Vehicle Dynamics, Expo 2009

DELPHI

Effective materials usage and materials properties utilization in automotive damper design

Speaker: Tomasz Pabin

Sebastian Kaffanke

Sławomir Dzierżek

PRESENTATION PLAN

- TECHNICAL CENTER KRAKOW – BASIC INFORMATION
- LOW MASS DAMPER DEVELOPMENT – GENERAL ASSUMPTIONS
- MATERIALS SELECTION
  - NEW MATERIALS – PROFITS
  - COMPLETE ALUMINUM MONOTUBE FOR SHOCK ABSORBERS
- MATERIAL USAGE OPTIMIZATION

  - VARIABLE WALL THICKNESS OF A TUBE

  - SPRING SEAT DESIGN ANALYSIS
- WELDLESS SOLUTIONS

  - BENEFITS

  - WELDLESS SOLUTIONS – PLASTICS PARTS
- WELDLESS TWIN TUBE MADE OF ALUMINUM ALLOYS
- SUMMARY

TECHNICAL CENTER KRAKOW

From 2000 till 2009
Global Passive Damper and Module Development Centre

SPECIFIC ENGINEERING CAPABILITIES

- Application Engineering (full PDP cycle from RFQ to SOP)
- Technology Development and Competitive Analysis
- CAE & Advanced Engineering Analysis
- Ride Development and Valving Systems Development
- Verification and Validation Testing
- Prototyping
- Industrial Engineering, Capacity Planning, Capital Management

