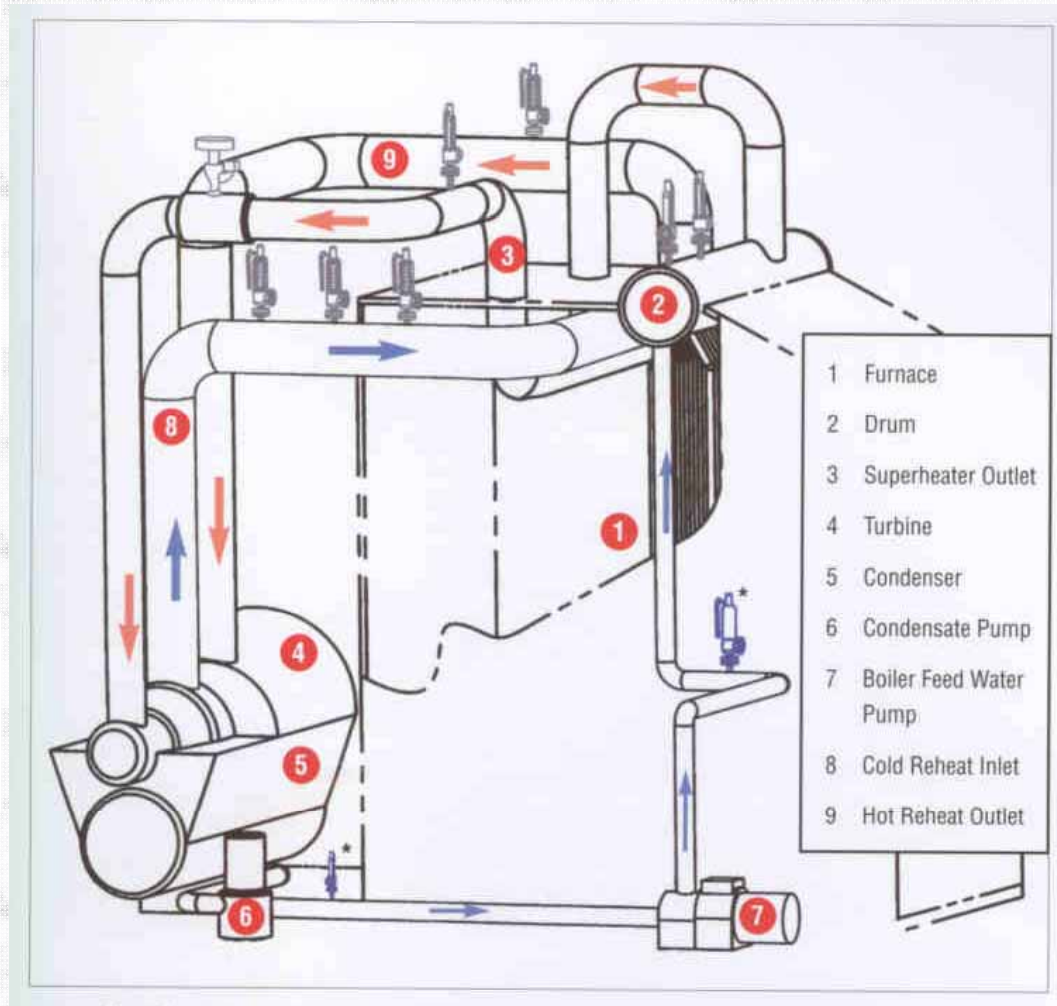
