

RDH TCH Issues

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ABSTRACT

RDH/TCH issues have been debated for years among specialists as flight inspectors and ground engineers. It is evident from both recent experience and from papers presented in the last international flight inspection symposiums that a degree of confusion exists in both the understanding of RDH/TCH and how it is measured. In order to solve definitively this problem ICASC decided to create a small working group gathering specialists from different major states involved in flight inspection members of ICASC.

The paper presented is the result of the work of the group and includes the following points:

- Definitions and measuring methods
- Tolerances to be applied
- Publication
- Proposed modifications of ICAO doc 8071⁽²⁾

BACKGROUND

For those of you who attended the Rome IFIS you probably remember the excellent presentation of Martin Wills from UK on RDH⁽³⁾. His conclusion was that we needed “a fresh perspective” on this topic.

That is exactly what the group has endeavoured to do. This was a real but very interesting challenge since every state or organisation has experienced for decades its own practise or habit on RDH/TCH/ARDH.

SUBJECT

Summary

- Definitions and measuring methods
- Tolerances
- “Grandfathering” policy for existing installations
- Publication
- Proposed modifications of ICAO doc. 8071

1. Definitions and measuring method

Threshold (THR)

“Beginning of the portion of the runway useable for landing” (current ICAO definition as explained in annex 14⁽⁴⁾).

Best fit straight line (BFSL)

Best Fit Straight Line obtained by computing “DDM zero” points on the relevant portion of the approach using an appropriate statistical method (linear regression is a commonly used method).

Reference datum height (RDH)

Height above the threshold of the BFSL obtained by computing “DDM zero” points between ILS A and B points when GP is set to the published angle (refer to ICAO doc 8071⁽²⁾ §4.381).

Note: RDH should be computed with 3D data. For older FIS recording only 2D data, an equivalent of 3D data should be obtained using external distance reference (DME, landmarks, MKR).

Note: RDH is used as an input for the calculation of obstacle clearance in the approach (refer to PANS-OPS Doc. 8168).

Achieved reference datum height (ARDH)

Height above the threshold of the BFSL obtained by computing “DDM zero” points between 1NM to ILS point C when GP is set to the published angle (equivalent to 6000ft - 1000ft from THR; refer to ICAO annex 10⁽¹⁾ §2.4.12).

Note: ARDH should be computed with 3D data. For older FIS recording only 2D data, an equivalent of 3D data should be obtained using external distance reference (DME, landmarks, MKR).

Note: In most cases, ARDH will be found higher than the RDH because of the GP's flare.

Note: The ARDH provides an estimation for the so-called “Threshold Crossing Height (TCH)”.

Calculated RDH

Value calculated by the installation engineers, considering the GP mast position and the ground slopes.

Note: the calculated RDH should closely correspond to the RDH value if slopes estimation is correct and if the scalloping is small. Almost no calculation can give a reliable estimation of ARDH since it depends on the GP structure.

Note: The recommended method to get the calculated RDH is the use of a 3D ground model associated with signal simulations. Note that the “green pages formula” (Attachment C §2.4.9) does not take into account the sideways slope.

2. Tolerances for new installations

Calculated RDH

The recommended value for new installations should be 16.5m (mean of the 15-18m tolerance).

For cat. I with short runway (code letter 1,2 refer to Annex 14⁽⁴⁾) the recommended value for new installations should be 15m (mean of the 12-18m tolerance).

RDH, ARDH: Safety issues

- ① Obstacle clearance during approach (RDH, cat I, II, III)
- ② Obstacle clearance in flare zone (ARDH, cat II, III)
- ③ LDA (cat II, III)

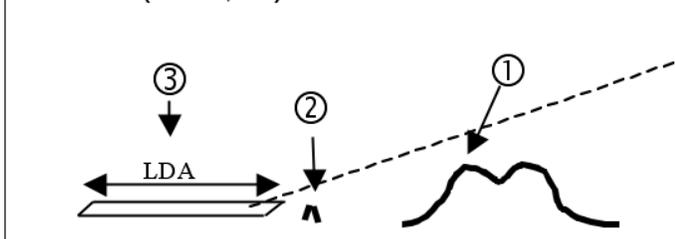


Figure 1: safety issues along the approach

RDH

Tolerance: $RDH_{Min} \leq RDH \leq 18m$.

Note: in the formulas, $RDH_{Min} = 12m$ for cat. I short runway (code letter 1,2) or 15m in other cases.

ARDH

For cat II / III, tolerance:
 $15m \leq ARDH \leq 18m$.

3. “Grandfathering” policy for existing installations

RDH in tolerance

The ILS remains in service.

RDH below tolerance (RDH < RDH Min)

For all categories, obstacle clearance should be recomputed with the RDH value. The ILS may remain in service if this computation shows a correct obstacle clearance. A new OCA/H should be published if necessary.

