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ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

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MAS/209-LAND/4347
18 July 1995

To : See MAS Distribution List No. 2

Subject : STANAG 4347 LAND (EDITION 1) - DEFINITION OF NOMINAL STATIC RANGE PERFORMANCE FOR THERMAL IMAGING SYSTEMS

Reference : AC/225-D/1096 / AC/225(Panel VI)D/377 dated 25 August 1989 (Edition 1)(1st Draft)

Enclosure : STANAG 4347 (Edition 1)

1. The enclosed NATO Standardization Agreement which has been ratified by nations as reflected in page iii is promulgated herewith.

2. The reference listed above is to be destroyed in accordance with local document destruction procedures.

3. AAP-4 should be amended to reflect the latest status of the STANAG.

ACTION BY NATIONAL STAFFS

4. National staffs are requested to examine page iii of the STANAG and if they have not already done so, to advise the Defence Support Division, IS, through their national delegation as appropriate of their intention regarding its ratification and implementation.

G.B. FERRARI
Major-General, ITAF
Chairman, MAS

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STANAG No. 4347
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)

MILITARY AGENCY FOR STANDARDIZATION
(MAS)

STANDARDIZATION AGREEMENT

SUBJECT : DEFINITION OF NOMINAL STATIC RANGE PERFORMANCE FOR THERMAL IMAGING SYSTEMS

Promulgated on 18 July 1995

G.B. FERRARI
Major-General, ITAF
Chairman, MAS

RECORD OF AMENDMENTS

No.	Reference/date of amendment	Date entered	Signature
1	MAS/199-LANDL/4347 v. 07.07.96	10.05.01	

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Chairman MAS under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "The declaration by which a nation formally accepts the content of this Standardization Agreement".

5. Implementation is "The fulfilment by a nation of its obligations under this Standardization Agreement".

6. Reservation is "The stated qualification by a nation which describes that part of this Standardization Agreement which it cannot implement or can implement only with limitations".

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page iii gives the details of ratification and implementation of this agreement. If no details are shown, it signifies that the nation has not yet notified the tasking authority of its intentions. Page iv (and subsequent) gives details of reservations and proprietary rights that have been stated.

STANAG 4347
(Edition 1)

ARMY

NATO STANDARDIZATION AGREEMENT
(STANAG)

DEFINITION OF NOMINAL STATIC RANGE PERFORMANCE FOR THERMAL IMAGING SYSTEMS

Annex A: Procedure for the determination of the performance.
Annex B: procedure for the determination of the average MRTD.
Related Document: ELT 65: Operations at night and in limited visibility by the eurogroup land forces in the post-1990 period (FINABEL Report nr 3.R. 17)and distributed also to CA, FR, SP and the US by NATO letter DS/A/LAND(84)37 dated 30th January 1984.

AIM

1. The aim of this agreement is to provide standardized technical criteria for the definition of nominal static range performance for thermal imaging systems to be used for ground targets seen from the surface or from slightly elevated positions, in order to compare the performance of different systems.

VALIDITY

2. There are many variables which affect the performance of thermal imaging systems. In order that different systems may be easily compared, a standard set of conditions need to be defined as a basis on which performance calculations can be made. "Nominal range performance" is the term applied to the range calculated under these standard conditions. The standard conditions have been chosen to be reasonably representative of conditions experienced in the field.

The task considered is that of static performance, no search, where the target location is within the field of view of the device and the observer has infinite time to find the target.

The procedure described is only valid for thermal imaging systems where the MRTD concept is defined (e.g. for properly sampled systems) and only applied to ground targets seen from the surface or from slightly elevated positions.

The applicable spectral ranges are 3-5 μm or 8-14 μm, or parts of these ranges.

AGREEMENT

3. Participating nations agreed that the criteria established in the following paragraphs will apply when stating nominal static range performance for thermal imaging systems in relevant military and technical documents.

4. Participating nations further agree to state ranges in the following form:

a. Nominal static detection range, in kilometres.

b. Nominal static recognition range, in kilometres.

c. Nominal static identification range, in kilometres.

The transmission conditions (good or limited) and the relevant field of view of the system, in degrees or milliradians shall be stated for each range, and the method of obtaining the minimum resolvable temperature difference (MRTD) (measured or calculated), shall be specified.

