

# BASELINE FÜR EIN ZUKÜNFTIGES REGIONALFLUGZEUG

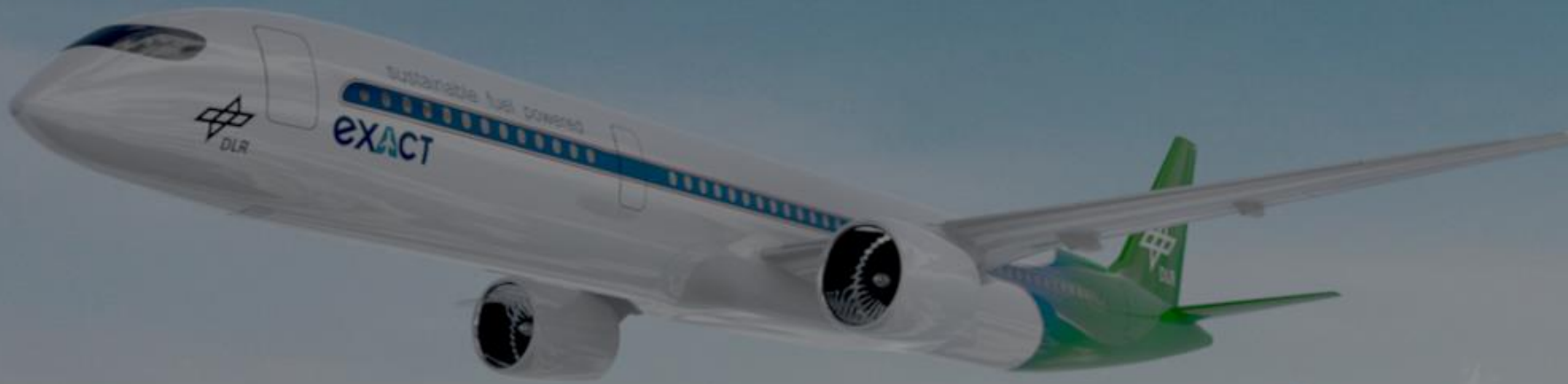
Nicolas Schneiders<sup>1</sup>, S. Müller<sup>1</sup>, G. Atanasov<sup>1</sup>, T. Zill<sup>1</sup>

<sup>1</sup>DLR Institut für Systemarchitekturen in der Luftfahrt

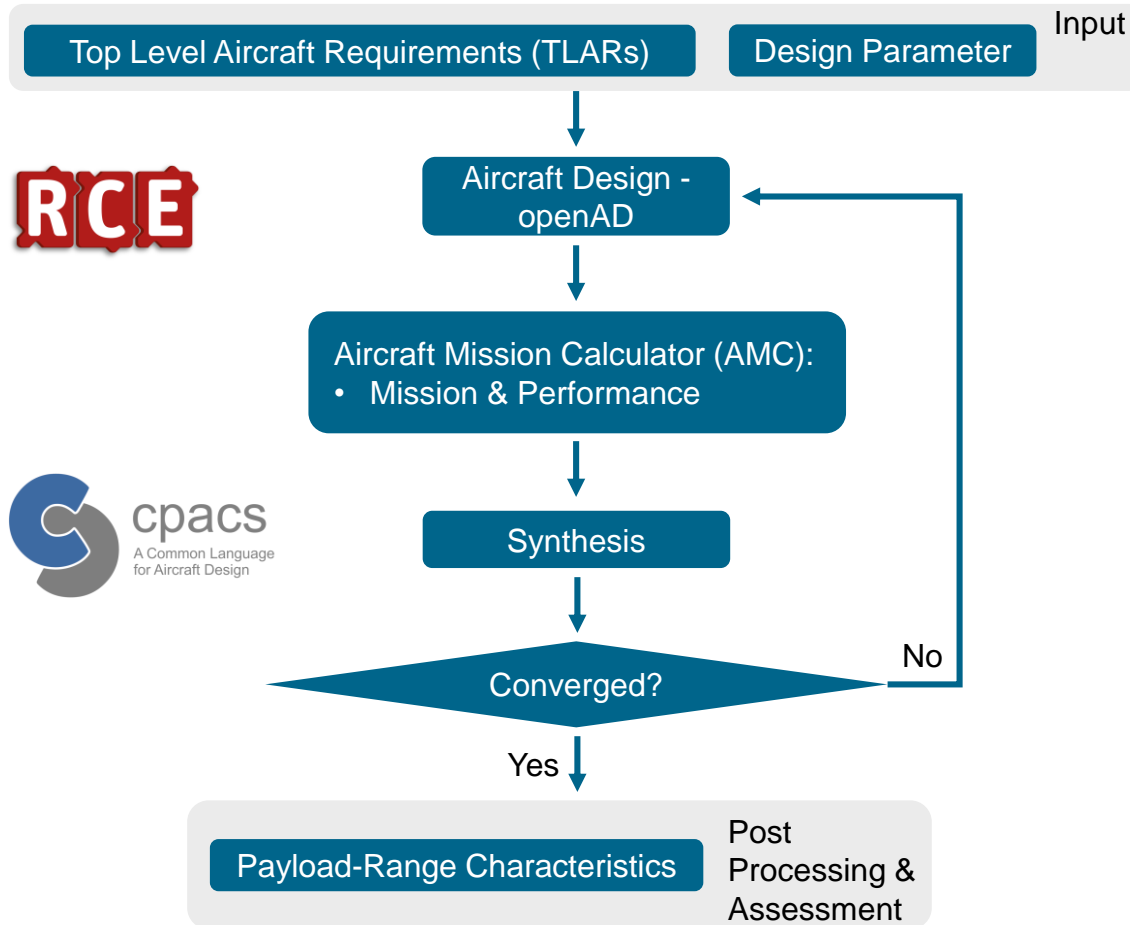
Deutscher Luft- und Raumfahrtkongress 2024, Hamburg







# Methodology & Terminology



## Reference

- Existing aircraft
- Used for calibration of the workflow

## Baseline

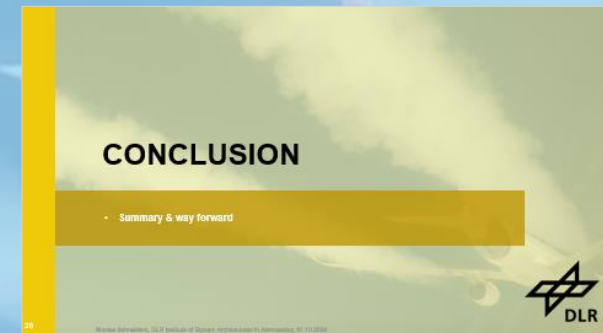
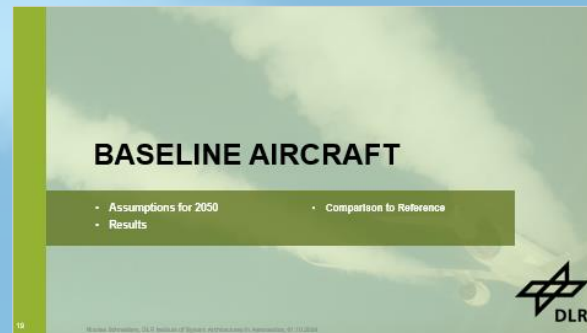
- Evolutionary advancement of the reference based on technology assumptions
- Usage of calibrated workflow

# BASELINE FÜR EIN ZUKÜNFTIGES REGIONALFLUGZEUG

Nicolas Schneiders<sup>1</sup>, S. Müller<sup>1</sup>, G. Atanasov<sup>1</sup>, T. Zill<sup>1</sup>

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Deutscher Luft- und Raumfahrtkongress 2024, Hamburg



# REFERENCE AIRCRAFT (ATR42-500)

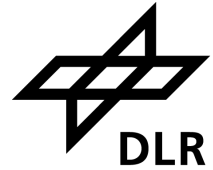
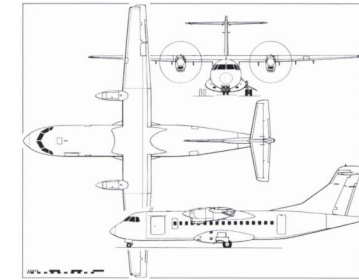
- Geometry
- Mass breakdown
- Performance