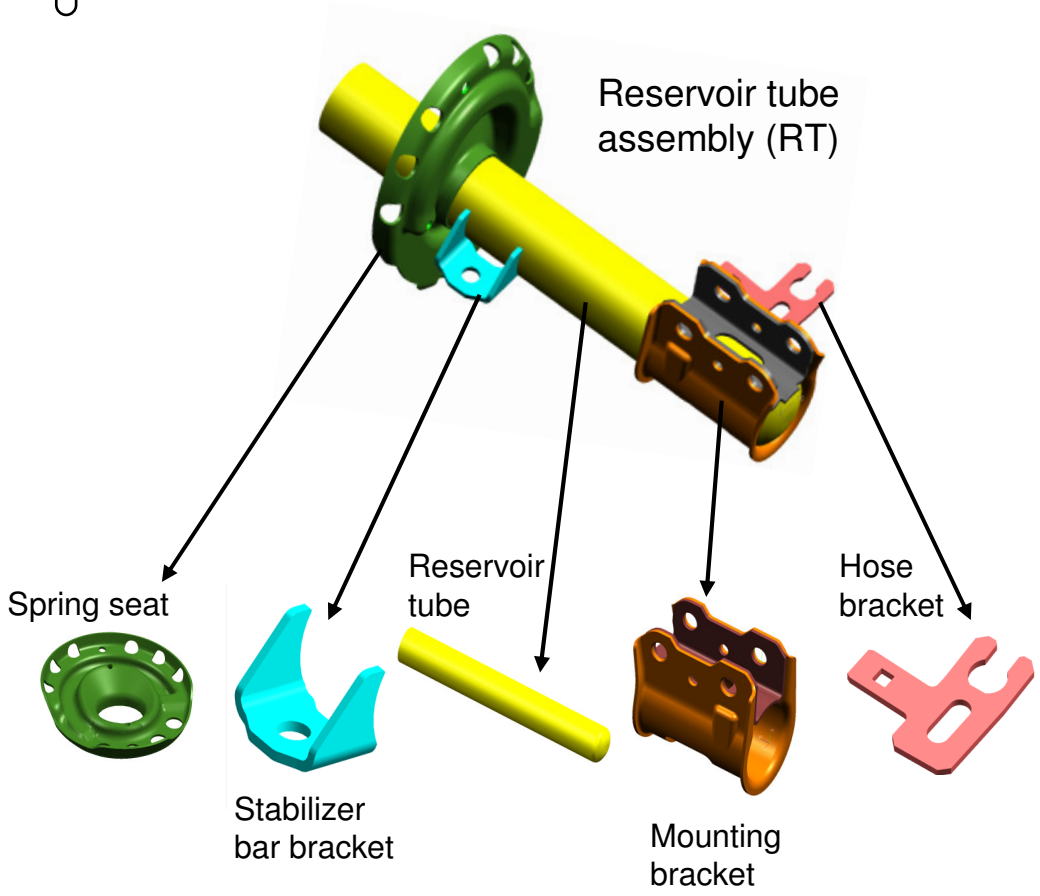
MATERIAL SELECTION

DELPHI APPROACH ⇒ **Effective - Applicable**

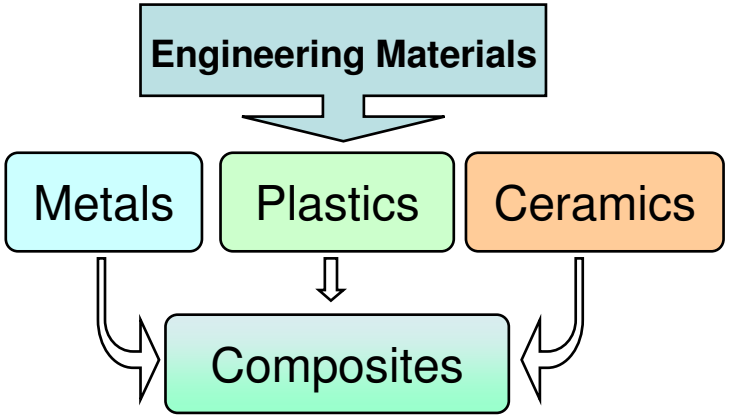
Low Mass Damper Concept

Alternative materials ⇔ New Designs

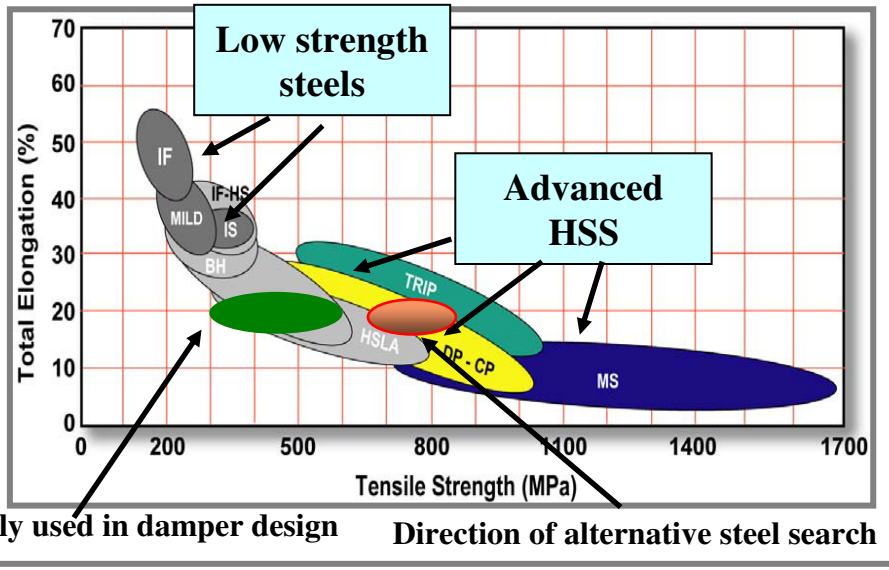
Manufacturing



MATERIALS SELECTION



Alternative to traditional deep draw steel



Why do we use aluminum alloys?

