

AIChE® Equipment Testing Procedure

TRAYED AND PACKED COLUMNS

A Guide to Performance Evaluation

Third Edition

Prepared by the Equipment Testing Procedures Committee of the
American Institute of Chemical Engineers

AIChE Equipment Testing Procedure
Trayed and Packed Columns

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AICHE Equipment Testing Procedure

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100.0 PURPOSE AND SCOPE

101.0 Purpose

This testing procedure offers methods of conducting and interpreting performance tests on trayed and packed distillation columns. Such tests are intended to accumulate reliable data in one or more of the following areas of interest: mass transfer efficiency, capacity, energy consumption and pressure drop. It is intended to be used as a guideline for a column performance test and not as a substitute for a vendor's acceptance test.

Possible uses of such data include:

- Troubleshooting performance problems
- Identifying capacity bottlenecks
- Determining if column performance meets vendor guarantees (“acceptance test”)
- Developing basic data for new designs
- Developing correlations
- Determining the operating range of a column
- Defining optimum operating conditions
- Calibrating computer simulations for use in optimizing, debottlenecking and design studies.

102.0 Scope

Rather than compulsory directions, this book offers a collection of techniques presented to guide the user, and emphasis is placed on principles, rather than on specific steps. It applies to columns that operate either at steady state or at total reflux. It does not apply to batch columns in which compositions are changing with time unless they are operated at total reflux or with distillate returned to the still pot during the test.

The procedure applies to both trayed and packed columns of any type. The tests determine the composite performance of the trays, packing, and any associated distributors and other auxiliary internals inside the column. It is important to realize that capacity may be restricted by these auxiliaries, particularly for packed towers.

This procedure does not apply to external testing of distributors or other internals.

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200.0 DEFINITION AND DESCRIPTION OF TERMS

201.0 Flow Quantities (Refer to Figure 1)

201.1 *Feed* is the material to be separated, including multiple feed streams.

201.2 *Bottoms* describes the high-boiling product leaving the bottom of the column (or the reboiler).

201.3 *Distillate* is the product distilled overhead. It may leave the distillation system as a vapor, liquid, or a combination of both.

201.4 *Side-stream Product* is product withdrawn from an intermediate section of the column.

201.5 *Overhead Vapor* designates the vapor from the top of the column and includes material to be condensed for reflux. It is the combined distillate and external reflux.

201.6 *Reflux* is used to designate the quantity of liquid returned to the column.

201.6.1 *External (Overhead) Reflux* is the quantity of liquid returned to the top of the column. External reflux may be subcooled, which can result in increased internal reflux.

201.6.2 *Internal Reflux* is the calculated quantity of liquid leaving the top theoretical stage inside the tower. The internal reflux is different from the external reflux in that it is in thermal equilibrium with the top theoretical stage inside the tower.

201.6.3 *Pumparound* is the quantity of liquid withdrawn from, and returned to, the column after being cooled. A pumparound can be subcooled, and then returned to the tower at a location other than the top. A pumparound is sometimes called *Circulating Reflux*.

201.6.4 *Reflux Ratio* is the ratio of the external reflux flow to the distillate. Some applications may use the ratio of external reflux flow to feed to represent the reflux ratio.

201.7 *Throughput* refers to the combined liquid and vapor traffic passing through a cross section of the column.

201.7.1 *Internal Liquid* is the calculated quantity of liquid flowing from point to point in the column.

201.7.2 *Internal Vapor* is the calculated quantity of vapor passing from point to point in the column.

201.7.3 *Entrainment* is the liquid carried upward by the vapor stream from one point to another.

201.7.4 *Weeping* is the liquid that flows downward through the deck openings in trayed towers.