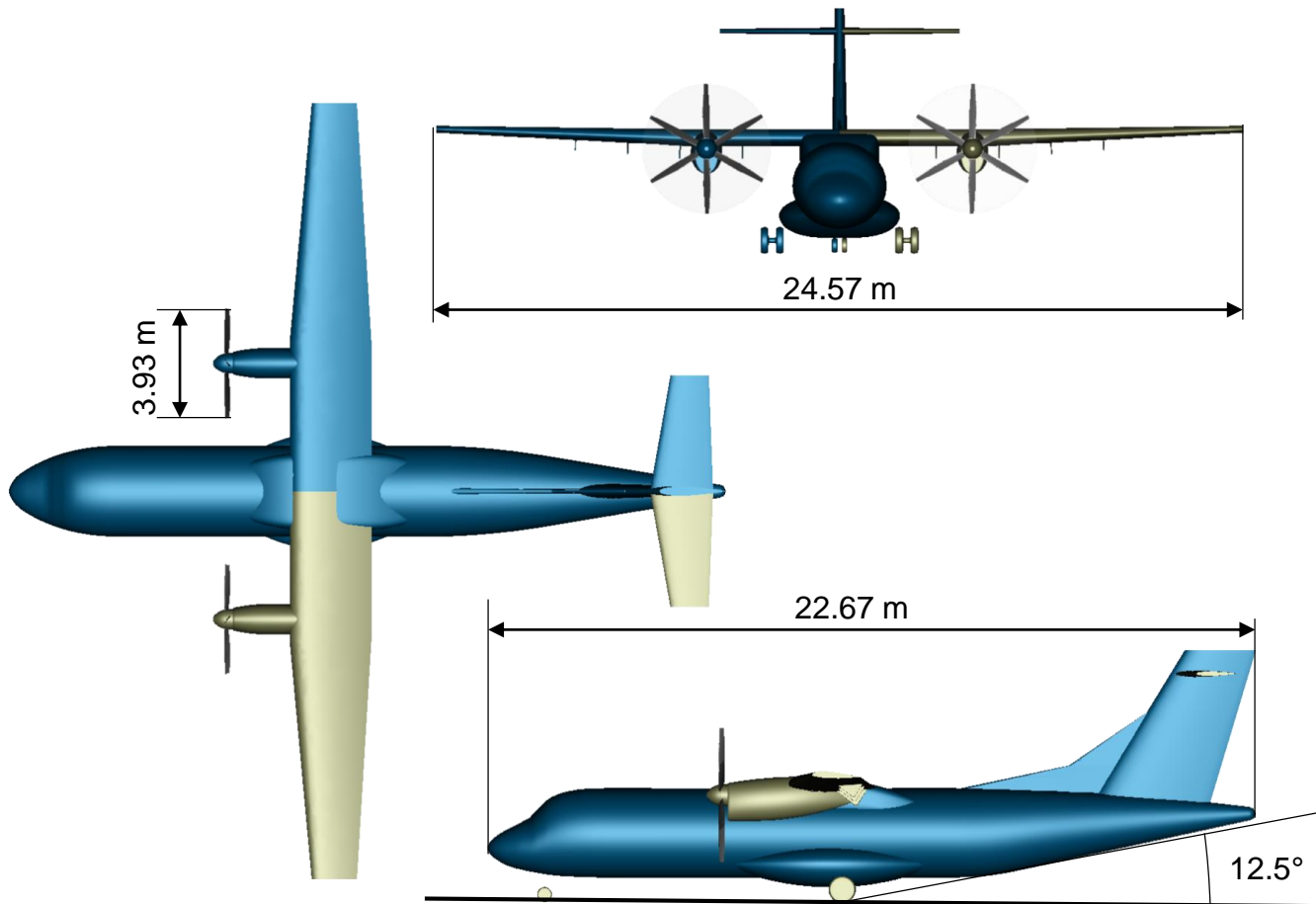


# Reference Aircraft: ATR 42-500

## - Geometry



Jane's All the World's Aircraft



Parameter	Unit	Value
Wing root chord	m	2.57
Wing aspect ratio	-	11
Wing area	m <sup>2</sup>	54.5
Fuselage width	m	2.87
Wheel track	m	4.1
HTP span	m	7.31
HTP area	m <sup>2</sup>	11.73
VTP area	m <sup>2</sup>	12.48



# Reference Aircraft: ATR 42-500

## - Profound data are available in literature



Jane's All the World's Aircraft

Geometry

GENERIC DATA OF TRANSPORT AIRCRAFT

ATR -42			
Item	Weight/kg	% MTOW	
Wing	1565	9.59	
Wingtip	209		
Horizontal tailplane	220		
Vertical tailplane	122		
Landing gear	534		
Engine nacelles	366		
Flight controls	195		
<b>Structure</b>	<b>3768</b>	<b>23.84</b>	
Developed engines	1212		
Engine controls	37		
Engine maintenance	10		
Fuel system	89		
<b>Propulsion</b>	<b>1342</b>	<b>8.34</b>	
Hydraulic generation	91		
Hydraulic distribution	50		
Air conditioning	287		
De-icing	75		
Fire protection	25		
Control Sensing	79		
Auto flight system	26		
Navigation	164		
Communication	94		
Electric generation	110		
Electric distribution	213		
<b>Systems</b>	<b>1414</b>	<b>8.76</b>	
Landing	865		
Oxygen	31		
Lighting	90		
Rotor installation	11		
<b>Avionics</b>	<b>977</b>	<b>6.05</b>	
<b>Manufacturer Empty Weight</b>	<b>8526</b>	<b>53.36</b>	
Ferry structure	45		
Passenger seats	122		
Other standard items	24		
<b>Standard items</b>	<b>461</b>	<b>2.88</b>	
<b>Delivery empty weight</b>	<b>8987</b>	<b>55.47</b>	
<b>Operational items</b>	<b>226</b>	<b>1.42</b>	
<b>Operational empty weight</b>	<b>10253</b>	<b>63.69</b>	
<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>	

Figure 42.24 - Weight breakdown ATR-42

Obert – Aerodyn. Design of Transport Aircraft

ATR 42-500

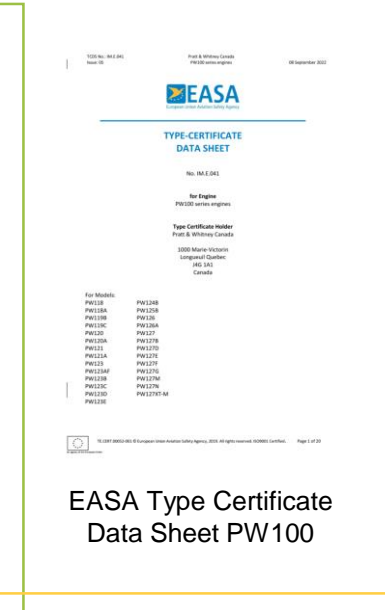
STANDARD CONFIGURATION	48 seats
Engines Pratt & Whitney Canada	PW127G/M
Take-off power	2,310 SHP
Take-off power - One engine	2,400 SHP
Max continuous	2,400 SHP
Max climb	2,360 SHP
Max cruise	2,132 SHP
Applicability Hamilton Standard	565E
Blades - diameter	6 - 3.73 m - 12.7 ft.
<b>Weights</b>	
Max take-off weight (basic)	18,400 kg - 41,005 lb.
Max landing weight (basic)	18,300 kg - 40,344 lb.
Max zero fuel weight (basic)	16,700 kg - 36,817 lb.
Max zero fuel weight (Option)	17,000 kg - 37,478 lb.
Operational empty weight (Tech. Spec)	11,250 kg - 24,802 lb.
Operational empty weight (Typical in-service)	11,500 kg - 25,355 lb.
Max payload (at typical in-service OEW)	5,500 kg - 12,125 lb.
Max fuel load	4,500 kg - 9,921 lb.
<b>Initial performance</b>	
Take-off distance	
- Basic - MTOW - ISA - SL	1,165 m - 3,822 ft.
- TOW for 300 NM - Max pax - SL - ISA	982 m - 3,224 ft.
- TOW for 300 NM - Max pax - 3,000 ft. - ISA +10	1,164 m - 3,818 ft.
Take-off speed (V2 min @ MTOW)	112 KCAS
Landing field length (EASA Air Ops)	
- Basic MLW - SL	966 m - 3,169 ft.
- LW (max pax + reserves) - SL	956 m - 3,137 ft.
- Reference speed at landing	154 KIAS
<b>Cruise performance</b>	
Optimum climb speed	160 KCAS
Rate of climb (ISA, SL, MTOW)	1,851 ft/min
Time to climb to FL370	12.7 min.
One engine net ceiling (95% MTOW, ISA +10)	12,010 ft.
Max Cruise speed (95% MTOW, ISA, Optimum FL)	300 KIAS - 556 mph
Fuel flow at cruise speed	811 kg/hr - 1,788 lb/hr
Range with max pax	703 NM
200 NM Block Fuel	514 kg - 1,137 lb.
300 NM Block Fuel	60 min.
300 NM Block Fuel	802 kg - 1,768 lb.
300 NM Block Fuel	81 min.

