



SURFACE VEHICLE INFORMATION REPORT

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Engine Poppet Valve Information Report

RATIONALE

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Foreword—Poppet valves control combustion chamber induction and exhaust gas flow in reciprocating combustion engines. Poppet valves are manufactured from iron, nickel, titanium, and cobalt-base metallic alloys that are often welded together in various combinations.

Martensitic and austenitic steels are used for intake valves. Specially designed high temperature martensitic alloys, austenitic alloys, and superalloys are used for exhaust valves.

Titanium alloys have been used for both intake and exhaust valves in some limited production, high performance applications. Special iron, nickel, and cobalt-base alloys are welded to many of the valve head alloys to improve seat face wear and corrosion resistance.

1. Scope—This specification supplies engineers and designers with:

- a. Poppet valve nomenclature
- b. Poppet valve alloy designations
- c. Chemical compositions of poppet valve alloys
- d. A guide to valve alloy metallurgy and heat treatments
- e. General information on properties of valve alloys
- f. A guide to the application of valve alloys
- g. A description of valve design and construction, and their relation to valve alloy selection
- h. Valve gear design considerations that affect valves

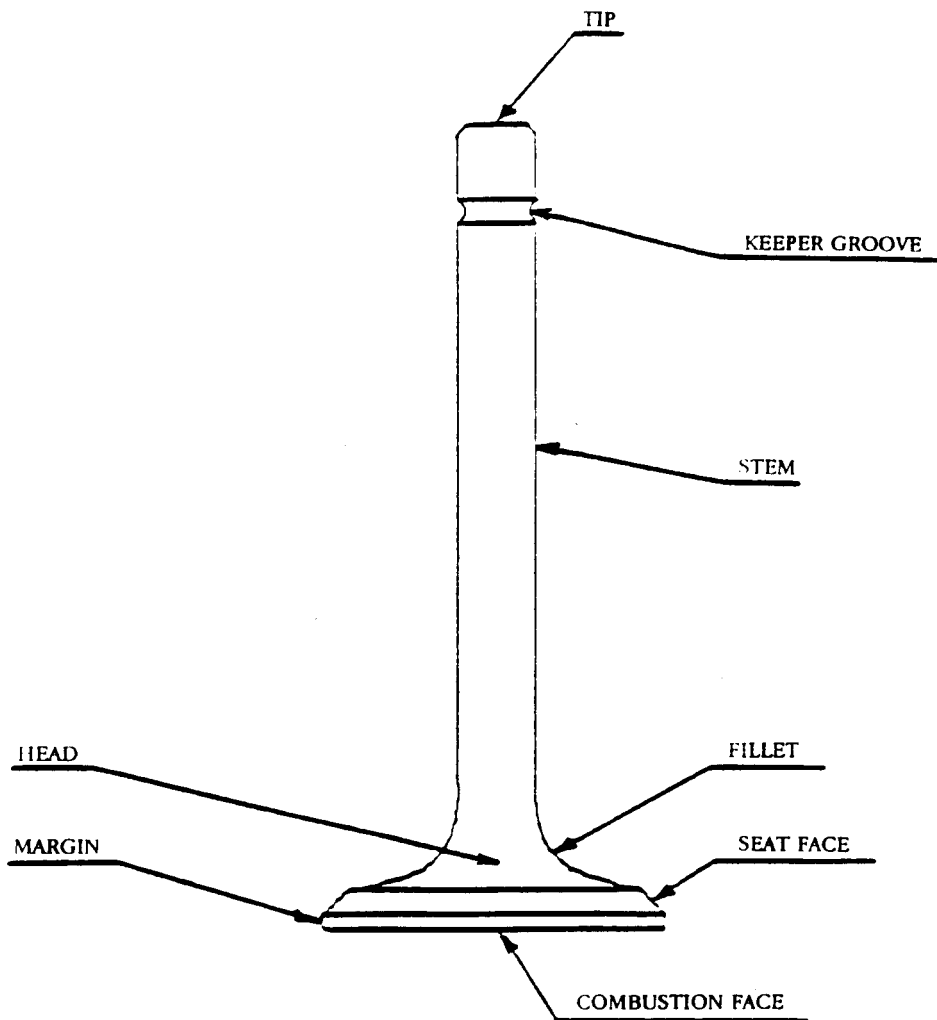
2. Reference

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein.

