TOPCAT USER MANUAL

version 1.0
revision 08

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written by

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Proof-read by

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What is "TOPCAT"

TOPCAT is an acronym for Take-Off Performance Calculation Tool.
It can be used to calculate the Maximum Allowed Take-Off Weight (MATOW) for a Boeing 747-400 with CF6-80C2B5F engines. The calculation includes allowances for different airports, runways, aircraft configurations, enviromental conditions, etc.
It can be used for various 747-400 flightsimulator aircrafts (i.e. PMDG747 or PS1).

TOPCAT shall not be used for real-world aviation related operations

How much does it cost?

Nothing. TOPCAT is **NOT** a commercial product. However, if you like the program and use it regularily you may consider making a PayPal donation at http://topcat.ofplan.net.

Installation and system requirements

TOPCAT requires Microsoft® Excel® 2000 or higher.

Due to its complexity, TOPCAT uses VBA macros. To enable macros, open Excel® and go to Extras/Options/Security.

TOPCAT consists of the following files:

- **TOPCAT.xls** the main program
- **airports.dat** containing all airports in .csv format
- **runways.dat** containing all runways in .csv format
- **eosids.dat** containing EOSIDs ("Engine out standard instrument departures") in .csv format
  Special thanks to Olivier Steinberg for his EOSID data!
- **intsects.dat** containing data for intersection take-offs in .csv format
- **clrstpway.dat** containing data for clearway and stopway lengths in .csv format
- **topcat.ini** file created after first program launch; containing all user data

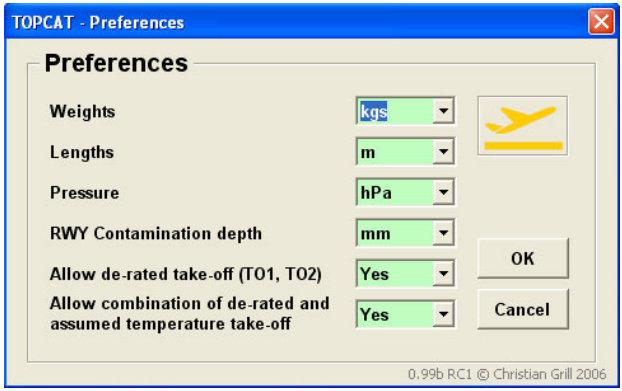
Unpack all files in one folder and run "TOPCAT.xls"

Registration

To use TOPCAT a registration code is required.
A code is available free of charge at http://topcat.ofplan.net

The expiry date of the program is shown at the bottom of the main menu. After this date you have to get a new registration code.

Preferences



- **Weights**
  Can either be:
  - **kgs** Kilograms
  - **lbs** Pounds

- **Lengths**
  Can either be:
  - **m** Meters
  - **ft** Feet

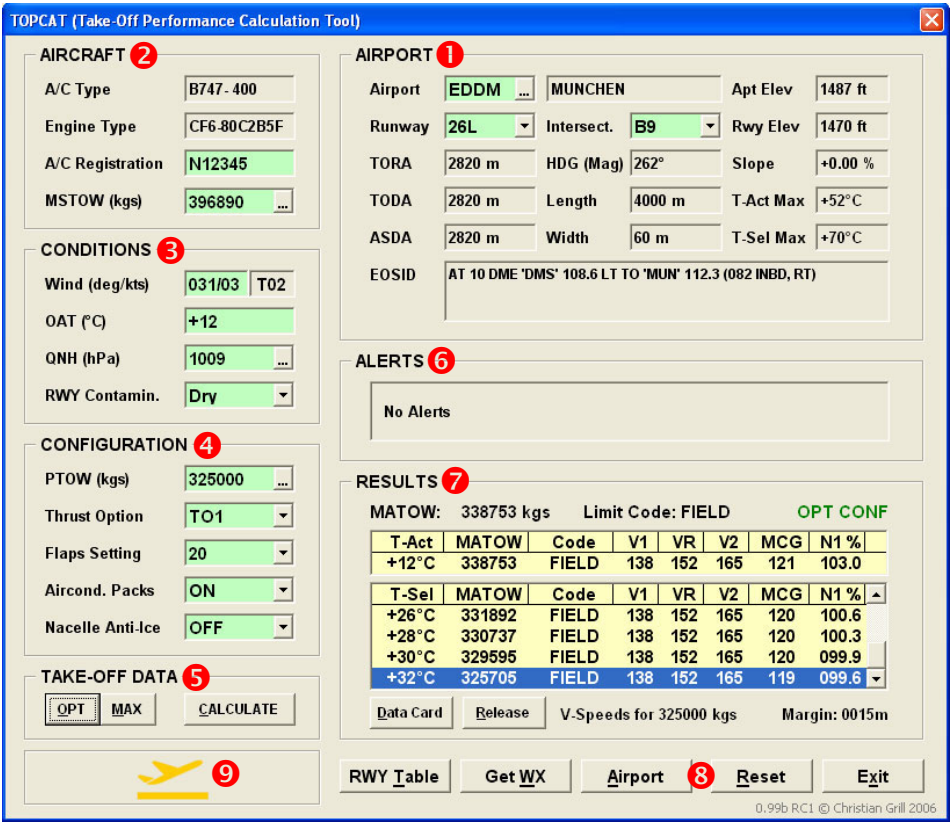
- **Pressure**
  Can either be:
  - **hPa** Hectopascal
  - **inHg** Inches of mercury

