Conclusions from the simulation:

- Since the increased chimney flow can not enter from the sides it must pass the throat:
  - The chimney has a sucking action!!
- The simulation neglects this: too simplified!
- A longer parallel chimney enhances the effect but this has a limit defined by the throat to orifice diameter ratio
- A tapered chimney increases the effect for an identical length, in theory there is no limit

Research: Dimensional ratios

- The Zeuner momentum equation can be developed into versions for parallel, tapered and parallel + diffuser chimneys.
- Applying these equations to the BR Rugby locomotive test results yields from a factor analysis:
- Chimney throat / Orifice diameter: 2.9 - 3
- Orifice to throat distance / Orif. diam: 6 - 7
- Chimney length / Throat diameter: >2

Improvement of front-ends

- Orifice shapes
- Chimney taper increase
  - This has a practical limit: flow detachment
  - A Diffuser chimney needs a fully developed entrance flow
- Multiple orifices

Diffuser chimneys: limits

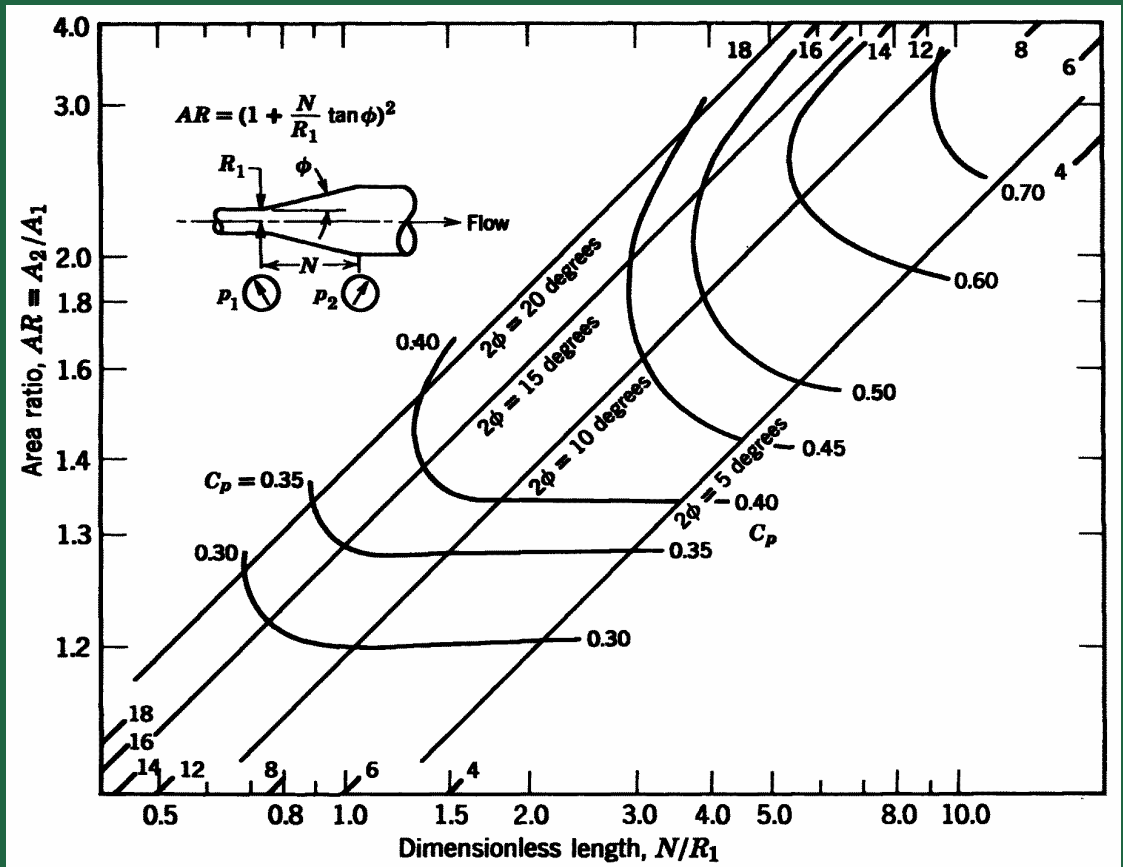
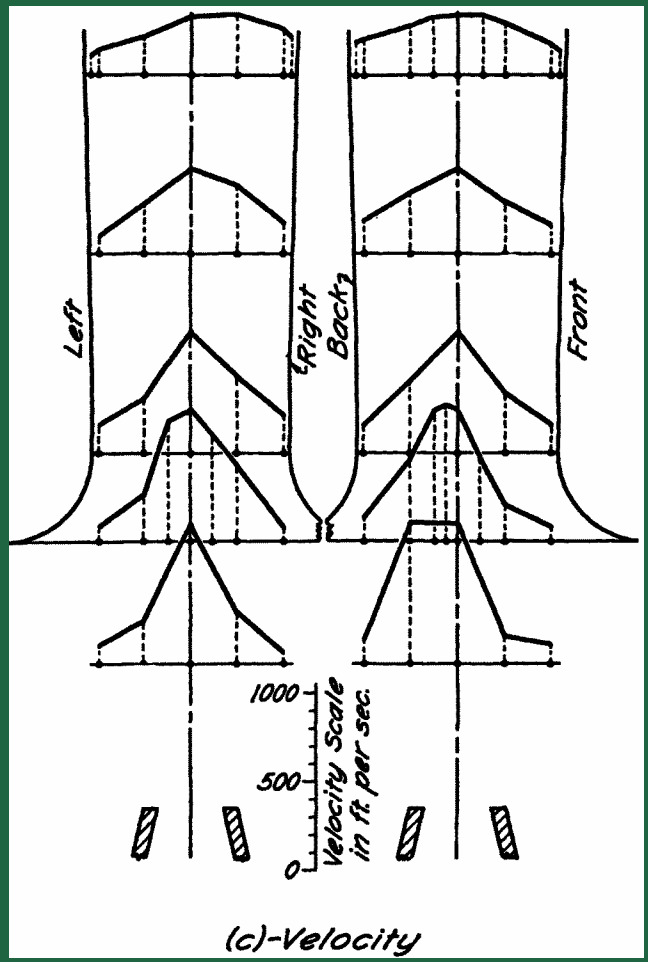
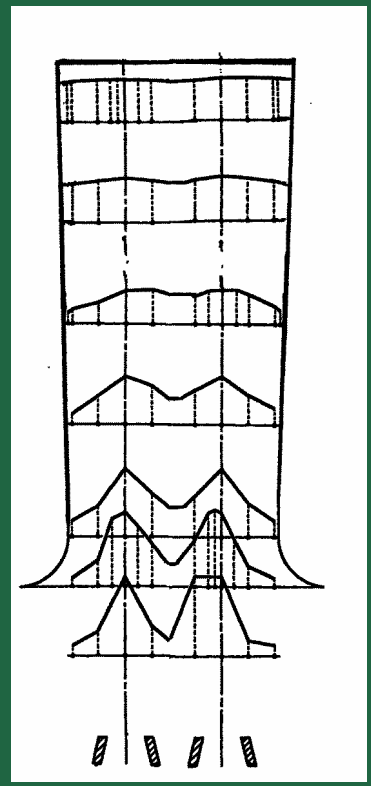


Fig. 8.18 Pressure recovery data for conical diffusers with fully developed turbulent pipe flow at inlet. (Data from [10].)

Multiple orifices: Why do they work?