For cat II / III, the ILS may remain in service if $15m \leq ARDH$. If $ARDH < 15m$ a specific evaluation of the environment in the landing flare zone should be considered to establish if the ILS has to be downgraded to cat I or not.

RDH above tolerance (RDH > 18m)

For cat I, the ILS may remain in service. For Cat II / III ILS the influence on LDA should be evaluated using the ARDH: ILS with $ARDH > 18m$ will be accepted if the LDA remains sufficient regarding the most critical aircraft using the related runway.

4. Publication

In the “radio navigation and landing aids” section of AIP, publish RDH in all cases and add if possible ARDH for cat II / III.

On approach plate, publish no value in the normal cases. For grandfathered cat II / III with ARDH out of tolerance, publish ARDH.

Note: if RDH is out of tolerance, notify the difference in the AIP (as per Annex 10⁽¹⁾ volume 1, §2.1.2).

5. Proposed modifications to ICAO doc. 8071⁽²⁾

§ 4.3.81 is modified, and two new paragraphs (4.3.81* and 4.3.81**) are created

4.3.81 Reference Datum Height (RDH)

During commissioning and categorization flight tests, it is necessary to determine the RDH. This is done using a high-quality approach recording, from which the angle and structure measurements are made. Position-corrected DDM values between ILS point A to B are used to extend a best-fit straight line (e.g. by linear regression) downward to a point above the threshold, when the glide path is set to the nominal angle. The height above the threshold is used as the RDH.

Note 1: RDH should be computed with 3D data. For older FIS recording only 2D data, an equivalent of 3D data may be obtained using external distance reference (DME, landmarks, markers).

Note 2: Cat I ILS with RDH above tolerance or Cat II and III ILS with RDH above tolerance and ARDH in tolerance may be accepted as “non standard”.

Note 3: RDH should be published in the AIP.

4.3.81* Achieved Reference Datum Height (ARDH) (refer to Annex 10 Attachment C § 2.4.12)

During commissioning and categorisation flight tests of cat II/III ILS, it is necessary to determine the ARDH in addition to the RDH. This is done using a high-quality approach recording, from which the angle and structure measurements are made. Position-corrected DDM values between 1NM to ILS point C (equivalent to 6000ft-1000ft from THR, refer to ICAO Annex 10 Attachment C §2.4.12) are used to extend a best-fit straight line (e.g. by linear regression) downward to a point above the threshold, when the glide path is set to the nominal angle. The height above the threshold is used as the ARDH.

Note 1: It is highly recommended to use a 3D data recording to get a correct precision of measurement of ARDH.

Note 2: For cat II / III ILS, ARDH should be published in the AIP in addition to the RDH. In non-standard cases, ARDH should be published on approach plates.

4.3.81** “Grandfathering” rules for existing installations

The following table describes the criteria for grandfathering in the different cases that may occur.

	Cat II, III with ARDH < 15m	- Cat II, III with ARDH within tolerance - Cat I	Cat II, III with ARDH > 18m
RDH < 15m	See note 1 and 2	See note 1	See note 1 and 3
RDH within tolerance	ILS may remain in service	standard ILS	ILS may remain in service
RDH > 18m	See note 2	ILS may remain in service	See 3

Note 1: in these cases, obstacle clearance should be recomputed with the RDH value. The ILS should not remain in service if this computation shows an incorrect obstacle clearance. A new OCA/H should be published if necessary.

Note 2: in these cases, a specific evaluation of the environment in the landing flare zone should be considered to establish if the ILS has to be downgraded to Cat I or not.

Note 3: In these cases, LDA should be re-evaluated using ARDH. The ILS should be downgraded to cat I, except if LDA remains sufficient regarding the most critical aircraft using the related runway.

Note 4: Notify the difference in the AIP if RDH (Cat I / II / III) or ARDH (Cat II / III) are outside tolerances.

Table I-4-8 Flight inspection requirements and tolerances for glide path Categories I,II and III (page 4-36)

Rephrase “height of reference datum” to “reference datum height” and add:

Parameter	Annex 10 Volume 1 reference	Doc 8071 Volume 1 reference	Measurement	Tolerance	Inspection type
				Uncertainty	
ARDH	Attachment C 2.4.12	4.3.81*	DDM	Cat II and III :15m (50ft) + 3m (10ft)	C,C
				0.6m	

Acronyms (Page vii)

- ARDH Achieved Reference Datum Height
- RDH Reference Datum Height
- LDA Landing Distance Available

CONCLUSIONS

We are fully aware that a modification of ICAO Doc 8071⁽²⁾ is a pretty long process but this topic has led in the recent years to so many controversies that we consider it was really worth doing it.

We would very much appreciate to receive your comments on this proposition.

An official letter from ICASC will be sent to ICAO before the end of the year.

REFERENCES

- [1] ICAO Annex 10, volume 1
- [2] ICAO Document 8071 volume 1
- [3] Martyn Wills, “Threshold crossing height: a fresh perspective”, 12th FIS proceedings.
- [4] ICAO Annex 14