- **Runway contamination depth**
  Can either be:
  - **mm** Millimeters
  - **inHg** Inches

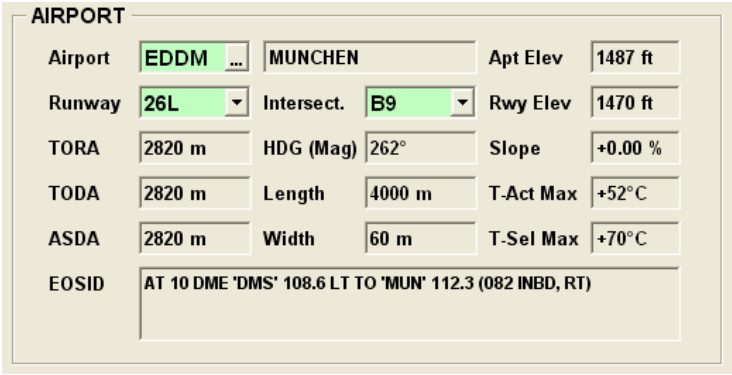
- **Allow de-rated take-off (TO1, TO2)**
  Can either be:
  - **Yes** TO1 and TO2 take-offs are allowed
  - **No** Only full rated take-offs (TO) are allowed

- **Allow combination of de-rated and assumed temperature take-off**
  Can either be:
  - **Yes** TO1 or TO2 in combination with assumed temperature take-offs are allowed
  - **No** Assumed temperature take-offs are only allowed with full thrust rating (TO)

User interface



AIRPORT



- **Airport (ALT+A)**
  ICAO identifier of the departure airport (**VHHH** for Hong Kong or **KJFK** for John F. Kennedy).

  ⓘ *Click the […] button to search the airport database by name and/or ICAO identifier.*

- **Runway**
  Take-off runway

- **Intersect (Intersection)**
  Only enabled, if intersection data are given in the "intsects.dat" file. Select "<Head>" for take-off from the runway head (full length) or the desired intersection, if available.

- **TORA (Take-off run available)**
  The length of runway which is declared available by the appropriate Authority and suitable for the ground run of an airplane taking off.

- **TODA (Take-off distance available)**
  The length of the take-off run available (TORA) plus the length of the clearway, if provided.

- **ASDA (Accelerate-stop distance available)**
  The length of the take-off run available (TORA) plus the length of the stopway, if provided.

- **Slope**
  Percentage of change in runway elevation over a defined distance.

  ⓘ *The maximum runway slope for take-off is +2% (up) and -2% (down).*

- **T-Act Max (Enviromental temperature limit)**
  Maximum OAT (Outside air temperature) in degrees celsius (°C) for take-off on this runway at present conditions.

- **T-Sel Max (Assumed temperature limit)**
  Maximum assumed OAT (Outside air temperature) in degrees celsius (°C) for take-off on this runway.

  ⓘ *Used for assumed temperature take-offs.*

- **EOSID (Engine out standard instrument departure)**
  Procedure to be flown in case of an engine failure during take-off. If no EOSID is given ("N/A"), follow the standard EOSID. This normally means to climb on runway track to MSA (minimum safe/sector altitude) to a maximum of 25NM out.