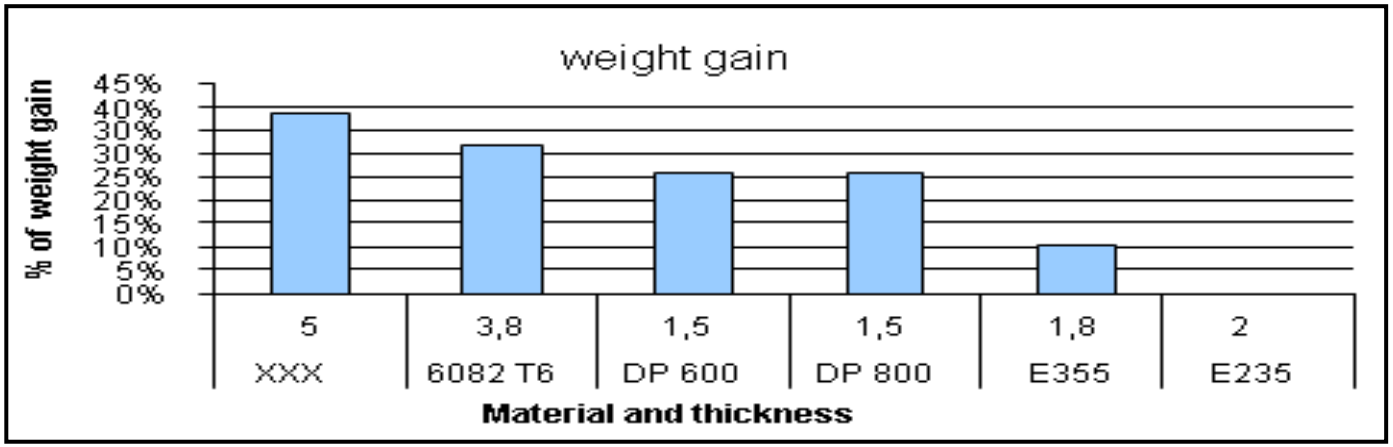
- Very good mass to strength ratio
- 65 % lower density than steel
- Weldless design used in DELPHI product
- Very good corrosion resistance
- Wide range of grades

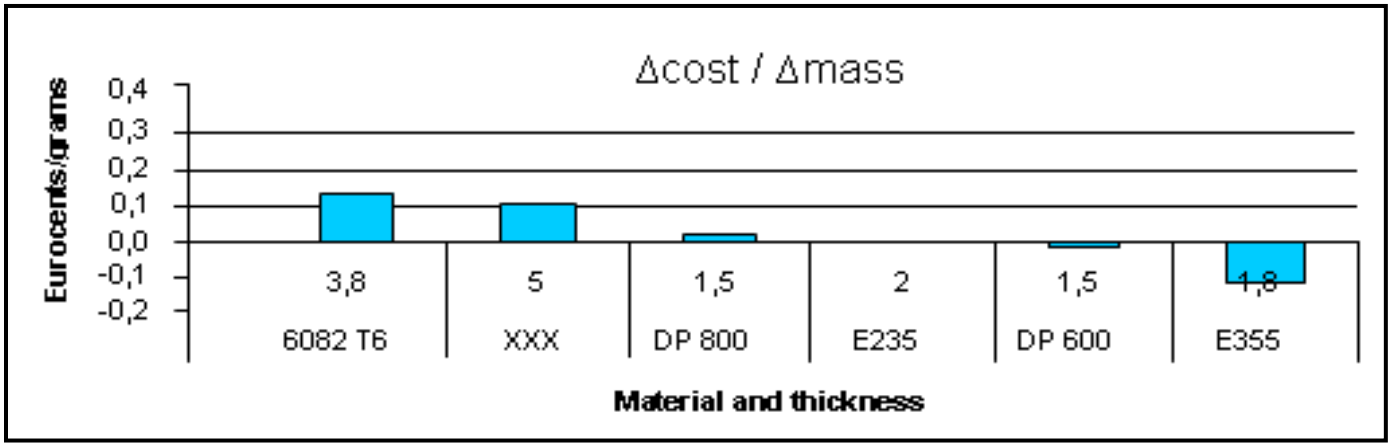
Why do we use plastics ?

