.MM.YY”.

**4.5** The CTP Calculator can be updated in two ways. Either by opening the current version and directly editing or by saving a new copy of the current version and directly editing the database records as described in this procedure. (If a new copy is saved and edited this must be used to replace the current file on the system when this is not in use.)

**4.6** The CTP Calculator on the public network drive is a shared file and MUST BE CLOSED when not in use. Leaving the application open can create issues on system disconnect, system shut down or system sleep for other users.

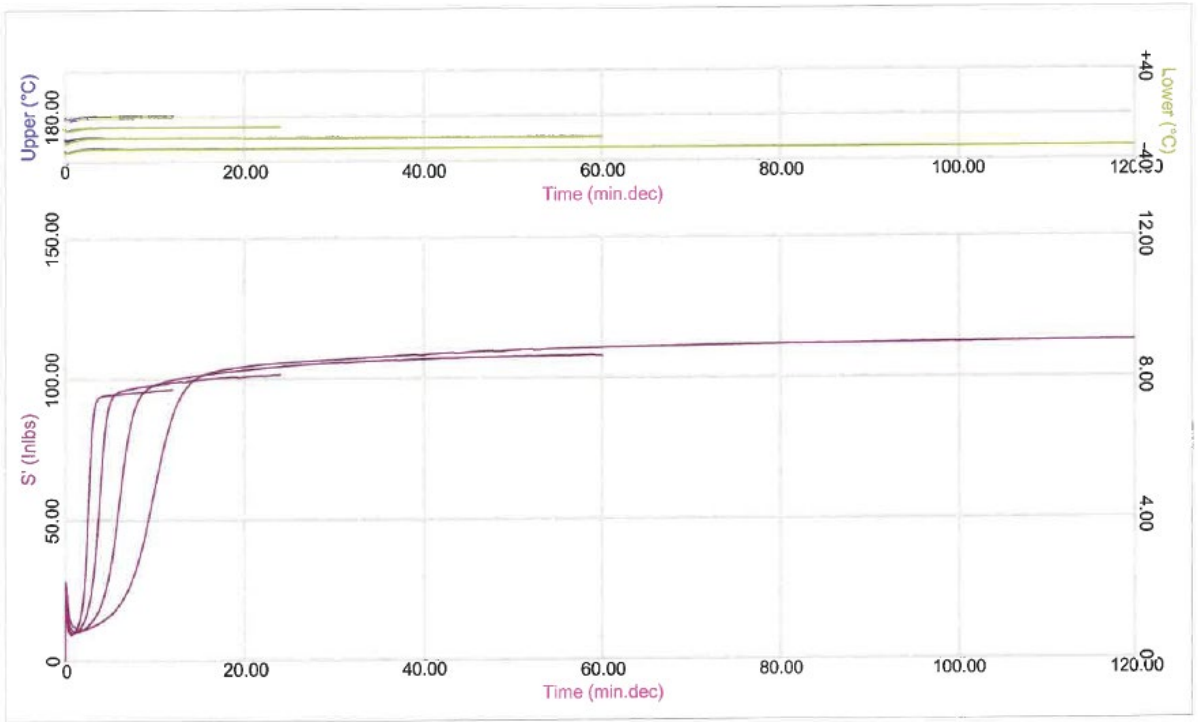
**4.7** The following information is required for each material added to the CTP Calculator:

- **T90** – The time to reach 90% cure for the compound at 150°C, 160°C, 170°C and 180°C. Alternative cure states can be used where required. (Based on stage 1 Rheo traces in min.dec)
- **TS1.13** – The scorch time or time to reach 1% cure for the compound at 150°C, 160°C, 170°C and 180°C. (based on stage 1 Rheo traces in min.dec)
- **Cure Coefficient A** – Automatically generated based on T90 results.
- **Cure Coefficient B** – Automatically generated based on T90 results.
- **Scorch Coefficient A** – Automatically generated based on TS1.13 results.
- **Scorch Coefficient B** – Automatically generated based on TS1.13 results.
- **Specific Gravity / Density –** Based on stage 1 testing of the compound in Kg/m³.
- **Thermal Conductivity** – Based on external testing of the compound or the approximate value based on comparable existing materials with external test results in W/mK.
- **Specific Heat Capacity –** JW take this as a constant 2000 J/kgK for all compounds.
- **Maximum Cure Time** – The max time at 150°C, 160°C, 170°C, 180°C, 190°C and 200°C the material can be cured for before material degradation will occur (typically standard values applied but varies for some materials).
- **Minimum Cure Temperature –** The lowest temperature the material can be successfully cured at (typically 150°C but can be left bank if desired).
- **Material Description** – Standard format as per previous entries but any details can be added as required.
- **Post Cure Description** – Standard format as per previous entries but any details can be added as required.
- **Center Percentage Cure** – Default value is 0%.
- **Cure Batch Variation** – The safety margin applied to predicted cure times. Default value is 5%.
- **Scorch Batch Variation** – The safety margin applied to predicted scorch times. Default value is 5%.