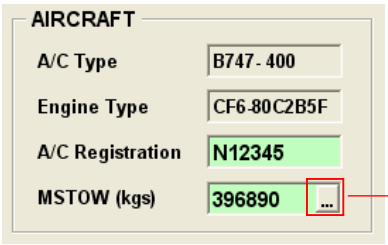
  ⓘ *EOSIDs can be modified/added by editing the "eosids.dat" file.*

- **Apt Elev (Airport elevation)**
  Elevation of the selected airport above mean sea level (MSL) in feet.

- **Rwy Elev (Runway elevation)**
  Elevation of the highest point of the selected runway above mean sea level (MSL) in feet.

  ⓘ *Airport elevation data is taken automatically, if no runway elevation is given in the "runways.dat" file.*

AIRCRAFT ❷



Click to reset the **MSTOW** to the predefined value of 396890 kgs (875000 lbs)

- **A/C Type (Aircraft type)**
  The aircraft type is B747-400 (Boeing 747-400) and can not be modified.

- **Engine Type**
  The engine type is CF6-80C2B5F and can not be modified.

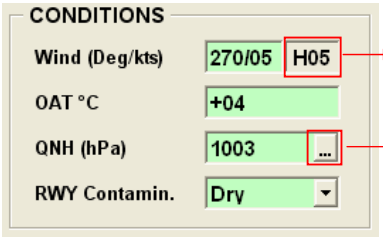
  ⓘ *This engine type is used in:*
  - PMDG 747 http://www.precisionmanuals.com
  - PS1 http://aerowinx.de

- **A/C Registration (Aircraft registration)**
  The registration of the airplane used (e.g. N12345).

- **MSTOW (Maximum structural take-off weight)**
  The maximum gross weight at the start of the take-off roll, due to design at which the aircraft is permitted to take off. This value must be between 332000 kgs (730400 lbs) and 415000 kgs (913000 lbs).

  ⓘ *Click the […] button to reset the MSTOW to the predefined value of 396890 kgs (875000 lbs)*

CONDITIONS ❸



Calculated wind component in knots.
("**T**" for tailwind, "**H**" for headwind)

Click to toggle between **hPa** an **inHg**

- **Wind (Deg/kts)**
  Wind direction in degrees magnetic and wind speed in knots. To enter a wind from 270 degress with 5 knots, type "270/05" or just "27005". Leave blank for no wind.

  ⓘ *Maximum wind speed is 70 kts.*

- **Wind component *(Calculated automatically)***
  Component of the wind along the longitudinal axis of the airplane.
  Can either be headwind (HW) or tailwind (TW).

  ⓘ *Maximum tailwind component (TWC) for take-off is 15 kts (T15).*

- **OAT °C (Outside air temperature) in degrees celsius**
  Temperature at the take-off airport. Must be between -50°C and the enviromental temperature limit (see Airport ❶).

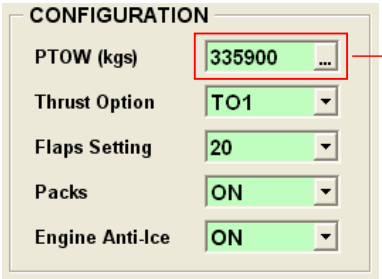
- **QNH (hPa) or ALT (inHg)**
  Local station (=airport) pressure. Must be between 950 hPa (28 inHg) and

1050 hPa (32 inHg)

ⓘ *Click the […] button to toggle between hPa and inHg.*

- **RWY Contamin. (Runway contamination)**
  From "Dry" (no contamination) to "13 mm" (0.5 inches) of water/slush or equivivalent.

CONFIGURATION ❹



Type "**M**" (= MAX) or **leave blank** to calculate with maximum allowed take-off weight **(MATOW)**.

- **PTOW (Planned take-off weight)**
  The weight of the aircraft at the start of the take-off roll. Must be between 200000 kgs (440000 lbs) and 415000 kgs (913000 lbs).

  ⓘ *Type "M" (= MAX) to calculate with maximum allowed take-off weight (MATOW)*

- **Thrust Option**
  Can either be:
  TO full take-off thrust
  TO1 full take-off thrust minus 5% *(if enabled in preferences)*
  TO2 full take-off thrust minus 15% *(if enabled in preferences)*

  ⓘ *In a VMCG limited take-off situation you can increase MATOW by decreasing take-off thrust.*

- **Flaps Setting**
  Take-off is approved with either "Flaps 10" or "Flaps 20".