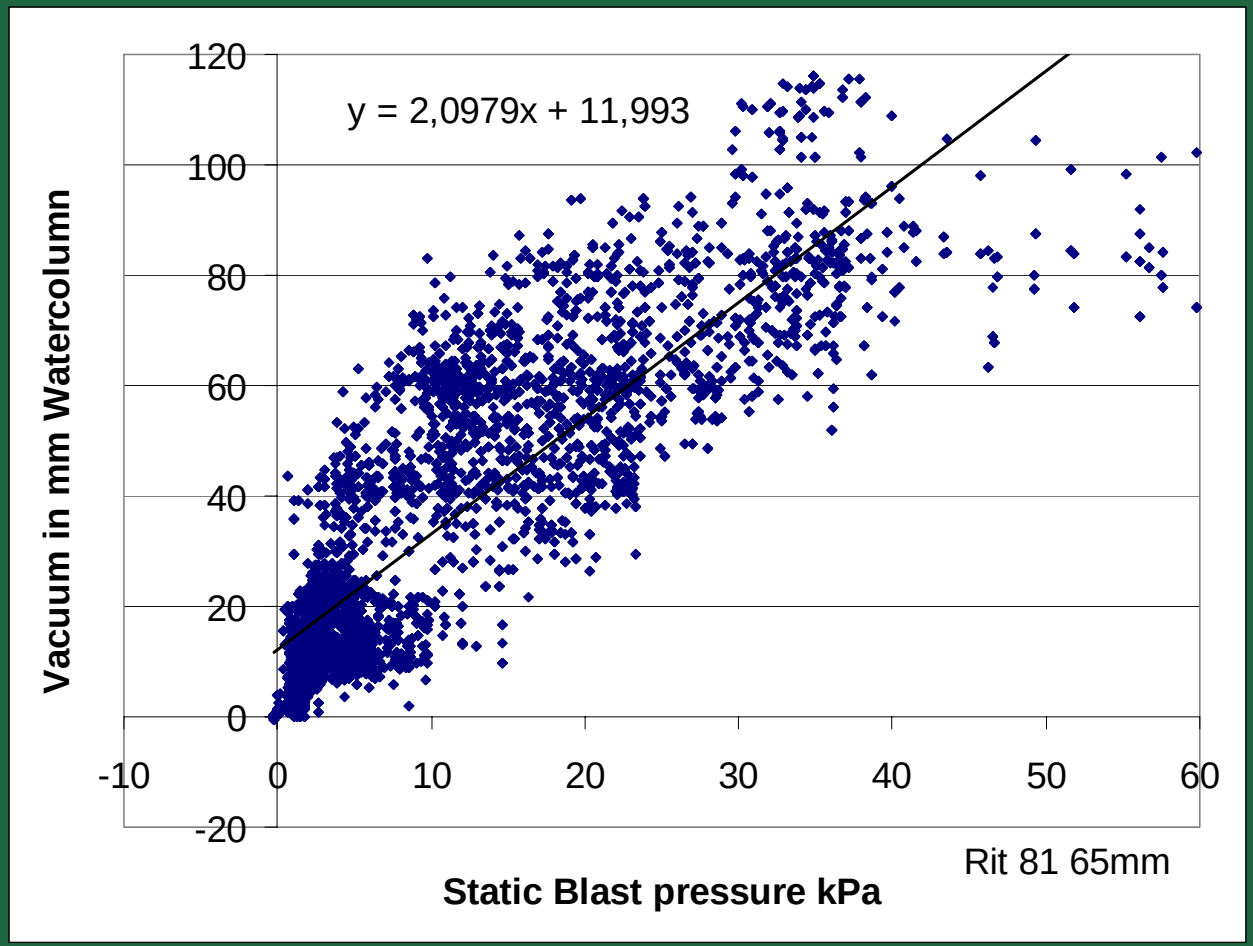




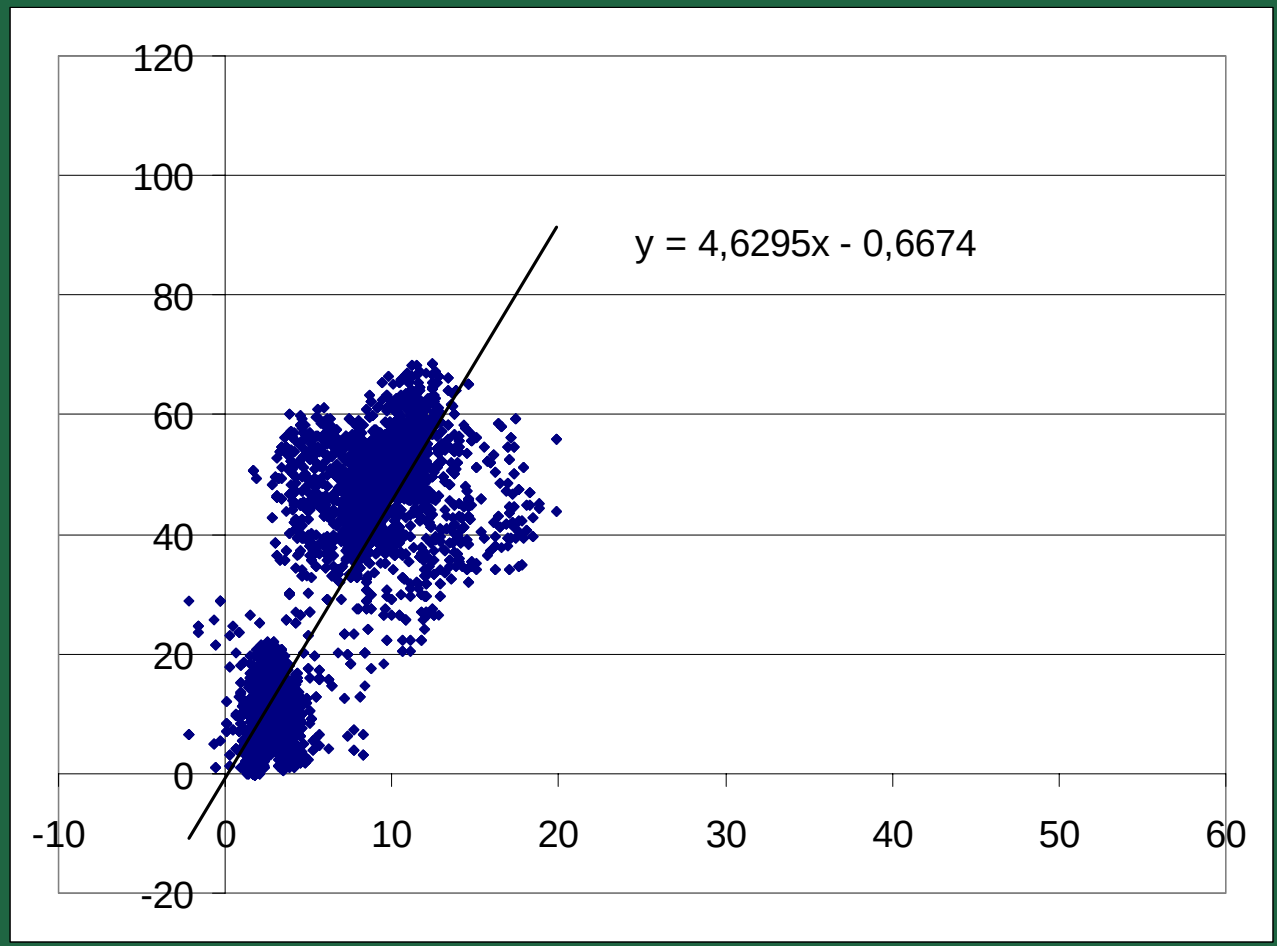
