



AUTOMOTIVE

INFOCOM

**TRANSPORT &
ENVIRONMENT**

AERONAUTICS

SPACE

**DEFENCE &
SECURITY**

Mass Analysis - An Important Discipline of the "Luftfahrttechnisches Handbuch" (LTH)

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iABG



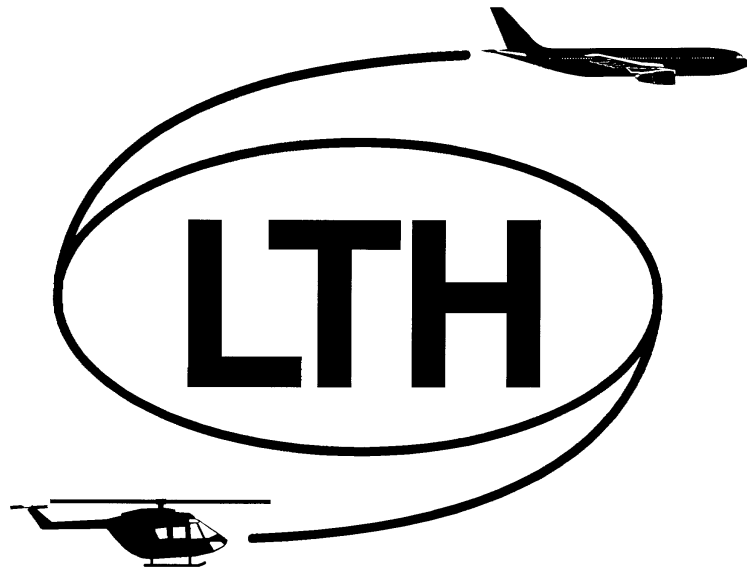
Aeronautical Engineering Handbook



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Luftfahrttechnisches Handbuch

Disciplines / Volumes:



AD	Aerodynamics
AT	Propulsion Technology
BM	Loads
FL	Composite Design Criteria
FV	Flight Test Engineering
MA	Mass Analysis
HSB	Structural Analysis
SE	Systems Engineering



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LTH is a Tool for Engineers and Students

in:

- Industry
- Institutions
- Authorities
- Universities

to:

- Specify
- Design
- Develop
- Verify
- Qualify
- Certify
- Analyse

of:

- Aeronautical Vehicles
- Systems
- Engines
- Equipment



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Aims and Benefits of LTH

Aims

- Standardisation of Procedures and Methods
- Summarize Knowledge centrally and searchable
- Rationalise by Generic Acceptance of Verification Process
- Expert Tools

Benefits

- Optimized and accelerated Development
- Standardised Basis for Authorities and Suppliers
- Reduced Effort during Type Certification
- Papers Approved by Working Committee
- Efficient Networking between members and partners

Outlook

- Continuous Enhancement of Knowledge, also by new Members
- Internationalisation by English Language
- Focusing of Papers and Calculation Software by current Questions
- Update of existing Papers as applicable



Background of LTH

Foundation

- Founded in 1969 as Working Groups
- Cooperation between Industry, Authorities and Research Organisations
- Funded by Industry and Authorities

Organisation

- Coordination Committee as Advisory Board
- Coordination Center, Management and Publication, Funding and Promotion
- Eight Working Groups:
 - Aerodynamics
 - Propulsion Technology
 - Loads
 - Composite Design Criteria
 - Flight Test Engineering
 - Mass Analysis
 - Structural Analysis
 - Systems Engineering

Publication

- Until 2002 Printed Publication with regular Updates
- Since 2002 completely digitised
- Published on CD with PDF-Files and comfortable Search Functionalities
- Calculation Software on CD
- Membership Area on Homepage



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LTH Stakeholders

Cooperation

- Active Cooperation of Aerospace Companies, Institutions, Universities and Authorities
- Cooperation focused on the disciplines of the respective working groups
- Edition of technical reports and presentations
- Establishing and maintaining of networking between the partners

Major Industry Contributors

- | | | |
|----------------------|----------------------|---------------------|
| • Airbus Operations | • IABG | • Rolls-Royce D |
| • Astrium | • Liebherr Aerospace | • RUAG |
| • Cassidian | • Lufthansa Technik | • SAAB |
| • Diehl | • MT Aerospace | • Stork Fokker AESP |
| • Elbe Flugzeugwerke | • MTU Aero Engines | • Zeppelin LT |
| • Eurocopter D + F | • Pilatus | |
| • Grob Aircraft | • Premium Aerotec | |

Institutions

- DLR (Gö, BS, K, S)
- NLR
- Universities, e.g. of BS, HH, M, S, Da, Delft,...

