

ASPHALT & BITUMEN

Asphalt is man's earliest organic engineering material. Its use as an adhesive and waterproof material dates back to the dawn of civilization. It is still used for these purposes today; huge quantities are used in road building, roofing and various types of repair work where its water-proofing qualities are required. It is also used in rubber and adhesive compounds.

This application datasheet will cover some of the most common asphalts, their characteristics and uses in industry. In addition, pump types and construction will be recommended for the varying types of asphalt

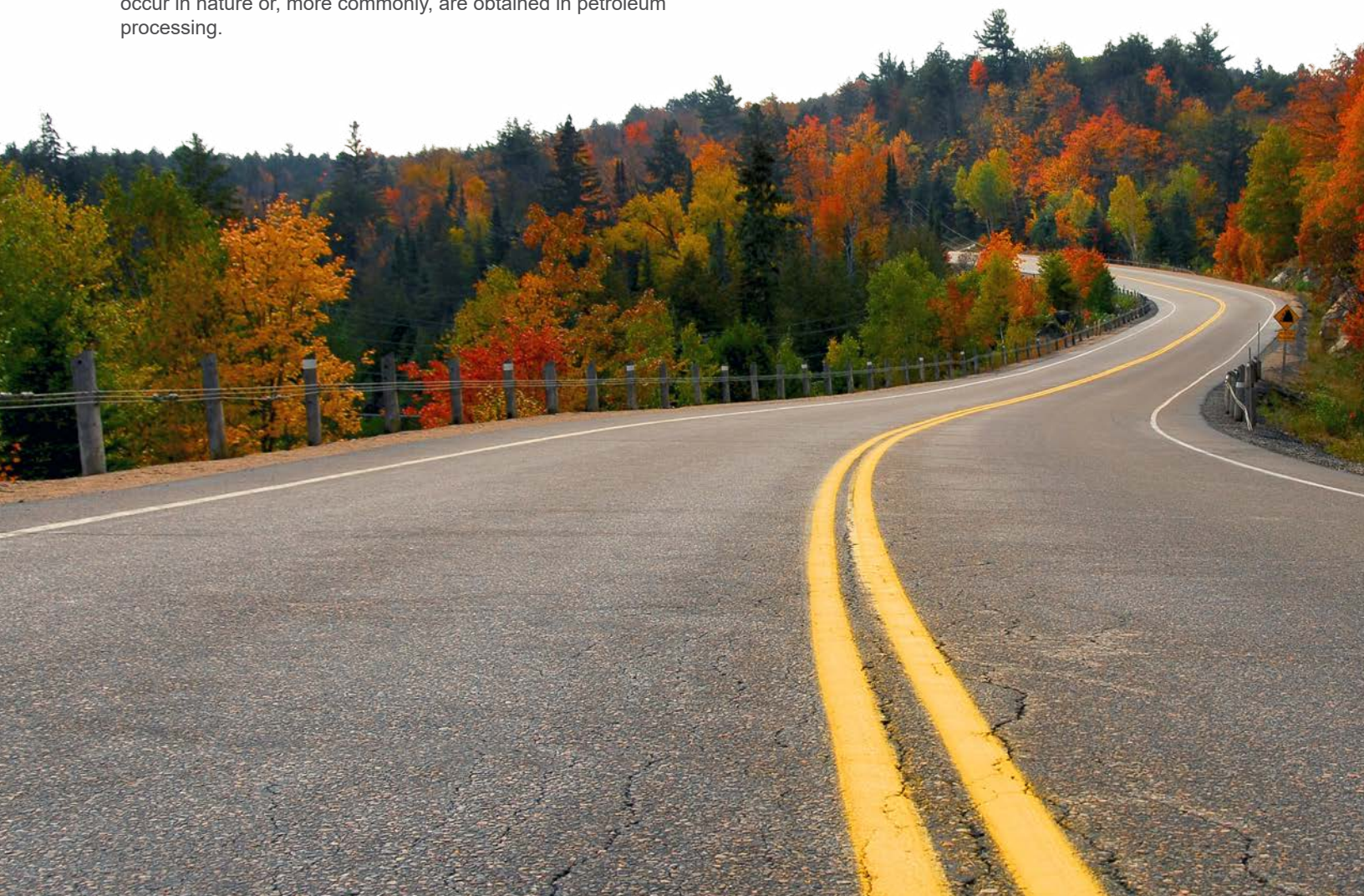
OVERVIEW

Bitumens are mixtures of hydrocarbons of natural or igneous origin, or combinations of both, frequently accompanied by their non-metallic derivatives, which may be gaseous, liquids, semi-solid or solid and which are completely soluble in carbon disulfide.