ATR factsheets & brochure

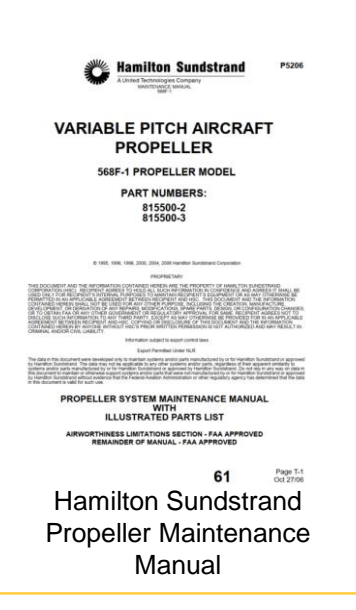
Mass breakdown



EASA Type Certificate Data Sheet ATR 42



EASA Type Certificate Data Sheet PW100



Hamilton Sundstrand Propeller Maintenance Manual

Performance

# Reference Aircraft: ATR 42-500

- Mass breakdown defined via Obert and aircraft history



AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT

ATR - 42		
Item	Weight [kg]	% MTOW
Wing	1565	9.69
Fuselage	2587	
Horizontal tailplane	220	
Vertical tailplane	322	
Landing gear	534	
Engine nacelles	366	
Flight controls	195	
<b>Structure</b>	<b>5788</b>	<b>35.84</b>
Equipped engines	1212	
Engine controls	37	
Engine instrumentation	10	
Fuel system	89	
<b>Propulsion</b>	<b>1347</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cockpit furnishing	79	
Auto-flight system	26	
Navigation	164	
Communication	94	
Electric generation	310	
Electric distribution	213	
<b>Systems</b>	<b>1414</b>	<b>8.76</b>
Furnishing	845	
Oxygen	31	
Lighting	90	
Water installation	11	
<b>Furnishings</b>	<b>977</b>	<b>6.05</b>
<b>Manufacturer's Empty Weight</b>	<b>9526</b>	<b>58.98</b>
Pantry structure	45	
Passenger seats	322	
Other standard items	34	
<b>Standard items</b>	<b>401</b>	<b>2.48</b>
<b>Delivery empty weight</b>	<b>9927</b>	<b>61.47</b>
<b>Operational items</b>	<b>326</b>	<b>2.02</b>
<b>Operational empty weight</b>	<b>10253</b>	<b>63.49</b>
<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>

Figure 42.24 - Weight breakdown ATR-42

## ATR 42-300

STANDARD CONFIGURATION	48 seats
<b>Weights</b>	
Max take-off weight (basic)	16,700 kg - 36,817 lb
Max take-off weight (option)	16,900 kg - 37,257 lb
Max landing weight (basic)	16,400 kg - 36,155 lb
Max zero fuel weight (basic)	15,200 kg - 33,510 lb
Max zero fuel weight (option)	15,540 kg - 34,259 lb
Operational empty weight (Tech. Spec.)	10,285 kg - 22,674 lb
Operational empty weight (Typical in-service)	10,900 kg - 24,030 lb
Max payload (at typical in-service OEW)	4,640 kg - 10,229 lb
Max fuel load	4,500 kg - 9,921 lb

Factsheet ATR42-300



~ +1 t

## ATR 42-500

STANDARD CONFIGURATION	48 seats
<b>Weights</b>	
Max take-off weight (basic)	18,600 kg - 41,005 lb
Max landing weight (basic)	18,300 kg - 40,344 lb
Max zero fuel weight (basic)	16,700 kg - 36,817 lb
Max zero fuel weight (Option)	17,000 kg - 37,478 lb
Operational empty weight (Tech. Spec.)	11,250 kg - 24,802 lb
Operational empty weight (Typical in-service)	11,500 kg - 25,353 lb
Max payload (at typical in-service OEW)	5,500 kg - 12,125 lb
Max fuel load	4,500 kg - 9,921 lb

Factsheet ATR42-500

### Changes from ATR 42-300 to ATR 42-500

- Reinforced wings to allow increased cruising speed and higher weights
- Reinforced fuselage and wing center-section
- Strengthened landing gear
- Fin and nacelles from ATR 72
- Cockpit and systems improvements of ATR 72, e.g. flight management computers
- Electrically operated main doors <sup>(1)</sup>
- Redesigned cabin, improved noise insulation <sup>(3)</sup>

# Reference Aircraft: ATR 42-500

- Mass breakdown defined via Obert and aircraft history



AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT

ATR - 42		
Item	Weight [kg]	% MTOW
Wing	1565	9.69
Fuselage	2587	
Horizontal tailplane	220	
Vertical tailplane	322	
Landing gear	534	
Engine nacelles	366	
Flight controls	195	
<b>Structure</b>	<b>5788</b>	<b>35.84</b>
Equipped engines	1212	
Engine controls	37	
Engine instrumentation	10	
Fuel system	89	
<b>Propulsion</b>	<b>1347</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cockpit furnishing	79	
Auto-flight system	26	
Navigation	164	
Communication	94	
Electric generation	310	
Electric distribution	213	
<b>Systems</b>	<b>1414</b>	<b>8.76</b>
Furnishing	845	
Oxygen	31	
Lighting	90	
Water installation	11	
<b>Furnishings</b>	<b>977</b>	<b>6.05</b>
<b>Manufacturer's Empty Weight</b>	<b>9526</b>	<b>58.98</b>
Pantry structure	45	
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<b>Operational empty weight</b>	<b>10253</b>	<b>63.49</b>
<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>

Figure 42.24 - Weight breakdown ATR-42

- Reinforced wings to allow increased cruising speed and higher weights
- Strengthened landing gear
- Reinforced fuselage and wing center-section
- Fin of ATR72

Component	Value [kg]
Wing	1600
Fuselage	2630
HTP	220
VTP	365
Landing Gear	595
<b>Structure</b>	<b>5410</b>
<b>Engine</b>	
<b>OEM</b>	<b>11250</b>
<b>MTOM</b>	<b>18600</b>

# Reference Aircraft: ATR 42-500

- Mass breakdown defined via Obert and aircraft history



AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT

ATR - 42		
Item	Weight [kg]	% MTOW
Wing	1565	9.69
Fuselage	2587	
Horizontal tailplane	220	
Vertical tailplane	322	
Landing gear	534	
Engine nacelles	366	
Flight controls	195	
<b>Structure</b>	<b>5788</b>	<b>35.84</b>
Equipped engines	1212	
Engine controls	37	
Engine instrumentation	10	
Fuel system	89	
<b>Propulsion</b>	<b>1347</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cockpit furnishing	79	
Auto-flight system	26	
Navigation	164	
Communication	94	
Electric generation	310	
Electric distribution	213	
<b>Systems</b>	<b>1414</b>	<b>8.76</b>
Furnishing	845	
Oxygen	31	
Lighting	90	
Water installation	11	
<b>Furnishings</b>	<b>977</b>	<b>6.05</b>
<b>Manufacturer's Empty Weight</b>	<b>9526</b>	<b>58.98</b>
Pantry structure	45	
Passenger seats	322	
Other standard items	34	
<b>Standard items</b>	<b>401</b>	<b>2.48</b>
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<b>Operational empty weight</b>	<b>10253</b>	<b>63.49</b>
<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>