RTM 54 front-end tests

RTM 54 tests: orifices tested

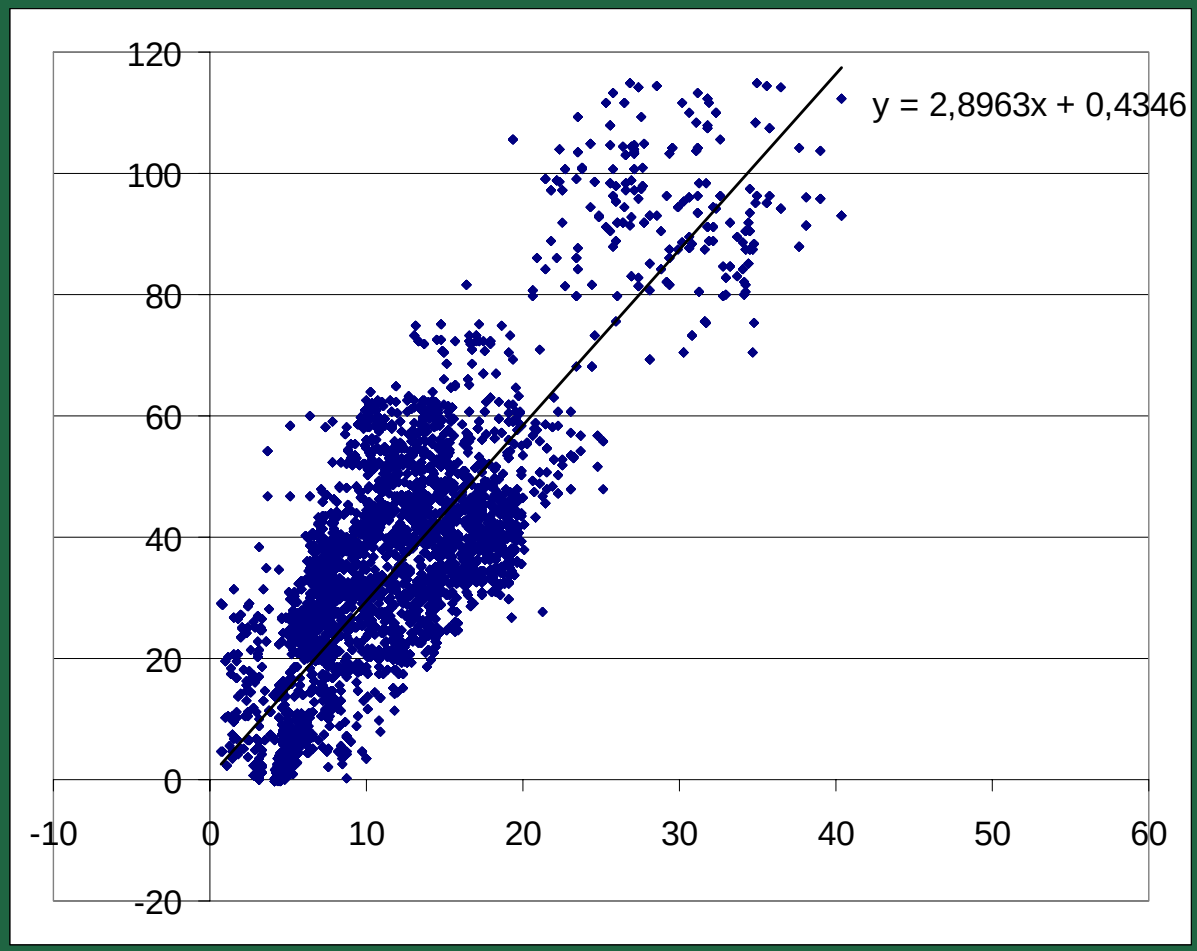
RTM 54 tests: 65 mm orifice (orig.)