Asphalts are dark brown to black cementitious materials in which the predominating constituents are bitumens, which can occur in nature or, more commonly, are obtained in petroleum processing.

The general connotation of asphalt also implies the crude mixture of bitumen with impurities, such as silt, clay, or mineral matter. Another term commonly used is natural asphalt, which represents a small percentage of asphalt production. This is asphalt containing impurities as found in nature, (Cuban, Trinidad, etc.) For example, the composition of Trinidad asphalt is about 34% fine colloidal clay, lava and other mineral matter. The term natural bitumen is also used. These are found in nature but are free of mineral matter and also soluble in carbon disulfide. These are wurtzilite, gilsonite, impsomite, elaterite and grahamite.

One of the largest deposits of asphalt is the tar sands of Canada. Recent estimates give the area of 54,000 square miles (140,000 square kilometers), estimating a reserve of between 100 and 200 billion barrels. Tar sands are also found in California, Mexico, Trinidad, Venezuela, Iran and other oil bearing regions.



ASPHALT PRODUCTION

Asphalts derived from crude oil constitute by far the largest source of asphalts used today and are the building blocks of other asphalt products. Distillation is the oldest of the three major processes for extracting asphalt from crude oil. To be accurate the distillation process is about extracting all the higher value, "light ends" from crude oil. What remains is asphalt. The first step is atmospheric fractionization where heated crude oil (340°C, 650°F) is introduced to the distillation tower. The lighter components naphtha, gasoline and kerosene vaporize, rise to the top, cool, condense and are drawn off for further processing. The residuum from this process (heavy gas oil) is sent to a vacuum distillation unit where the heaviest gas oils are produced. The hydrocarbons that remain (cut points 430-560°C, 800-1050°F) are straight-run asphalts.

Straight-run asphalts from crude oil distillation are further refined by contacting with an extraction solvent such as propane or butane in a process called solvent deasphalting. The resulting liquid is taken away as deasphalted oil (DAO) and the remaining product is a high softening point, hard asphalt used to manufacture asphalt cement.

The ROSE Process (Residuum Oil Supercritical Extraction) is the most modern means of producing asphalt. The resid from the distillation process is mixed with a low-boiling point hydrocarbon solvent such as pentane under supercritical conditions. This mixture is then fed into a separator at a predetermined control temperature and pressure to separate an asphaltene concentrate. The first fraction (asphaltenes) is then recovered by stripping off the solvent used. The extract portion from the preceding operation is then fed into a second separator where at a controlled higher temperature a decrease in solubility results, causing the precipitation of a second fraction (resins). The third fraction, oils are then similarly separated and recovered. Asphaltenes or resin fractions from the ROSE process are used as blending components for asphalt cements to meet specification requirements.

Asphalt Cement is an asphalt which has been specially refined as to quality and consistency for direct use in the construction of asphalt pavements. An asphalt cement has to be heated to an appropriate high temperature in order to be fluid enough to be mixed and placed.