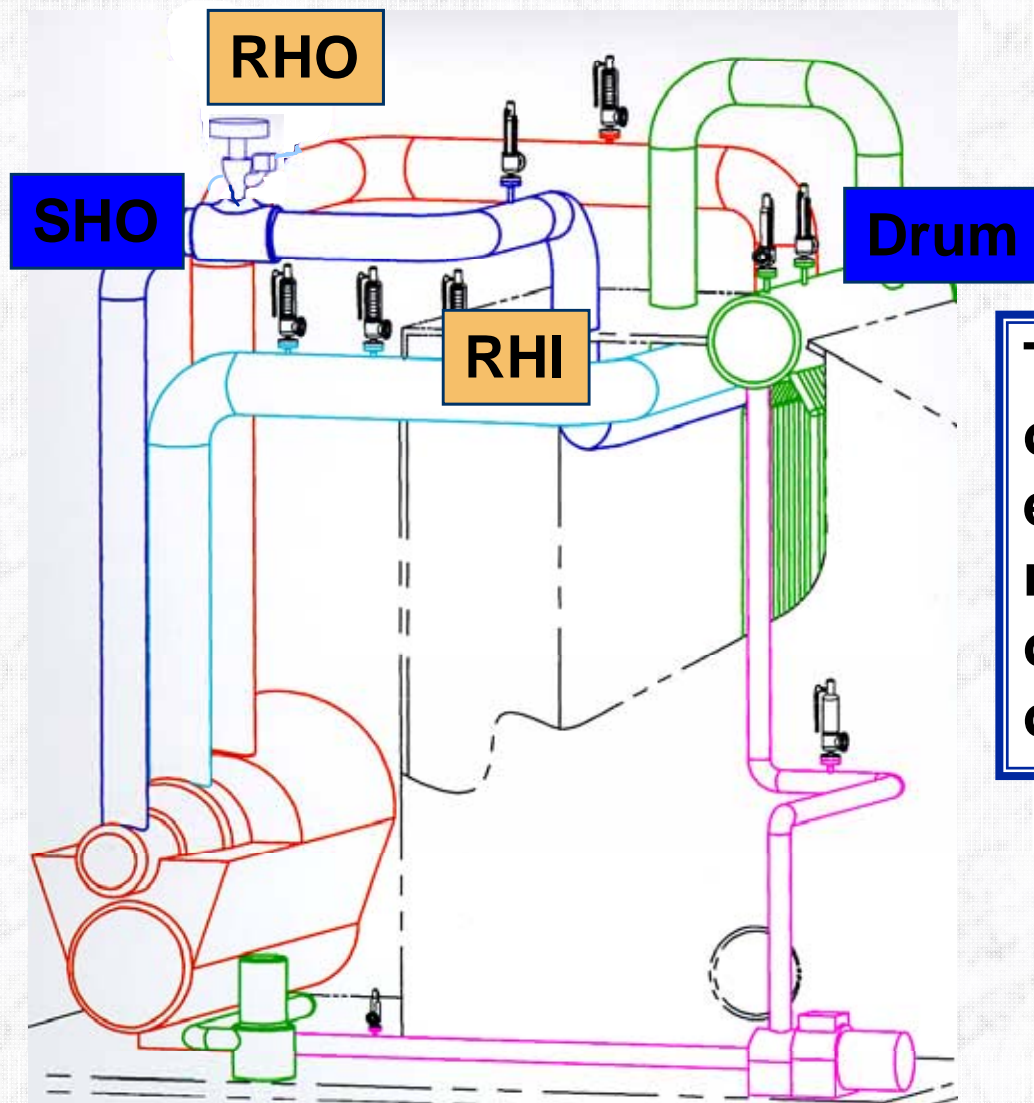