2.1.1 ISO PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

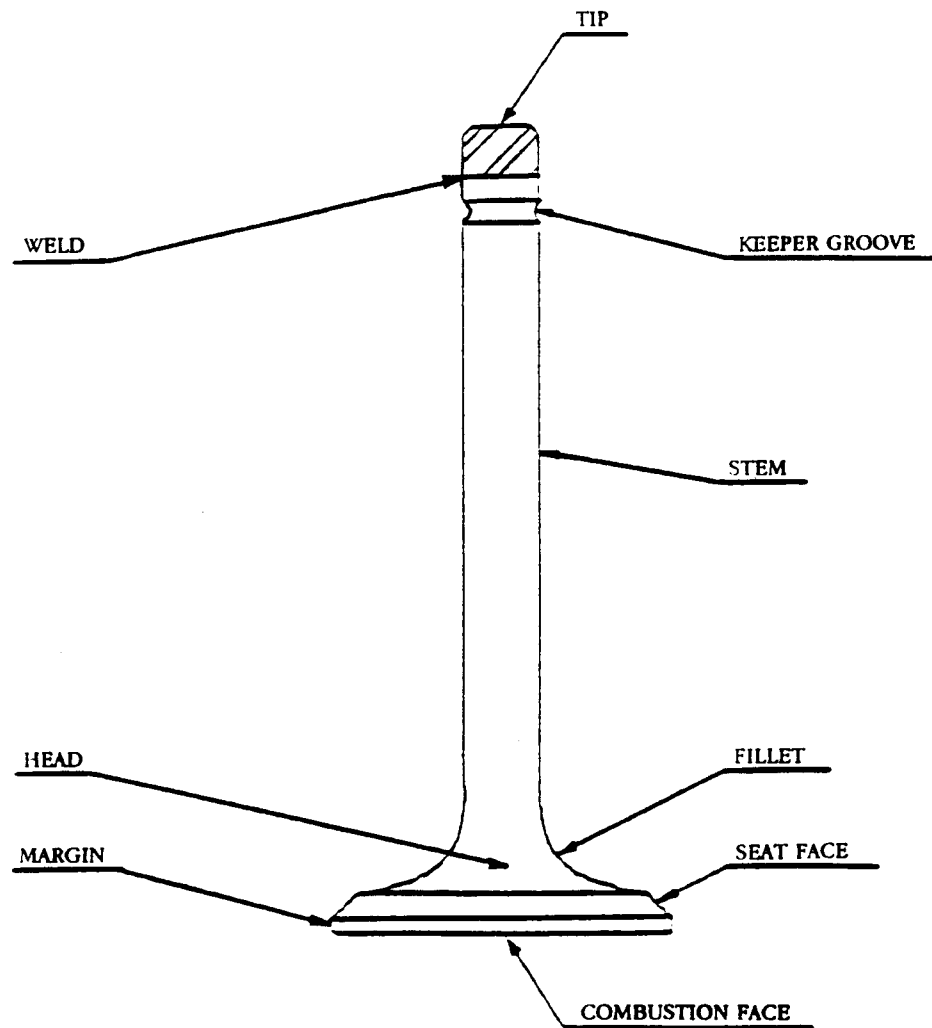
ISO 683-15—Heat-treatable steels, alloy steels and free-cutting steels—Part 15: Valve steels for internal combustion engines