The method of grading of asphalt cements by standard penetration at 25°C (77°F) was the first systematic method developed. The basic principle of the penetration test is to see how far a needle penetrates an asphalt sample under specified conditions of load, time and temperature. The current penetration test starts with melting and cooling the asphalt binder sample under controlled conditions. Then measure the penetration of a standard needle into the asphalt sample at a load of 100 grams, temperature of 25°C and time of 5 seconds. The depth of penetration is measured in units of 0.1 mm and reported in penetration units (e.g., if the needle penetrates 8 mm, the asphalt penetration number is 80). Some of the standard grades classified by this method include 60/70, 85/100 and 200/300 asphalts, which have penetrations of 60 to 70, 85 to 100 and 200 to 300, respectively. ASTM D946 provides a specification for penetration-graded asphalt cements. According to this specification, the only requirement on the consistency of the asphalt cements is the penetration at 25°C. There is no requirement on the consistency at either a higher or lower temperature, and thus no requirement on the temperature susceptibility of the asphalt cements. Two

asphalts may be of the same penetration grade and yet have substantially different viscosities at 60°C (140°F).

This led to viscosity grading of asphalts. The temperature for grading asphalt cement by viscosity is at 60°C, which represents approximately the highest temperature pavements may experience in most parts of the United States. When an asphalt is graded by this system, it is designated as AC followed by a number which represents its absolute viscosity at 60°C in units of 100 poise. For example, an AC-20 would have an absolute viscosity of around 2,000 poise at 60°C.

Another grading system is to grade asphalts according to their viscosity when placed on the road (after aging due to the heating and mixing process). This grading system is based on the absolute viscosity at 60°C of the asphalt residue after the Rolling Thin Film Oven Test (RTFOT) procedure, which simulates the effects of the hot-mix plant operation. An asphalt graded by this system is designated as AR followed by a number which represents the viscosity of the aged residue at 60°C in units of poise. For example, an AR-6000 would have an aged residue with an absolute viscosity of around 6000 poise. An AR-6000 would roughly correspond to an AC-20 or a 60/70 pen. asphalt. However, it should be recognized that the conversion from an AR grade to an AC grade depends on the hardening characteristics of the asphalt.

PUMP RECOMMENDATIONS:

- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP1 Models)
- Steel fitted construction and extra clearances may be required depending on viscosity.
- Bronze bushings can be utilized for temperatures up to 232°C (450°F). Carbon graphite is required for temperatures above 232°C Note: High temperature graphite may be required for some pump sizes.
- **Acceptable shaft seals include:**
 - O-Pro® Cartridge Seal
 - Packing
 - Cartridge lip seal with quench
 - Single metal bellows mechanical seal with hard faces and quench
 - Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid



Terminals

COMMERCIAL ASPHALTS

Asphalts from the refining processes are further modified for specific uses. Most are used in the road paving and roofing industries. These applications will be discussed as well as pump recommendations.

Emulsified Asphalts are mixtures of asphalt cement, a surfactant and water that is used in preparing base courses for pavement. It is also used in cold laid mixes, mix-in-place and surface treatments. They are produced with hot asphalt oil (99°C, 210°F) that is run through a colloid mill with a soap or emulsifier solution. The colloid mill grinds the asphalt oil into droplets small enough (0.001 - 0.005 inches, 25 – 125 microns) to be held in suspension by the emulsifier. The product is then stored in large tanks and shipped to customers. It usually must be delivered at temperatures from 49-66°C, 120-150°F.

Anionic Emulsions carry negative charges on the surfaces of the asphalt droplets and are comprised of acids reacted with a base such as caustic potash or caustic soda to form a salt. It is this salt that is the active emulsifier. The emulsifier attaches itself to the asphalt particles.

Cationic Emulsions carry positive charges on the surfaces of the asphalt droplets and are also made of acid salts. Most aggregates or pavements have a negative charge and thus attract cationic emulsifiers. This causes a good bond to form between the aggregate and asphalt. Cationic emulsions are less sensitive to weather because they have a chemical 'break'. They can be stabilized without making break times longer. No precoat is required for a cationic emulsion if aggregate is clean and dust-free. However, cationic emulsions are more sensitive in handling and require greater attention to storage procedures.

Breaking refers to the event when the asphalt and water separate from each other. This occurs as the emulsifier leaves the surface of the asphalt particles due to it's attraction to the surface of the aggregate. Since asphalt is heavier than water, the asphalt particles will settle to the bottom of the solution.