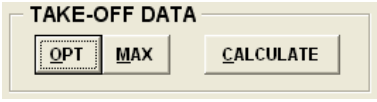
  ⓘ *Flaps 20 configuration allows take-off on shorter runways, but decreases climb-out performance due to increased drag.*

- **Packs**
  Can either be:
  ON all airconditioning packs on
  1ON one airconditioning pack on
  APU one airconditioning pack on, supplied from the APU

OFF all airconditioning packs off

- **Engine Anti-Ice**
  Must be switched on in case of actual or expected icing conditions during take-off. Must be off at outside air temperatures (OAT) above 10°C.

TAKE-OFF DATA ❺



- **CALCULATE (ALT+C)**
  Calculates take-off data for the actual configuration (see CONFIGURATION❹ and RESULTS❼).

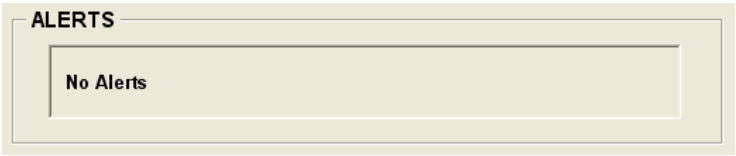
  ⓘ *The button is disabled if the* PTOW *exceeds the MATOW, or a take-off is not allowed in this configuration (*"***OVRWGT***" warning)*

- **OPT (ALT+O)**
  Calculates the optimum flaps/thrust configuration for a given PTOW resulting in the **lowest N1%** under given conditions.

  ⓘ *The button is disabled if PTOW is set to "MAX".*

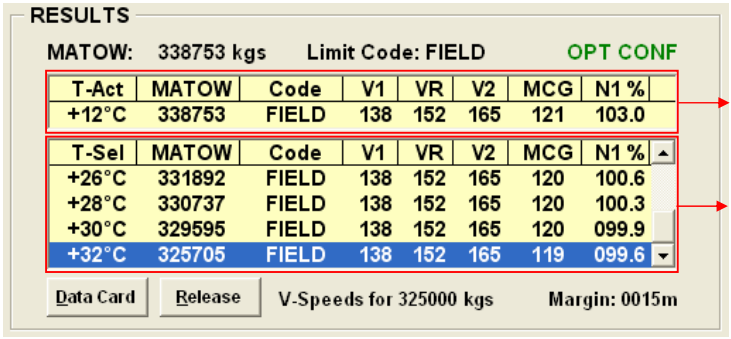
- **MAX (ALT+M)**
  Calculates the optimum flaps/thrust configuration resulting in the **highest MATOW** under given conditions.

ALERTS ❻



- **Alerts**
  Shows various error messages.

RESULTS ❼



Take-off data for actual outside air temperature (T-Act)

Take-off data for assumed temperature (T-Sel), resulting in lower N1% and thus reducing engine wear and maintenance

- **MATOW (Maximum allowed take-off weight)**
  The maximum allowed take-off weight with selected aircraft configuration under present enviromental conditions. If take-off is not allowed under present conditions an "**OVRWGT**" warning is displayed instead.

- **Limit Code**
  The most limiting condition for this take-off at selected aircraft configuration under given conditions. Can either be:
  - **MSTOW (M):** Limited by the maximum structural take-off weight (MSTOW)
  - **FIELD (F):** Limited by field length
  - **TIRE (T):** Limited by the maximum rotation speed of aircraft tires.
  - **VMCG (V):** Limited by the minimum speed required to maintain directional control in case of a sudden failure of the critical engine by use of the primary flight controls only, the other engines remaining at takeoff power.
  - **VMBE (B):** Limited by the maximum speed for brake energy absorption capability.
  - **CLIMB (C):** Limited by the maximum weight at which the aircraft can meet the JAR/FAR part 25 climb gradient requirements for takeoff (First, second, third and fourth)

- **Margin**
  Horizontal distance given in meters or feet to the DER (departure end of runway) when
  (a) Airplane comes to a complete stop after an aborted take-off at V1
  (b) Airplane reaches 35 feet above the take-off surface after an engine failure at V1
  whichever is more limiting.

- **Details (ALT+D)**
  Generates take-off data for the selected configuration which can be entered

directly into the airplane FMC.

- **Release (ALT+R)**
  Generates text-based take-off data for the selected configuration and temperature ready for print-out.

- **T-Act**
  Actual outside air temperature (OAT) in degrees celsius.

- **T-Sel**
  Selected (assumed) outside air temperature (OAT) in degrees celsius. Must be higher than T-Act.

