Acme Alloys®
Private Limited

WH-76, Mayapuri Industrial Area
Phase-I, New Delhi 110 064, India
T : +91-11-2811 5474
F : +91-11-2812 6900
E : contact@acmealloys.com
W : www.acmealloys.com

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STATIC CAST END FITTINGS

For

Catalytic steam reformers for hydrogen or ammonia or methanol production and ethylene cracking

Product Name **Product X:** **Static Cast Tubes**

Product Y: **Static Cast Reducers**

Product Form
& Specifications Example

Product X: Cast tube custom made to following specification

Length of the tube = 38’9” (988.00 mm)
Outer diameter of the pipe (O.D.)
= 4.72 inch (119.888 mm)
+1/16 inch (1.5875 mm)
- 0.00 inch (0.0000 mm)

Internal diameter of the pipe (I.D.)
= 4.00 inch (101.600 mm)
+0.00 inch (0.000 mm)
- 1/16 inch (1.5875 mm)
Cast dimensions of the manufactured tube

Length of the tube = 38’9” (988.00 mm)
Outer diameter of the pipe (O.D.)
= 4.72 inch (120.00 mm)
+1/16 inch (1.600 mm)
- 0.00 inch (0.000 mm)

Internal diameter of the pipe (I.D.)
= 4.00 inch (101.600 mm)
+0.00 inch (0.000 mm)
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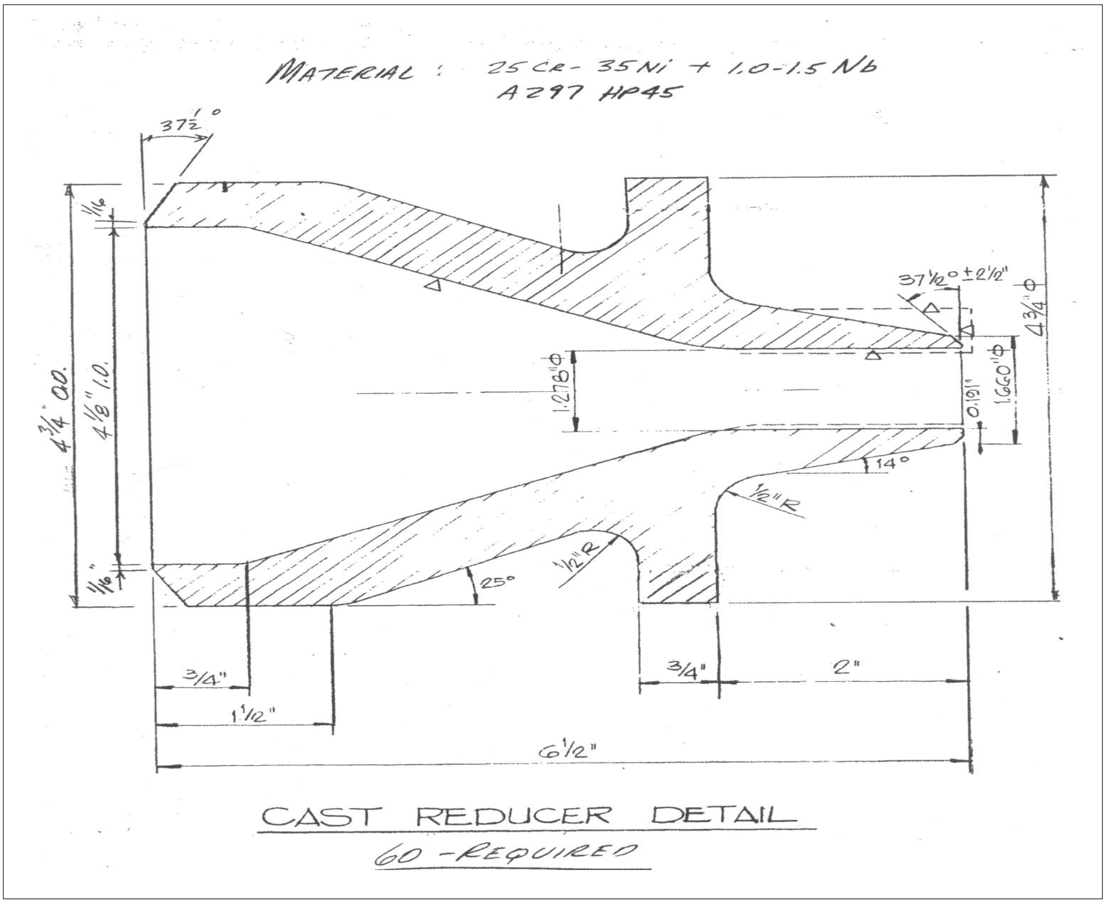
Product Y: Cast reducer, fully finished to drawing sketch provided having dimensions as mentioned below:



Material	Heat resistant stainless steel
	Specified material
	Product X: Cast Tubes, 25Cr-35Ni; 1.0-1.5 Nb; A-608-HP
	Product Y: Cast Reducers, 25Cr-35Ni; 1.0-1.5 Nb; A297-HP45
Application	Expected application/s area of components/parts requiring heat resistance: Catalytic steam reformers for hydrogen or ammonia or methanol production and ethylene cracking.
Alloy Standard & Composition	Various standard, standard modifications and proprietary heat resistant stainless steels are used in refining and petrochemical industry. The requested alloy is a modification of American Society of Testing Materials (ASTM)

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Designation: ASTM A 297A/A 297M

Standard Specification for Steel Castings,
Iron-Chromium and Iron-Chromium-Nickel,
Heat Resistant, for General Application
Type: 26 Chromium-35 Nickel
Grade: HP

Keeping in perspective the desired chemical composition type 25Cr-35Ni, two modifications of grade HP alloy are suggested while referring to ASTM A297/A297 M, Grade HP, Type 26Cr-35Ni

Alloy A: AA-HP45-Nb-W-Mo
Alloy B: AA-HP45-Nb

Chemical Composition Range of Alloys

	Alloy A AA-HP45-Nb-W-Mo	Alloy B AA-HP45-Nb	Standard
Reference Standard	ASTM A297	ASTM A297	ASTM A297
Reference Grade	25Cr-35Ni	25Cr-35Ni	26Cr-35Ni
Reference Type	HP	HP	HP
	HP-Modified	HP-Modified	
Element			
Carbon **C**	0.30%-0.50%	0.30%-0.50%	0.35%-0.75%
Manganese **Mn**	1.00%-1.25%	1.00%-1.50%	2.00%
Silicon **Si**	1.50%-1.80%	1.00%-1.50%	2.00%
Phosphorus **P**	0.04%	0.04%	0.04%
Sulphur **S**	0.04%	0.04%	0.04%
Chromium **Cr**	24.0%-26.0%	24.0%-26.0%	24.0%-28.0%
Nickel **Ni**	33.0%-37.0%	33.0%-37.0%	33.0%-37.0%
Niobium **Nb**	1.00%-1.30%	1.00%-1.50%	Nil
Tungsten **W**	1.00%-1.30%	Nil	Nil
Molybdenum **Mo**	0.50%	Nil	0.50% (Optional)
Iron **Fe**	Balance	Balance	Balance

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Metallurgical Note on Alloys

Although in the reformer business HP-modified (HP-Mod) is generally understood to 25Cr-35Ni-1Nb-0.40C, in the ethylene market it is used to describe a range of HP-Mod alloys, which are none other than Alloy Castings Institute (ACI) /American Society of Testing Materials (ASTM) A 297, HP alloys, with restricted carbon range and additions or micro-alloying of niobium, niobium and tungsten, tungsten and molybdenum. The HP-45 mentioned by you reflects the mid-carbon range of certain specifications and we shall offer the carbon range as desired by you.

Superior properties of the HP-Mod alloys benefit the petrochemical user in many ways

For steam reformers the answer is the profitable combination of longer life and higher performance using thinner wall cross-section tubes. The higher strength of HP-Mod and new advanced alloys impart substantially longer stress-to-rupture life. Hence, HP-Mod and new advanced alloys permit process operations with a thinner wall cross-section, that enhances rates of heat transfer, eventually resulting in considerable savings in energy and cost. Alternatively, in new designs, it can utilize few tubes of larger diameter and save considerably in tubing cost and furnace size. In addition, lighter tubing eventually allows lighter tube supports. Other benefits include easy equipment handling, lower process down times, higher productivity and enhanced service life of parts.