NOTE 1: The operational definitions of detection, recognition and identification can be found in the related document.

NOTE 2: Depending upon the type of system only one or two of the three specified ranges might be appropriate.

DETERMINATION OF THE NOMINAL STATIC RANGE PERFORMANCE

5. The procedure needed for the calculation of the nominal static range is included in Annex A. The detailed parameters for the calculation are specified in paragraph 6.

DETAILED PARAMETERS

6. The nominal static range performance for thermal imaging systems will be determined from the averaged MRTD (see Annex B) and under the following conditions:

- target size: 2.3 x 2.3 m;

- oT_o: 2K between target and background (related to a black body temperature of 288 K);

- atmospheric IR-transmission, characterised within the relevant spectral ranges by:
  $\tau(R) = e^{-\sigma R}$
  with
  R = distance in km,
  $\sigma = 0.2\ km^{-1}$ for good transmission conditions
  $\sigma = 1.0\ km^{-1}$ for limited transmission conditions;

- resolution criteria, according to a 50% probability:

detection	:	1	line pair /target
recognition	:	3	line pairs/target
identification	:	6	line pairs/target

IMPLEMENTATION OF THE AGREEMENT

7. This STANAG is implemented when a nation has issued instructions that the nominal static range performance of thermal imaging systems will be calculated in accordance with this STANAG.

ANNEX A to
STANAG 4347
(Edition 1)

Procedure for the determination of the performance

1. For the nominal static range calculations the horizontal MRTD ($MRTD_h$) and the vertical MRTD ($MRTD_v$) are required (fig. 1).

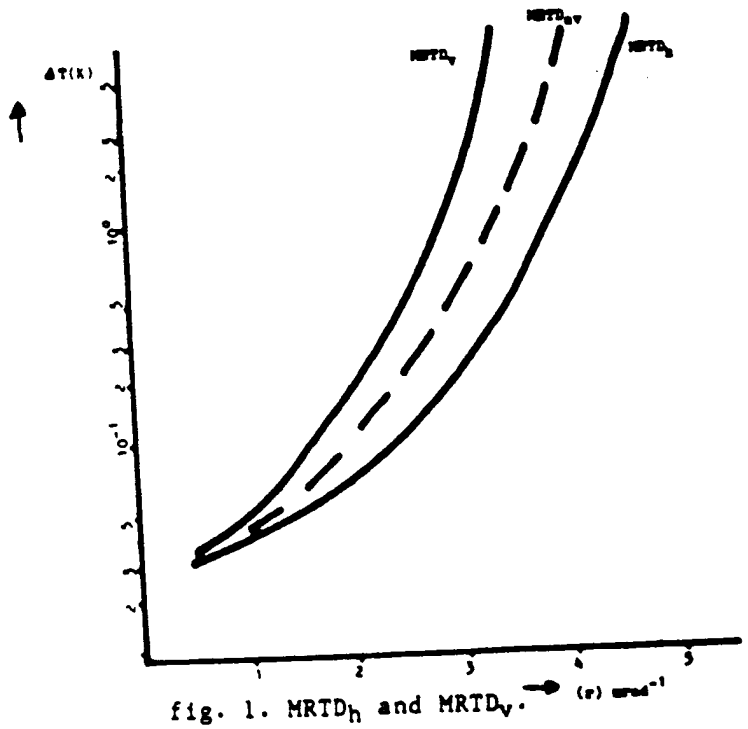

fig. 1. $MRTD_h$ and $MRTD_v$.

2. The average MRTD ($MRTD_{av}$) will be determined from $MRTD_h$ and $MRTD_v$ as given in Annex B.

3. The $MRTD_{av}$ function must be transformed into three new functions, which are:

a. the $MRTD_{av}$ as a function of the distance for detection (R_{Det}):

b. the $MRTD_{av}$ as a function of the distance for recognition (R_{Rec});

c. the $MRTD_{av}$ as a function of the distance for identification (R_{id}).