- Adequate for mass production
- Non-corrosive
- Adequate for parts with complicated shape
- Wide range of grades
- Available on the global market

NEW MATERIALS – PROFITS

New Materials for Damper Reservoir Tube – Potential Profits

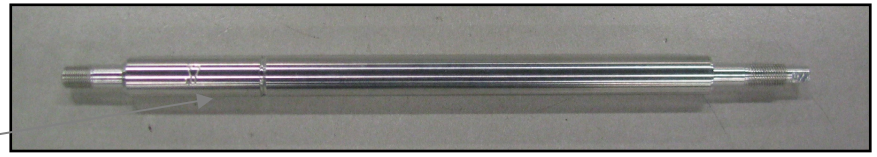




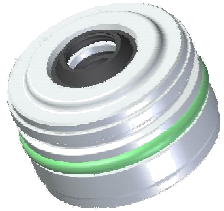
The goal was to find such wall thickness to get better or the same Max Bending moment as on E235 dia 50x2mm

COMPLETE ALUMINUM MONOTUBE FOR SHOCK ABSORBERS

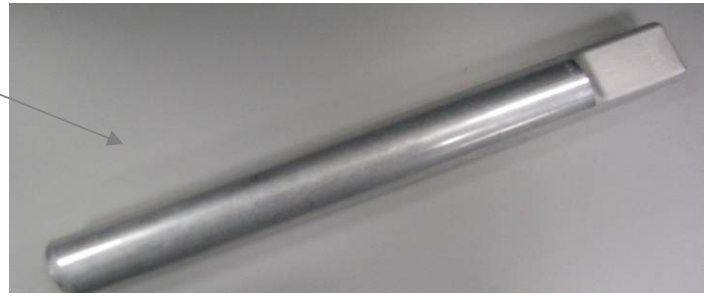
Steel standard design



Aluminum Piston Rod



Aluminum Rod Guide



Aluminum Tube

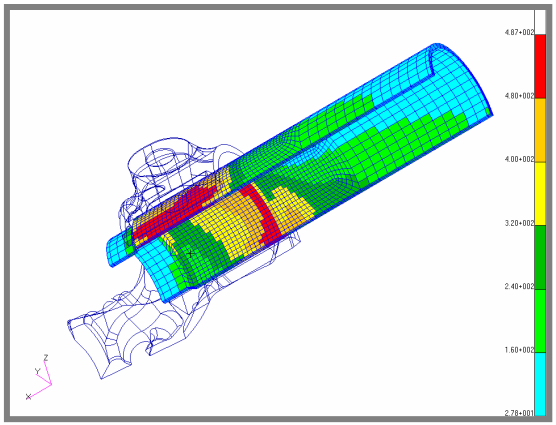
Total mass reduction 50%

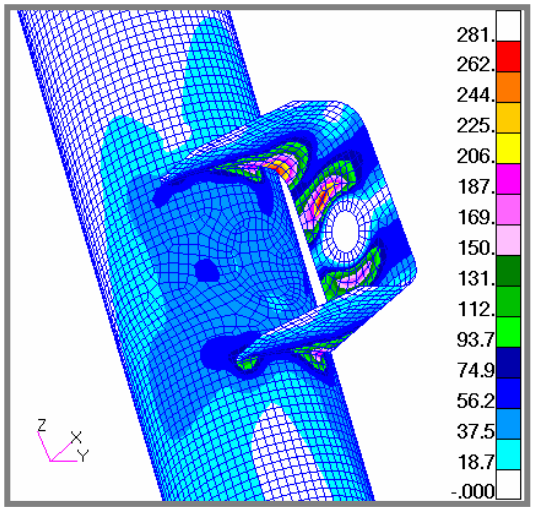
Aluminum design

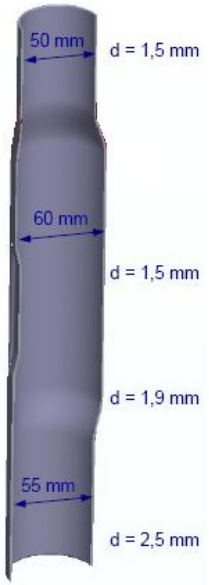
MATERIAL USAGE OPTIMIZATION

