Illustrations

to the 80% / 80% rule in CISPR standards

Frank Deter,
Miele & Cie. KG, Oelde
Member of CISPR SC/A/WG1+WG2, SC/B/WG1 and SC/F/WG1+WG2

Normative text of the 80% / 80% rule in CISPR 14-1:

„At least 80 % of the mass-produced equipment shall comply with the limits with at least 80 % confidence.”

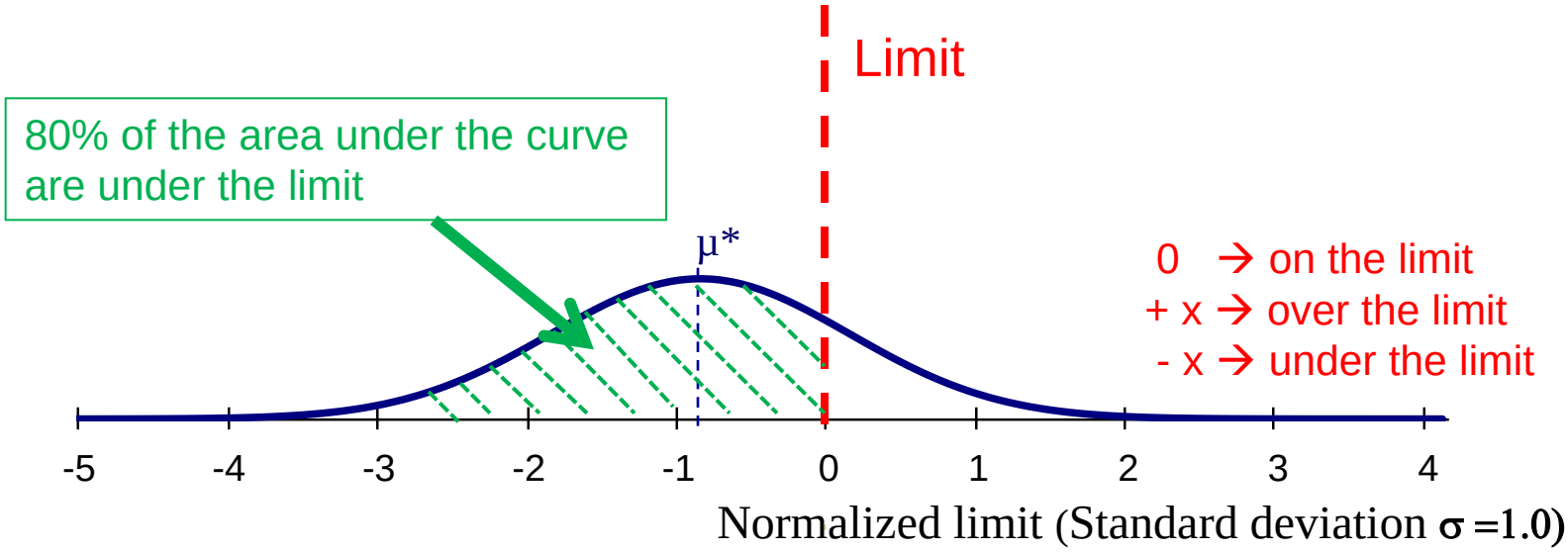
→ The following pictures focus on some technical aspects of this rule:

- What means “80% confidence” in real life?
- How should a manufacturer use the 80%/80% rule to define the necessary margin to the limit?

Illustration of the 80% under the limit

Amplitude density of highest RFI-measurement for a population in mass production, meeting exactly the 80% rule.

Assuming normal distribution of the measured values with **σ =1.0**, the centre of the amplitude density curve of the population is at μ* = -0,8416.



The first part of the 80% / 80% rule – without the required confidence – would be a relaxation of the limit.

Illustration of the 80% confidence level

The confidence level of 80% can be illustrated, using the binomial distribution with a sample of 7 EUT – none shall be over the limit.

BUT: If the population is exacly at the 80% borderline, there is a probability of 80%, that 1 out of 7 is over the limit.