**4.8** To gather the **T90** and **TS1.13** data carry out rheometer traces using the **ODR** (NOT the MDR) on the material to be added to the CTP Calculator. The standard programs for characterising materials on the **ODR** are listed below:

- CURETIME PREDICTOR 2HRS@150°C
- CURETIME PREDICTOR 1HR@160°C
- CURETIME PREDICTOR 24MINS@170°C
- CURETIME PREDICTOR 12MINS@180°C

(Note – **T90** values are only valid from fully cured material i.e. consistent torque values achieved with no obvious 'marching modulus' or 'reversion')


Upper (°C)
180.00
0
20.00
40.00
60.00
80.00
100.00
120.00
Time (min.dec)
Lower (°C)
+40
-40
S' (lnlbs)
150.00
100.00
50.00
0
12.00
8.00
4.00
0
Time (min.dec)

| Compound | Method | Batch | Result | Date/Time | S':Minimum | S':Maximum | S':TS1.13 |
|---|---|---|---|---|---|---|---|
| CURETIME PREDICTOR 12MINS@180°C | Test | NM59-74/80 12/269/18 | Passed | 29/03/2018 15:22:42 | 9.08 | 96.31 | 1.10 |
| | | | | | 9.08 | 96.31 | 1.10 |
| | | | | | 0.00 | 0.00 | 0.00 |
| CURETIME PREDICTOR 24MINS@170°C | 24MINS@170C | NM59-74/80 12/269/18 | Passed | 29/03/2018 12:08:37 | 9.69 | 101.55 | 1.47 |
| | | | | | 9.69 | 101.55 | 1.47 |
| | | | | | 0.00 | 0.00 | 0.00 |
| CURETIME PREDICTOR 1HR@160°C | 1HR@160C | NM59-74/80 12/269/18 | Passed | 29/03/2018 11:30:27 | 10.08 | 108.15 | 2.11 |
| | | | | | 10.08 | 108.15 | 2.11 |
| | | | | | 0.00 | 0.00 | 0.00 |
| CURETIME PREDICTOR 2HRS@150°C | 2 HRS @ 150°C | NM59-74/80 12/269/18 | Passed | 04/04/2018 11:05:48 | 10.95 | 112.94 | 3.02 |
| | | | | | 10.95 | 112.94 | 3.02 |
| | | | | | 0.00 | 0.00 | 0.00 |

