1. General Features:

- Consideration of scattering by non-linear averaging (no arithmetic averaging)
- No serial evaluation of tests required, all parameters are identified simultaneously
- Adaptation to load states and load ranges controllable by assignment of weights
- Parameters can be hold at a fixed value during the parameter fitting. Dependent on the present measurement types *FEMCard Basic* makes a pre-selection of parameters that should be held fixed during the fittings.

For all material laws the following test types are available:

- Uniaxial tension / pressure
- Biaxial tension / pressure

The test type "simple shear" is also available for the majority of material laws.

For all test types loads with any load history may be used.

Examples: change of load direction (e.g. from tension to compression), experiments with unloading, cyclic loading, relaxation tests, creep tests.

Considering the tensile tests the transverse strain, if being measured, can be taken into account for all material models. Thus, the parameters that describe the compressibility (change in volume) of the material are also determined.
Note: Regarding the material laws for which shear tests can be read in, the compressibility can be also determined by combining shear tests with tensile tests (without transverse strain).

Biaxial tests do not need to be equibiaxial tests and therefore can have different stress combinations in the two loaded directions.

2. Examples:

With the above mentioned features *FEMCard Basic* offers a very high range of possibilities to determine material parameters for given applications.

Below some application examples and the opportunities by using *FEMCard Basic* are described:

2.1. Hyperelasticity

Often incompressibility is assumed when determining material parameters for hyper elasticity (Neo-Hooke, Mooney Rivlin, Ogden). But if it is not known for

sure that the material is incompressible, the parameters for compressibility have to be determined. With the consideration of transverse strain in the tensile tests FEMCard Basic can identify the parameters for compressibility.

2.2. Viscoelasticity

Often for time-dependent material models such as e.g. viscoelasticity a parameter set for short- and long-term exposure is required. For this purpose, e.g. test data from tensile tests at slow strain rates can be combined with tensile test data at high strain rates (crash) for the identification of a valid parameter set for all strain rates in between. However, also relaxation tests and creep tests can be included in the parameter identification process.

2.3. Von Mises plasticity

For most FEA solvers material parameters for von Mises plasticity are the elastic constants and a table with the yield stresses versus the corresponding (equivalent) plastic strain. After the parameter determination these material parameters are automatically exported by *FEMCard Basic.* If in the tensile or compressive tests lateral strains have been measured, in addition to determining the Poisson's ratio it can also be checked whether the Mises yield criterion is valid for this material. Moreover, based on testing of (elastic) unloading the elastic moduli can be identified even with already existing plastic strains.

2.4. Von Mises Viscoplasticity

The Cowper-Symonds or Power Law model implemented in *FEMCard Basic* can be used both for simulation of crash, as well as for long-term loads (creep and relaxation). Often the material parameter determination should be carried out by incorporating several tests with different time and load ranges. As *FEMCard Basic* can process loads of any load history for all types of tests, *FEMCard Basic* is the ideal tool to meet these requirements.

2.5. Hill- (visco) - plasticity

As the Hill-plasticity (1948) is not only the default material model in the field of sheet metal forming, but can also be used for many other anisotropic materials, this model was implemented in the first version of *FEMCard Basic.* The special features of *FEMCard Basic* for this material model are:

- Parameters can be identified for orthotropy or transverse isotropy
- By considering the assigned measurement types *FEMCard Basic* makes a pre-selection of parameters that should be kept fixed during the fitting.

- Determination of a plastic hardening curve which is equally well fitted to all the experiments in all measured load directions.
- The Cowper-Symonds or power law model can be used both for simulation of crash, as well as long-term loads (creep and relaxation)
- Based on testing of (elastic) unloading the elastic moduli can be identified even with already existing plastic strains
- If in the tensile or compression tests the respective transverse strains are considered, in addition to determining the Poisson's ratio it can also be checked whether the Hill yield criterion is valid for this material.