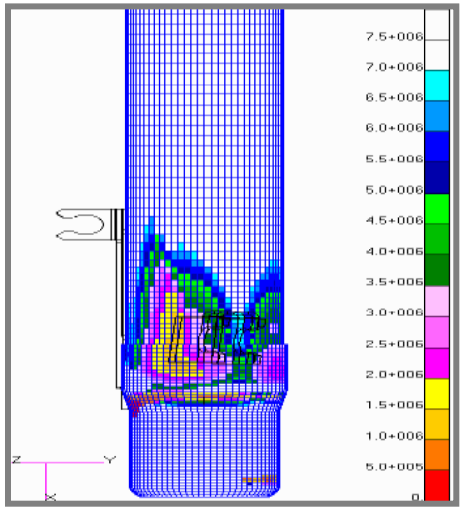
VARIABLE WALL THICKNESS OF THE RESERVOIR TUBE

RT FEA stress analysis

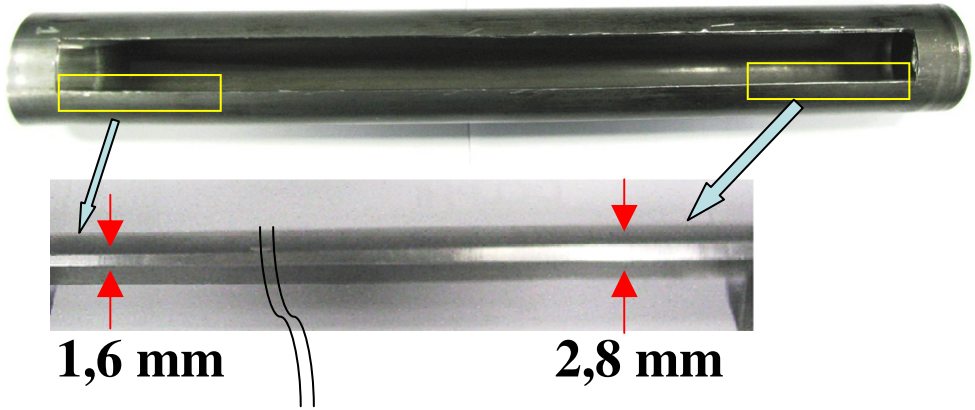




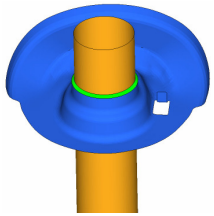




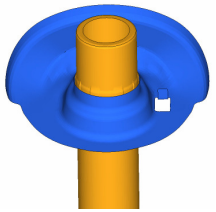
Reservoir tube with VWT, ΔM ≈20%

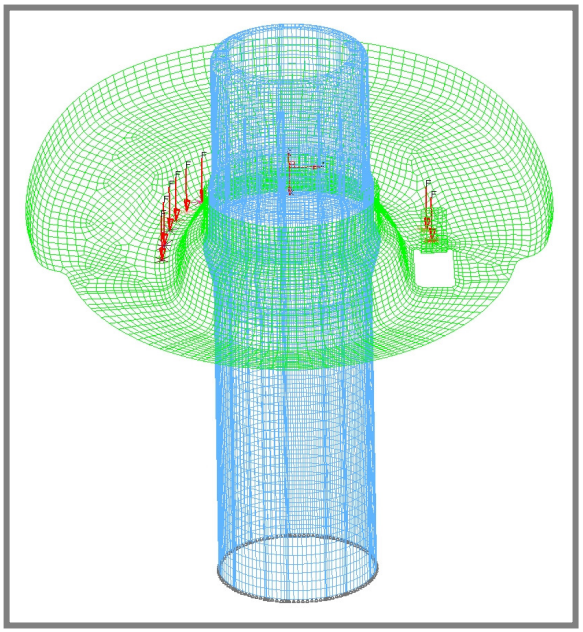


SPRING SEAT DESIGN ANALYSIS



Welded against Press-Fit





	Material	Min. Thickness [mm]	Fatigue life
Welded spring seat	S315MC	2,18	306 000
	S355MC		472 000
	S420MC		839 000
	S315MC	2,38	55 000
	S355MC		850 000
	S420MC		1 650 000
Press-fit spring seat	S315MC	2,18	536 000
	S355MC		879 000
	S420MC		1 700 000
	S315MC	2,38	1 750 000
	S355MC		3 330 000
	S420MC		7 820 000

Conclusion:
Weldless solution may lead to mass reduction of the spring seat and reservoir tube.