  ⓘ *Higher assumed temperatures give a lower take-off %N1, resulting in a lower MATOW, but also reduce engine wear and maintenance costs.*

- **V1**
  Decision speed, up to which it is possible to abort a take-off and stop safely within the remaining runway length.

  ⓘ *After reaching V1 the take-off must be continued.*

- **VR**
  Rotation speed, at which to raise the nose for take-off.

- **V2**
  Is the takeoff safety speed. This minimum speed must be reached before the aircraft reaches 35ft above the takeoff surface with one engine inoperative.

- **MCG (=VMCG)**
  Is the minimum control speed on ground from which a sudden failure of the critical engine can be controlled by use of the primary flight controls only, the other engines remaining at takeoff power.

  ⓘ *On a VMCG limiting take-off, decrease the thrust setting to decrease VMCG and thus increasing MATOW.*

- **N1%**
  The rotational speed of the low-pressure compressor in a dual-spool gas turbine engine.

  ⓘ *The lower the N1 for take-off, the lower the engine wear and maintenance costs and the higher engine reliability.*

BUTTONS ❽

- **RWY Table (ALT+T)**
  Generates an "Individual Runway Table" (IRT) for the selected runway in Adobe .pdf format.

  ⓘ *Be sure to select the desired MSTOW, thrust rating, flaps configuration, bleeds/packs setting and runway condition before generating an IRT.*

- **Get WX (ALT+W)**
  Retrieves the latest METAR of the selected airport from the NOAA weather server.

  ⓘ *Requires an internet connection.*

- **Airport (ALT+A)**
  Opens a window to search the airport database by airport name.

- **Reset (ALT+R)**
  Resets all data in TOPCAT to begin a new take-off calculation.

- **Exit (ALT+X)**
  Closes the TOPCAT window and returns to main menu.

DEBUG ❾

- **Aircraft Symbol (in case of problems)**
  Click here to create a "debug.csv" file in the TOPCAT directory containing some technical informations in case you have troubles using TOPCAT. Send this file along with a short description of your problem to topcat@gmx.at.

Sample take-off scenario

This sample shows a step-by-step tutorial on how to perform all required calculations for a take-off at **HONG KONG INTL (VHHH)** airport.

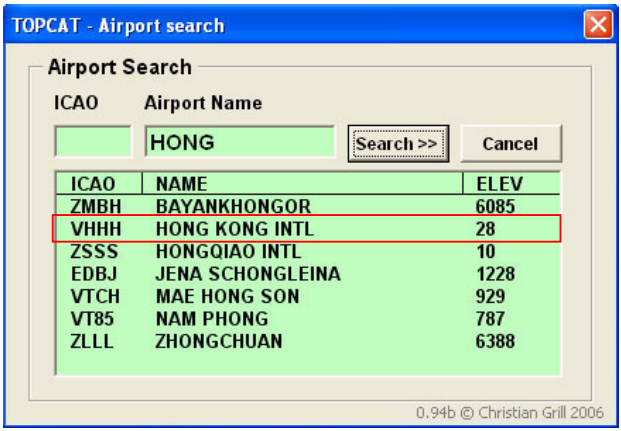
The following units are being used:

kgs for weights
m for runway lengths
hPa for air pressure
mm for precipitation depths

The planned take-off weight (PTOW) is **345000 kgs**

- Launch TOPCAT and click the "**Reset**" button or **ALT+R**.
- You are automatically taken to the "**Airport**" textbox to enter the ICAO identifier of the take-off airport.

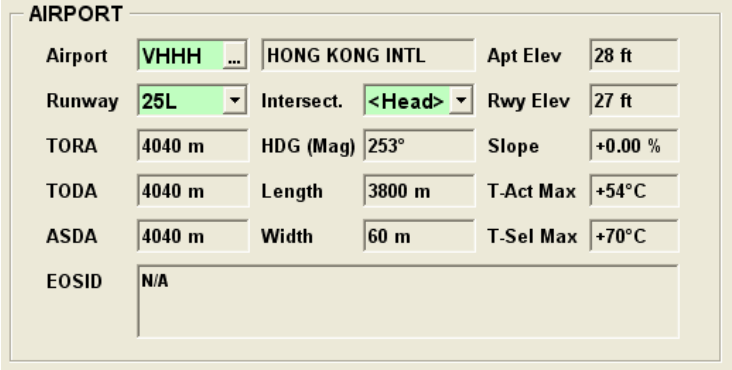
ⓘ *If you don't know the identifier of an airport, click the **[...]** button or **ALT+A** to search the database by airport name (shown below).*