The deposition of the asphalt globules into a surface from a cationic emulsion takes place in startling contrast to the anionic variety. The "break" of cationic emulsions begins to take place at the moment of contact, because of the natural attraction of the cationic asphalt particles to the anionic aggregate. Surface and atmospheric conditions have little effect on the adherent properties of the cationic asphalt. The presence of moisture on a surface is no deterrent to adhesion.

The term "inverted emulsion" is used to designate a system that has asphalt as the external and water as the internal phase. Usually these are emulsions of water in cutback asphalt and contain considerable amounts of emulsifier. When such emulsions are diluted with water an asphalt-in-water system containing various small drops of asphalt will form.

The blending of a cationic and anionic emulsion will result in immediate coalescence of the asphalt particles. The manufacturer of both types must handle and store each type separately.

The stability of an asphalt emulsion (resistance to coagulation of droplets of asphalt) depends upon a number of factors, each may assume a greater or lesser degree of importance depending on the kind of emulsion.

The consistency of asphalt emulsions is governed principally by (1) the asphalt content, (2) asphalt particle size and size distribution, (3) nature of liquid surrounding the asphalt droplet. Viscosity of an emulsion decreases with dilution or decrease in asphalt content. This is one of the values of asphalt emulsion in commercial use. The high viscosity emulsion can be quickly, easily and economically reduced to a lower and more workable consistency by the addition of water. The dilution of emulsion can be controlled to leave a film of desired thickness on stone or other solid surfaces. Viscosity may be regulated by processing methods which change particle size distribution without change in asphalt content.

The amount of material adsorbed at the asphalt surface, and the quantity of bound water, influence the consistency of an asphalt emulsion. Variations in viscosity of as much as 35% are obtained for emulsions identical in every respect except the presence of a small amount of stabilizer.

There are three general classes of asphalt emulsions commonly used. They are known as RS, rapid setting; MS, medium setting; SS, slow setting emulsions. High-float emulsions are also available, with the HF designation preceding the class of asphalt. High-float emulsions, so designated because they pass the Float Test (AASHTO T-50 or ASTM D-139), have a quality imparted by the addition of certain chemicals that permit a thicker asphalt film on the aggregate particles with a minimum probability of drainage. This property allows high-float emulsions to be used with somewhat dusty aggregate with good success.

TYPICAL VISCOSITIES OF ASPHALT EMULSIONS

Grade	Setting Speed	Viscosity (SSU)	Temperature
RS-1	Rapid	200-1000	25°C (77°F)
RS-1h	Rapid	200-1000	25°C (77°F)
RS-2	Rapid	700-4000	50°C (122°F)
HFRS-2	Rapid	700-4000	50°C (122°F)
MS-1	Medium	200-1000	25°C (77°F)
MS-2	Medium	≥1000	25°C (77°F)
MS-2h	Medium	≥1000	25°C (77°F)
HFMS-1	Medium	200-1000	25°C (77°F)
HFMS-2	Medium	≥500	50°C (122°F)
HFMS-2h	Medium	≥500	50°C (122°F)
HFMS-2s	Medium	≥500	50°C (122°F)
SS-1	Slow	200-1000	25°C (77°F)
SS-1h	Slow	200-1000	25°C (77°F)
CRS-1	Rapid	200-1000	25°C (77°F)
CRS-1h	Rapid	200-1000	25°C (77°F)
CRS-2	Rapid	1000-4000	25°C (77°F)
CMS-2	Medium	500-4500	25°C (77°F)
CMS-2h	Medium	500-4500	25°C (77°F)
CSS-1	Slow	200-1000	50°C (122°F)
CSS-1h	Slow	200-1000	50°C (122°F)

Finally, emulsions are subdivided by a series of numbers that relate to the viscosity of the emulsion and the hardness of the base asphalt cement. The numbers "1" and "2" are used to designate the viscosity of the emulsion. The lower the number,

the lower the viscosity and the more fluid the emulsion is. If the number is followed by the letter "h", the emulsion has a harder base asphalt.

The letter "C" in front of the emulsion type denotes cationic. The absence of the "C" denotes anionic or nonionic. For example, RS-1 is anionic or nonionic and CRS-1 is cationic.

