

Felt Metal

A practical guide to felt metal, covering the reader intent, the relationship to felt metal, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the landscape of industrial filtration and advanced material science, felt metal—often referred to as sintered metal fiber felt—represents a pinnacle of porous media engineering. Unlike traditional woven wire mesh or sintered powder structures, felt metal is a non-woven medium composed of microscopic metal fibers that are randomly laid, compressed, and metallurgically bonded through a high-temperature vacuum sintering process. This unique architecture results in a material that combines the structural integrity of solid metal with the high porosity and permeability required for the most demanding filtration and separation tasks.

For engineers and technical procurement teams, understanding the nuances of felt metal is essential when selecting components for high-pressure, high-temperature, or highly corrosive environments. This guide explores the technical properties, manufacturing complexities, and application-specific advantages of felt metal to assist in informed decision-making for industrial systems.

| The Architecture and Manufacturing of Felt Metal

The performance of felt metal is a direct result of its manufacturing process. The journey begins with the production of metal fibers, typically through a bundle drawing process. These fibers can be engineered to specific diameters, often ranging from 1 to 100 micrometers. The choice of fiber diameter is the primary determinant of the final medium's filtration rating and permeability.

| The Felting Process

Once the fibers are produced, they are cut to specific lengths and laid out in a random, non-woven web. This "felting" stage is critical; the goal is to achieve a uniform distribution of fibers to ensure consistent pore size across the entire sheet. In many high-performance applications, multiple layers of different fiber diameters are used to create a gradient structure. A gradient felt metal sheet features larger pores on the upstream side to capture coarse particles and finer pores on the downstream side for absolute filtration. This design significantly increases the dirt-holding capacity compared to single-layer media.

| Vacuum Sintering

The loose fiber web is then subjected to vacuum sintering. Under intense heat—just below the melting point of the alloy—and controlled pressure, the contact points between the fibers fuse together through molecular diffusion. This creates a rigid, three-dimensional matrix. Because no binders or adhesives are used, the resulting felt metal retains the pure chemical properties of the base alloy, such as 316L stainless steel or Hastelloy.

| Calendering and Finishing

After sintering, the material may undergo calendering. This process involves passing the felt through heavy rollers to achieve a precise thickness and to further fine-tune the porosity and pore size distribution. The result is a robust, metallic fabric that can be pleated, welded, and machined into various forms, including cartridges, discs, and complex custom shapes.

| Key Technical Properties of Felt Metal

When evaluating felt metal against other porous media like sintered powder or multi-layer wire mesh, several technical advantages become apparent. These properties are what make the material a preferred choice for critical industrial processes.

| High Porosity and Permeability

One of the most significant characteristics of felt metal is its high porosity, which can reach up to 85% or even 90%. In contrast, sintered metal powders typically offer porosities between 30% and 50%. High porosity translates directly to lower pressure drop across the filter medium. For industrial operators, this means lower energy consumption for pumps and compressors and longer intervals between cleaning cycles.

| Superior Dirt Holding Capacity (DHC)

Because felt metal functions as a depth filtration medium, it can trap contaminants throughout the entire thickness of the material, not just on the surface. The tortuous path created by the randomly oriented fibers ensures that particles are captured effectively. This high DHC is particularly valuable in applications with high contaminant loads, as it prevents the rapid "blinding" or plugging that can occur with surface-loading filters like plain wire mesh.

| Thermal and Chemical Resistance

Since felt metal is constructed from high-performance alloys, it inherits the thermal and chemical resistance of the base metal. Stainless steel 316L is the standard for general industrial use, offering excellent corrosion resistance. For more extreme environments, alloys like Inconel, Monel, or Hastelloy are used. These materials allow felt metal to operate at temperatures exceeding 500°C (and much higher in non-oxidizing atmospheres) and withstand exposure to aggressive acids and alkalis.

| Mechanical Integrity and Pleatability

Despite its high porosity, the sintered bonds provide felt metal with significant mechanical strength. It can withstand high differential pressures without deforming. Furthermore, unlike sintered powder which is brittle, felt metal is ductile. It can be pleated to increase the effective filtration area within a standard housing size, which is a common requirement in hydraulic and polymer filtration systems.