Figure 42.24 - Weight breakdown ATR-42

Propeller Weight (Dry) 376 Lbs

Hamilton Sundstrand Propeller Maintenance Manual

#### 4. Dimensions and Weight

Engine Model	Overall Length (mm)	Overall Width (mm)	Dry Spec. Weight (kg)
PW118	2046	635	390.5
PW118A	2046	635	392.8
PW119B	2046	635	411.4
PW119C	2046	635	411.4
PW120	2130	635	417.3
PW120A	2130	635	423.2
PW121	2130	635	423.2
PW121A	2130	635	434.0
PW123	2130	660	450.0
PW123AF	2130	660	450.0
PW123B	2130	660	450.0
PW123C	2130	660	450.0
PW123D	2130	660	450.0
PW123E	2130	660	450.0
PW124B	2130	679	480.8
PW125B	2130	679	480.8
PW126	2130	679	480.8
PW126A	2130	679	480.8
PW127	2130	720	480.8
PW127B	2130	720	480.8
PW127D	2130	679	480.8
PW127E	2130	720	480.8
PW127F	2130	720	480.8
PW127G	2130	679	484.4
PW127M	2130	720	481.7
PW127N	2130	720	481.7
PW127XT-M	2130	720	494.7

Component	Value [kg]
Wing	1600
Fuselage	2630
HTP	220
VTP	365
Landing Gear	595
<b>Structure</b>	<b>5410</b>
Gasturbine + Gearbox	990
Propeller	360
Structure	365
Systems	165
<b>Engine</b>	<b>1880</b>
<b>OEM</b>	<b>11250</b>
<b>MTOM</b>	<b>18600</b>

580

Obert – Aerodyn. Design of Transport Aircraft

EASA Type Certificate Data Sheet PW100

# Reference Aircraft: ATR 42-500

- Mass breakdown defined via Obert and aircraft history



AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT

ATR - 42		
Item	Weight [kg]	% MTOW
Wing	1565	9.69
Fuselage	2587	
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Vertical tailplane	322	
Landing gear	534	
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Flight controls	195	
<b>Structure</b>	<b>5788</b>	<b>35.84</b>
Equipped engines	1212	
Engine controls	37	
Engine instrumentation	10	
Fuel system	89	
<b>Propulsion</b>	<b>1347</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cockpit furnishing	79	
Auto-flight system	26	
Navigation	164	
Communication	94	
Electric generation	310	
Electric distribution	213	
<b>Systems</b>	<b>1414</b>	<b>8.76</b>
Furnishing	845	
Oxygen	31	
Lighting	90	
Water installation	11	
<b>Furnishings</b>	<b>977</b>	<b>6.05</b>
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<b>Operational empty weight</b>	<b>10253</b>	<b>63.49</b>
<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>

- Cockpit and systems improvements of ATR 72, e.g. flight management computers
- Electrically operated main doors

Component	Value [kg]
Wing	1600
Fuselage	2630
HTP	220
VTP	365
Landing Gear	595
<b>Structure</b>	<b>5410</b>
Gasturbine + Gearbox	990
Propeller	360
Structure	365
Systems	165
<b>Engine</b>	<b>1880</b>
Systems	1750
<b>OEM</b>	<b>11250</b>
<b>MTOM</b>	<b>18600</b>

Figure 42.24 - Weight breakdown ATR-42

# Reference Aircraft: ATR 42-500

- Mass breakdown defined via Obert and aircraft history



AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT

ATR - 42		
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Engine controls	37	
Engine instrumentation	10	
Fuel system	89	
<b>Propulsion</b>	<b>1347</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cockpit furnishing	79	
Auto-flight system	26	
Navigation	164	
Communication	94	
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<b>Maximum take-off weight (MTOW)</b>	<b>16150</b>	<b>100</b>

- Redesigned cabin, improved noise insulation

Figure 42.24 - Weight breakdown ATR-42

Component	Value [kg]
Wing	1600
Fuselage	2630
HTP	220
VTP	365
Landing Gear	595
<b>Structure</b>	<b>5410</b>
Gasturbine + Gearbox	990
Propeller	360
Structure	365
Systems	165
<b>Engine</b>	<b>1880</b>
Systems	1750
Furnishings	1220
Operator Items	990
<b>OEM</b>	<b>11250</b>
Max Fuel Load	4500
Max Payload	5450
<b>MTOM</b>	<b>18600</b>

# Reference Aircraft: ATR 42-500

## - Profound data are available in literature



Jane's All the World's Aircraft

Geometry

GENERIC DATA SHEET FOR TRANSPORT AIRCRAFT

**ATR -42**

Item	Weight (kg)	% MTOW
Wing	1565	9.59
Wingtip	209	
Horizontal tailplane	220	
Vertical tailplane	122	
Landing gear	534	
Engine nacelles	366	
Flight controls	195	
<b>Structure</b>	<b>3768</b>	<b>23.84</b>
Developed engines	1212	
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Engine maintenance	10	
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<b>Propulsion</b>	<b>1342</b>	<b>8.34</b>
Hydraulic generation	91	
Hydraulic distribution	50	
Air conditioning	287	
De-icing	75	
Fire protection	25	
Cabin heating	79	
Auto flight system	26	
Navigation	164	
Communication	94	
Electric generation	310	
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<b>Systems</b>	<b>1414</b>	<b>8.76</b>
Landing	865	
Oxygen	31	
Lighting	90	
Rotor installation	11	
<b>Avionics</b>	<b>977</b>	<b>6.05</b>
<b>Manufacturer's Empty Weight</b>	<b>8526</b>	<b>53.36</b>
Ferry structure	45	
Passenger seats	122	
Other standard items	24	
<b>Standard items</b>	<b>461</b>	<b>2.88</b>
<b>Delivery empty weight</b>	<b>8987</b>	<b>55.47</b>
<b>Operational items</b>	<b>226</b>	<b>1.42</b>
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Figure 42.24 - Weight breakdown ATR-42

Obert – Aerodyn. Design of Transport Aircraft

**ATR 42-500**

STANDARD CONFIGURATION	48 seats
Engines Pratt & Whitney Canada	PW127G/M
Take-off power	2,310 SHP
Take-off power - One engine	2,400 SHP
Max continuous	2,400 SHP
Max climb	2,310 SHP
Max cruise	2,132 SHP
Applicability Hamilton Standard	565E
Wingspan	26.37 m - 87.2 ft.
Wingtip	
Max take-off weight (basic)	18,400 kg - 41,005 lb.
Max landing weight (basic)	18,300 kg - 40,344 lb.
Max zero fuel weight (basic)	16,700 kg - 36,817 lb.
Max zero fuel weight (Option)	17,000 kg - 37,478 lb.
Operational empty weight (Tech. Spec)	11,250 kg - 24,802 lb.
Operational empty weight (Typical in-service)	11,500 kg - 25,355 lb.
Max payload (at typical in-service OEW)	5,500 kg - 12,125 lb.
Max fuel load	4,500 kg - 9,921 lb.
<b>Initial performance</b>	
Take-off distance	
- Basic - MTOW - ISA - SL	1,165 m - 3,822 ft.
- TOW for 300 NM - Max pax - SL - ISA	982 m - 3,224 ft.
- TOW for 300 NM - Max pax - 3,000 ft. - ISA +10	1,164 m - 3,818 ft.
Take-off speed (V2 min @ MTOW)	112 KCAS
Landing field length (EASA Air Ops)	
- Basic MLW - SL	966 m - 3,169 ft.
- LW (max pax + reserves) - SL	956 m - 3,137 ft.
- Reference speed at landing	154 KIAS
<b>Enroute performance</b>	
Optimum climb speed	160 KCAS
Rate of climb (ISA, SL, MTOW)	1,853 ft/min
Time to climb to FL370	12.7 min.
One engine net ceiling (95% MTOW, ISA +10)	12,010 ft.
Max Cruise speed (95% MTOW, ISA, Optimum FL)	300 KIAS - 556 mph
Fuel flow at cruise speed	811 kg/hr - 1,788 lb/hr
Range with max pax	703 NM
200 NM Block Fuel	514 kg - 1,137 lb.
300 NM Block Fuel	80 mm
300 NM Block Fuel	802 kg - 1,768 lb.
300 NM Block Fuel	81 mm