Examples of cast fittings for reformer tubes in heat resistant high alloys

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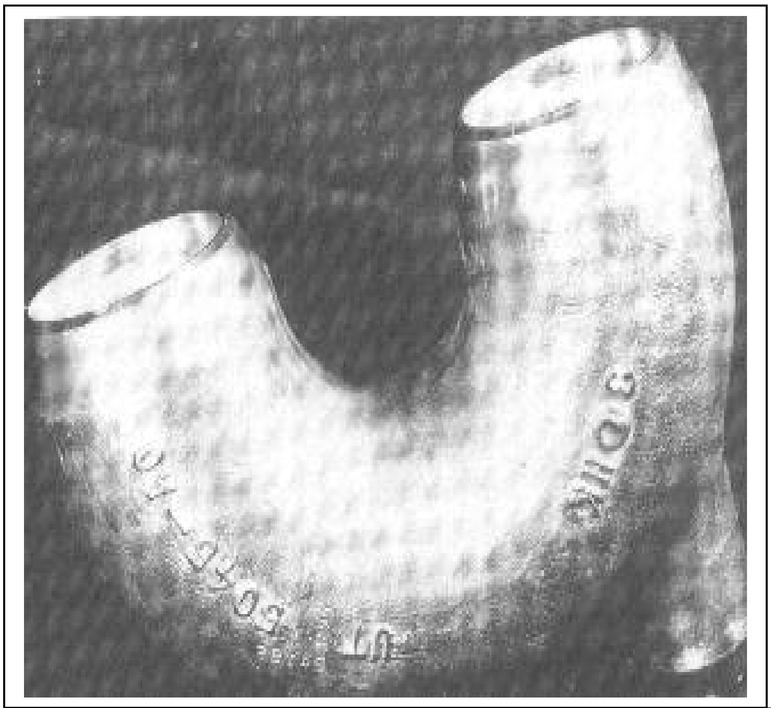
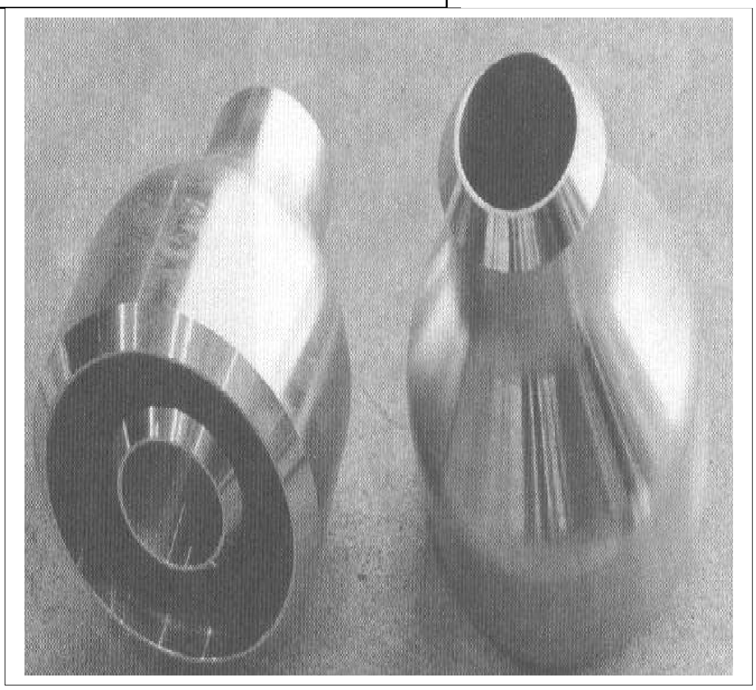
<u>For steam crackers</u> the answer lies in profitable combination of higher operating efficiency and production rates, at elevated temperatures. The increase in nickel content of alloy in such a case is crucial to stabilize the austenite structure, therefore, substantially improving the resistance to carburisation of the alloy, either on its own merits or in conjunction with silicon or added presence of aluminium. High nickel content improves resistance to thermal shock (rapid heating and cooling), adherence of protective oxide films, and thermal fatigue properties due to changes in the stability of the oxide films and diffusion process.