- As you now have entered an ICAO identifier (**VHHH**) you can use the "**Get WX**" (**ALT+W**) button to retrieve the latest weather at **HONG KONG** airport. Let's assume the following weather report:

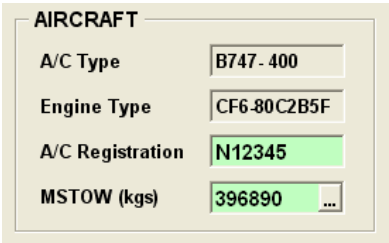
```
VHHH 070900Z 27006KT 6000 NSC 22/14 Q1020 NOSIG
```

- As the wind is coming from the west with 6 knots (27006KT) you can expect either runway **25L** or **25R** for departure. Let's choose runway **25L** for this example. We start take-off roll from the runway head ("**<Head>**").

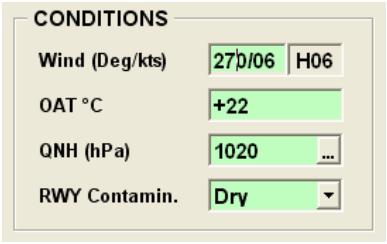


- Now continue in the "**AIRCRAFT**" section and enter the registration (e.g. **N12345**) and the maximum structural take-off weight (**MSTOW**) of your airplane.

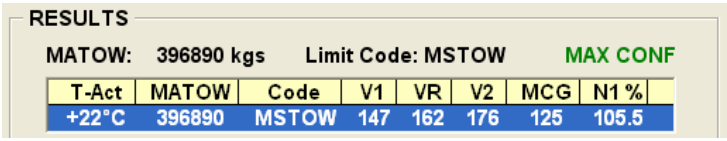
  ⓘ *Click the **[...]** button to reset the **MSTOW** to the predefined value of 396890 kgs (875000 lbs)*



- Next step is to enter the actual weather conditions in the "**CONDITIONS**" section. When entering the actual wind (**270/06** or **27006**) the headwind or tailwind component is immediately displayed (in this case "H06", which means 6 knots headwind). As the weather report shows no indications of rain or snow, select "**Dry**" in the "**RWY Contamination**" box.

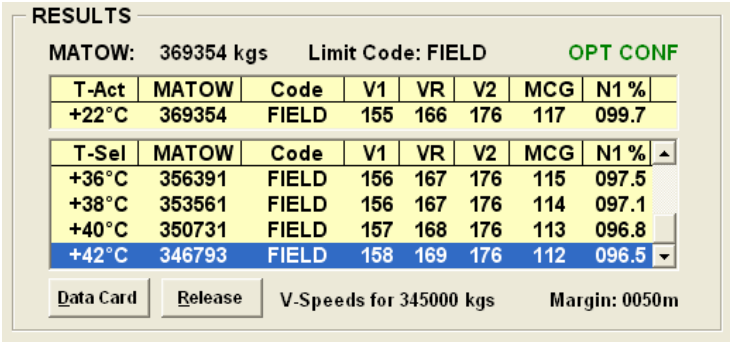


- Now go ahead with the "**CONFIGURATION**" section and select Packs "**ON**". As the temperature is 22°C, engine anti-ice is not required and you can switch it "**OFF**".
  Now click the "**MAX**" button in the "**TAKE-OFF DATA**" section or **ALT+M** to calculate the flaps/thrust configuration resulting in the highest maximum allowed take-off weight (**MATOW**) for this take-off:



  The MATOW is limited by the maximum structural take-off weight (**MSTOW**) of 396800 kgs. The %N1 in this case is **105.5%**. As the planned take-off weight (**PTOW**) of 345000 kgs is considerably lower than the **MATOW** there is a possibility to reduce the %N1 (=engine thrust) to increase engine life and reliability and to reduce maintenance costs (=derated take-off).

- Therefore you have to enter your planned take-off weight (**PTOW**) in the "**CONFIGURATION**" section at "**PTOW**". If a valid weight is entered, the "**OPT**" button in the "**TAKE-OFF DATA**" section is enabled.
  Now click this button or **ALT+O** to calculate the flaps/thrust configuration resulting in the lowest possible N1% for a given planned take-off weight (**PTOW**) for this take-off:



The optimum configuration in this case is "**Flaps 10**" with a "**TO2**" thrust rating resulting in a take-off **%N1** of **96.5** at an assumed temperature (**T-Sel**) of **+42°C**. There is a runway margin of **50m**.

