Control Valve Materials for ~600-750°F Services

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Background

- **For a 6” Emergency Isolation Valve (ESD) in a non-corrosive service, Fluor specified:**
  - Body: CS
  - Ball: 13% Cr and
  - Stem: 13% Cr
- **The Operating and Design Conditions were:**
  - Temperature: 638 / 725°F
  - Pressure: 25 / 240 psig
- **There were no special materials or fabrication requirements.**
- **We realize that valve suppliers often need to upgrade materials to meet various strength or other mechanical design requirements, and**
- **We were willing to review any proposed changes, but …**

Proposed Materials – Cases 1 and 2

- One proposed valve after another had materials that were not appropriate for the temperature.
- Cases 1 and 2:
- SUS329J1 was proposed for seat in one valve and the stem in another

SUS329J1
Chemical composition, standards and properties

Grade :	SUS329J1
Classification:	Corrosion-resisting / heat-resisting steel Austenitic-ferritic steel

Chemical composition 成分 % of grade SUS329J1

C	Si	Mn	P	S	Ni	Cr	Mo
max 0.08	max 1	max 1.5	max 0.04	max 0.03	3 - 6	23 - 28	1 - 3

Proposed Materials - Cases 1 and 2

- This is a Japanese duplex SS grade,
- However, we are concerned with the embrittlement and loss of properties on duplex SS operating above ~600°F,
- These concerns are in lots of references; one is shown on the next slide,
- Our valve experts reported that even for stems and seats, we would only use materials which codes or material references report to be acceptable for the required temperature.
- One valve brochure with this duplex SS stem, stated that the valve was good to 500°C (932°F),

Limit from B16.34, Valves – Flanged, Threaded and Welding End

Table 2-2.8C Ratings for Group 2.8 Materials

A182 Gr. F44	A240 Gr. S32760 (1)	A479 Gr. S32750 (1)	A790 Gr. S32750 (1)
A182 Gr. F51 (1)	A312 Gr. S31254	A479 Gr. S32760 (1)	A790 Gr. S32760 (1)
A182 Gr. F53 (1)	A351 Gr. CK3MCuN	A789 Gr. S31803 (1)	A995 Gr. CD3MN (1)
A182 Gr. F55	A358 Gr. S31254	A789 Gr. S32750 (1)	A995 Gr. CD3MWCuN
A240 Gr. S31254	A479 Gr. S31254	A789 Gr. S32760 (1)	A995 Gr. CD4MCuN (1)
A240 Gr. S31803 (1)	A479 Gr. S31803 (1)	A790 Gr. S31803 (1)	A995 Gr. CE8MN (1)
A240 Gr. S32750 (1)			

A — Standard Class

Temperature, °F	Working Pressures by Class, psig						
	150	300	600	900	1500	2500	4500
–20 to 100	290	750	1,500	2,250	3,750	6,250	11,250

NOTE: (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 600°F.

- All the duplex SS grades in this table have Note 1 and the 600°F limit.
- Granted this is for bodies, but embrittlement will still occur on stems.
- We asked the valve supplier if they had analyzed this, and how could duplex SS be acceptable, but they had no answer.

Proposed Material – Case 3

- Next, some valve suppliers proposed A564, Type 630 for the stem,
- This is a 17-4 PH SS,
- Lots of sources, including ASTM A564, state that this material should also be limited to 600°F

Max. Temperature for 17-4 PH

Designation: A564/A564M – 13

Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes[1]

1.2 These steels are generally used for parts requiring corrosion resistance and high strength at room temperature, or at temperatures up to 600°F [315°C]; 700°F [370°C] for Type 632; 840°F [450°C] for Type UNS S46910. They are suitable for machining in the solution-annealed condition after which they may be age-hardened to the mechanical properties specified in Section 7 without danger of cracking or distortion. Type

Max. Temperature for 17-4 PH

UNS S17400

- High Strength
- Good Corrosion Resistance
- Good Properties Up To 600°F (316°C)