ATR factsheets & brochure

Mass breakdown

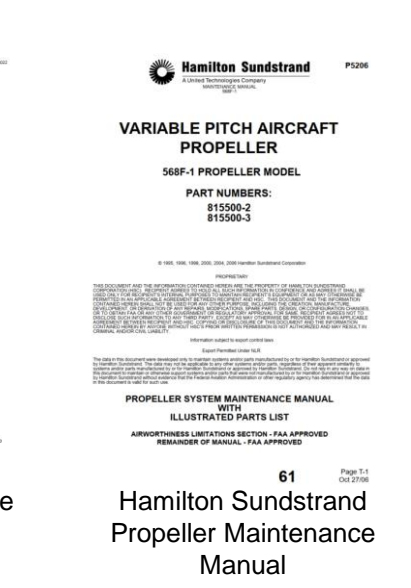


EASA Type Certificate Data Sheet ATR 42



EASA Type Certificate Data Sheet PW100

Performance



Hamilton Sundstrand Propeller Maintenance Manual

# Reference Aircraft: ATR 42-500

## - Performance



### ATR 42-500

STANDARD CONFIGURATION	48 seats
Engines Pratt & Whitney Canada	PW127E/M
Take-off power	2,160 SHP
Take-off power - One engine	2,400 SHP
Max continuous	2,400 SHP
Max climb	2,160 SHP
Max cruise	2,132 SHP
Propellers Hamilton Standard	568F
Blades - diameter	6 - 3.93 m - 12.9 ft
<b>Weights</b>	
Max take-off weight (basic)	18,600 kg - 41,005 lb
Max landing weight (basic)	18,300 kg - 40,344 lb
Max zero fuel weight (basic)	16,700 kg - 36,817 lb
Max zero fuel weight (Option)	17,000 kg - 37,478 lb
Operational empty weight (Tech. Spec.)	11,250 kg - 24,802 lb
Operational empty weight (Typical in-service)	11,500 kg - 25,353 lb
Max payload (at typical in-service OEW)	5,500 kg - 12,125 lb
Max fuel load	4,500 kg - 9,921 lb
<b>Airfield performance</b>	
Take-off distance	
> Basic - MTOW - ISA - SL	1,165 m - 3,822 ft
> TOW for 300 NM - Max pax - SL - ISA	982 m - 3,221 ft
> TOW for 300 NM - Max pax - 3,000 ft - ISA +10	1,164 m - 3,818 ft
Take-off speed (V2 min @ MTOW)	112 KCAS
Landing field length (EASA Air Ops)	
> Basic MLW - SL	966 m - 3,169 ft
> LW (max pax + reserves) - SL	906 m - 2,972 ft
> Reference speed at landing	104 KIAS
<b>En-route performance</b>	
Optimum climb speed	160 KCAS
Rate of climb (ISA, SL, MTOW)	1,851 ft/min
Time to climb to FL170	12.7 min
One engine net ceiling (95% MTOW, ISA +10)	13,010 ft
Max Cruise speed (95% MTOW - ISA - Optimum FL)	300 KTAS - 556 km/h
Fuel flow at cruise speed	811 kg/hr - 1,788 lb/h
Range with max pax	703 NM
200 NM Block Fuel	584 kg - 1,287 lb
200 NM Block Time	60 min
300 NM Block Fuel	802 kg - 1,768 lb
300 NM Block Time	81 min



MTOW 18,600 kg (41,005 lb)  
 OEW: 11,250 kg (24,802 kg)  
 ISA conditions; high cruise speed  
 Reserves: 45 min continued cruise & 87 Nm alternate

Engine Model	Maximum Take-off Power – 5 min. (*)	Normal Take-off Power – 5 min. (*)		Maximum Continuous Power	
		Maximum Air Temp for Rated Power (°C)	Shaft Power (kW)	Maximum Air Temp for Rated Power (°C)	Shaft Power (kW)
PW127	2003	26	1454	26	1454
PW121A	1640	25	1476	25	1417
PW123	1775	35	1598	35	1604
PW123AF	1775	35	-	-	1603
PW123B	1865	30	1687	30	1603
PW123C	1604	26	1454	26	1454
PW123D	1604	45	1454	45	1454
PW123E	1775	41	1598	41	1604
PW124B	1790	34	1611	34	1790
PW125B	1864	30	1678	30	1603
PW126 (**)	-	-	1648	28	1648
PW126A	1985	29	1787	29	1769
PW127	2051	32	1846	32	1864
PW127B	2051	30	1846	30	1864
PW127D	2051	33	1846	33	2051
PW127E	1790	45	1611	45	1790
PW127F	2051	35	1846	35	1864
PW127G	2178	35	1973	35	2178
PW127M	2051	39	1846	39	1864
PW127N	2051	44	1846	44	1864
PW127XT-M	2051	39	1846	39	1864

(\*) See Note 2  
 (\*\*) PW126 Contingency Power Ratings: see Table below  
 EASA Type Certificate Data Sheet PW100

Parameter	Unit	Value
Installed power	kW	1790
Design range	NM	840
Design Payload	kg	4560
Cruise Mach	-	0.48

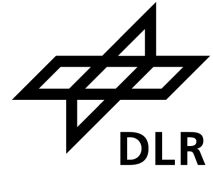


ATR factsheets & brochure

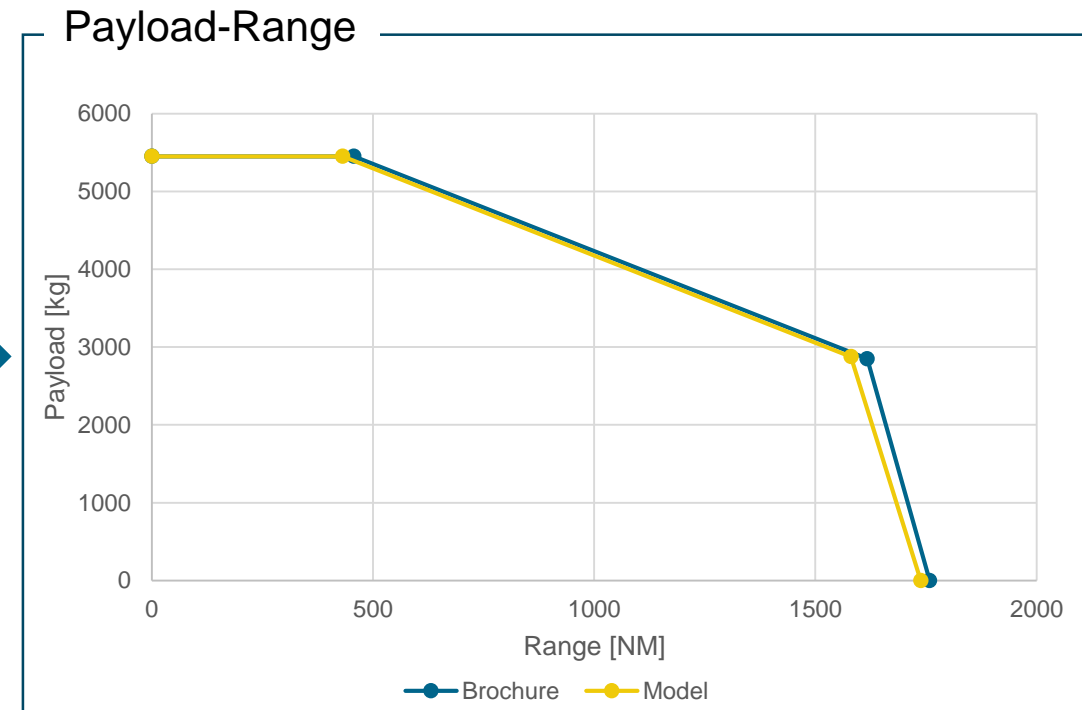
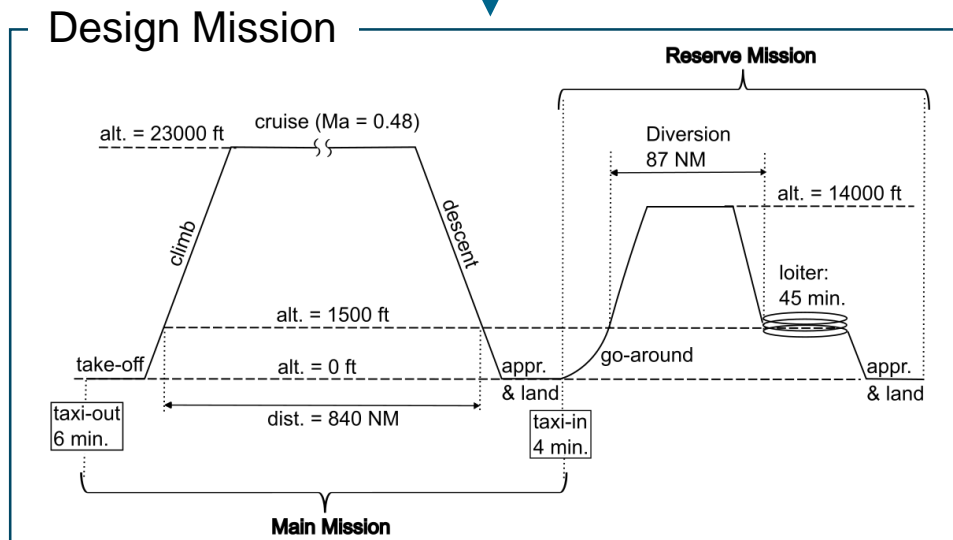
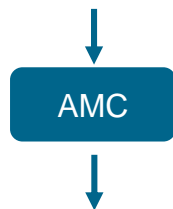