Asphalt emulsions must be perfectly homogeneous and able to with-stand storage and shipping. Most emulsions must not be subjected to temperatures below 0°C, 32°F because freezing of the aqueous solution will coagulate the asphalt particles.

THE FOLLOWING ARE THE GENERAL USES OF THE GRADE OF ASPHALT MENTIONED:

- **RS-1** Low viscosity for penetration and surface treatment.
- **RS-2** High viscosity for surface treatment.
- **MS-1** Low viscosity for re-tread mixes with coarse aggregate.
- **MS-2** Medium viscosity for plant mixers with coarse aggregates.
- **SS-1** For fine aggregate mixes.

Emulsified asphalt is produced at both refineries where the asphalt is produced and facilities solely built for the production of emulsified asphalt. Pumps are used to deliver asphalt and the aqueous solution to the mixer or colloid mill.

Fog Seals are applications of asphalt emulsion sprayed onto a pavement surface with or without a sand cover (the emulsion is diluted to the proper consistency in order to get complete coverage on the roadway but not be too thick to cause a slippery surface). Fog seals are used to delay weathering of the pavement, waterproof the pavement surface, improve the pavement's ability to keep water from penetrating the base course or subgrade, and reduce raveling.

Raveling is the loss of aggregate particles on the pavement surface. This could be caused by the loss of the binding properties of the asphalt in the mix due to oxidation and/or asphalt stripping. When these two problems occur, vehicle tires can wear wheel paths by raveling off coarse aggregate.

Sand Seals are a sprayed application of asphalt emulsion followed by a covering of clean sand or fine aggregate. A pneumatic-tire roller is often used after applying the sand. Excess sand is removed from the road surface after rolling. Sand seals enrich weathered pavements and fills fine cracks in the pavement surface. The sand can provide additional skid resistance to the pavement while also inhibiting raveling.

Scrub Seals use an asphalt emulsion to fill the pavement cracks and voids. After the emulsion has been applied, a brooming mechanism is drug over the road surface. A layer of sand or aggregate is applied over the emulsion followed by another drag broom, forcing the sand into the emulsion filled cracks and voids. A pneumatic tire roller is then used over the seal. The excess sand or aggregate is broomed off the roadway a couple of hours after application depending on weather conditions. Scrub Seals are used to fill large cracks up to 13mm, 0.5" wide.

Slurry Seals are mixtures of quick setting asphalt emulsion, fine aggregate, mineral filler, additive, and water. The ingredients are carefully measured and combined on the project site and spread with a squeegee device. In small areas and parking lots, a hand squeegee is commonly used to spread the mixture. Typically, a specially designed vehicle mixes the ingredients and spreads the slurry. The vehicle has a spreader box towed behind that spreads slurry in a uniform layer. There are three common sizes of slurry seal mixtures. The three mixtures are Type III (3/8-inch minus), Type II (1/4-inch minus), and Type I (1/8-inch minus). Generally, Type I slurry seals are used in parking lots and Type II and III seals are used on streets and higher traffic roads. Slurry seals will fill small surface cracks, stop raveling, and improve the skid resistance of the pavement.

PUMP RECOMMENDATIONS:

- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP1 Models)
- Limit pump speed to 25% of the maximum rated speed listed in the catalog. Emulsified asphalt is sensitive to shearing.
- Extra clearances are required.
- Bronze bushings recommended.
- A drilled idler will be required for added bushing lubrication.
- Steel fitted construction may be required depending upon viscosity.
- **Acceptable shaft seals include:**
 - O-Pro® Cartridge Seal
 - Packing
 - Cartridge lip seal with quench
 - Single metal bellows mechanical seal with hard faces and quench
 - Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid

Polymer Modified Asphalts (PMA) are produced through the addition of a polymer (and usually several other components in smaller amounts) to liquid hot base asphalt. PMA is made primarily to meet Superpave requirements, with added strength and flexibility at a wider temperature range than conventional asphalt. Superpave, which stands for SUPERior PERforming Asphalt PAVements consists of two basic components.