Final Materials

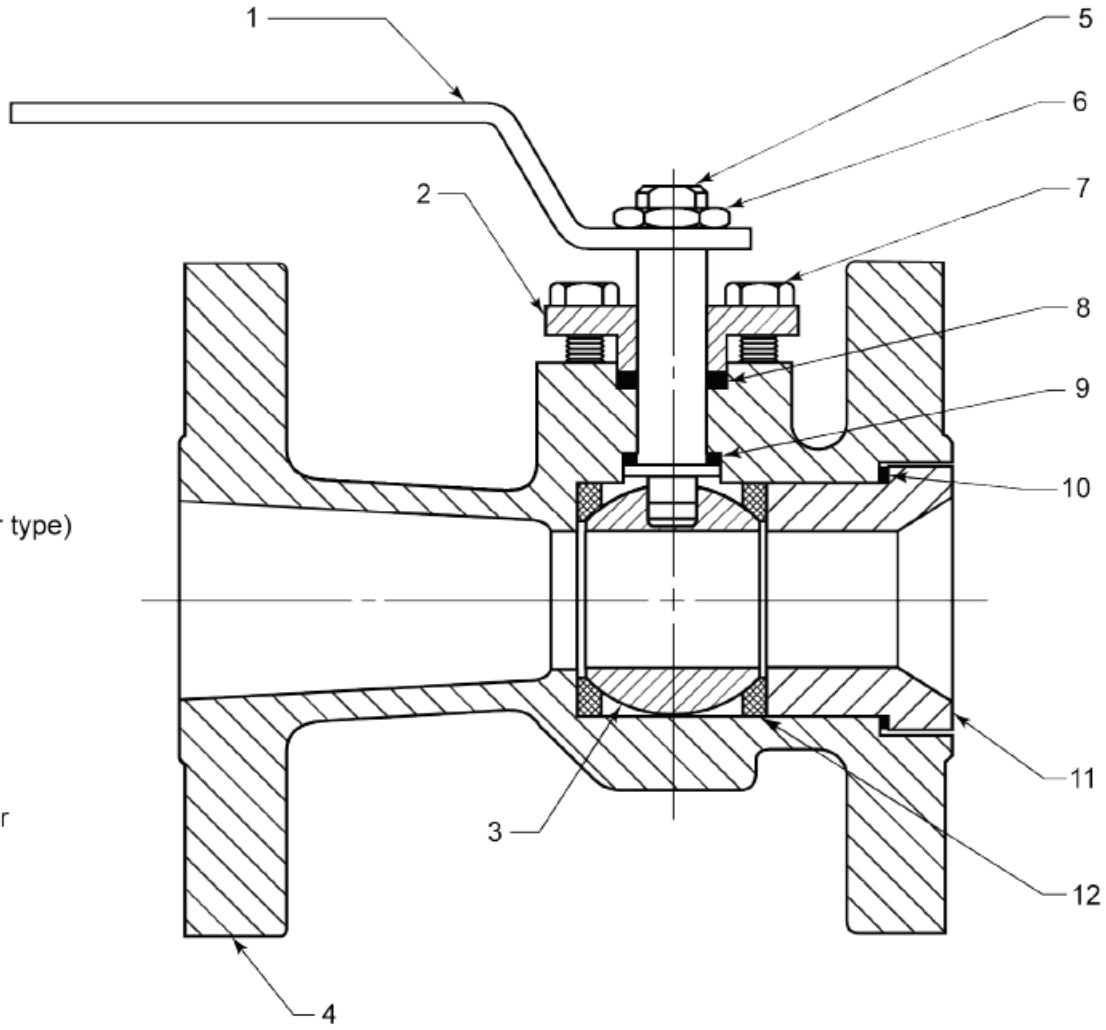
- **Body - CS**
- **Ball and Seat – 316 SS (some sizes with Chrome or Chrome Carbide)**
- **Seat Ring – 316 (some sizes with Chrome Carbide)**
- **Spring Disc – Inconel 718**
- **Stem – A638 Gr. 660 (A286)**

- **This experience shows:**
  - the need for a detailed review of materials, and
  - that valve vendor brochures may show temperature ranges that are not considering the materials of these components.

Thank You for Your Attention

Any Questions?

Typical Floating and Trunnion Ball Valve Component Nomenclature



Key

1 handle (lever type)
2 gland flange
3 ball
4 body
5 stem
6 stem nut
7 gland bolting
8 stem seal
9 thrust washer
10 body seal
11 body insert
12 seat