Authorities

- EASA / LBA
- WTD61 - ML (=GE OTC)
- NL in DIN



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Application of LTH

Civil Applications

- Airbus A 300, A 310, Beluga
- Airbus A 320, A 318, A 319
- Airbus A 330, A 340
- Airbus A 380, A 380 F
- Airbus A 350
- Dornier Do 228, Do 328
- Dornier Do 728 (Development)
- Pilatus PC-6, PC-12
- MBB Bo 105
- Eurocopter EC 135
- Eurocopter EC 145
- IAE V 2500
- Rolls Royce BR700, Tay, Spey, Dart
- Saab 340, Saab 2000
- P&W (MTU) PW 6000, PW 7000, PW 8000

Military Applications

- Airbus A 400 M
- Eurofighter EF 2000
- Panavia Tornado
- Saab Gripen
- Dornier Alpha-Jet
- Eurocopter NH 90
- Eurocopter Tiger
- Grob Strato 2C
- Pilatus PC-7, PC-7 MkII, PC-9, PC-21
- Cassidian UAVs (Barracuda, Talarion)
- Eurojet EJ 200
- Turbo Union (MTU) RB 199
- EPI (MTU) TP400-D6
- MTR (MTU) MTR 390

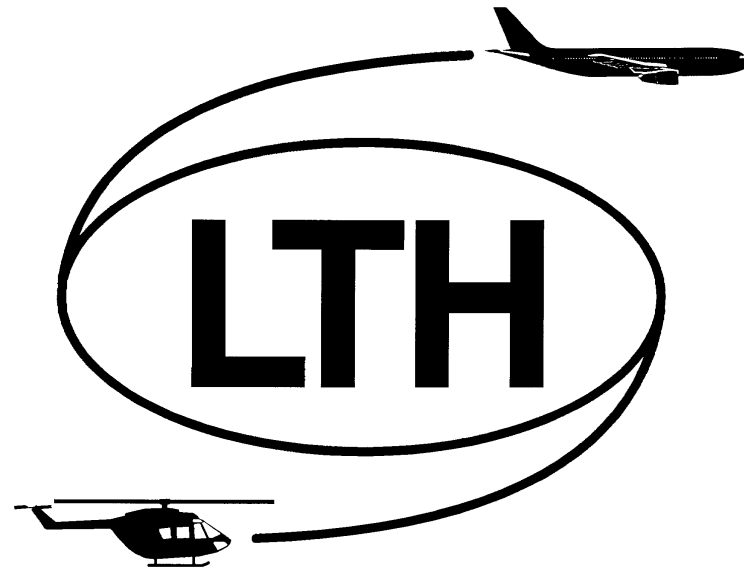


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Part II: Discipline / Volume Mass Analysis (MA)



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Discipline / Volume Mass Analysis (MA):

0. Introduction
1. Basic Principles (except from Mass Analysis)
2. Methodology of Mass Analysis
3. Mass Control (Methodology and Basic Principles of Mass - Recording, - Control, - Tracking)
4. Total Mass (in different load status)
5. Structure
6. Propulsion System
7. Equipment (Standard Equipment, Special Equipment, Mass Deflections)
8. Payload
9. Others / Miscellaneous



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Discipline / Volume Mass Analysis (MA):

Dedicated examples of representative current reports of the volume "Mass Analysis":

- Moment of inertia with respect to a user-defined axis of rotation (MA 114 00-03)
- Mass and Centre of Gravity Forms for Military Aircraft (MA 211 11-01)
- Mass Main Groups and Terms of Mass, Comparison of different Mass Standards (MA 212 00-04)
- Comparison of Mass Standards, Mil-Std-1374A (USA.) vs. AIR 2001/C (France) (MA 212 00-05)
- Mass Breakdown for Cost Estimation of Aircraft, AMPR-Mass Estimation based on Mass Breakdowns according to different Mass Standards (MA 212 00-09)
- Mass Influence Coefficient (MA 230 00-02)
- Definition of an AECMA-Cost-Weight and definition of AECMA-Cost-Hours for aircraft manufacture (MA 240 00-04)



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Discipline / Volume Mass Analysis (MA):

Dedicated examples of representative current reports of the volume "Mass Analysis":