Section I Boiler Safety Valve Sizing & Selection

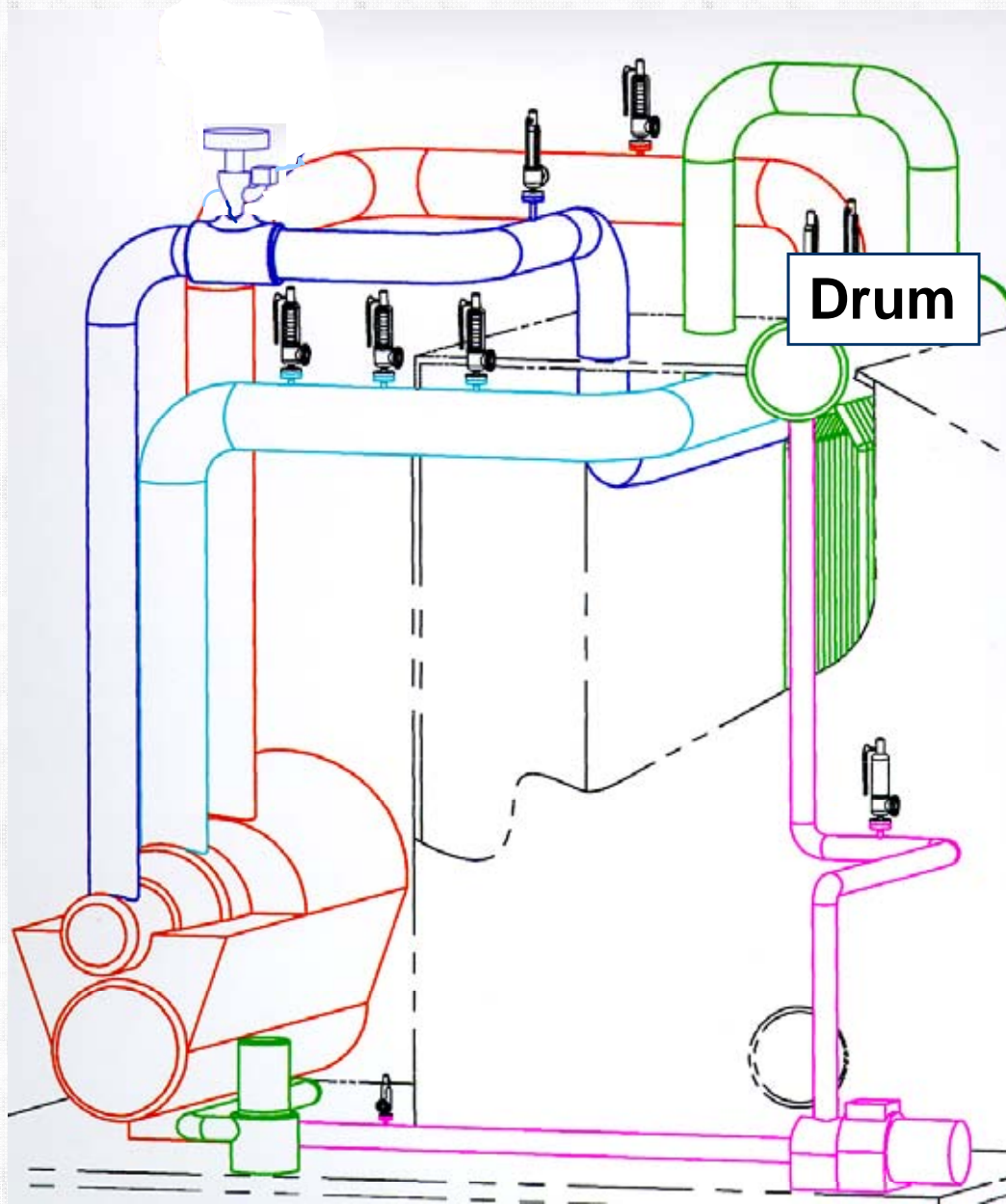


Boiler Set Sizing



Total Relieving Capacity of all Code valves must be equal to or greater than the maximum continuous rating of the boiler(Drum & SHO) or reheater (RHO & RHI).