| Batch | S':T50% | S':T57% | S':T75% | S':T80% | S':T90% | S':Final |
|---|---|---|---|---|---|---|
| NM59-74/80 12/269/18 | 2.60 | 2.68 | 2.91 | 2.99 | 3.22 | |
| | 2.60 | 2.68 | 2.91 | 2.99 | 3.22 | |
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| NM59-74/80 12/269/18 | 3.84 | 3.98 | 4.40 | 4.55 | 5.13 | 101.52 |
| | 3.84 | 3.98 | 4.40 | 4.55 | 5.13 | 101.52 |
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NM59-74/80 12/269/18 | 6.19 | 6.46 | 7.34 | 7.73 | 10.49 | 107.92 |
| | 6.19 | 6.46 | 7.34 | 7.73 | 10.49 | 107.92 |
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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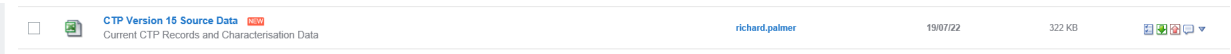
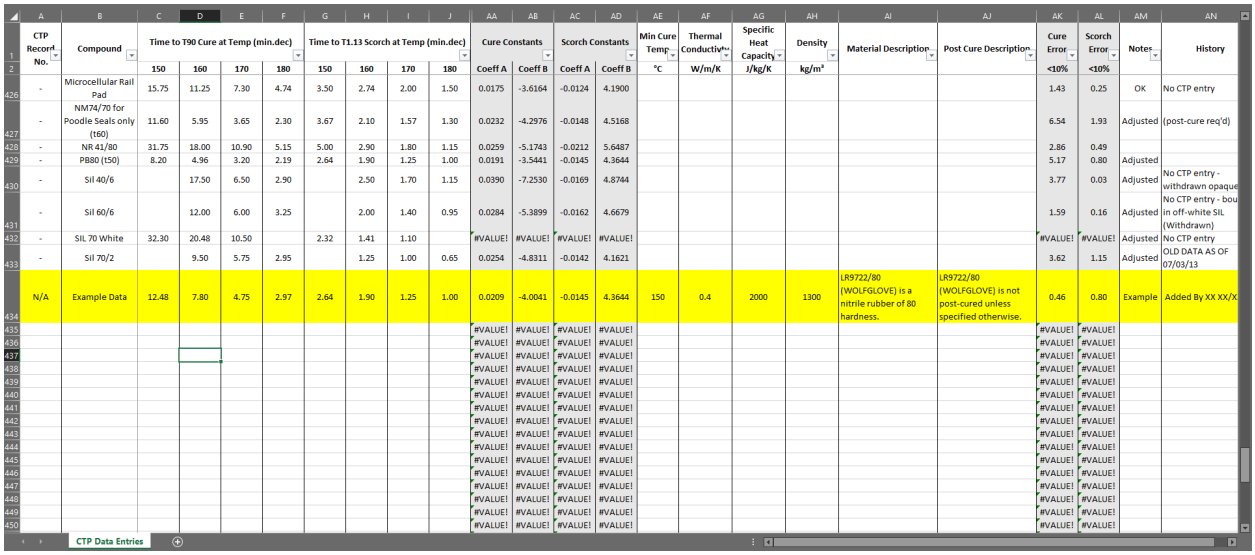
| Batch | S':T50% | S':T57% | S':T75% | S':T80% | S':T90% | S':Final |
|---|---|---|---|---|---|---|
| NM59-74/80 12/269/18 | 10.09 | 10.56 | 12.07 | 12.75 | 16.69 | |
| | 10.09 | 10.56 | 12.07 | 12.75 | 16.69 | |
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |

**4.9** Check out and download the Microsoft Excel spreadsheet '**CTP Version 15 Source Data**' in the Lionshare / Docushare collection Cure Time Predictor Collection. (click the green arrow to check out).




**4.10** Existing materials being fully re-characterised must have a new entry created in the **CTP Version 15 Source Data** Microsoft Excel spreadsheet to preserve details of previous characterisations. The **CTP Record No.** can be moved to the current entry for the material and **Cure Time Predictor Version 15** Microsoft Access database updated to reflect only the current information.

**4.11** Locate the material to be updated in the **Compound** column (This is searchable on the drop down filter). If adding a new material clear any compound filters, scroll to the bottom of the list of compounds and add the compound name as shown in the JW material chart. (Note – **CTP Record No.** reflects the Microsoft Access database)