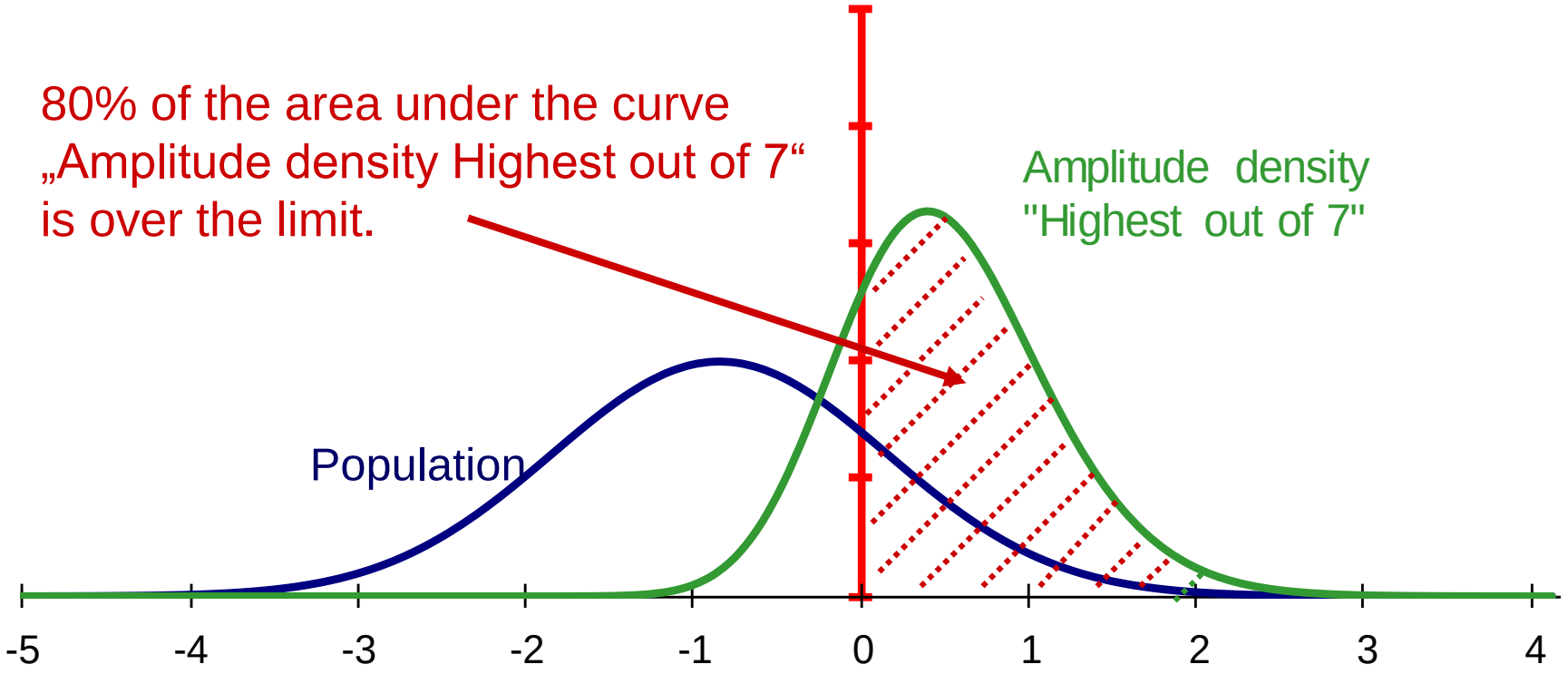