WELDLESS SOLUTIONS - BENEFITS

BENEFITS

Corrosion resistance

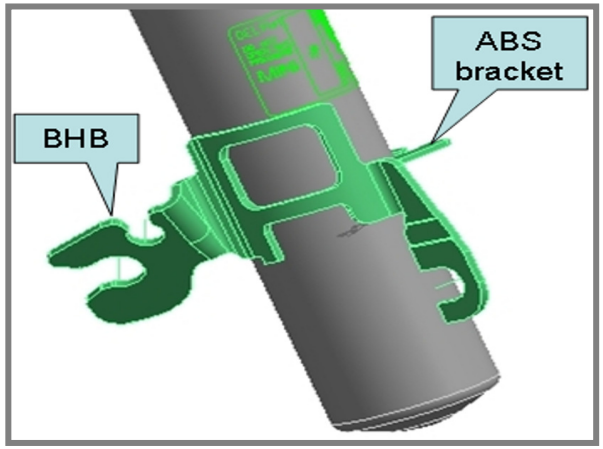
- lack of carbon black contamination and superficial oxides → easier washing
- lack of welding spatters → avoidance of problems at interfaces

- better tube strength in the spring seat and brackets area→ avoidance of material weakening due to internal stresses (thermal and microscopic)

- flexible and easy to assembly design → logistic, transportation
- process parameters control → manufacturing aspect
- lack of additional materials: welding wire, technical gas → commercial aspect