| | A | B | C | D | E | F | G | H | I | J | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ | AK | AL | AM | AN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CTP Record No. | Compound | Time to T90 Cure at Temp (min.dec) | | | | Time to T1.13 Scorch at Temp (min.dec) | | | | Cure Constants | | Scorch Constants | | Min Cure Temp | Thermal Conductivity | Specific Heat Capacity | Density | Material Description | Post Cure Description | Cure Error | Scorch Error | Notes | History |
| 2 | | | 150 | 160 | 170 | 180 | 150 | 160 | 170 | 180 | Coeff A | Coeff B | Coeff A | Coeff B | °C | W/m/K | J/kg/K | kg/m³ | | | <10% | <10% | | |
| 426 | - | Microcellular Rail Pad | 15.75 | 11.25 | 7.30 | 4.74 | 3.50 | 2.74 | 2.00 | 1.50 | 0.0175 | -3.6164 | -0.0124 | 4.1900 | | | | | | | 1.43 | 0.25 | OK | No CTP entry |
| 427 | - | NM74/70 for Poodle Seals only (t60) | 11.60 | 5.95 | 3.65 | 2.30 | 3.67 | 2.10 | 1.57 | 1.30 | 0.0232 | -4.2976 | -0.0148 | 4.5168 | | | | | | | 6.54 | 1.93 | Adjusted | (post-cure req'd) |
| 428 | - | NR 41/80 | 31.75 | 18.00 | 10.90 | 5.15 | 5.00 | 2.90 | 1.80 | 1.15 | 0.0259 | -5.1743 | -0.0212 | 5.6487 | | | | | | | 2.86 | 0.49 | | |
| 429 | - | PB80 (t50) | 8.20 | 4.96 | 3.20 | 2.19 | 2.64 | 1.90 | 1.25 | 1.00 | 0.0191 | -3.5441 | -0.0145 | 4.3644 | | | | | | | 5.17 | 0.80 | Adjusted | |
| 430 | - | Sil 40/6 | | 17.50 | 6.50 | 2.90 | | 2.50 | 1.70 | 1.15 | 0.0390 | -7.2530 | -0.0169 | 4.8744 | | | | | | | 3.77 | 0.03 | Adjusted | No CTP entry - withdrawn opaque |
| 431 | - | Sil 60/6 | | 12.00 | 6.00 | 3.25 | | 2.00 | 1.40 | 0.95 | 0.0284 | -5.3899 | -0.0162 | 4.6679 | | | | | | | 1.59 | 0.16 | Adjusted | No CTP entry - bou in off-white SIL (Withdrawn) |
| 432 | - | SIL 70 White | 32.30 | 20.48 | 10.50 | | 2.32 | 1.41 | 1.10 | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | Adjusted | No CTP entry |
| 433 | - | Sil 70/2 | | 9.50 | 5.75 | 2.95 | | 1.25 | 1.00 | 0.65 | 0.0254 | -4.8311 | -0.0142 | 4.1621 | | | | | | | 3.62 | 1.15 | Adjusted | OLD DATA AS OF 07/03/13 |
| 434 | N/A | Example Data | 12.48 | 7.80 | 4.75 | 2.97 | 2.64 | 1.90 | 1.25 | 1.00 | 0.0209 | -4.0041 | -0.0145 | 4.3644 | 150 | 0.4 | 2000 | 1300 | LR9722/80 (WOLFGLOVE) is a nitrile rubber of 80 hardness. | LR9722/80 (WOLFGLOVE) is not post-cured unless specified otherwise. | 0.46 | 0.80 | Example | Added By XX XX/X |
| 435 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 436 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 437 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 438 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 439 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 440 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 441 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 442 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 443 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 444 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 445 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 446 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 447 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 448 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 449 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |
| 450 | | | | | | | | | | | #VALUE! | #VALUE! | #VALUE! | #VALUE! | | | | | | | #VALUE! | #VALUE! | | |

CTP Data Entries

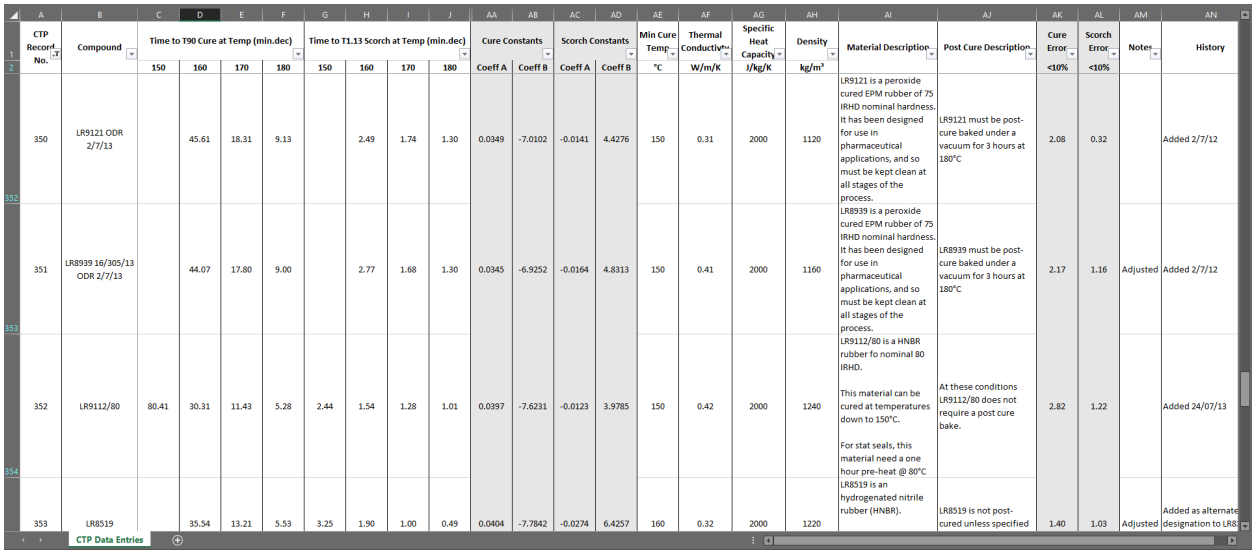
**4.12** Enter **T90** time from the Rheo traces for each temperature in columns C to F (**T90** time is min.dec). **Cure Coefficient A** and **Cure Coefficient B** will calculate and display in columns AA and AB.

