

ALLOY STEEL MATERIAL FLANGES

USAGE OF ALLOY FLANGES

Alloy steel flanges, particularly those made from chrome molybdenum (chrome moly) steel, are selected for specific applications that require enhanced properties not offered by carbon steel flanges. Chrome moly steels, designated as ASTM A182 F1, F5, F9, F11, F22, and F91, are known for their strength, durability, and resistance to high temperatures and pressures.

ASTM A182 alloy flanges are extremely ductile, strong, tough, and easy to weld and offer oxidation and scaling resistance. These grades match with ASTM A335 alloy steel pipes.



Here are several scenarios where alloy steel (chrome moly) flanges are the preferred choice:

1. High-Temperature Applications

Chrome moly flanges are particularly suitable for high-temperature applications, such as in the power generation industry (including boilers and heat exchangers) and petrochemical plants. The addition of chromium and molybdenum improves the steel's ability to withstand elevated temperatures without losing strength or undergoing deformation.

2. High-Pressure Environments

The enhanced strength of chrome-moly steel makes these flanges ideal for use in high-pressure systems. They can maintain integrity under stress and are often used in pressure vessels, high-pressure piping systems, and in applications where mechanical properties must be maintained under stress.

3. Corrosive Environments

While not as resistant to corrosion as stainless steel, chrome-moly flanges offer better corrosion resistance than carbon steel flanges, especially in environments where oxidation is a concern. Their use in mildly corrosive environments can reduce the risk of rust and corrosion-related failures.

4. Refineries and Chemical Processing

The robust nature of alloy steel flanges makes them suitable for the harsh conditions found in refineries and chemical processing plants. These flanges can withstand the thermal and mechanical stresses associated with processing high-temperature fluids and gases.

5. Oil and Gas Industry

In the oil and gas sector, chrome-moly flanges are used for drilling and extraction equipment, as well as for piping systems that transport hot oils, gases, and steam. Their durability and temperature resistance are crucial for the reliability and safety of these applications.

6. Fossil and Nuclear Power Plants

Alloy steel flanges play a critical role in both fossil fuel and nuclear power plants, where they are used in the construction of turbines, reactors, and other high-temperature, high-pressure components.

Key Considerations:

- **Material Specification:** Selecting the correct grade of chrome moly steel is essential, depending on the specific temperature and pressure conditions of the application.
- **Cost vs. Performance:** Alloy steel flanges are generally more expensive than carbon steel flanges, so their use should be justified by the operational requirements that necessitate their enhanced properties.
- **Welding and Fabrication:** Special care must be taken during the welding and fabrication of alloy steel flanges to prevent issues such as cracking. Preheating and post-weld heat treatment may be necessary, depending on the alloy composition and the application.

Alloy flange materials (chrome-moly) have higher chrome and molybdenum content than carbon steel flanges. Alloy steel flange materials suit high-temperature and high-pressure applications and improve corrosion resistance when compared to regular carbon steel flange grades.

CHEMICAL COMPOSITION ASTM A182 F5, F9, F11, F22

ELEMENT & PROPERTIES	LOW ALLOY STEEL		MEDIUM ALLOY STEEL	
	F11 CL2	F22 CL3	F5	F9
CARBON	0.10-0.20	0.05-0.15	0.15 MAX	0.15 MAX
MANGANESE	0.30-0.80	0.30-0.60	0.30-0.60	0.30-0.60
PHOSPHORUS MAX	0.040	0.040	0.03	0.030
SULFUR MAX	0.040	0.040	0.03	0.030
SILICON	0.50-1.00	0.50 MAX	0.50 MAX	0.50-1.00
NICKEL MAX	-	-	0.50	-
CHROMIUM	1.00-1.50	2.00-2.50	4.00-6.00	8.0-10.0
MOLYBDENUM	0.44-0.65	0.87-1.13	0.44-0.65	0.90-1.10
OPPER MA	-	-	-	-
COLUMBIUM MAX	-	-	-	-
VANADIUM MAX	-	-	-	-

MECHANICAL PROPERTIES A182

ELEMENT & PROPERTIES	LOW ALLOY STEEL		MEDIUM ALLOY STEEL	
	F11 CL2	F22 CL3	F5	F9
TENSILE STRENGTH PSI (MPA)	70,000 (485)	75,000 (515)	70,000 (485)	85,000 (585)
YIELD STRENGTH PSI MIN	40,000 (275)	45,000 (310)	40,000 (275)	55,000 (380)
ELONGATION 2" % MIN	20	20	20	20
REDUCTION AREA % MIN	30	30	35	40
HARDNESS (HB) MAX*	143 ~ 207	156 ~ 207	143 ~ 217	179 ~ 217

Recommended service for alloy steel flange material grades ASTM A182:

ASTM A182 ALLOY STEEL FLANGE	TRADE DESIGNATION	RECOMMENDED SERVICE
A182 F1	C-1/2 Mo Low Alloy Steel	Non-corrosive applications Including water, oil, and gases at temperatures between -29 ~ 593°C* (Not prolonged use > 470°C).
A182 F2	0.75% Ni; Mo; 0.75% Cr Low Alloy Steel	Non-corrosive applications including water, oil, and gases at temperatures F2:-29°C ~ 538°C, WC5: -29°C ~ 575°C
A182 F11	1 1/4% Chrome; 1/2% Moly Low Alloy Steel	Non-corrosive applications inclusive of water, oil, and gases at temperatures between -30°C (-20°F) and +593°C (+1100°F).
A182 F22	2 1/4% Chrome Low Alloy Steel	Non-corrosive applications inclusive of water, oil, and gases at temperatures between -30°C (-20°F) and +593°C (+1100°F).
A182 F5/F5a	5% Chrome; 1/2% Moly, Medium Alloy Steel	Mild corrosive or erosive applications as well as non-corrosive applications at temperatures between -30°C (-20°F) and +650°C (+1200°F).
A182 F9	9% Chrome; 1% Moly, Medium Alloy Steel	Mild corrosive or erosive applications as well as non-corrosive applications at temperatures between -30°C (-20°F) and +650°C (+1200°F).
A182 F91	9% Chrome; 1% Moly; V-N, Medium Alloy Steel	Mild corrosive or erosive applications as well as non-corrosive applications at temperatures between -30°C (-20°F) and +650°C (+1200°F).