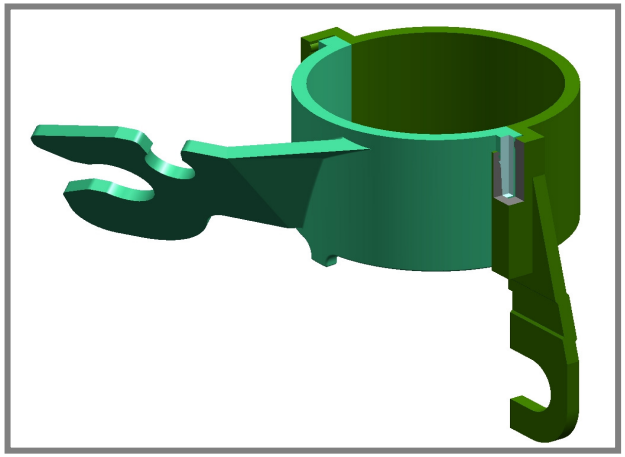
WELDLESS SOLUTIONS – PLASTIC PARTS

Welded steel bracket

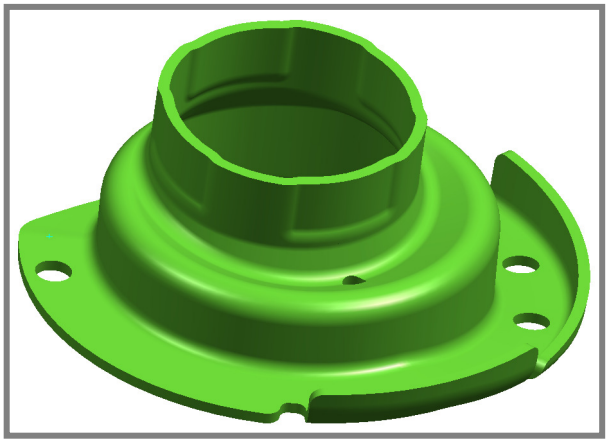


50 %
mass reduction

Plastic brackets

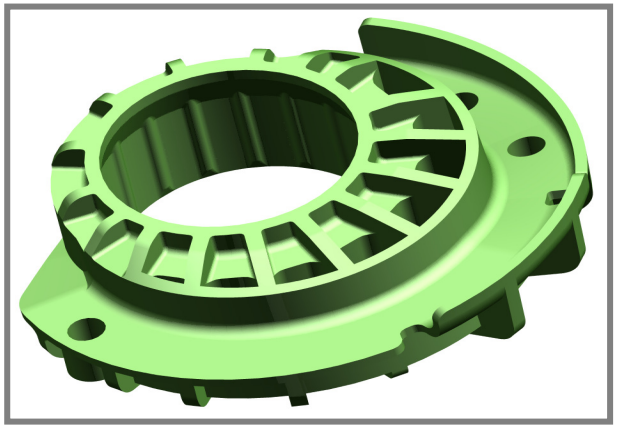


Steel Spring Seat

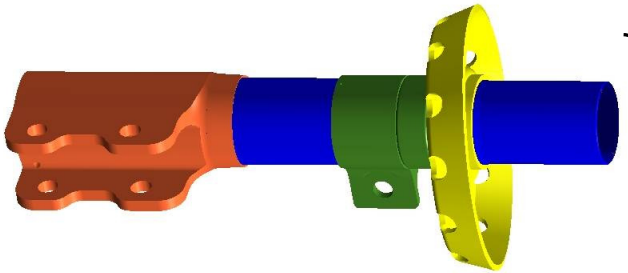


50 %
mass reduction

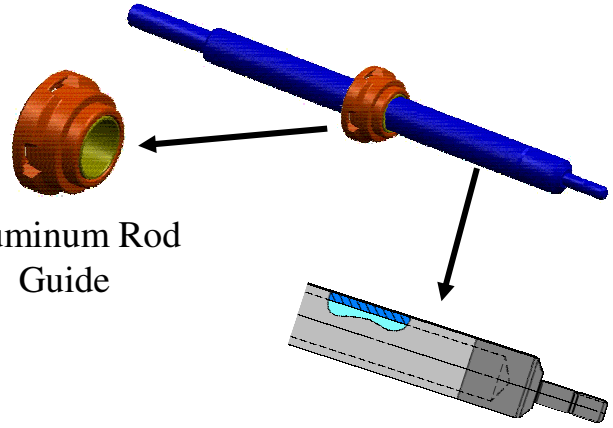
Plastic Spring Seat



WELDLESS TWIN TUBE MADE OF ALUMINUM ALLOYS



Aluminum weldless design



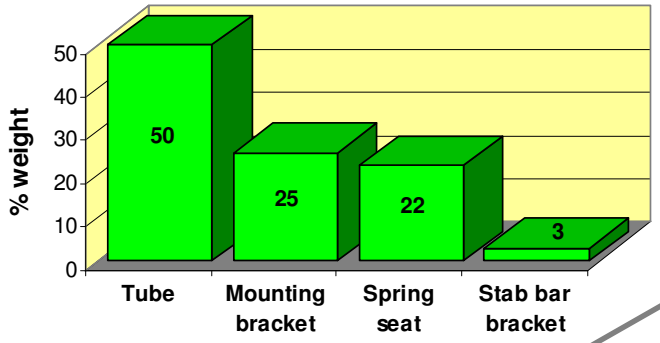
Aluminum Rod Guide

Hollow rod

Total mass reduction 44%

SUMMARY

Typical RTA weight breakdown



TYPICAL RESERVOIR TUBE ASSEMBLY

SPRING SEAT
Proposed material:
- Aluminum (-40%)
- High strength steel (-30%)
- Plastic (-50%)

SBB BRACKET
Proposed material:
- High strength steel (-35%)

TUBE
Proposed material:
- Steel, variable wall thickness (- 20%)
- Aluminum (-35%)
- High strength steel (-25%)

MOUNTING BRACKET
Proposed material:
- High strength steel (-30%)
- Aluminum (-35%)

OTHER BRACKETS
Proposed material:
- Plastic (-50%)