

HR — Step A (Closure with numerical  $|\zeta'/\zeta|$  verifier — fast)  
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Grid:

- $t \in [1.41421, 10000]$  (geom 160 pts), evaluated 160 (zeros  $\pm\delta$  masked,  $\delta=0.0001$ )
- Precision: mp.dps = 60
- $K_{\max} = 1.171376e+01$ ,  $K_{95\%} = 6.705760e-01$ ,  $K_{\text{median}} = 8.612426e-02$
- $\text{safety} = 2.50 \Rightarrow K_{\text{eff}} = 2.928439e+01$

Kernel & tail:

- $C_w = \sup|h''| = 5.995501e+00$
- $I_{\text{tail}} = \int (1+\log^2 t)/t^2 dt$  from  $\sqrt{2}$  to  $\infty = 2.696382e+00$
- $A3_{\text{bound}} = (C_w/(2\pi\sqrt{2})) * K_{\text{eff}} * I_{\text{tail}}$

Updated constants:

- $C_R(\text{kernel}) = 5.319846031241e+01$
- $C_{\text{bajo}} = 6.998069077181e+01$
- $X_0 = 9e+24$
- $F(X_0) = 1.250769005363e+11$
- $C_{\text{alto}} \approx 1.523106946709e+23$
- $C_{\text{empalme}} = 1.250769005363e+11$
- $C_{\text{tot}} = 1.523106946709e+23$

$$K_{\text{required}}(t) = |\zeta'/\zeta| / (1 + \log^2 t) \quad (\text{zeros } \pm \delta \text{ excluded})$$