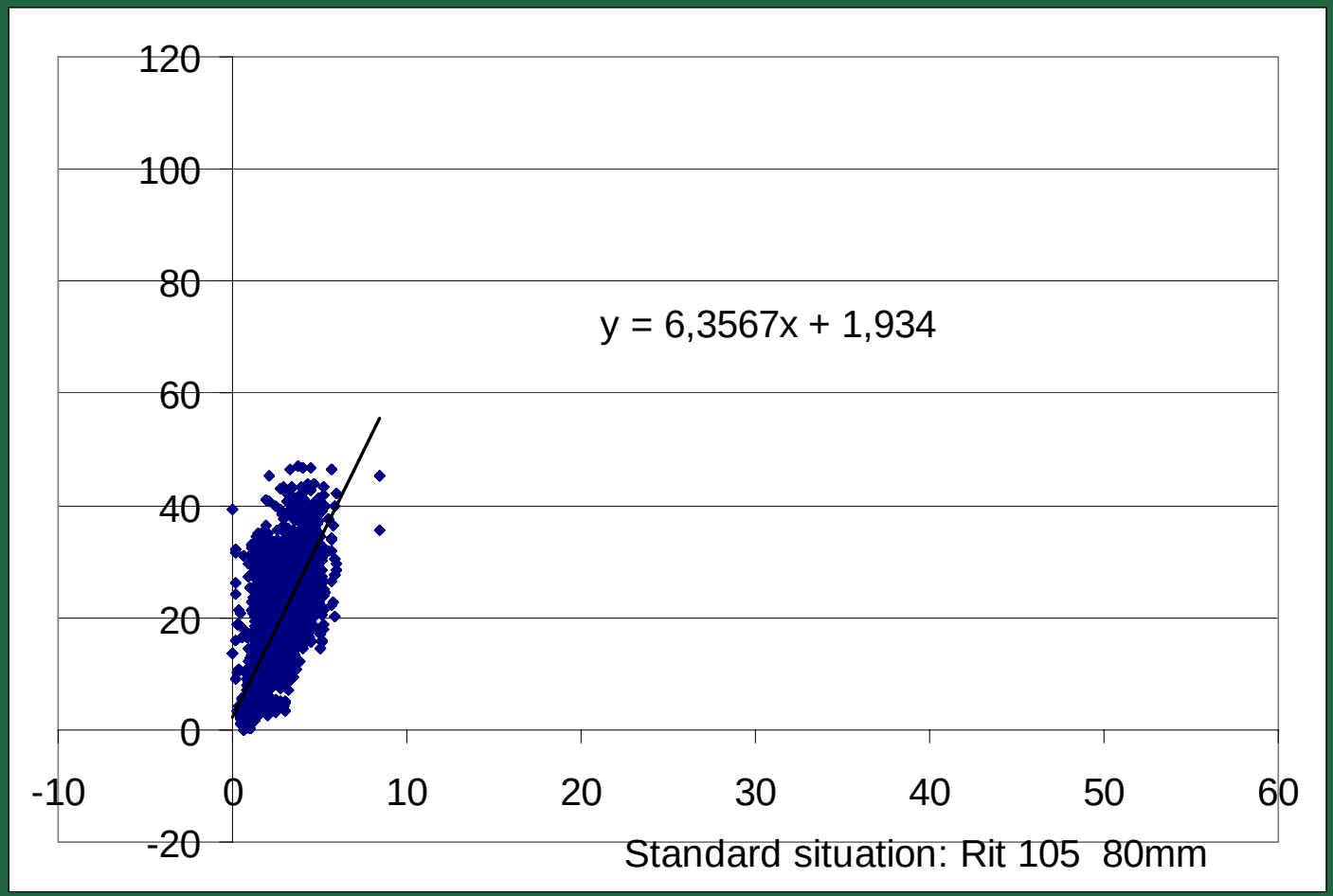
RTM 54 tests: 4x40 mm orifices



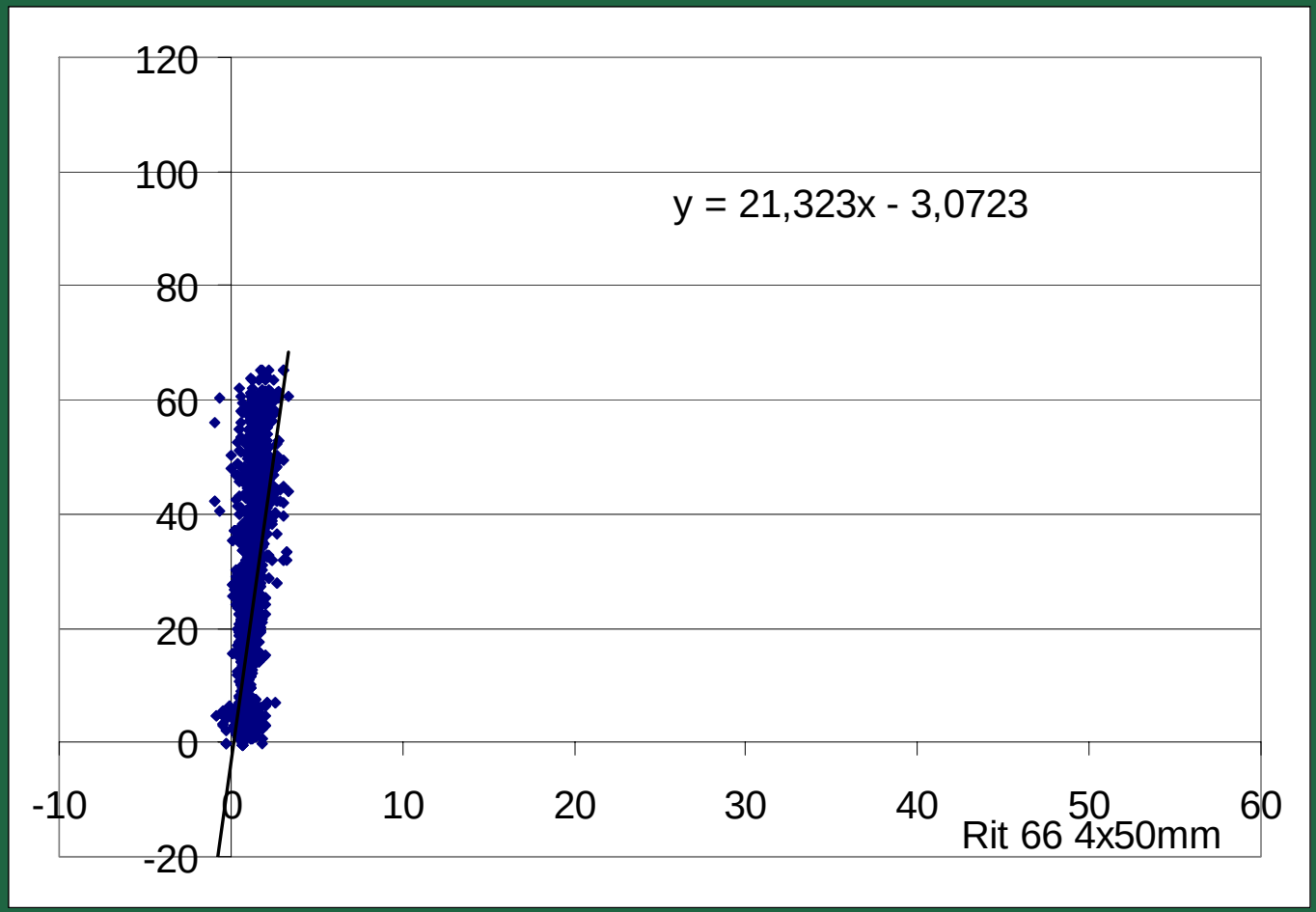
RTM 54 tests: “square+Gf” orifice



RTM 54 tests: 80 mm orifice (std)



RTM 54 tests: 4x50 mm orifices



Conclusion and Recommendations

- Any steam locomotive can have its front-end improved
- Check the dimensional ratios of front-end
- Apply a multiple orifice blast cap