# Reference Aircraft: ATR 42-500

## - Performance

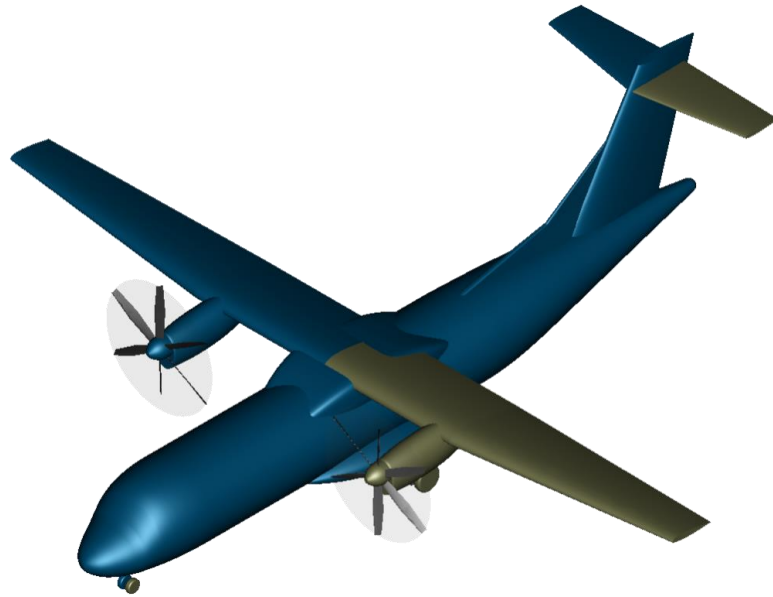


Parameter	Unit	Value
Installed power	kW	1790
Design range	NM	840
Design Payload	kg	4560
Cruise Mach	-	0.48



# Reference Aircraft: ATR 42-500

## - Key data



Parameter	Unit	Value
MTOM	kg	18600
OEM	kg	11250
Max. Payload	kg	5450
Wing area	m <sup>2</sup>	54.5
Wing span	m	24.57
Fuselage width	m	2.87
Cruise Ma	-	0.48
Design range	NM	840
Cruise altitude	ft	23000
L/D mid cruise	-	12.7

# BASELINE AIRCRAFT

- Assumptions for 2050
- Results
- Comparison to Reference



# Baseline Aircraft

- ATR 42 in 2050 powered by gas turbines with SAF



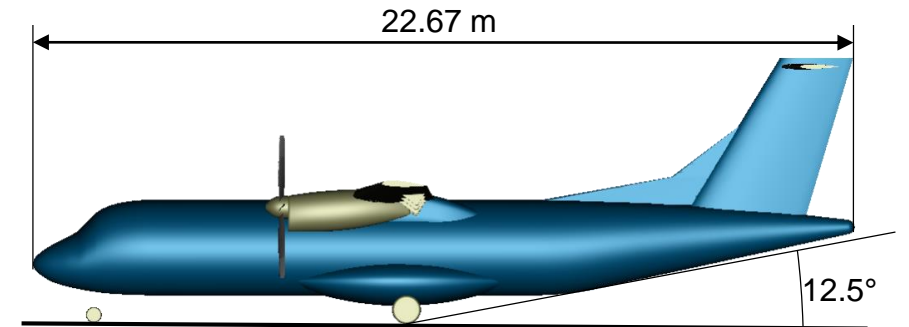
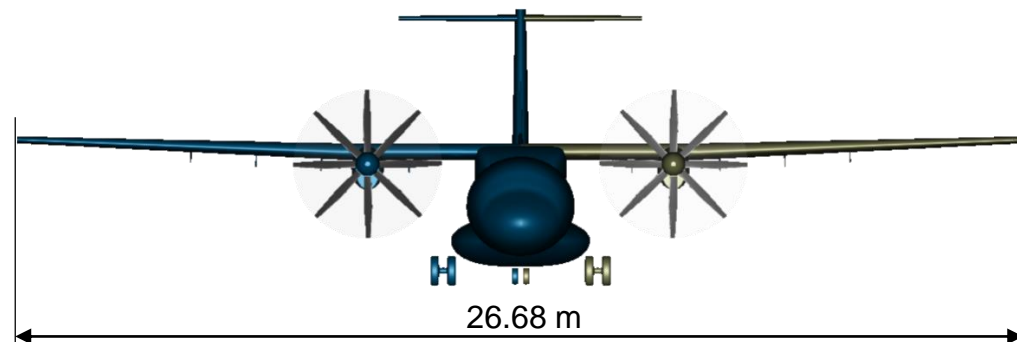
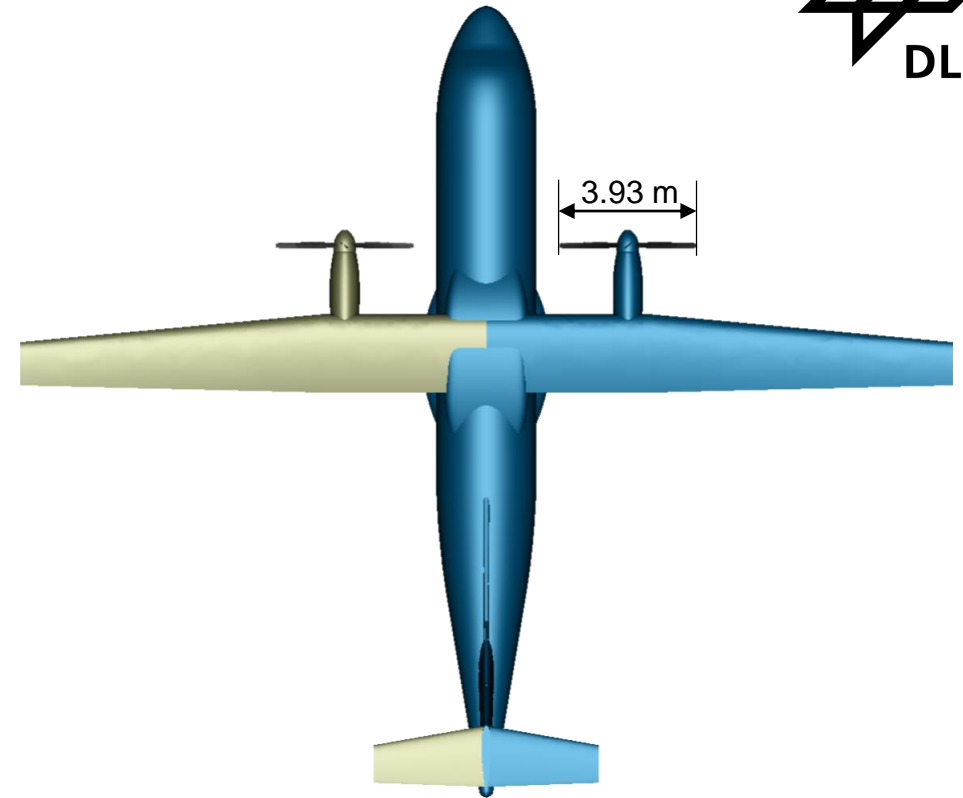
Parameter	Assumptions 2050	Description
Wing mass	- 10%	Improved manufacturing
Empenage mass	- 10%	Improved manufacturing
Fuselage mass	- 5%	Improved manufacturing
Landing gear mass	- 5%	Improved manufacturing
Empennage	Dorsal fin area: - 15 %, T-tail (fly-by-wire)	Aerodynamic improvement
Systems	Electric system mass: + 10%	Fly-by-wire, anti-ice
Drag ( $C_{D0}$ )	- 15 %	Improved manufacturing
Aspect Ratio	11 → 14	Project IMOTHEP
Gas turbine efficiency	+ 15 %	0.25 % improvement p.a.
Propeller	8 Blade	Noise reduction (ATR Evo)

