For test with gas:

\[ W_T = \text{CAP} \sqrt{\frac{M}{ZT}} \]

where

\[ A = \text{actual discharge area through the valve at developed lift, in}^2 \text{ (mm}^2) \]

\[ C = \text{constant for gas or vapor which is a function of the ratio of specific heats, } k \]

\[ k = \frac{c_p}{c_v} \text{ (see Section III Appendices, Mandatory Appendix XVIII, Figure XVIII-1110-1)} \]

\[ M = \text{molecular weight} \]

\[ P = \text{(set pressure} \times 1.03) \text{ plus atmospheric pressure, psia (kPa abs), or set pressure plus 2 psi (15 kPa) plus atmospheric pressure, whichever is greater, for test pressures determined by NB-7731.3(a)} \]

\[ = \text{(set pressure} \times 1.10) \text{ plus atmospheric pressure, psia (kPa abs), or set pressure plus 3 psi (20 kPa) plus atmospheric pressure, whichever is greater, for test pressures determined by NB-7731.3(b) or (c)} \]

\[ T = \text{temperature at inlet, } ^\circ\text{F} + 460 \text{ (K)} \]

\[ Z = \text{compressibility factor corresponding to } P \text{ and } T \]

The average of the coefficients of discharge \( K_D \) of the tests required shall be multiplied by 0.90, and their product shall be taken as the coefficient \( K \) of that design. The coefficient of the design shall not be greater than 0.878 (the product of 0.9 \times 0.975).

(b) If any of the experimentally determined coefficients fall outside of a range of ±5% of the average coefficient, the unacceptable valves shall be replaced by two valves of the same size and set pressure. Following the test of these valves, a new average coefficient shall be determined, excluding the replaced valve test results. If any individual coefficient is now outside of the ±5% range, then the test shall be considered unsatisfactory and shall be cause for the ASME Designated Organization to refuse certification of the particular valve design.

**NB-7734.3 Calculation of Certified Capacity.**

(a) The certified capacity of all sizes and pressures of a given design, for which the value of \( K \) has been established under the provisions of NB-7734.2 and which are manufactured subsequently, shall not exceed the value calculated by the appropriate equation multiplied by the coefficient \( K \).

(b) The coefficient shall not be applied to valves whose beta ratio (the ratio of valve throat and inlet diameter) lies outside the range of 0.15 to 0.75, unless tests have demonstrated that individual coefficients of discharge, \( K_D \), for valves of the extreme ends of a larger range is within ±5% of the average coefficient, \( K \). For designs where lift is used to determine the flow area, all valves shall have the same nominal lift-to-seat diameter ratio \( (L/D) \).

**NB-7734.4 Demonstration of Function.** Tests shall be conducted as prescribed in NB-7732.2.

**NB-7735 Single Valve Method**

**NB-7735.1 Valve Capacity Within Test Facility Limits.**

(a) When a single valve is to be capacity tested, the certified capacity may be based on three separate tests associated with each set pressure for which capacity certification is required.

(b) The certified capacity associated with each set pressure shall not exceed 90% of the average capacity established by the tests. Failure of the individual test capacities to fall within ±5% of the average capacity associated with each set pressure shall be cause for rejection of the test. The reason for the failure shall be determined, and the test repeated.

(c) Should additional valves of the same design be constructed at a later date, the results of the tests on the original valve may be included as applicable to the particular test method selected.

**NB-7735.2 Valve Capacity in Excess of Test Facility Limits.** For valves whose pressure exceeds that of the test facility, the certified capacity may be based on a flow coefficient \( K \) (NB-7734.2) determined from either blocked open flow tests or flow model tests, provided the orifice area is such that choked flow conditions are obtained. The certified capacity shall be calculated as directed in NB-7734.3.

**NB-7735.3 Valve Demonstration of Function.** Tests shall be conducted as prescribed in NB-7732.2, except that one valve of the specific inlet size, orifice size, and specific design shall be tested. Should additional valves of the same design be constructed at a later date, the results of the tests on the original valve may be included as applicable to meet the three valve requirement of NB-7732.2.

**NB-7736 Proration of Capacity**

(a) The capacity of a pressure relief valve applied to a system may be prorated to an overpressure greater than the overpressure for which the valve design is certified. This overpressure shall be within the allowable limits of the system.

