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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!!

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