The change of variable from spatial frequency(r) into range(R) is done by using the following formulae:

$$R_{det}\ (km) = 2.3x\ r\ (mrad^{-1})$$

$$R_{rec}\ (km) = \frac{2.3x\ r\ (mrad^{-1})}{3}$$

$$R_{id}\ (km) = \frac{2.3x\ r\ (mrad^{-1})}{6}$$

4. Next the decrease of the initial ΔT_o between target and background, due to atmospheric transmission, must be considered:

$$\Delta T(R) = \Delta To.e^{-\sigma.R}$$

NOTE: Because an exponential decrease of atmospheric transmission is assumed, two straight lines can be drawn on log scale with a slope, relating to the two different extinction coëfficients.

5. The respective nominal static ranges are given by the intersections of $\Delta T(R)$ and the appropriate functions (see fig. 2, 3 and 4).

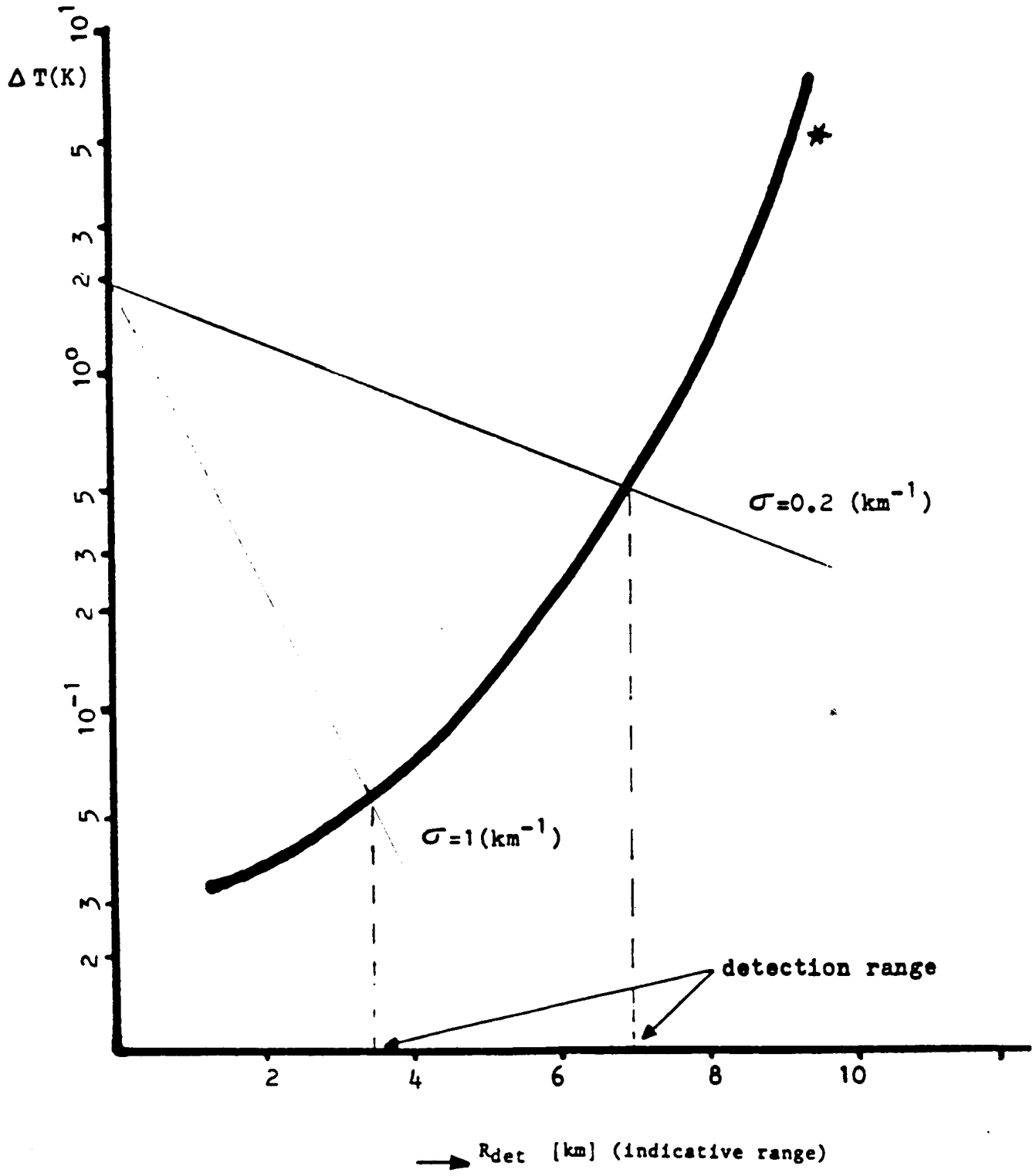

fig. 2 Determination of the nominal static detection range.
* see Annex A par. 3

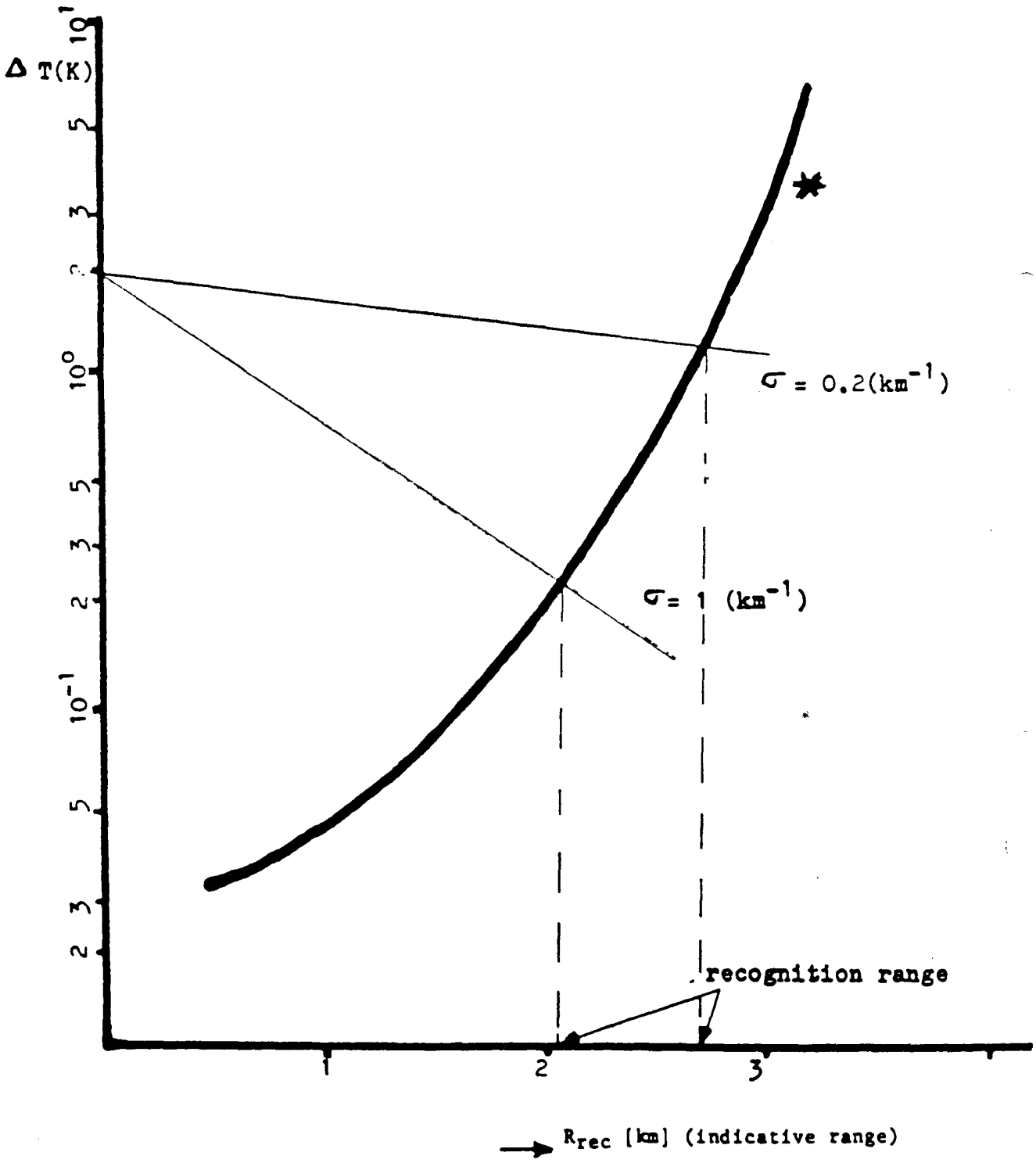

fig. 3 Determination of the nominal static recognition range.
* see Annex A par. 3