**4.13** Enter **TS1.13** time from the Rheo traces for each temperature in columns G to J (**TS1.13** time is min.dec). **Scorch Coefficient A** and **Scorch Coefficient B** will calculate and display in columns AC and AD.

**4.14** Error percentages will calculate and display in column AK for the cure and AL for the scorch. These should be below 10%. If these exceed 10% the **T90** and **TS1.13** Rheo data should be reviewed for suitability (**T90** values taken from Rheo traces which do not reach full cure will notably effect this – 150°C data may need to be omitted in some cases).

**4.15** Enter **Minimum Cure Temperature** (optional), **Thermal Conductivity**, **Specific Heat Capacity**, **Density**, **Material Description** and **Post Cure Description** for the material in columns AE to AJ.

**4.16** Enter any **Notes** and **History** comments in columns AM and AN. Details of entry creation must be recorded in the format “Added by XX DD/MM/YY”. Existing entry updates must be recorded in the format “Updated by XX DD/MM/YY”.



| CTP Record No. | Compound | Time to T90 Cure at Temp (min.dec) | | | | Time to T1.13 Scorch at Temp (min.dec) | | | | Cure Constants | | Scorch Constants | | Min Cure Temp | Thermal Conductivity | Specific Heat Capacity | Density | Material Description | Post Cure Description | Cure Error | Scorch Error | Notes | History |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 150 | 160 | 170 | 180 | 150 | 160 | 170 | 180 | Coeff A | Coeff B | Coeff A | Coeff B | °C | W/m/K | J/kg/K | kg/m³ | | | <10% | <10% | | |
| 350 | LR9121 ODR 2/7/13 | | 45.61 | 18.31 | 9.13 | | 2.49 | 1.74 | 1.30 | 0.0349 | -7.0102 | -0.0141 | 4.4276 | 150 | 0.31 | 2000 | 1120 | LR9121 is a peroxide cured EPM rubber of 75 IRHD nominal hardness. It has been designed for use in pharmaceutical applications, and so must be kept clean at all stages of the process. | LR9121 must be post-cure baked under a vacuum for 3 hours at 180°C | 2.08 | 0.32 | | Added 2/7/12 |
| 351 | LR8939 16/305/13 ODR 2/7/13 | | 44.07 | 17.80 | 9.00 | | 2.77 | 1.68 | 1.30 | 0.0345 | -6.9252 | -0.0164 | 4.8313 | 150 | 0.41 | 2000 | 1160 | LR8939 is a peroxide cured EPM rubber of 75 IRHD nominal hardness. It has been designed for use in pharmaceutical applications, and so must be kept clean at all stages of the process. | LR8939 must be post-cure baked under a vacuum for 3 hours at 180°C | 2.17 | 1.16 | Adjusted | Added 2/7/12 |
| 352 | LR9112/80 | 80.41 | 30.31 | 11.43 | 5.28 | 2.44 | 1.54 | 1.28 | 1.01 | 0.0397 | -7.6231 | -0.0123 | 3.9785 | 150 | 0.42 | 2000 | 1240 | LR9112/80 is a HNBR rubber fo nominal 80 IRHD.<br><br>This material can be cured at temperatures down to 150°C.<br><br>For stat seals, this material need a one hour pre-heat @ 80°C | At these conditions LR9112/80 does not require a post cure bake. | 2.82 | 1.22 | | Added 24/07/13 |
| 353 | LR8519 | | 35.54 | 13.21 | 5.53 | 3.25 | 1.90 | 1.00 | 0.49 | 0.0404 | -7.7842 | -0.0274 | 6.4257 | 160 | 0.32 | 2000 | 1220 | LR8519 is an hydrogenated nitrile rubber (HNBR). | LR8519 is not post-cured unless specified | 1.40 | 1.03 | Adjusted | Added as alternate designation to LR8 |