- Use the "**Release**" or the "**Details**" button for detailed take-off data.

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How to use a runway table

This sample shows how to use a TOPCAT runway table for quick take-off calculations, where a computer is not readily available. Let's assume a takeoff at **EDDM** (München) from intersection **B9** under following conditions:

- Wind from 310° with 7 knots (310/07)
- Temperature +8°C
- Altimeter 30.12
- Dry runway
- Planned take-off weight (PTOW) 290500 kgs

```
**********************************************************************************************
* (1)EDDM 26L-B9          *   FLAPS 20   (2)  TO1   *   MUNCHEN                        (3)KGS *
**********************************************************************************************
:   ELEVATION = 01470 (FT)   :       LIMITATION CODES       :    BOEING 747-400/CF6-80C2B5F    :
:   SLOPE     = +0,1  (% )   :                              :    DATED  02/23/06 12:59Z        :
:   T.O.R.A   = 02820 (M )   :   F-FIELD LENGTH             :                                  :
:(4)T.O.D.A   = 02820 (M )   :   T-TIRE SPEED (235MPH)      :    ALT = 29,92 INHG              :
:   A.S.D.A   = 02820 (M )   :   B-BRAKE ENERGY             :    PACKS            ON           :
:   LENGTH    = 04000 (M )   :   C-CLIMB                    :    ENGINE ANTI ICE  OFF          :
:   WIDTH     = 00060 (M )   :   V-VMC-GROUND              :(5)                               :
:--------------------------:-------------------------------:    DRY RUNWAY                    :
:(6)EOSID:                                                 :    NO REVERSE THRUST             :
:   AT 10 DME 'DMS' 108.6 LT TO 'MUN' 112.3 (082 INBD,     :                                  :
:   RT)                                                    :                                  :
:--------:-------------:-------------:-------------:-------:------:-------------:-------------:
:  TEMP  :  WIND COMP  :  WIND COMP  :(7)WIND COMP :  WIND COMP  :  WIND COMP  :  WIND COMP  :
:   °C   :    -05 KTS  :    +00 KTS  :    +04 KTS  :    +08 KTS  :    +12 KTS  :    +16 KTS  :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  -10   :  343192 (F) :  354754 (F) :  357598 (F) :  360442 (F) :  363285 (F) :  366129 (F) :
:        : 143 158 169 : 148 161 172 : 149 162 173 : 150 163 174 : 151 164 175 : 152 165 175 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  -05   :  340784 (F) :  352394 (F) :  355203 (F) :  358011 (F) :  360820 (F) :  363629 (F) :
:        : 142 157 168 : 148 161 172 : 149 162 173 : 149 162 173 : 150 163 174 : 151 164 175 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +00   :  338191 (F) :  349940 (F) :  352733 (F) :  355526 (F) :  358320 (F) :  361112 (F) :
:        : 141 156 168 : 147 160 171 : 148 161 172 : 149 162 173 : 149 162 173 : 150 163 174 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
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:        : 141 156 167 : 146 159 170 : 147 160 171 : 148 161 172 : 149 162 173 : 150 163 174 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +10   :  333233 (F) :  344933 (F) :  347927 (F) :  350772 (F) :  353535 (F) :  356299 (F) :
:   (7)  : 140 155 167 : 145 158 169 : 146 159 170 : 147 160 171 : 148 161 172 : 149 162 173 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +15   :  331101 (F) :  342746 (F) :  345726 (F) :  348706 (F) :  351479 (F) :  354229 (F) :
:        : 139 154 166 : 145 158 169 : 146 159 170 : 147 160 171 : 147 160 171 : 148 161 172 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:

:  +45   :  292837 (F) :  303061 (F) :  305677 (F) :  308292 (F) :  310932 (F) :  313616 (F) :
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:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +50   :  280522 (F) :  290906 (F) :(8)293435 (F) :  295959 (F) :  298483 (F) :  301006 (F) :
:   (9)  : 131 142 152 : 137 145 155 : 138 146 156 : 139 147 157 : 140 148 158 : 140 148 158 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +60*  :  264439 (F) :  273866 (F) :  276366 (F) :  278866 (F) :  281366 (F) :  283866 (F) :
:        : 129 138 147 : 135 142 150 : 136 143 151 : 137 144 152 : 137 144 152 : 138 145 153 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:  +70*  :  252095 (F) :  260832 (F) :  263067 (F) :  265303 (F) :  267538 (F) :  269774 (F) :
:        : 129 136 144 : 134 139 146 : 135 140 147 : 136 141 148 : 137 142 148 : 138 143 149 :
:--------:-------------:-------------:-------------:-------------:-------------:-------------:
:     * = EXCEEDS RWY ENV TEMP LIMIT :  RWY ENV LIMIT =  +52°C   :(10)+0.10 inHg:   +00577 KGS :
:                                    :  RWY ASS LIMIT =  +70°C   :   -0.10 inHg:   -01035 KGS :
:-----------------------------------:-----------------------------:-------------:-------------:

MAX BRAKE RELEASE WT MUST NOT EXCEED MAX CERT TAKEOFF WT OF 396890 KGS
```