# Baseline Aircraft

## - Geometry

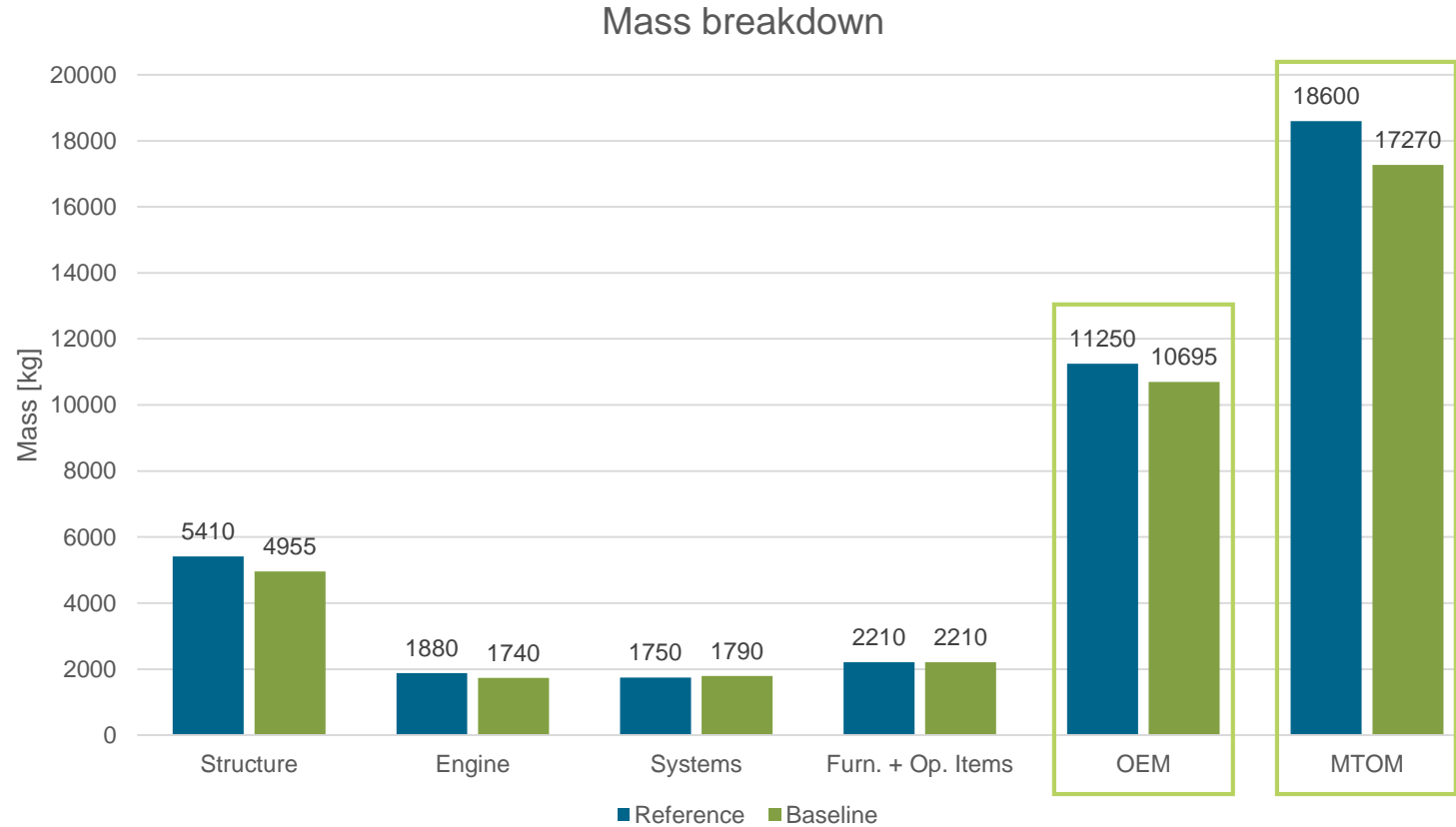


Parameter	Unit	Value	Diff to Ref
Wing root chord	m	2.2	- 13 %
Wing aspect ratio	-	14	
Wing area	m <sup>2</sup>	50.8	- 7 %
Wing loading	kg/m <sup>2</sup>	340	- 0.3%
Fuselage width	m	2.87	-
HTP span	m	6.5	- 12 %
HTP area	m <sup>2</sup>	9.1	- 22 %
VTP area	m <sup>2</sup>	11.6	-7%