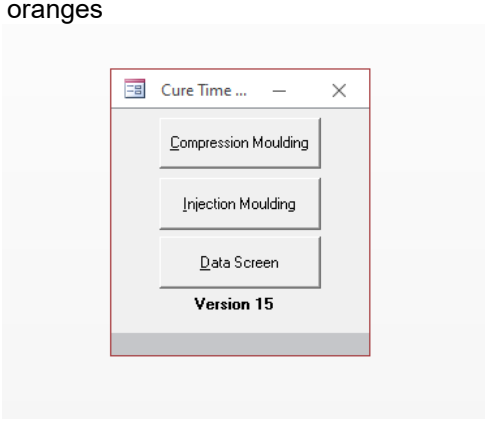
CTP Data Entries

**4.17** Close and check in the Microsoft Excel spreadsheet '**CTP Version 15 Source Data**' to save changes to Lionshare / Docushare.

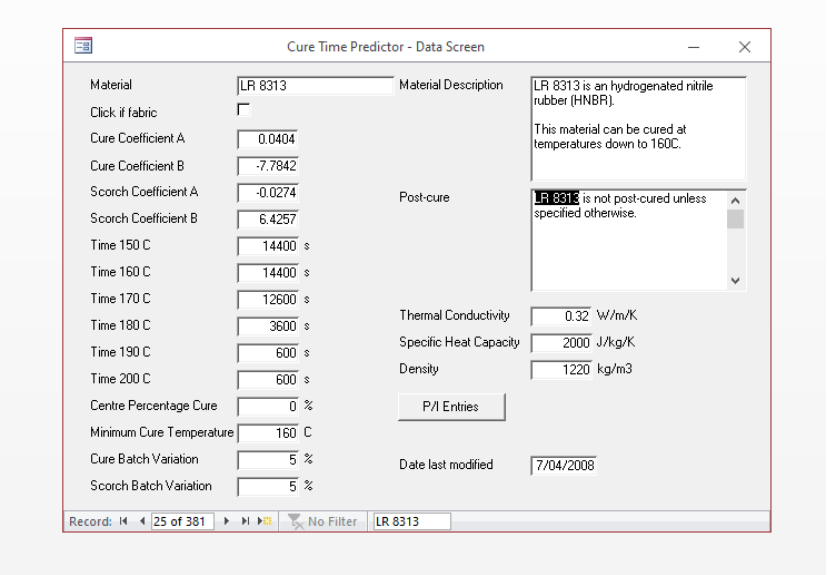
**4.18** Open the **Cure Time Predictor Version 15** Microsoft Access database as per steps 3.3 only after completing step 3.4 and referencing step 3.5.

**4.19** On opening the **Cure Time Predictor Version 15** Microsoft Access database select **Data Screen** button from the three options and use the login details below to access the data entry screen.

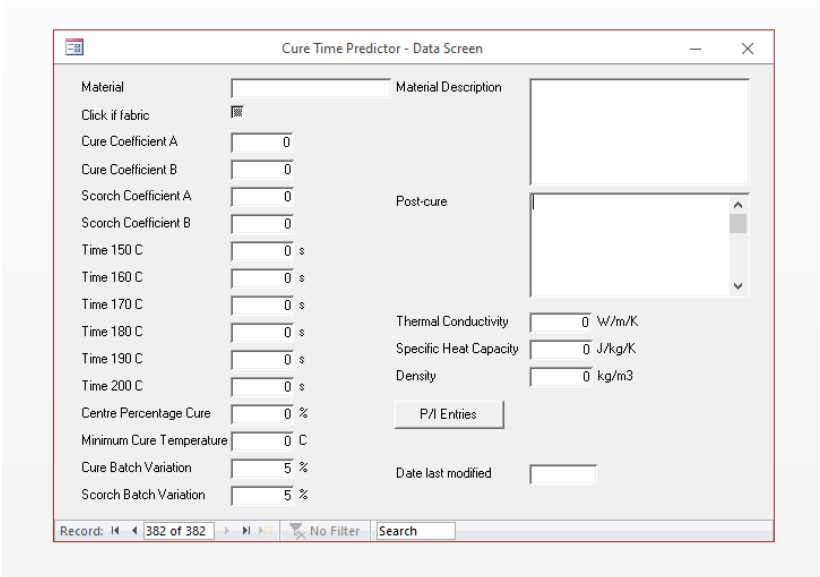
- LOGON – admin
- PASSWORD – oranges




**4.20** To edit an existing entry the CTP Record No. can be entered to go straight to that record or the compound name can be entered in the search box to go to the relevant database record.