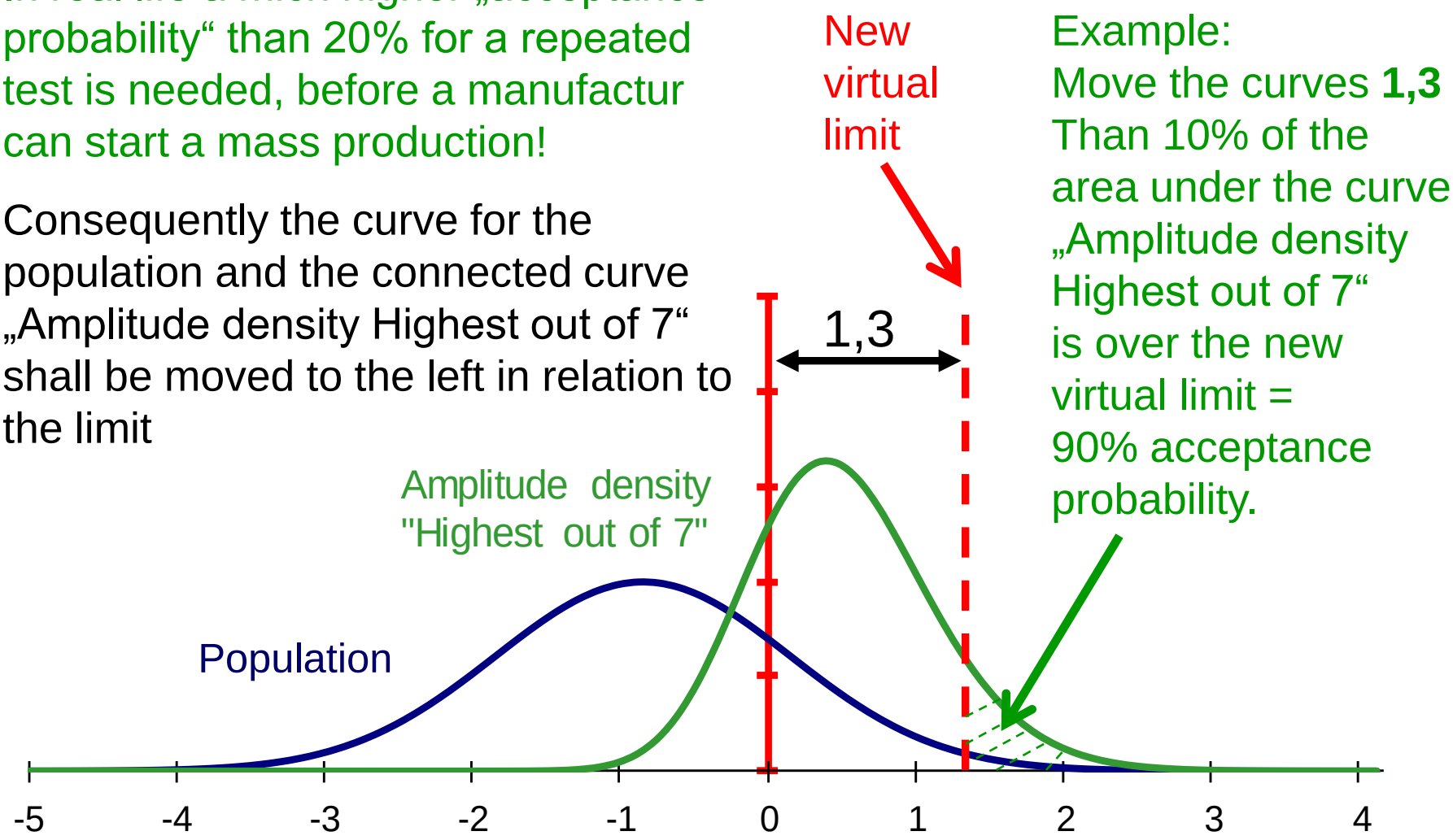


