development, manufacture, and quality assurance (QA). These tools, when used within a system, can provide effective and efficient means for acquiring information to facilitate process understanding, develop risk-mitigation strategies, achieve continuous improvement, and share information and knowledge. In the PAT framework, these tools can be categorized as follows:

- Multivariate data acquisition and analysis tools
- Modern process analyzers or process analytical chemistry tools
- Process and endpoint monitoring and control tools
- Continuous improvement and knowledge management tools

An appropriate combination of some, or all, of these tools may be applicable to a single-unit operation or to an entire manufacturing process and its QA. A variety of sophisticated software, such as RAPID-Pharma (2), are now available to consolidate many functions required to manage the initiatives related to PAT.

8.2.1 Specifications

The following tests and acceptance criteria are considered generally applicable to all new drug substances.

8.2.1.1 Description

Description is a qualitative statement about the state (e.g., solids and liquids) and color of the new drug substance. If any of these characteristics changes during storage, this change should be investigated, and appropriate action needs to be taken.

8.2.1.2 Identification

Identification testing should optimally be able to discriminate between compounds of closely related structures that are likely to be present. Identification tests should be specific for the new drug substance, for example, infrared (IR) spectroscopy. Identification solely by a single chromatographic retention time, for example, is not regarded as being specific. However, the use of two chromatographic procedures, where the separation is based on different principles or a combination of tests into a single procedure, such as high-pressure liquid chromatography (HPLC)/ultraviolet (UV) diode array, HPLC/mass spectroscopy (MS), and gas chromatography (GC)/MS, is generally acceptable. If the new drug substance is a salt, identification testing should be specific for the individual ions. An identification test that is specific for the salt should suffice.

8.2.1.3 Chirality

New drug substances that are optically active may also need specific identification testing or performance of a chiral assay. For chiral drug substances that are developed as a single enantiomer, control of the other enantiomer should be considered in the same manner as for other impurities. However, technical limitations may preclude the