Boiler Set Sizing

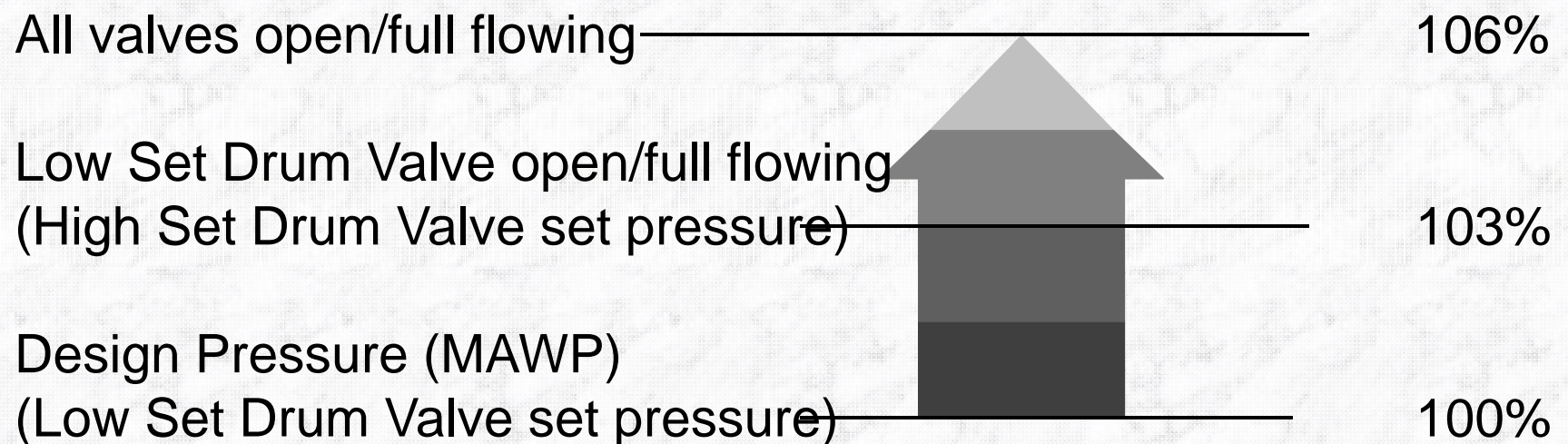


Steam Drum Valves must relieve a minimum of 75% of boiler capacity.

Basic Section I Sizing Rules

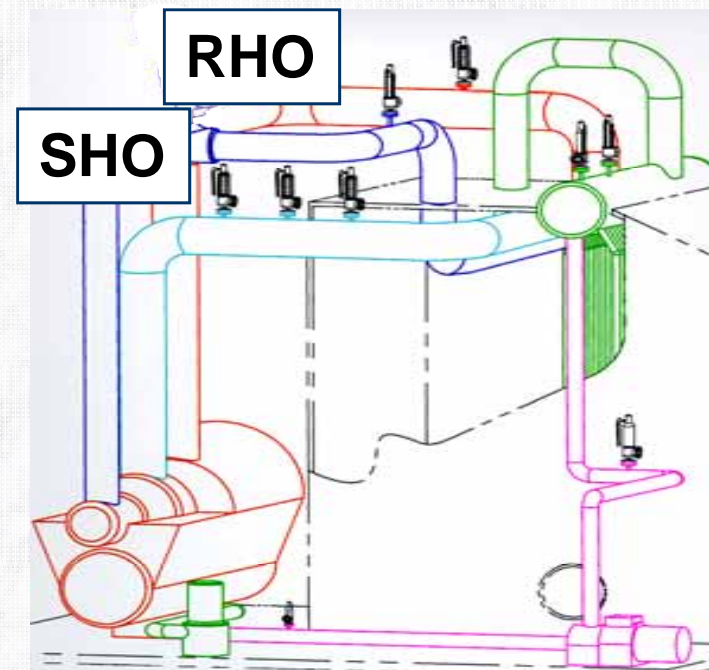
Basic Section I Sizing Rules

- Low set drum valve set at design pressure
- Other valves shall have staggered settings
- Not permitted to rise more than 6% above MAWP, taking into account 3% accumulation



Sizing

- **Basic Section I Sizing Rules**
 - **Superheater outlet safety valve must be set to insure opening prior to drum safeties**



Data Needed to Properly Select Boiler Safety Valve Set

- Total Boiler Capacity
- Maximum Allowable Working Pressure (MAWP)
- Drum Operating pressure
- Superheater Operating Pressure
- Superheater Operating Temperature

For Units with Reheaters:

- Capacity
- MAWP
- Inlet Operating Pressure
- Inlet Temperature
- Outlet Operating Pressure
- Outlet Operating Temperature



Sizing

- To determine SHO Safety Valve Set Pressure, the pressure drop through the superheater must be considered:
- To determine the pressure drop:
 - Drum Operating Pressure
 - Less SHO operating pressure

=

Superheater Pressure Drop

Sizing

- Superheater SV Set Pressure is then determined by:
 - Design Pressure
 - Less SHO pressure drop
 - Less 20 PSIG safety factor*