| Critical Applications in Industrial Filtration

The unique combination of depth filtration and metallic durability makes felt metal indispensable in several key sectors.

| Polymer Melt Filtration

In the production of synthetic fibers and plastic films, polymer melts must be filtered at extremely high pressures and temperatures to remove gels and inorganic impurities. Felt metal is the industry standard here because it can handle the high viscosity of the melt while providing the absolute filtration necessary to prevent fiber breakage or film defects. Its ability to be cleaned and reused multiple times makes it a cost-effective solution for these continuous processes.

| Chemical and Petrochemical Processing

Felt metal is used for catalyst recovery and gas-solid separation in harsh chemical environments. In fluid catalytic cracking (FCC) or the production of specialty chemicals, filters must resist both chemical attack and the abrasive nature of catalyst fines. The structural stability of sintered fibers ensures that the filter does not shed media into the process stream, protecting downstream equipment.

| Aerospace and Hydraulic Systems

In hydraulic systems where weight and space are at a premium, the high permeability of felt metal allows for smaller filter footprints. It is used to protect sensitive valves and actuators from particulate contamination. In aerospace, felt metal is also utilized for acoustic attenuation in jet engines, where its porous structure helps dissipate sound energy.

| Green Energy: Fuel Cells and Electrolyzers

Beyond traditional filtration, felt metal is finding increasing use in the hydrogen economy. It serves as a Gas Diffusion Layer (GDL) or a current collector in Proton Exchange Membrane (PEM) electrolyzers and fuel cells. The material's high electrical conductivity, coupled with its ability to facilitate the transport of gases and water through its pores, makes it an ideal component for these electrochemical cells.

| Engineering Considerations for Selection

Selecting the right felt metal specification requires a balance of several engineering factors. To ensure optimal performance, the following parameters must be confirmed during the design phase:

1. **Micron Rating (Absolute vs. Nominal):** It is vital to distinguish between absolute ratings (the size of the largest particle that can pass through) and nominal ratings (an average pore size). For critical protection, absolute-rated felt metal is required.
2. **Alloy Compatibility:** While 316L is common, applications involving chlorides may require Hastelloy to prevent pitting and stress corrosion cracking. High-temperature oxidation may necessitate 310S or Inconel.
3. **Pressure Drop (ΔP) Limits:** Engineers must calculate the clean pressure drop based on fluid viscosity and flow rate to ensure the system's pump capacity is sufficient as the filter loads with contaminants.
4. **Cleaning Protocols:** Felt metal can be cleaned via ultrasonic baths, chemical cleaning, or thermal decomposition (burn-off). The choice of cleaning method must be compatible with both the alloy and the type of contaminant being removed.

| Total Cost of Ownership and Sustainability

While the initial acquisition cost of felt metal is higher than disposable glass fiber or paper elements, the Total Cost of Ownership (TCO) is often significantly lower in industrial settings. The durability of the metal matrix allows for dozens, or even hundreds, of cleaning cycles. This reduces the recurring costs of replacement filters, lowers disposal costs for hazardous waste, and minimizes system downtime.

From a sustainability perspective, the longevity of felt metal contributes to a circular economy. Instead of sending spent filter cartridges to a landfill, industrial operators can restore them to near-original performance levels through professional cleaning, significantly reducing the environmental footprint of the filtration process.

| Conclusion

Felt metal stands as a sophisticated solution for complex filtration challenges where performance cannot be compromised. Its high porosity, exceptional dirt-holding capacity, and resilience in extreme environments provide engineers with a versatile tool for optimizing process efficiency and protecting high-value equipment. By selecting the appropriate alloy, fiber diameter, and structure, industrial facilities can achieve precise separation results that are both reliable and cost-effective over the long term.

As a manufacturer specializing in custom stainless steel filtration solutions, Kaifil provides technical expertise to help engineers navigate these choices. Whether you require standard sheets or complex pleated cartridges, our team ensures that the filtration media is engineered to meet your specific operational demands. For more information on our manufacturing capabilities and to explore our full range of products, please visit our [Main Page](#). Review product options and application support to find the ideal filtration solution for your industrial requirements.