(b) Depending on the method used for the initial capacity certification:

(1) the prorated capacity shall be 90% of the average slope determined in NB-7733 multiplied by the prorated relieving pressure, psia (kPa abs); or

(2) the prorated capacity shall be calculated using the appropriate equation from NB-7734.2 [where \( P \) is the prorated relieving pressure (psia) multiplied by the coefficient \( K \)].

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in no case shall the stamped burst pressure of the rupture
disk at the operating temperature plus any pressure in
the outlet piping from the rupture disk device exceed
the limits of NB-7400;

(d) the opening provided through the rupture disk de-
vice after burst is sufficient for the pressure relief valve
to flow at its certified capacity.

**NB-7700 CERTIFICATION**

**NB-7710 RESPONSIBILITY FOR CERTIFICATION
OF PRESSURE RELIEF VALVES**

The Certificate Holder shall be responsible for having
the relieving capacity of its valves certified as prescribed
in this subarticle.

**NB-7720 RESPONSIBILITY FOR CERTIFICATION
OF NONRECLOSING PRESSURE RELIEF
DEVICES**

The rupture disk Manufacturer shall certify the
stamped burst pressure of the disk.

**NB-7730 CAPACITY CERTIFICATION
OF PRESSURE RELIEF VALVES —
COMPRESSIBLE FLUIDS**

**NB-7731 General Requirements**

**NB-7731.1 Capacity Certification.**

(a) Capacity certification procedures shall be as re-
quired in NB-7732 through NB-7737.

(b) Capacity certification tests of pressure relief valves
for air and gas service shall be conducted with air, gas, or
dry saturated steam.

(c) The capacity certification tests shall be performed
using the same fluid media to which the pressure relief
valve is expected to be exposed in service.

**NB-7731.3 Test Pressure.**

(a) Capacity certification tests of pressure relief valves
(except safety relief valves) for steam service shall be con-
ducted at a pressure which does not exceed the set pres-
sure by more than 3% or 2 psi (15 kPa), whichever is
greater, except as permitted in (b).

(b) Capacity certification tests of safety relief valves
(NB-7513) for steam service shall be conducted at a pres-
sure which does not exceed the set pressure by more than
10% or 3 psi (20 kPa), whichever is greater.

(c) Capacity certification tests of pressure relief valves
for the set pressure by more than 10% or 3 psi
for fire or gas shall be conducted at a pressure which does
(20 kPa), whichever is greater.

**NB-7731.4 Blowdown.** Valves having an adjustable
blowdown construction shall be adjusted prior to capacity
certification testing so that the blowdown does not ex-
cess 5% of the set pressure.

**NB-7731.5 Drawings.** Prior to capacity certification
and demonstration of function tests, the Certificate
Holder shall submit drawings showing the valve construc-
tion to the Authorized Observer. The Authorized Obser-
vator shall submit the drawings and all test results to the
ASME Designated Organization for review and
acceptance.

**NB-7731.6 Design Changes.** When changes are made
in the design of a pressure relief valve which affect the
flow path, lift, or performance characteristics, new tests
shall be performed in accordance with this subarticle.

**NB-7732 Flow Model Test Method**

**NB-7732.1 Flow Capacity.** When test facility limita-
tions make it impossible to perform tests of the full-scale
pressure relief valves, flow models of three different sizes
may be utilized as a basis for capacity certification. Such
flow models shall be sized consistent with the capabilities
of the accepted test laboratory where the tests will be
conducted and shall accurately model those features
which affect flow capacity, such as orifice size, valve lift,
and internal flow configuration. The test models need
not be functional pressure relief valves, provided that
other tests are conducted to demonstrate proper function
of the valve design as prescribed in NB-7732.2. The
relieving capacity of valve designs certified by the use of
flow models shall be established by the coefficient of dis-
charge method similar to that outlined in NB-7734.1 and
NB-7734.2. The certified relieving capacity of all sizes and
pressures of a given design for which the value of \( K \) has
been established, based on flow model tests in accordance

\[
(0.1906P - 1,000) / [0.2292P - 1,061]
\]

\[
(27.6P - 1,000) / [33.2P - 1,061]
\]

where

\( P \) = set pressure, psig

This correction is also applicable to the certified reliev-
ing capacity as determined by the curve method. This cor-
rection shall only be used if it is 1.0 or greater.

**NB-7731.2 Test Media.**

(a) Capacity certification tests of pressure relief valves
for steam service shall be conducted with dry saturated
steam. For test purposes, the limits of 90% minimum
quality and 20°F (10°C) maximum superheat shall apply.
Capacity shall be corrected to the dry saturated condition
from within these limits.