1. Introduction

The aim of extensive weight reduction in car design leads on the one hand to the use of lighter materials. But - on the other hand it leads to the increased exploitation of traditional materials. - This trend can be detected in body and trim features, steering systems,, in running gear and drive components. When using alternative materials it should be borne in mind, that alongside the often many-sided aspects of function and reliability, economy frequently has a decisive influence. Fig. 1 compares the weight of cars in the past with future trends. By far the greatest part of vehicle's weight in 1984, left hand side, consists of steel and cast iron, followed by plastics and aluminium. The bar graph on the right hand side shows the estimated shifts in each material's percentage of the total weight. The proportion of steel, which was 60 % in 1984, will decrease to app. 45 % by the year 2000. The proportion of cast iron, on the other hand, will hardly change. A growth of between 5 and 8 % in the amount of plastics used can be expected. It will also be possible to achieve considerable weight reductions in running gear and drive components by development of fibre compound materials. The same applies to the increased use of aluminium, the proportion of which will rise from app. 3 % in 1984 to app. 10 % in the year 2000.

2. Advantages of new materials and material selection criteria

In order to oust long-established materials such as steel and cast iron from components, so-called new materials will have to offer considerable technical and economic advantages:
When developing new running gear and drive-line components, the designer must always ask himself what is the most suitable material. Uncritically adopting the material data from a preceding model or competitor’s component is in general no way to make progress. In the case of front axle, steering system and drive components, the main aspect is that of safety. The following guidelines govern the dimensions and choice of materials for safety-critical components. Firstly: Fractures must not occur at any time throughout the car’s service life, even when subjected to extreme operating loads. And secondly: When overloaded as a result of an accident or abuse the components must deform plastically to a measurable level, so that the correctness of the dimensioning can be confirmed at any time. Some material selection criteria are listed:

- Technically important properties
  - Static and dynamic strength
  - Resistance to wear
  - Toughness
  - Thermal properties
  - Processing properties
  - Corrosion resistance
  - Suitability for checking
- Costs
- Availability
- Suitability for recycling

3. Tests results
In the following test-rig results achieved with four parts made of various materials are described:
- control arm: steel and aluminium
- steering shaft: steel, aluminium and fibre reinforced plastics
- connecting rod: steel and fibre reinforced plastics
- propshaft: steel, aluminium and fibre reinforced plastics.

On account of varying mechanical and physical material properties, it is only possible in a few exceptional cases to replace existing standard components of a material such as steel with aluminium or fibre compound components without having to modify the whole system. In most cases, limited space available for the steel component is not sufficient for the larger aluminium or fibre compound component. For this reason, it is only possible to use the new materials efficiently for particular structural purposes, as an intelligent design. An intelligent design - in particular with regard to parts integration - suits the material and has to be created in the pre-development stage.

3.1 Control arm
The first example deals with the front control arm. It illustrates the experiments required to replace the standard steel control arm on the BMW 3-series with an aluminium one, the assembly is shown in fig. 2. The main aim of these experiments is to reduce the weight of the front axle. There is no doubt, that the aluminium control arm has to meet the same requirements in terms of static and dynamic strength as those on the