Illustration of the 80% confidence level

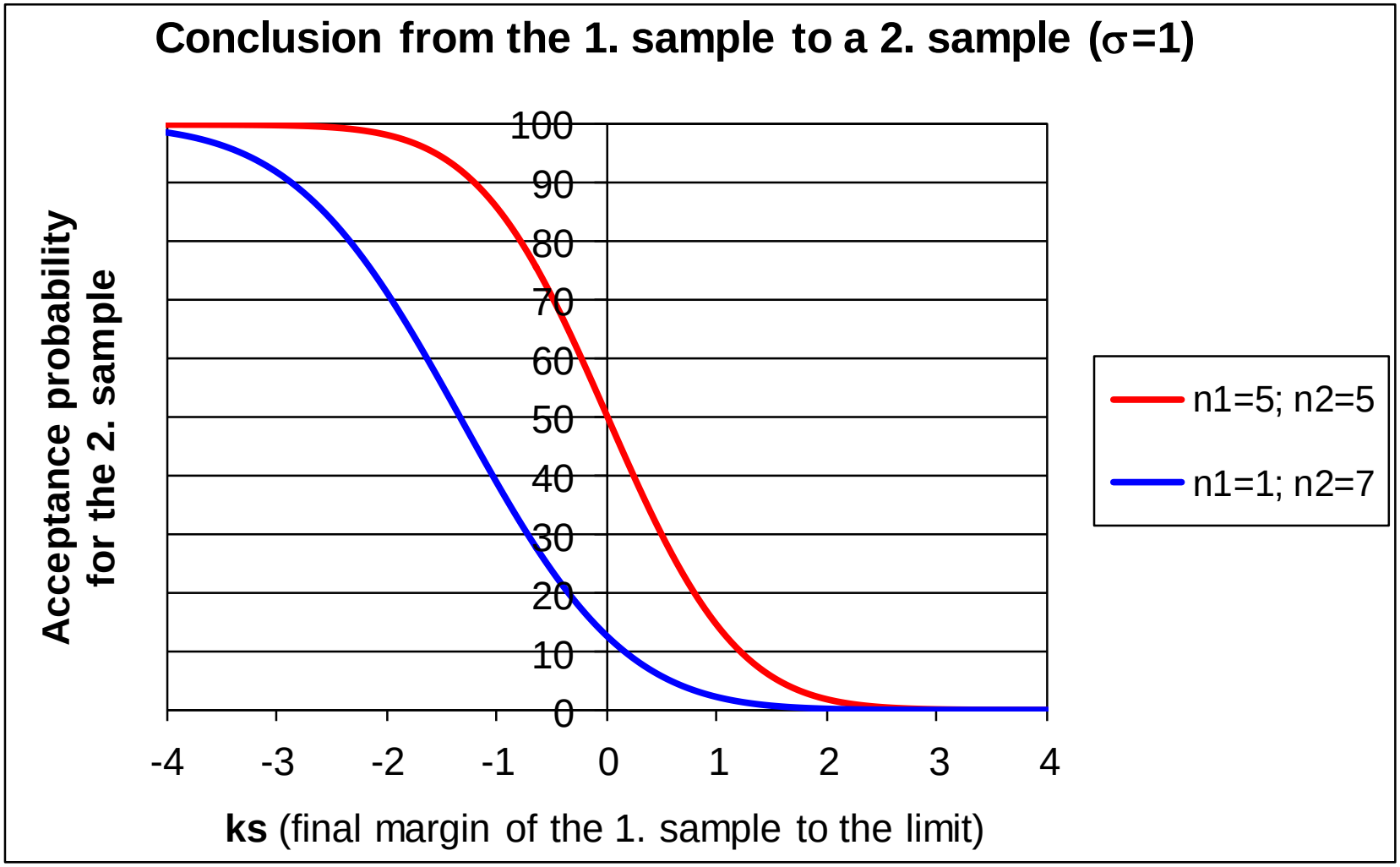
In real life a mich higher „acceptance probability“ than 20% for a repeated test is needed, before a manufactur can start a mass production!

Consequently the curve for the population and the connected curve „Amplitude density Highest out of 7“ shall be moved to the left in relation to the limit



Real margin → multiply 1,3 with the real standard deviation

More sophisticated calculations in CIS/A/666/DTR (Annex to CISPR 16-3)
“acceptance probability of test samples” (Project leader in CIS/A: F. Deter)



Example 1: Estimation of the acceptance probability for a repeated test

Application of the chart:

Example 1

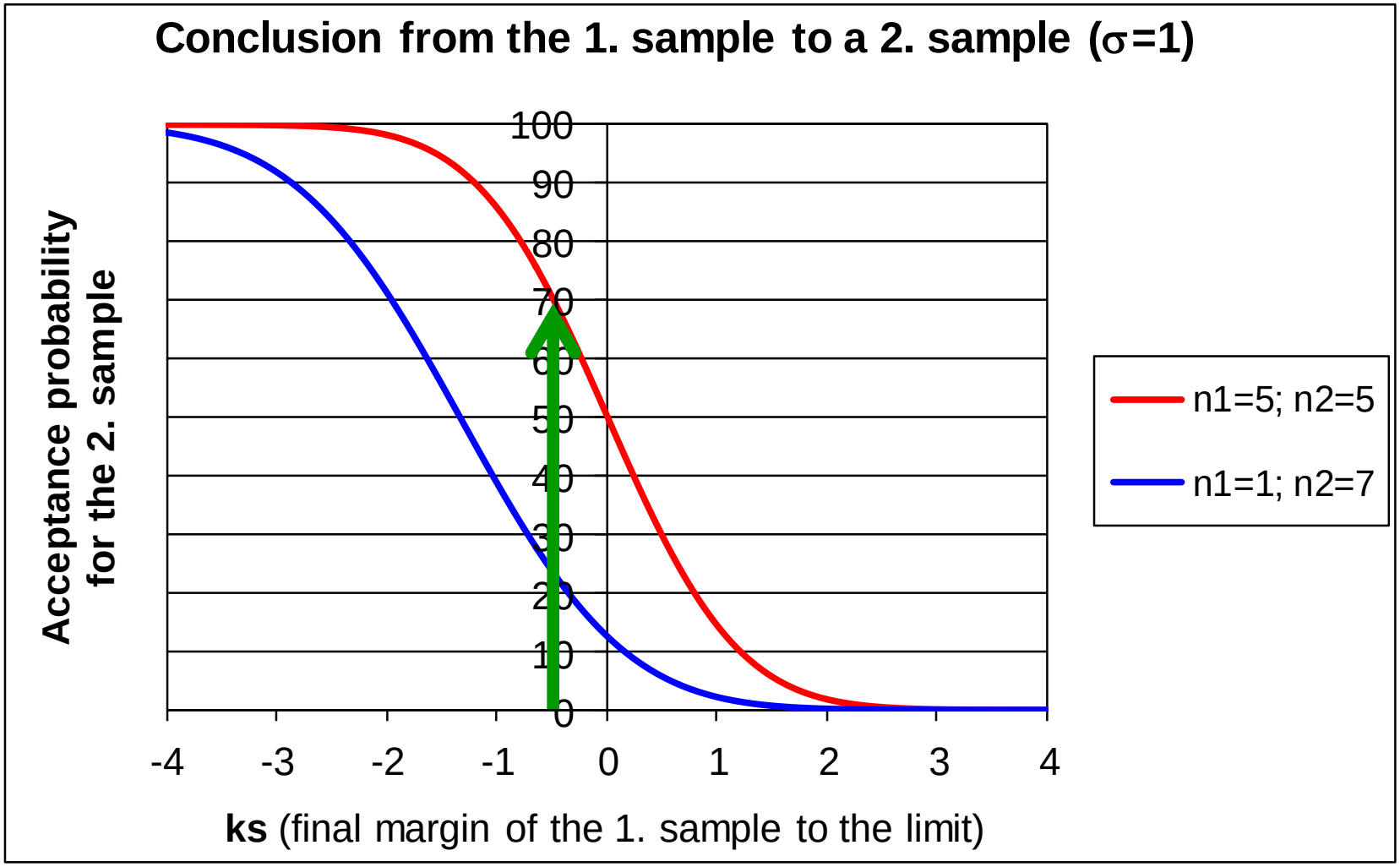
The manufactuer measures a sample of 5.
His minimum margin to the limit is 2 dB, the measured σ = 4 dB.

Question:
What is the acceptance probability for a repeated test with n=5?

Answer:
1. → Normalize the margin to σ = 1 (divide all values by 4 dB):
   k_S = 2 dB / 4 dB = 0,5
2. → Go in the chart from „– 0,5“ up to the red curve
(n1=5, n2=5) and read on the Y-axis:

estimated acceptance probability → about 70%

Illustration to example 1:



