

PENN MACHINE

*YOUR SOURCE FOR CHROME-MOLY
PIPE FITTINGS*

F5

P5

WP5

F9

P9

WP9

F11

P11

WP11

F22

P22

WP22

F91

P91

WP91

Each Grade of Chrome-Moly has specific characteristics which classifies the grade for a particular application. Penn Machine Chrome-Moly products are unique and can serve many design applications

**What makes your Customer buy
F11 or F22 Material?**

**They need a low alloy material -
an iron steel with an alloy
element composition of only 2 to
3 percent with chromium &
molybdenum**

This small amount of chrome and moly in the material makes F11 and F22 different from carbon steel (A105/A106/A53).

The alloy elements strengthen the product allowing it to be used in temperatures/pressures that would cripple carbon steel if installed.

F11 and F22 are used primarily for their stress/rupture properties. The materials can be held at high temperatures with high pressure and have a strong resistance to rupturing

WHY SPECIFY PENN MACHINE FOR YOUR F11 & F22 REQUIREMENTS?

- Material is furnished for different classes**
- Material is certifiable to NACE-MRO 175**
- Material restricts Chemistry for Hydrogen Service**
- Material restricts Chemistry for No Post Weld Heat Treatment**

If stronger mechanical properties are required, both F11 and F22 are available in various Classes. So if the application requires higher Stress/Rupture values, then the Chrome-Class is higher (example: Class 3 instead of Class 1 for grade F11)

**Penn Machine's F11 and F22 meet
NACE-MRO 175. The product is
supplied with:**

- Nickel Content less than 1 percent**
- Alloy Elements less than 5 percent**
- Normalized and Tempered Condition**
- Hardness Tested at less than 22RC (237 HB)**

**Your Stocking F11 and F22 Inventory may be
used for Hydrogen Sulfide Corrosion Services**



Penn Machine heat treats material to overlap classes of F11 and F22 to ensure that you get material meeting several classes allowing your inventory to meet the changing needs of your customer base



Penn Machine's F11 may be used for Hydrogen Service:

- Material is furnished with Phosphorous and Tin Chemistries at residual levels
- Restriction of Chemistry enables the material to be resistant to cracking from hydrogen attack in service

The Biggest advantage of Penn Machine F11 and F22

Material is restricted in Chemistry to a .15 maximum in Carbon

ASME Power Piping Code and Chemical Processing Piping Code permits F11 and F22 to not be post weld heat treated if furnished with the .15 maximum Carbon content and is 4" NPS or smaller

- **Savings to your customer in field costs of heat treatment**
- **No extra cost to you as our customer**

F5 (5 CHROME - 1/2 MOLY)

- Petrochemical cracking unit alloy**
- Chromium alloys this material for strong resistance to hot sulfide corrosion cracking**
- Material has higher minimum mechanical properties than F11 and F22 which makes the material ideal for high temperature and pressure applications**

Penn Machine's F5

Material is supplied as both F5 and F5A which gives the material the proper chemistry and mechanical properties to be inventoried for your customers who may require F5A instead of F5

Penn Machine's F9 (9 Chrome - 1 Moly)

Used primarily for NACE Applications where sour environments under high temperatures/pressures are expected

Chromium of 9 percent gives F9 the corrosion resistance similar to 400 series stainless steel, but higher tensile properties at hotter temperatures than 405 or 410 stainless

Penn Machine's F9

Material is supplied with a Hardness to 22 RC (237 HB) maximum which lends the material to be used in NACE-MRO 175 Sour Service and to resist Hydrogen Induced Cracking

Product is FORGED into a variety of forms such as Laterals, Street Ells, and Branch Outlets. Forging maintains and reinforces the product grain structure giving the fitting an integrity not possible in a block pattern fitting

**F91 (9 Chrome - 1 Moly
+ Alloy Elements)**

**F91 IS THE NEW SUPER
Chrome-Moly Alloy of the Future**

Why is F91 the Alloy of Our Future?

- It has all the strength of a chrome-moly steel, but the superior corrosion resistance of 300 series stainless steel
- It is the only chrome-moly which is "Solution Annealed". Unlike stainless, the annealing solutions Vanadium (V) and Niobium (Cb) instead of Chromium (Cr) which strengthens this material
- The annealing produces coarse grains which makes F91 the premier product for "creep rupture" applications

- **Minimal susceptibility to cracking because the alloying elements in F91 make this material resistant to hydrogen attack and embrittlement**
- **Preferred over stainless steel because F91 takes high temperatures with very low elasticity making F91 suitable for high octane gasoline processing**
- **Provides an approximate 60% weight reduction in material as compared to F22 due to the reduction in wall thickness**

The History of F91:

1974

The Department of Energy started a task group to study a replacement material for stainless steel in high temperature service which encountered premature failure

1975-1976

A major international engineering and construction firm proposed a modified 9 Chrome - 1 Moly material to solve the premature failures of stainless steel

1983

ASTM approves F91 as a marketable material grade for installation use with governing specifications for this material

1984

**ASME Case Codes are developed
for F91 to be used on Power and Chemical
processing applications**

1986

**NACE grandfathers F91 as an accepted
material for use due to the material's corrosion
and cracking resistance**

1986

**A major international utility company uses
the 1st project job for F91 in the world on a
co-power generation plant expansion**

1987

A major international refining company replaces F22, F304L, and F316L with F91 worldwide for all petrochemical cracking units

1988

A major international refining company builds a Singapore plant with F91 as the major material for processing lines

1990

England constructs two 500 Megawatt Power Plants using F91 instead of F22

PENN MACHINE MANUFACTURES AND INVENTORIES A FULL LINE OF PRODUCTS IN ALL GRADES OF CHROME-MOLY

90' elbows

tees

reducing tees

crosses

45' elbows

laterals

unions

branch outlets

street elbows

butt weld tees

nipples

caps

couplings

bushings

inserts

plugs

swage nipples

union elbows

union tees

custom fittings

branch tees

street tees

Why Penn Machine Chrome-Moly?

- Major AML Product Acceptance
- Canadian CRN (s) In Every Province
- Approved Navy Level I Program
- US Government Approved
- Largest Chrome-Moly Inventory
- In-House Forging Facility
- 24 Hours A Day / 7 Days A Week Availability
- Full 24 Hours A Day Internet Access On Products



**WE ARE CONTINUALLY ADDING NEW
TRAINING DISKETTES.
WE CURRENTLY OFFER:**

- PENN MACHINE OVERVIEW(English/French/Spanish)**
- DANGERS OF MATERIAL GRADE MIXES**
- BASICS OF BRANCH OUTLETS**
- BENEFITS OF ELECTROPOLISHED STAINLESS**
- REFINERY MATERIALS AND THEIR APPLICATIONS**

PENN MACHINE

THE OBVIOUS CHOICE!!

1-800-PENN-USA

WWW.PENNU.SA.COM