**4.21** To create a new entry click the new record button (►✳) to create a new blank record with the next available number in the database.



**4.22** For new entries add the **Compound** name as shown in the JW Materials Chart and note the **CTP Record No.** to add to the **CTP Version 15 Source Data** spreadsheet (as per steps 4.3 and 4.4).

**4.23** Enter or update the **Cure Coefficient A**, **Cure Coefficient B**, **Scorch Coefficient A** and **Scorch Coefficient B** as calculated by the **CTP Version 15 Source Data** spreadsheet (these should be typed in to 4 d.p. as shown in the spreadsheet NOT copied / pasted in).

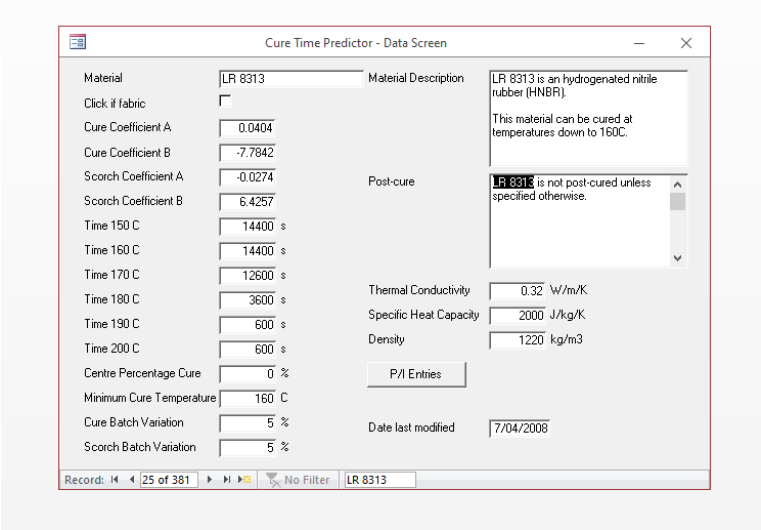
**4.24** Enter or update the **Maximum Cure Time** values (typical standard values shown below).

- Time 150°C – 14400s
- Time 160°C – 14400s
- Time 170°C – 12600s
- Time 180°C – 3600s
- Time 190°C – 600s
- Time 200°C – 600s

**4.25** Enter or update the **Minimum Cure Temperature**, **Thermal Conductivity**, **Specific Heat Capacity** and **Density** as per the **CTP Version 15 Source Data** spreadsheet.

**4.26** Enter or update the **Material Description** and **Post Cure Description** as per the **CTP Version 15 Source Data** spreadsheet.

**4.27** Enter or update the **Date Last Modified** as the current date and check **Centre Percentage Cure**, **Cure Batch Variation** and **Scorch Batch Variation** show the default values.




**4.28** If the material being added is a fabric entry ensure the **Click If Fabric** check box is selected. For rubber compounds this should be un-ticked by default. (NOTE – fabric entries are based on Rheo traces and material properties of the rubber proofing compound.)

**4.29** Note the **P/I Entries** button will open a separate window where Process Instructions can be noted should an entry for a NONE characterised material be required. It is NOT standard procedure to add none characterised materials to the CTP so this is not covered in this document.

**4.30** Complete the **Cure Time Predictor Version 15** Microsoft Access database update by closing the **Data Screen** window. The new / updated entry will now be available in the database and appear in the **Compression Moulding** and **Injection Moulding** screens.

**4.31** As per steps 3.5 and 3.6 ensure the updated **Cure Time Predictor Version 15** Microsoft Access database is available in the on the public network drive in the Cure Time Predictor folder ("P:\Cure Time Predictor"). If the current document cannot be replaced due to being open and in use by other users you will need to wait for this to be closed by all users first. (The start or end of the day is recommended as optimal times to replace the working file.)