=

Superheater Set Pressure

Application: Recommended Valve Selection

System	15-600 (psig)	601-2000 (psig)	2001-3000 (psig)
DRUM	HSJ/HL	HCI	HE
SUPERHEAT OUTLET	HSJ/HL	HCI	HCI
REHEATER OUTLET	HSJ/HL	HCI	HCI
REHEATER INLET	HSJ/HL	HCI	HCI

Boiler Specifications

Total steam generation:	813,036 lbs/hr
Design Pressure:	2190 psig
Drum Operating Pressure:	2018 psig
SHO Operating Pressure:	1948 psig
SHO Design Temp:	1064°F
SHO Operating Temp:	1054°F

ASME Code Requirements

- Drum valves must relieve a minimum of 75% of total required relieving capacity.
- Two drum valves typically required.



Drum Safety Valves Capacity

- To determine minimum flow through all drum valves:
 $813,036 \text{ lbs/hr} \times .75 = 609,777 \text{ lbs/hr}$
- Approximate flow through each valve:
 $609,777 \div 2 = 304,888.5 \text{ lbs/hr (per valve)}$

Drum Safety Valves Set Pressures

- To determine drum valve set pressures:
 - Low set valve = 2190 psig (design pressure)
 - High set valve = 2254 psig (design pressure x 1.03)

Valve Capacity

- **Saturated steam capacities (Catalog CROMC-0295):**
 - Smallest valve to flow approximately 304,888 lbs/hr – K2 orifice
- **Low set drum K2 orifice-**
 - 2190 psig @ sat steam 274,145 lbs/hr
- **High set drum M orifice-**
 - 2254 psig @ sat steam 401,428 lbs/hr
- **Total through both valves: 675,573 lbs/hr**

SHO Valve Capacity

- **The balance of the total required capacity must pass through the superheater outlet safety valve (typically between 15% - 25% of total capacity).**

SHO Valve Capacity

- Minimum SH Outlet Valve flow for this example:

Total required capacity:	813,036 lbs/hr
Less total drum valve capacity:	675,573 lbs/hr
Minimum SH capacity:	<hr/> 137,463 lbs/hr

SHO Valve Set Pressure

- To determine Superheater Outlet Valve Set Pressure, the pressure drop through the superheater must be considered:

To determine the pressure drop:

Drum operating pressure: 2018 psig

Less SH outlet operating pressure: - 1948 psig

Superheater pressure drop: 70 psig

SHO Valve Set Pressure

- **Set Pressure is then determined by:**

Design pressure: 2190 psig

Less SH outlet pressure drop: - 70 psig

Less safety factor*: - 20 psig

SHO valve set pressure: 2100 psig

* Safety factor provided by Crosby Engineering to ensure SHO safety valve opens first.

Valve Capacity

- **Saturated Steam Capacities (Catalog CROMC-0295):**
Smallest valve to flow a minimum of 137,463 lbs/hr – K2 orifice
SHO Safety Valve -
2100 psig @ 1054°F*: 192,014 lbs/hr

* At set pressure, SHO operating temperature is above sat steam temperature, therefore K2 saturated capacity is multiplied by correction factor (Ksh) is 0.736.

Boiler Set Safety Valve selection

<i>Location</i>	<i>Valve Size</i>	<i>Valve Model</i>	<i>Set Pressure (PSIG)</i>	<i>Temp (F)</i>	<i>Capacity (Lbs/Hr)</i>	<i>% of Total Capacity</i>
Low Set Drum Safety Valve	2-1/2 K2 6	HE-86	2190 PSIG	Sat. Steam	274,145 Lbs/Hr	
High Set Drum Safety Valve	3 M 6	HE-86	2254 PSIG	Sat. Steam	401,428 Lbs/Hr	
Total Flow thru Drum SV's					675,573 Lbs/Hr	83.1%
SHO Outlet Safety Valve	2-1/2 K2 6	HCI-99	2100 PSIG	1054F	192,014 Lbs/Hr	23.6%
Total Flow thru all SV's					867,587 Lbs/Hr	106.7% of MCR

Safety Valve Sizing & Selection

- **Boiler Set Sizing Program**
 - **Available September 2007**
 - **Datasheets / Calculation Sheets**
 - **Marketing-linked catalog pdf's**
 - **Reaction Forces**
 - **Noise Calculations**