3. Valve Nomenclature—Valve nomenclature and constructions are illustrated in Figures 1 to 5.



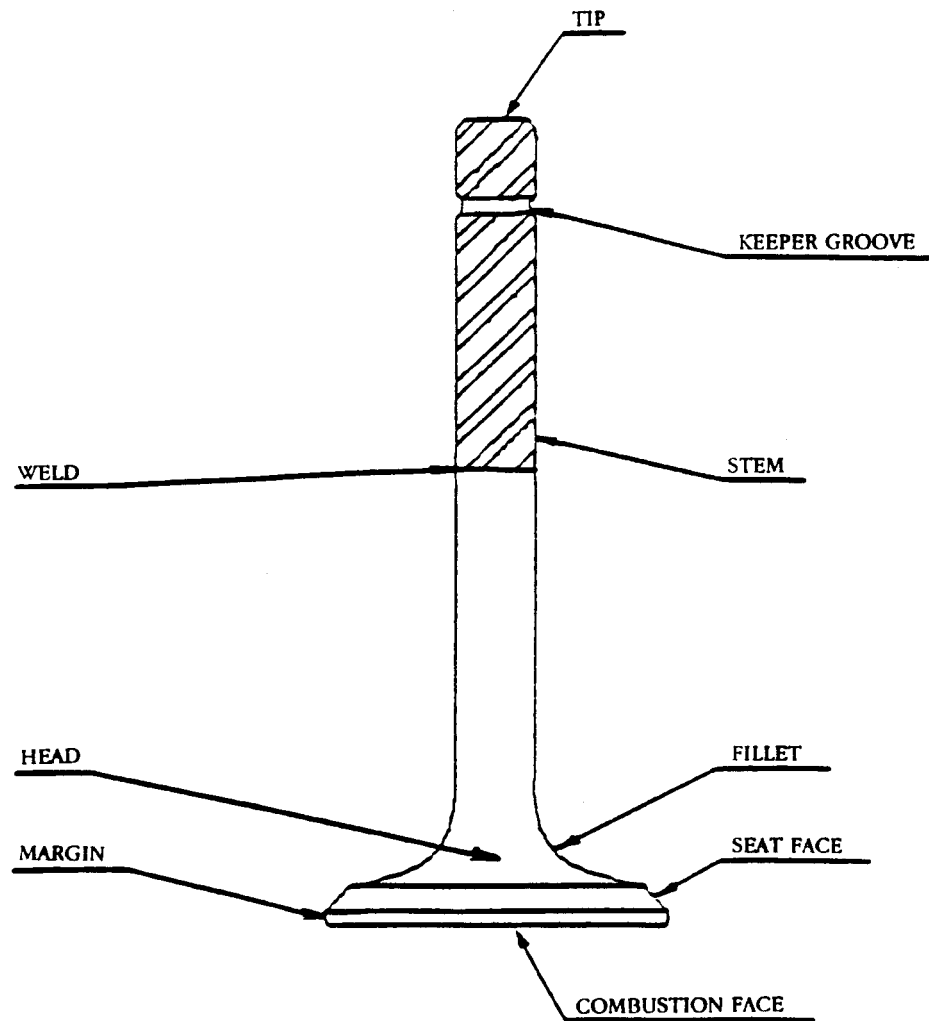
The majority of intake valves for all applications are one-piece construction that also has significant usage in spark ignition engine exhaust valves.