The first is an asphalt binder specification called performance grading (PG). This is based on the idea that an HMA asphalt binder's properties should be related to the conditions under which it is used. For asphalt binders, this involves expected climatic conditions as well as aging considerations. The PG system uses a common battery of tests, but specifies that a particular asphalt binder must pass these tests at specific temperatures that are dependant upon the specific climatic conditions in the area of use. PG is reported using two numbers – the first being the average seven-day maximum pavement temperature and the second being the minimum pavement design temperature likely to be experienced. For example, a PG 58-22 is intended for use where the average seven-day maximum pavement temperature is 58°C and the expected minimum pavement temperature is -22°C. Notice that these numbers are pavement temperatures and not air temperatures

The second is a design and analysis system based on the volumetric properties of the asphalt mix. This also includes mix analysis tests and performance prediction models. This is the Superpave mix design method, which replaces the Hveem and Marshall methods. The volumetric analysis common to older methods provides the basis for the new method. The Superpave system ties asphalt binder and aggregate selection into the mix design process, and considers traffic and climate as well. The compaction devices from the Hveem and Marshall procedures have been replaced by a gyratory compactor and the compaction effort in mix design is tied to expected traffic.

PMA can be produced in several different methods. The simplest is a batch approach where asphalt cement and the polymer are mixed in a large tank. The asphalt must be maintained at 196°C (385°F) while the polymer is slowly added from a hopper with a feeder (Note: Where the polymer comes in a solid form). A mixer with two sets of blades is required to ensure complete mixing. After mixing (which can take nearly a day) the PMA is pumped to a separate storage tank.

A faster approach involves the use of phosphoric acid as a catalyst. This allows the asphalt producer to decrease the processing temperature from 196°C (385°F) to 157°C (315°F) and to cut the processing time by around 70%.

A number of other approaches are also used for making PMAs. The common denominator is mixing the polymer with the asphalt cement under the right conditions so that the polymer can chemically bond to the asphalt molecule.

PMAs are either produced at the refinery or a separate facility like a hot mix plant.

Pump applications in this scheme include an asphalt supply pump to move the asphalt cement from the storage tank to the mixer. A recirculation pump is needed to pump the asphalt from the bottom of the tank to the top. A pump is also used to unload the PMA from the PMA storage tank. Depending on the method used, there is an additional application to pump the phosphoric acid into the mixing tank. Phosphoric acid is quite viscous at ambient temperatures and it is recommended to keep it at a minimum temperature of 60°C (140°F).

Microsurfacing is similar to a slurry seal operation. It allows a thicker layer to be placed and cures faster than a slurry seal. Microsurfacing uses a polymer-modified emulsion mixed with crushed aggregate, mineral filler (cement, lime, limestone dust, flyash), water, and additives. The additives influence the mix time and set time.

Pavement Dressings are emulsions made from asphalt, coal tar, or a combination of both. They may include rejuvenators and a variety of fillers such as fibers and mineral fillers. Polymer modified asphalt emulsions are also used in some of the pavement dressings. Pavement dressings are used for, but are not limited to, campgrounds, administrative sites, parking lots, and driveways. The pavement dressings containing coal tar are used where protection from petroleum spills are needed. This material is sprayed or squeegeed onto the pavement. The pavement dressings fill small cracks, seal and protect the asphalt pavement from oxidation and deterioration.

PUMP RECOMMENDATIONS:

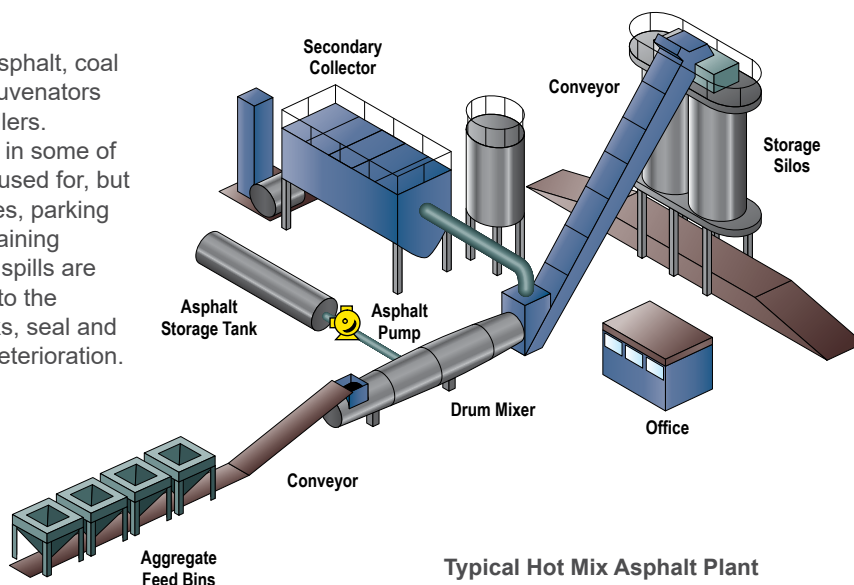
- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP1 Models)
- Steel fitted construction and extra clearances are required depending on viscosity.
- Bronze bushings recommended
- For shear sensitive grades of PMA the following additional specifications may be required:
 - Extra clearances and reduced pump speeds beyond viscosity requirements.
 - Drilled idler for added idler bushing lubrication.
- **Acceptable shaft seals include:**
 - O-Pro® Cartridge Seal
 - Packing
 - Cartridge lip seal with quench
 - Single metal bellows mechanical seal with hard faces and quench
 - Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid

Hot Mix Asphalts (HMA) are processed in batch mix facilities where any type of commercial asphalt can be made.

A typical HMA production facility will stock pile several types of aggregate. A front loader is used to load each kind of aggregate into a separate bin. Using computers to control openings in the bottom of the bins, the aggregate is precisely measured onto a conveyor belt that carries the damp aggregate to a dryer.

A burner is located at one end of the dryer. The burner mixes fuel oil or natural gas with air. This ignites the same way the furnace in a home works. The dryer turns and tumbles the aggregate through the hot air stream, similar to a clothes dryer.

The dry aggregate is then transported to the “mixing towers” by an elevator. Here the hot aggregate is separated by size into several hot storage bins, using vibrating screens. Based on a mix recipe, the aggregates are then batched from each hot bin into the “weigh hopper.” After the aggregates are weighed, the asphalt cement is pumped from a storage tank into a “weigh bucket.” If RAP is going to be used, it is added at this time as well.



When all materials have been weighed, they are transferred to a mixing device called a “pugmill.” The pugmill mixes the aggregate and asphalt cement with beater like equipment, until it is properly coated. The finished mixture is either loaded directly into waiting trucks or it is moved to a silo for temporary storage, since HMA may be produced faster than trucks can haul it away.

In a drum mix facility, the individual aggregates are weighed from their bins onto a conveyor. The conveyor takes the aggregates to a dryer, where they are dried and heated. If RAP (recycled asphalt pavement) is used, it is metered in when the aggregate is mostly dry. The difference now is that in a drum mix facility, the addition of the asphalt cement occurs here in a continuous process. In most drum mix facilities, the mixing occurs in the dryer itself, away from the combustion process. Some drum mixers use longer dryers than those found in batch facilities, to accommodate this mixing area. Others use a separate chamber to mix the asphalt and aggregate. The finished HMA is transferred to silos for temporary holding, until it is transferred into trucks. Drum mix facilities must use silos, because they run continuously. Once the silos are full, the facilities shut down. Therefore, drum facilities are not running all of the time.

PUMP RECOMMENDATIONS:

- Varies with the type of asphalt being produced.

Cutback Asphalt is produced by fluxing an asphaltic base with a suitable solvent. Upon exposure to the atmosphere the solvent evaporates leaving the asphalt cement to perform its function. Cutbacks are used because they reduce asphalt viscosity for lower temperature. The solvent varies depending on the grade of asphalt and its curing time.