# Baseline Aircraft

## - Mass breakdown

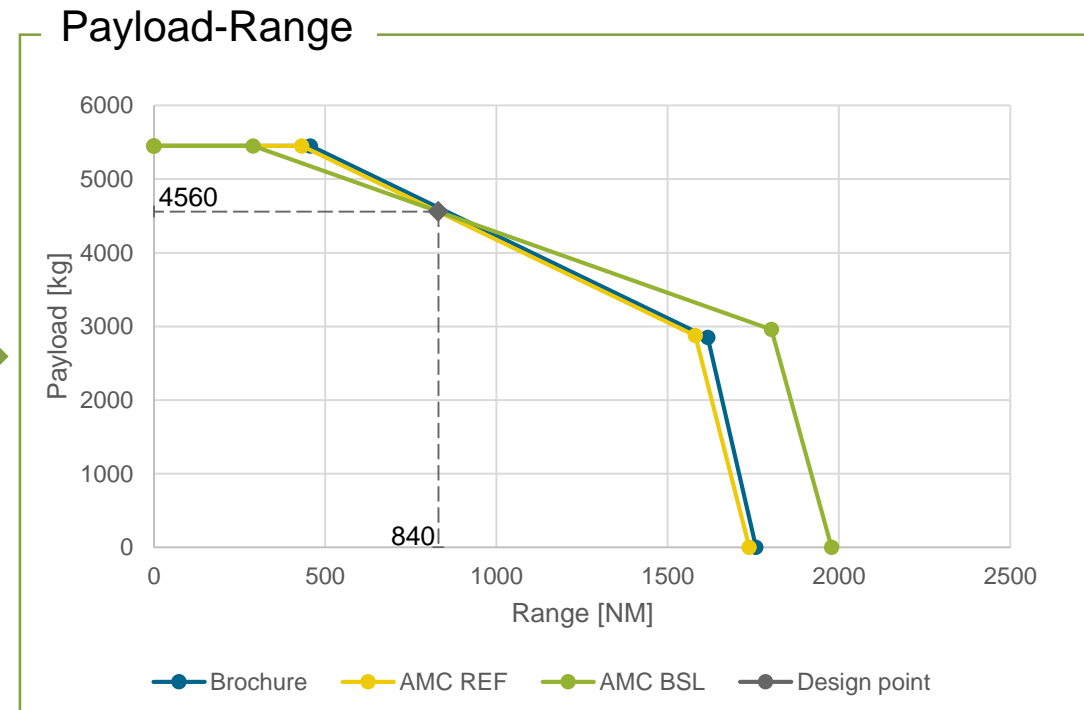
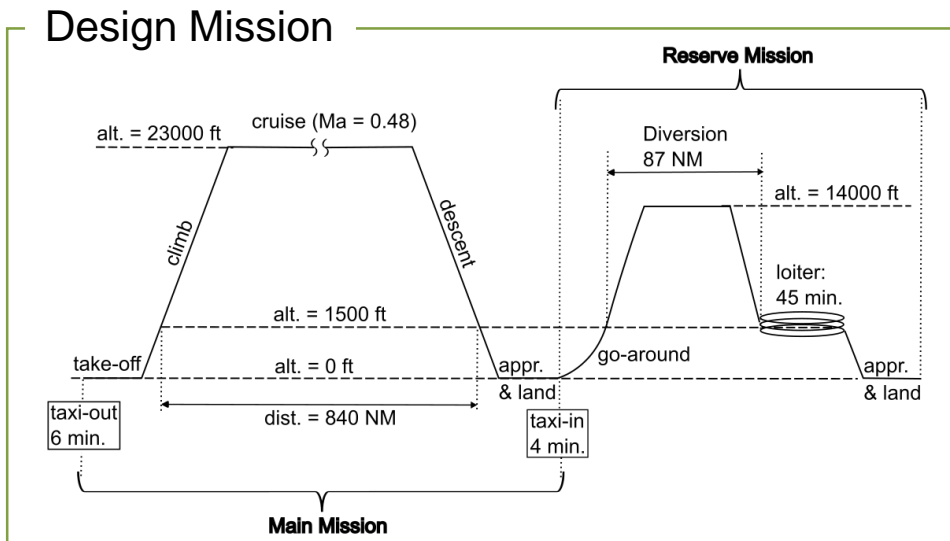


Parameter	Change to Reference
OEM	- 5%
MTOM	- 7%

# Baseline Aircraft

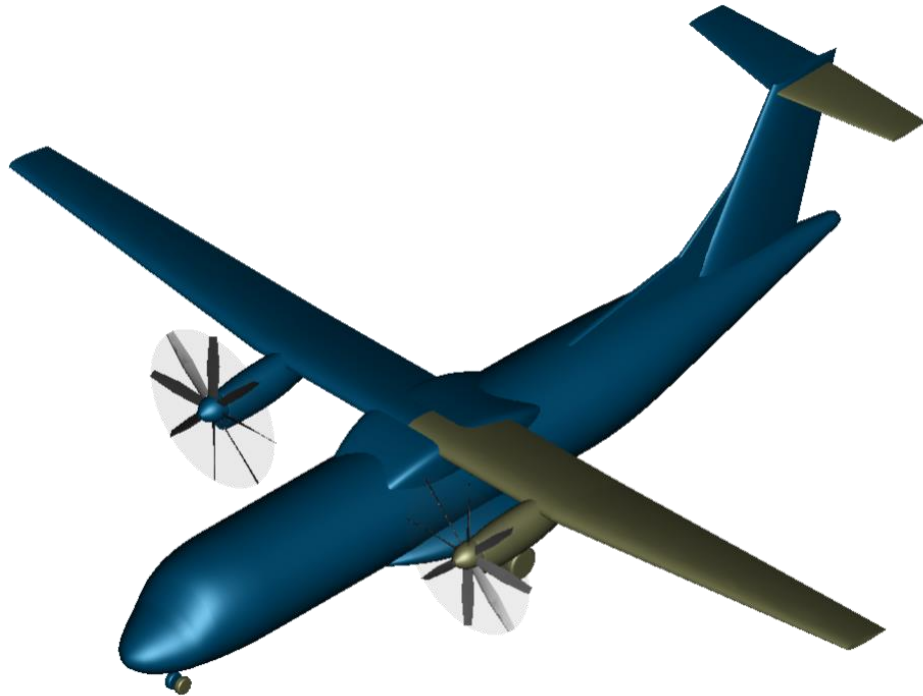
## - Performance

Parameter	Unit	Value	Diff zu Ref.
Installed power	kW	1655	-7.5%
Design range	NM	840	-
Design Payload	kg	4560	-
Cruise altitude	ft	23000	-
Max. Cruise Mach	-	0.48	-



# Baseline Aircraft

## - Key data

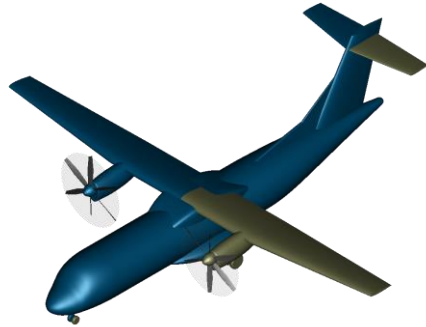


Parameter	Unit	Value	Reference	Diff.
MTOM	kg	17270	18600	- 7%
OEM	kg	10695	11250	- 5%
PAX	-	48	48	-
Max Payload	kg	5450	5450	-
Wing area	m <sup>2</sup>	50.8	54.5	- 7%
Wing span	m	24.57	26.68	9%
Fuselage width	m	2.87	2.87	-
Design Range	NM	840	840	-
Cruise Ma	-	0.48	0.48	-
Cruise altitude	ft	23000	23000	-
L/D mid cruise	-	14.9	12.7	17%

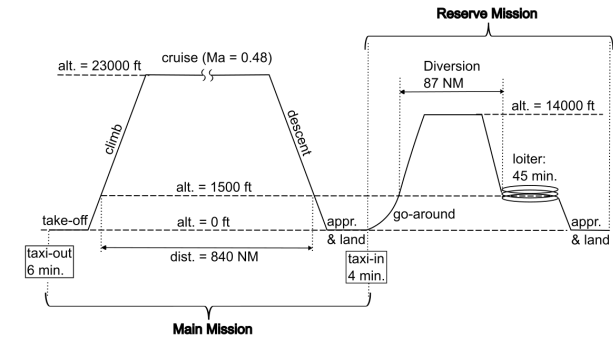


# Baseline Aircraft

## - Comparison to Reference



Reference: ATR42-500

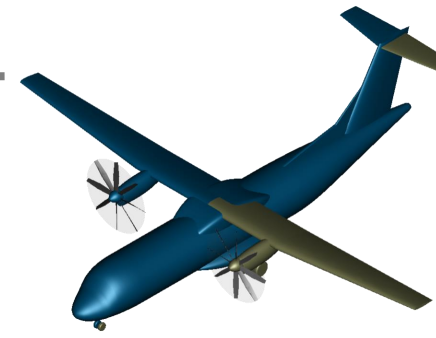


-2 % Block Fuel  
Lighter Airframe

-13.6 % Block Fuel  
New Engines

-11.3 % Block Fuel  
Improved Aero

-26.9 % Block Fuel



Baseline (2050)

# CONCLUSION

- Summary & way forward



# Conclusion

## - Summary & way forward

### Summary

- Derivation of an ATR42-500 as reference aircraft
- Extrapolation of a future ATR42 in 2050 with an evolutionary technology approach
- Baseline is used in project H2EAT

**6.2 Fuel Cell II**  
**Di 01.10., 17:15 – 17:40**  
**VMP4 - Audimax 2**

### Way forward

- Baseline with family concept (ATR72)
- Hydrogen Baseline (LH2, combustion)

# VIELEN DANK FÜR IHRE AUFMERKSAMKEIT!

**Topic:** Baseline für ein zukünftiges Regionalflugzeug

**Date:** 01.10.2023

**Author:** Nicolas Schneiders, M.Sc.

**Institute:** Institute of System Architectures in Aeronautics

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