FIGURE 1—ONE-PIECE CONSTRUCTION



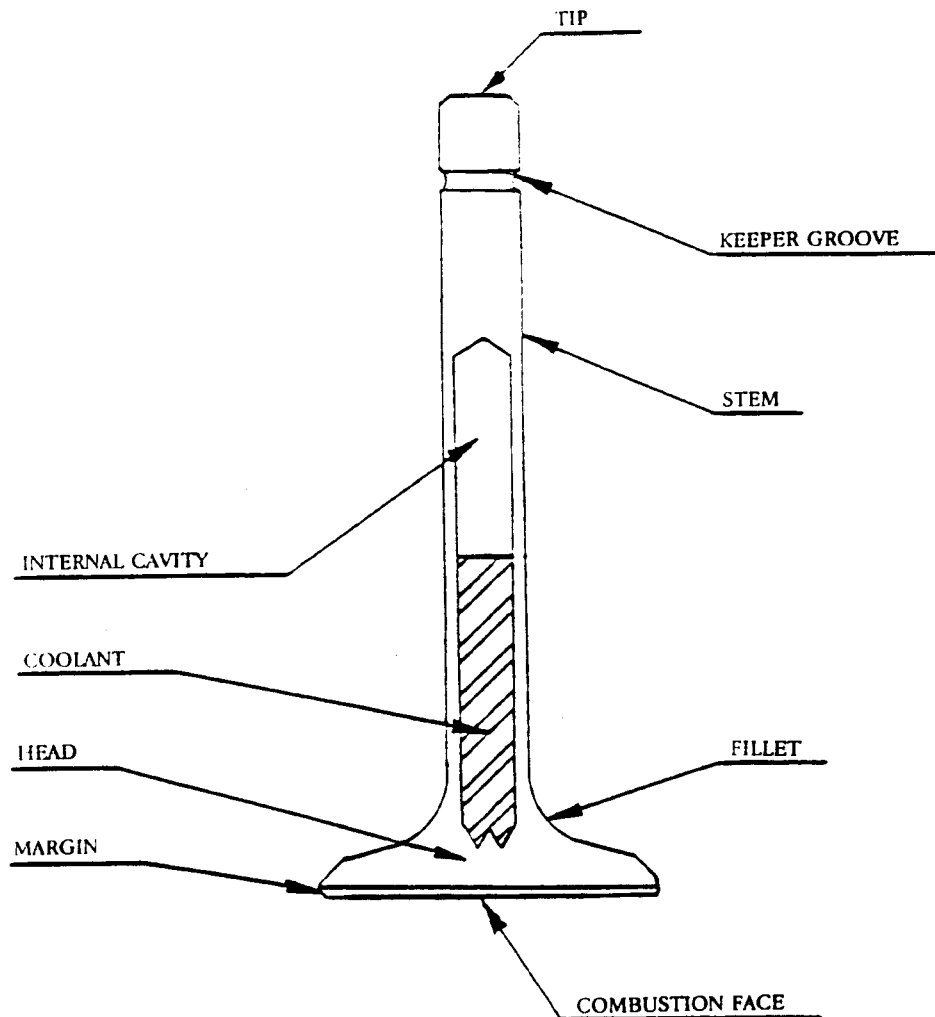
Welded tip construction has significant usage in spark and compression ignition engine valves.

FIGURE 2—WELDED TIP CONSTRUCTION



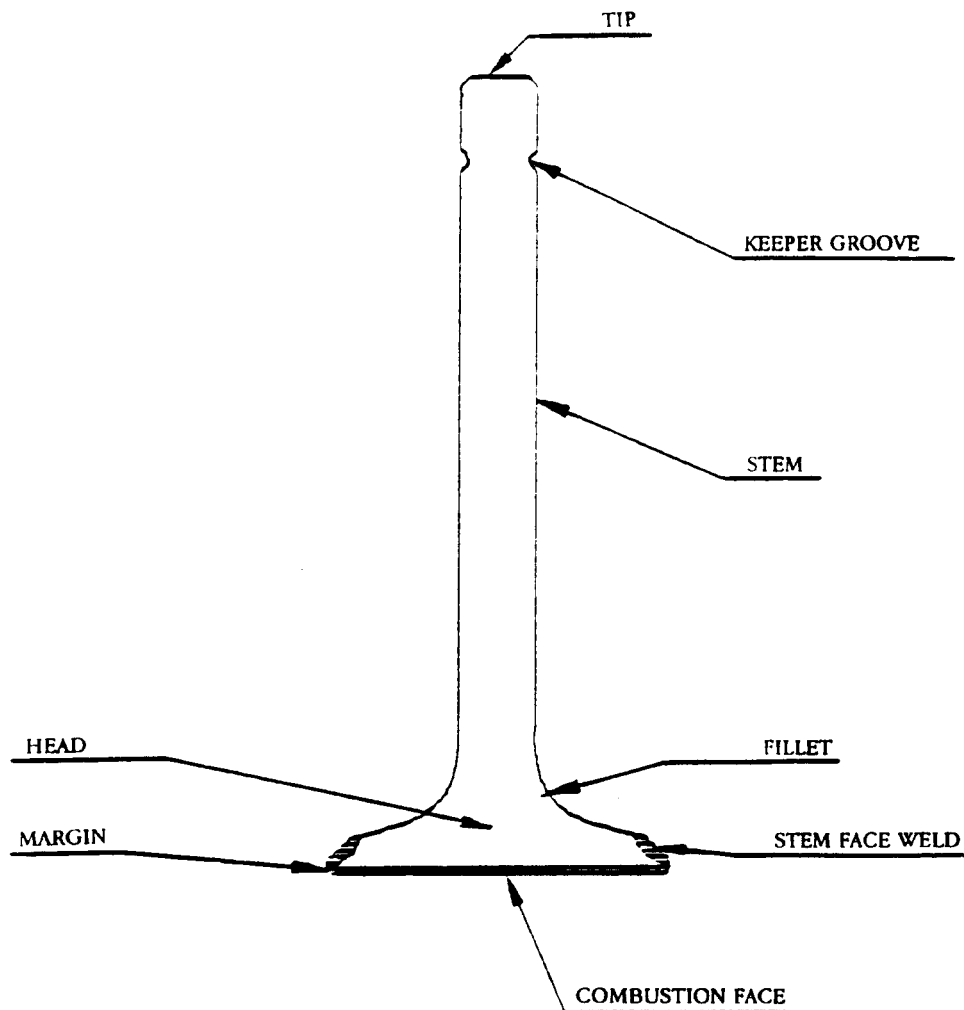
Two-piece construction has significant usage in spark and compression ignition engine exhaust valves.