- Tolerances between calculated and weighed parts (MA 300 00-12)
- Different kind of weighing procedures and possible occurring errors (MA 311 00-04)
- Weighing of semi-rigid and rigid airships (MA 311 19-01)
- Effective moment of inertia of fuel in fighter aircraft (MA 323 00-03)
- List of Micro and Mini fixed wing UAV (MA 400 17-02)
- List of Micro and Mini rotary wing UAV (MA 400 17-03)
- Large Civil Jet Transport (MTOM > 40t), Statistical Mass Estimation (MA 401 12-01)
- Comparison Operating Mass Empty vs. Max. T.O. Mass, Transport Aircraft (MA 403 12-01)

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Discipline / Volume Mass Analysis (MA):

Dedicated examples of representative current reports of the volume "Mass Analysis":

- Specific Structure Mass vs. Year of first Flight, Ultimate Load Factor and maximum Mach-Number - Fighter and Trainer Aircraft (MA 500 11-01)
- Comparison Structure Mass without Undercarriage vs. Max. T.O. Mass, Transport Aircraft (MA 500 22-01)
- Comparison Structure Mass without Undercarriage vs. Operating Mass Empty, Transport Aircraft (MA 500 22-02)
- Comparison Wetted Area (Total) vs. Structure Mass without Undercarriage, Transport Aircraft (MA 500 22-03)
- Comparison Area Load (Total) Structure without Undercarriage / Wetted Area (Total), Transport Aircraft (MA 500 22-04)
- Wing: Statistical Mass Estimation of Landing Flaps, Transport Aircraft (MA 501 52-03)
- Comparison Fuselage Gross Area vs. Fuselage Mass, Transport Aircraft (MA 508 12-03)
- Comparison Area Load (Fuselage) Fuselage Mass/ Fuselage Gross Area, Transport Aircraft (MA 508 12-04)



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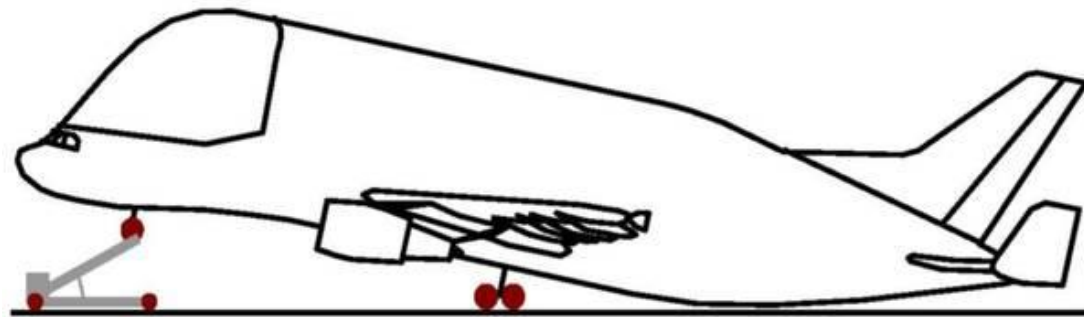
Discipline / Volume Mass Analysis (MA):

Dedicated examples of representative current reports of the volume "Mass Analysis":

- Turbine Engine and Nacelle, Transport Aircraft, Mass-relevant Data (MA 600 12-02)
- Engine Mass Estimation in the Predesign Phase (MA 600 22-01)
- Engine Internal Rotorburst Analysis (MA 600 90-01)
- Engine Mass Estimation in the Predesign Phase (MA 601 00-02)
- Thrust Reverse, Mass Relevant Data (MA 601 59-01)
- Considerations at the "More Electric Aircraft" Concept (MA 700 19-01)
- Mass estimation of Fuel Cell Systems (MA 700 19-02)
- Aircraft Gun - Fighter and Trainer Aircraft - Mass-Relevant Data (MA 707 51-01)
- Deceleration Chute Group - Military Aircraft - Statistical Mass Estimation (MA 712 21-01)
- Arresting Gear in Arresting Gear Group (MA 712 21-02)
- Wing and fuselage pylon, fighter aircraft and trainer, mass data (MA 817 11-01)
- Weapons Provisions, Pylons, Mass-relevant Data (MA 818 21-01)

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Discipline / Volume Mass Analysis (MA):



© Airbus Operations

Weighing of Airbus "Beluga"

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Discipline / Volume Mass Analysis (MA):



© Fokker

Weighing of Fokker 70 Nose and Main Landing Gear Platform



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Discipline / Volume Mass Analysis (MA):



Weighing of Eurocopter EC145

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Discipline / Volume Mass Analysis (MA):



Weighing of Eurocopter EC145

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