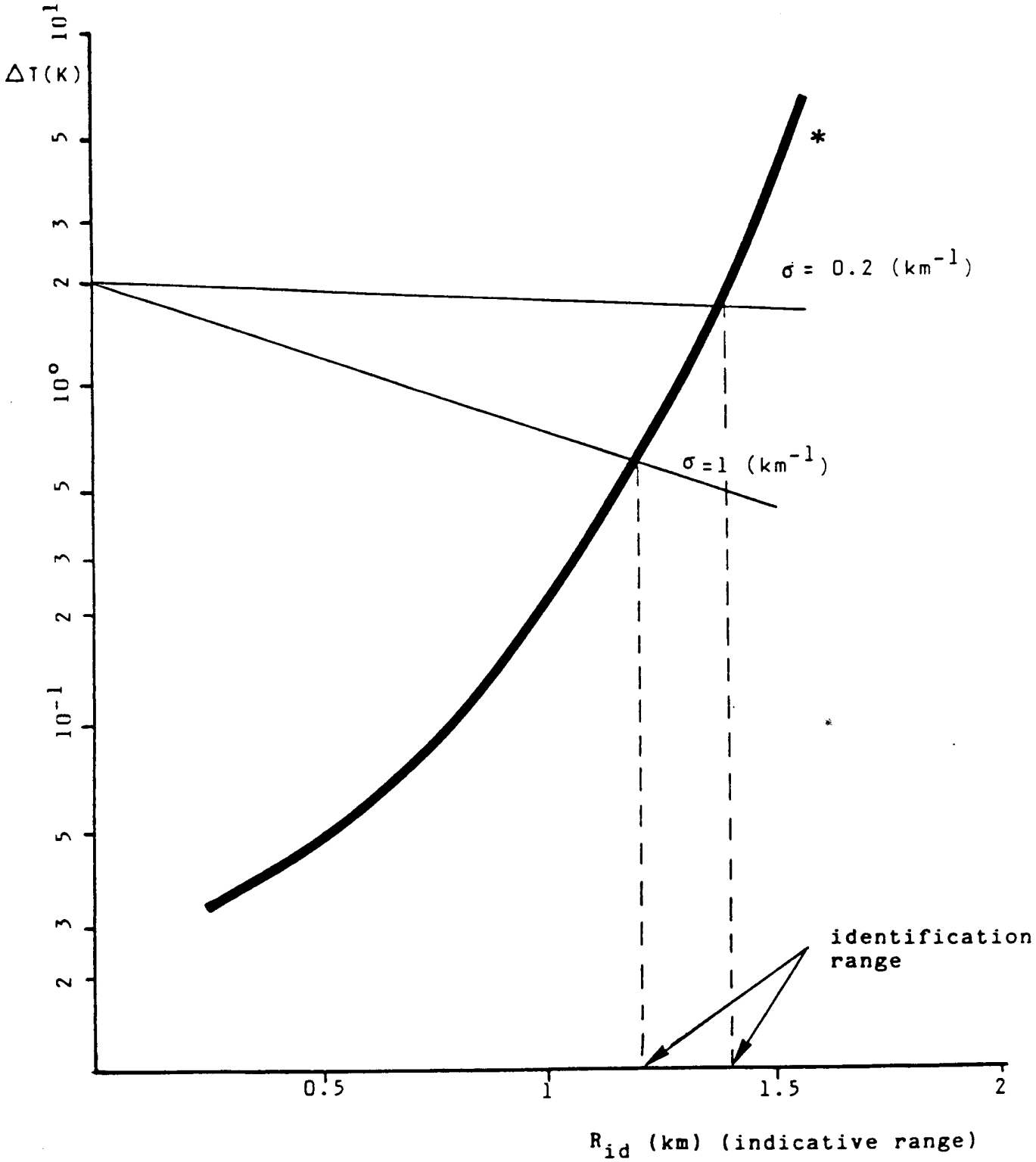

Fig. 4 Determination of the nominal static identification range.