❶ Verify the correct runway ("**26L**") and intersection ("**B9**").

❷ Verify the correct flaps ("**20**") and take-off thrust ("**TO1**") setting.

❸ Verify the correct weight units used ("**KGS**").

❹ Verify the correct elevation, slope, **TORA**, **TODA**, **ASDA**, **runway length** and **width**.

ⓘ *Runway **26L** in EDDM is **4000m** long. As we start the take-off roll from intersection **B9**, there is a take-off distance available (**TODA**) of only **2820m**.*

❺ Verify the packs ("**ON**") and engine anti-ice ("**OFF**") configuration and check runway condition ("**DRY**")

❻ Memorize the EOSID to be flown in case of an engine failure during take-off

❼ A wind of **310/07** gives a headwind component (HWC) of **6 knots** on runway **26L**. To be conservative, we start in the **+4 knots** column. Follow this column down to the outside air temperature of **+8°C**. Again be conservative and go to the **+10°C** row.
This gives us a MATOW of **347927 kgs** and V1=146, Vr=159 and V2=170.
Correct this weight for pressure deviation from standard (❿) which is **+577 kgs** per 0.1 inHg above standard (29.92) in this case.
A pressure of 30.02 inHg equals a correction of **+1154 kgs** ([30.12-29.92] x 577) and gives a corrected MATOW of **349081 kgs** (347927+1154).

❽ If the planned take-off weight (PTOW) is lower than the MATOW, you can "assume" a higher temperature to decrease engine thrust.
This is done by moving further down the column as long as the MATOW is higher than the PTOW of **290500 kgs**.

❾ Move down vertically, as long as the MATOW is higher or equal than the PTOW, which is **+50°C** in our example.
The new MATOW is **293435 kgs**. Correct this weight for deviation from standard pressure again (+1154 kgs, see ❼ and ❿).
Our corrected MATOW is now **294589 kgs** and is still above our PTOW of 290500 kgs. The new speeds are V1=**138**, VR=**146**, V2=**156**.

Enter these speeds along with an assumed temperature (T-Sel) of +50°C in the airplane FMS or fill out a take-off data card before performing the take-off.

Sample take-off data

```
ACARS BEGIN - 02-27-06 06:58UTC
N12345
B744 CF6-80C2B5F
DISP - TOPCAT

TOPCAT 1.00

** NOT FOR OPERATIONAL USE **

     APT =VHHH    RWY=25L
     ELEV=27ft
     WIND=270/06  CMP=H06
     TEMP=+22°C   QNH=1020
     DRY RUNWAY
- - - - - - - - - - - - - - - - - - -
     T.O.R.A  - 4040m
     T.O.D.A  - 4040m
     A.S.D.A  - 4040m
     LENGTH   - 3800m
     WIDTH    - 60m

     FLAPS    - 10
     AIR COND - ON
     NAC A/I  - OFF

     MAX TOW  - 346793
     ACT TOW  - 345000

     MSTOW    - 396890
     FIELD    - 346793 LIMIT
     TIRE     - 438430
     CLIMB    - 349897
- - - - - - - - - - - - - - - - - - -
THRUST CONF: D-TO2 T=+42°C (096.5% N1)
     VMCG  -   112

     V1    -   158
     VR    -   169
     V2    -   176

     VREF30-   170
     MARGIN-   50m
- - - - - - - - - - - - - - - - - - -
EOSID:
N/A

ACARS END
```

Sample take-off data card

ⓘ *An empty Take-Off Data Card ready for printout is available in the TOPCAT directory ("TOPCAT DataCard.pdf")*