Typically these HP-Mod and new advanced heat resistant alloys contain carbon levels between 0.30% and 0.50%. Carbon plays a significant role as it reacts with chromium in the alloy forming very strong, chromium carbide microstructure in the alloy matrix. In addition, it mitigates alloy's deformation that is operating at elevated temperatures. Above 1000°C (1830°F) these carbides rapidly coalesce eventually decreasing the creep-rupture strength sharply. Understandably, additions and micro alloying of elements that are known to be as strong carbide formers, like niobium, columbium, titanium, tantalum, tungsten, and molybdenum result in improving the creep strength properties of an alloy that operates at high-temperature ranges and demanding service conditions.



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Recent developments and advances in high alloy metallurgy

Newly developed proprietary heat resistant alloys, 30Cr-45Ni perform better than the 25Cr-35Ni HP-Modified alloys. Many proprietary grades of heat resistant alloys can be broadly classified into three base groups, with the following base compositions

- HK-20Ni-25Cr
- HP-35Ni-25Cr (popularly known as HP-Mod)
- 45Ni-30Cr

Our HP-35Ni-25Cr (HP-Mod) include the following generic alloy base options

1. AA-HP-Nb
2. AA-HP-Nb-Si
3. AA-HP-Nb-Ti
4. AA-HP-Nb-W
5. AA-HP-Nb-W-Mo
6. AA-HP-Mo
7. AA-HP-W
8. AA-HP-Co

Desideratum for cost-effective reformer design, are maximum reliability, operating stability, and high thermal efficiency. Therefore, these alloys must possess high creep strength in conjunction with good strain relaxation, good weld ability, excellent oxidation resistance, and not to mention, after aging possess good-ductility and weld ability. HP-Mod alloys do meet most of these requirements. However, recent advancements in high alloy metallurgy, is successfully giving way to superior alloys, 45Ni-30Cr heat resistant alloys that are known to have outperformed HP-Mod as they contain higher levels of key constituents, nickel and chromium than that available in HP-Mod. Some of the alloys in the 45Ni-30Cr categories include

1. AA-HRSA-3045-Nb-W
2. AA-HRSA-3045-Nb-Ti
3. AA-HRSA-3045-W
4. AA-HRSA-3045-W-Co
5. AA-HRSA-3045-W-Al

This evolution is continuing as reflected by the increasing use of the 30Cr-45Cr alloys. Even some of then the newer wrought alloys that have been introduced are now displacing the cast alloys in some niche applications, for example, short residence time ethylene cracking furnaces.

Cost Savings & Lower Life Cycle Costs

Economics enter into every business decision. But, important criteria for evaluation should not be the initial costs of an alloy. Its life-cycle cost or cost-effectiveness should govern instead. It is usually more cost-effective to specify an alloy that will provide an extended life, particularly in areas of application that are difficult to repair or in components that would cause major shut-downs in the plants, in case of failure. In these situations, the original cost of the material can prove to be insignificant compared to the loss of production cause by the use of a lower cost option, but less effective alloy in the application.

Unfortunately, competitive bidding and increasing cost control initiatives of companies frequently create barriers that inhibit realization of long equipment life. Honestly, we believe that the companies and customers do understand the long-term benefits of using superior alloys, but are hapless so as to keep into perspective other issues in decision of equipment, components and replacement parts. However, the enlightened company will recognise the value of life cycle cost approach on long-term financial health and not embrace only the low initial cost alloy option.

Discuss you end application needs and know more about high performance cost effective solutions.

Contact Person*:*
Vishal Kumar, Head-Manufacturing & Marketing
E: vishal@acmealloys.com M: +91-98-111-15423

For Sales within India
ACMECAST
WH-76, Mayapuri Industrial Area, Phase-I
New Delhi 110064

T: +91-(011)-2811-5021
F: +91-(011)-2811-7433
E: acmecast@bol.net.in & acmecast@acmealloys.com
W: www.acmealloys.com

For Sales outside India
ACME ALLOYS PRIVATE LIMITED
WH-76, Mayapuri Industrial Area, Phase-I
New Delhi 110064

T: +91-(011)-2811-5474
F: +91-(011)-2812-6900
E: contact@acmealloys.com
W: www.acmealloys.com