FIGURE 3—TWO-PIECE CONSTRUCTION



Internally cooled construction used in extreme duty truck, high performance, and aircraft spark ignition engine exhaust valves.

FIGURE 4—INTERNALLY-COOLED CONSTRUCTION



Welded seat face construction predominates in compression ignition engine exhaust valves and has some usage in other valve applications. It supplements other types of valve construction.

FIGURE 5—WELDED SEAT FACE CONSTRUCTION

4. Valve Alloy Designation

- 4.1 UNS Designations**—SAE, in conjunction with American Society for Testing and Materials (ASTM), has adopted the Unified Numbering System (UNS) for the identification of all metallic alloys. Tables 1A to 4B use the UNS identification codes for valve alloys. These UNS numbers supersede the previous SAE functional numbering system.

TABLE 1A—CURRENT NORTH AMERICAN VALVE ALLOYS (MARTENSITIC STEELS)⁽¹⁾

UNS/ISO 683/15	COMMERCIAL	C	Mn	P (max)	S (max)	Si	Cr	Ni	W	Mo	Fe	Other
H15410	1541H	0.35/0.45	1.25/1.75	0.040	0.050	0.15/0.35	—	—	—	—	Base	
G15470	1547	0.43/0.51	1.35/1.65	0.040	0.050	—	—	—	—	—	Base	
G86450	8645	0.43/0.48	0.75/1.00	0.035	0.040	0.15/0.35	0.40/0.60	0.40/0.70	—	0.15/0.25	Base	
H41400	4140H	0.37/0.44	0.65/1.10	0.035	0.040	0.15/0.35	0.75/1.20	—	—	0.15/0.25	Base	
K14072	ASTM-A193B16	0.36/0.44	0.45/0.70	0.040	0.040	0.15/0.35	0.80/1.15	—	—	0.50/0.65	Base	V 0.25/0.35
S65007/ X 45 CrSi 9 3	Sil 1	0.40/0.50	0.80 max	0.040	0.030	2.70/3.30	8.00/10.00	0.60 max	—	—	Base	
S65006	Sil XB	0.75/0.90	0.80 max	0.040	0.040	1.75/2.60	19.00/ 21.00	1.00/1.70	—	—	Base	
S42200	422 SS	0.20/0.25	1.00 max	0.040	0.030	0.75 max	11.00/ 12.50	0.50/1.00	0.75/1.25	0.75/1.25	Base	V 0.15/0.30 Cu 0.50 max
S64004/ X50CrSi 8 2	SUH 11/ SUH 11M	0.45/0.55 0.47/0.55	0.60 max 0.60 max	0.030 0.030	0.030 0.030	1.00/2.00 1.00/2.00	7.50/9.50 7.50/9.50	0.60 max 0.60 max	—	—	Base	
—	FMS-235	0.47/0.53	0.60 max	0.030	0.030	1.05/2.00	4.80/5.50	0.60 max	—	—	Base	
	SUH-3	0.35/0.45	0.60	0.030	0.030	1.80/2.50	10.0/12.0	0.60 max	—	0.70/1.30	Base	Cu 0.30 max

1. All chemical contents are expressed in weight percent.