

**\*DEFINE\_CURVE\_FLC**

Purpose: This keyword allows for defining Forming Limit Diagram (FLD) using sheet metal thickness ‘t’ and strain hardening value ‘n’, applicable to shell elements only.

Card 1	1	2	3	4	5	6	7	8
Variable	LCID	TH	N					
Type	I	F	F					
Default	none	0.0	0.0					

<u>VARIABLE</u>	<u>DESCRIPTION</u>
LCID	Load curve ID.
TH	Sheet metal thickness.
N	Strain hardening value of the sheet metal, as in power law.

**Remarks:**

1. This keyword is used in conjunction with keyword \*MAT\_TRANSVERSELY \_ANISOTROPIC\_ELASTIC\_PLASTIC\_NLP\_FAILURE, and for shell elements only. For detailed formula of calculating the FLD based on sheet metal thickness and n-value, please refer to the following paper: *Ming F. Shi, Shawn Gelisse, “Issues on the AHSS Forming Limit Determination”, IDDRG 2006.*
2. It is noted that this FLD calculation method is limited to sheet metal steels with thickness equal to or less than 2.5 mm, and it is not suitable for aluminum sheets.
3. In a validation example shown in Figure 0-1, a single shell element is stretched in three typical strain paths (linear): uniaxial, plane strain and equi-biaxial. Strain limits for each path are recovered when the history variable (Formability Index limit in \*MAT\_037) reaches 1.0, shown in Figure 0-2. The top most point (strain limit) of each strain path coincides with the FLC curve calculated according to the paper, indicating the FLC defined by this keyword is working correctly. As shown in a partial keyword file below, the FLC is defined using a thickness value of 1.5 and n-value of 0.159. The ‘LCID’ of 891 is used to define a variable ‘ICFLD’ in keyword \*MAT\_TRANSVERSELY \_ANISOTROPIC \_ELASTIC\_PLASTIC\_NLP\_FAILURE.

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*MAT_TRANSVERSELY_ANISOTROPIC_ELASTIC_PLASTIC_NLP_FAILURE
$ MID RO E PR SIGY ETAN R HLCID
1 7.830E-09 2.070E+05 0.28 0.0 0.0 -0.864 200
$ IDY EA COE ICFLD
891

*DEFINE_CURVE_FLC
$ LCID, TH, N

```

```
891,1.5,0.159
$ DP600 NUMISHEET'05 Xnbr, Power law fitted
*DEFINE_CURVE
200
0.000,395.000
0.001,425.200
0.003,440.300
...
```

- 4. For aluminum sheets, \*DEFINE\_CURVE can be used to input the FLC for the variable 'ICFLD' in \*MAT\_TRANSVERSELY\_ANISOTROPIC\_ELASTIC\_PLASTIC\_NLP\_FAILURE.
- 5. This feature is available in LS-DYNA Revision 61435 and later releases.

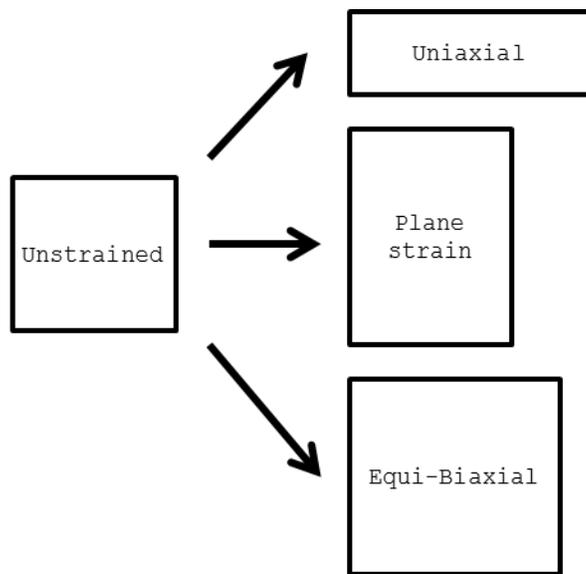


Figure 0-1. A single shell element strained in three linear strain paths

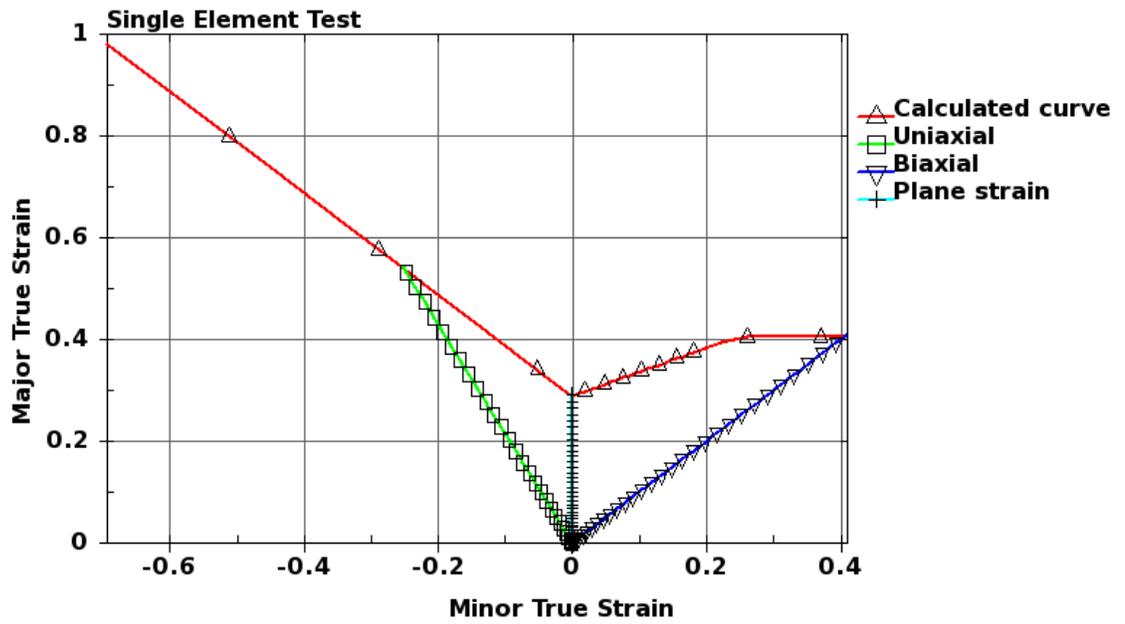


Figure 0-2. Validation of the FLC defined by this keyword

**\*DEFINE**

**\*DEFINE\_CURVE\_FLC**

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