* See Annex A par. 3

Procedure for the determination of the average $MRTD_{av}$.

The average MRTD ($MRTD_{av}$) is determined as follows:

1) Draw a graphic of spatial frequency (vertical axis) against temperature difference (horizontal axis) using values obtained from the MRTD-graph. The resulting graph shows the "spatial resolution function" (SRF).

NOTE: The SRF is the inverse function of the MRTD (See also fig. 1 and fig. 2).

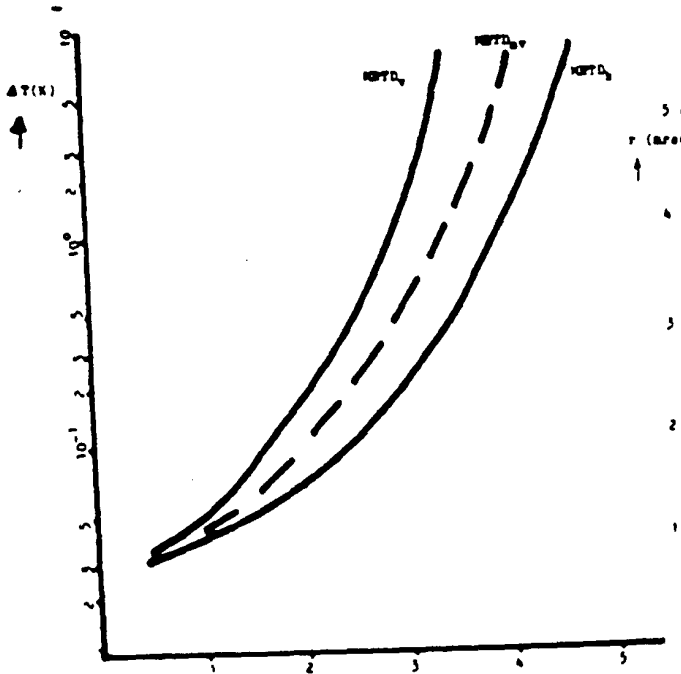

fig. 1 MRTD-curves.

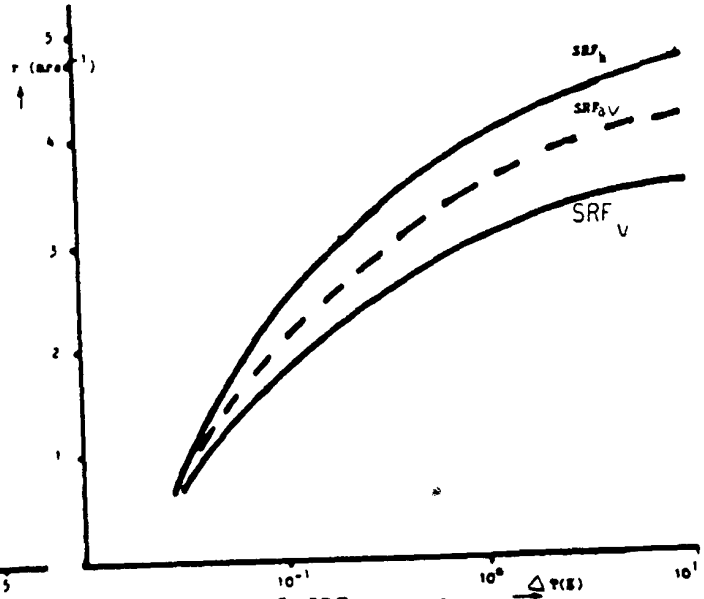

fig. 2 SRF-curves.

2) Determine at a given temperature difference ΔT the SRF_h and the SRF_V.

3) Calculate an average $SRF_{av}(\Delta T)$ according to equation (1):

$$SRF_{av}(\Delta T) = \sqrt{SRF_{av}(\Delta T).SRF_V(\Delta T)} \qquad (1)$$

4) Repeat step 2 and 3 for a number of values of temperature difference ΔT.

5) Draw a curve, using the average SRF-values found at step 3 and 4.

6) Reverse the process of step 1. Draw the MRTD-curve with spatial frequency along the horizontal axis and temperature difference along the vertical axis. For the average $MRTD_{av}$-curve use the calculated average SRF_{av}-values.