Example 2

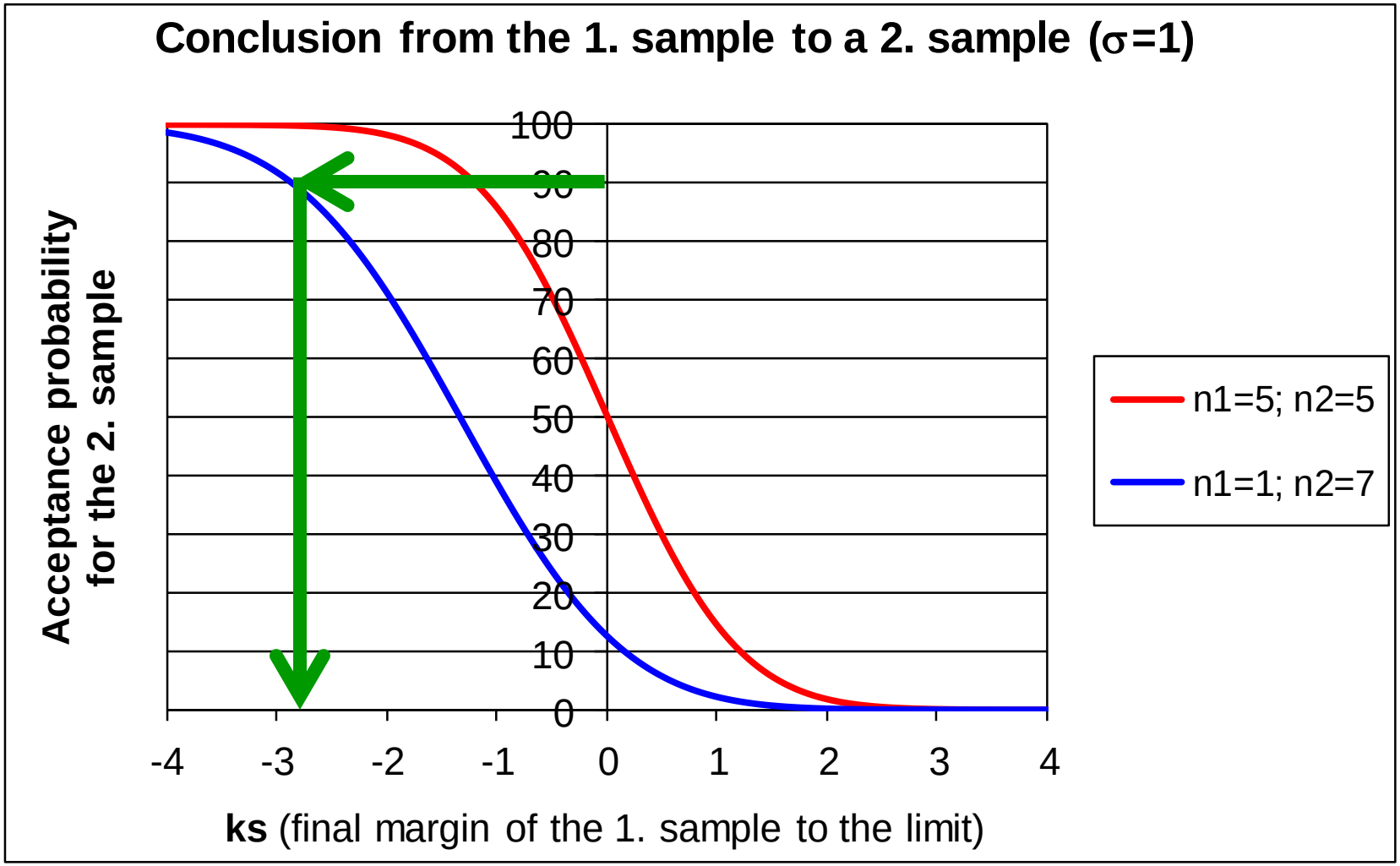
Often at the moment, when the decision about the start of a mass production has to be made, no sample of 5 EUT is available.
The manufactuer measures one single prototype.
But from experience he knows, that the standard deviation for his kind of product is about 2 dB.

Question:
What margin to the limit is needed to get an acceptance probability of about 90% for a repeated test with n=7?

Answer:
1. Go from 90% on the Y-axis horizontally to the blue curve (n1=1, n2=7).
2. Go from the point on the blue curve vertically down and find a k_S about 2,8
3. Multiply the k_S with the assumed σ = 2,0 and conclude:

→ The required margin is about 5,6 dB.

Illustration to example 2:



Conclusions

- The 80%/80% rule not only sets clear requirements for the statistical evaluation on a limited sample of EUT out of a mass production, but allows also to predict the acceptance probability for a repeated test.

- A manufacturer, knowing the typical standard deviation of RFI measurements on his products, can – using the 80%/80% rule - estimate the required margin to the limit already with a single prototype.

- Having such clear definitions is an advantage for any user of the standards. Therefore the 80%/80% rule shall remain to be an integral part of the CISPR limits.