The use of cutback asphalts is decreasing because of environmental regulations and loss of high energy products. Cutback asphalts contain volatile organic chemicals that evaporate into the atmosphere. Emulsified asphalts evaporate water into the atmosphere. The petroleum solvents used require higher amounts of energy to manufacture and are expensive compared to the water and emulsifying agents used in emulsified asphalts. In many places, cutback asphalt use is restricted to patching materials for use in cold weather.

THE THREE GRADES OF CUTBACK ASPHALT ARE:

- **RC Asphalt** or rapid curing cutback asphalt is composed of asphalt cement and a light diluent of high volatility, generally in the gasoline or naphtha boiling point range. Specific grades are RC-70, 250, 800, and 3000.
- **MC Asphalt** is a medium curing asphalt composed of asphalt cement and a medium diluent of intermediate volatility, generally in the kerosene boiling point range. Specific grades are MC-38, 70, 250, 800 and 3000.
- **SC Asphalt** is slow curing asphalt is composed of asphalt cement and a low volatility oil. Slow curing asphalts are often called road-oils from the days when asphalt residual oil was used to give roads a low-cost, all-weather surface.

PUMP RECOMMENDATIONS:

- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP1 Models)
- Steel fitted construction and extra clearances are required depending on viscosity. See the master catalog for details.
- Bronze bushings can be utilized for temperatures up to 232°C (450°F). Carbon graphite is required for temperatures above 232°C. Note: High temperature graphite may be required for some pump sizes.
- **Acceptable shaft seals include:**
 - O-Pro® Cartridge Seal
 - Packing
 - Cartridge lip seal with quench
 - Single metal bellows mechanical seal with hard faces and quench
 - Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid

Chip Seals are the most common surface treatment for low-volume roads. A chip seal is an application of asphalt followed by an aggregate cover. The asphalt is usually applied as a hot asphalt cement, cutback asphalt, or emulsified asphalt. After the asphalt is applied to the pavement surface, aggregate is immediately applied over the asphalt before the hot asphalt cools or the emulsion breaks. A pneumatic roller is used to reorient or seat the aggregate particles and tighten the rock matrix. After the asphalt cures, the excess aggregate is removed by brooming. A chip seal application corrects raveling and seals small cracks on the old pavement surface while providing a new skid resistant surface. Chip sealing may also be used following crack sealing.

Cape Seals are an application of a chip seal followed by a slurry seal.

Tack Coats are thin layers of asphalt, emulsion or cutback, applied between HMA pavement lifts to promote bonding.

Roofing Asphalts are primarily used to produce shingles and felts for both industrial and residential construction.



The length of the asphalt shingle processing line is approximately the length of a football field. At the beginning of the line there is a huge spool of fiberglass fabric, called “felt,” that can be 1-2 meters wide. The process begins by

unrolling 150m of this felt into loops. The felt is then pulled through what is called a “coater” where it is pulled taught and simultaneously sprayed, top and bottom with a hot asphalt mix in predetermined amounts. The asphalt mix consists of liquid asphalt and fillers, such as limestone or flyash that are mixed prior to the coating process.

After the felt has been coated with asphalt, it is pulled through a set of rollers, in order to shape it into a consistent thickness. Once it comes out of these rollers, granules are dropped on top of the shingle while the asphalt is still hot. The material is then passed through another set of rollers in order to embed the granules into the asphalt-coated felt. At this point, the material is transposed so that sand can be dropped on the backside of the shingle.

Finally the shingle goes through a cooling looper (rollers that build up a lot of slack so it can be pulled through more slowly to cool). From here the material goes to laminating, or straight to cutting. After the shingles are cut, they are stacked, wrapped into bundles, and palletized.

Blown Asphalt is Blown asphalts are typically used in the roofing industry and manufactured by blowing 232-315°C (450-600°F) air through asphalt to make it harder or to have a higher viscosity.

Viking pumps are used extensively in the manufacture of asphalt roofings. They are used for unloading pumps; transfer pumps from storage tanks to blending tanks; transfer of coating asphalts; transfer of any additives that may be used; transfer service from blending tanks to saturator tanks; circulating pumps; circulating hot asphalt in the saturator tank; circulating hot oil from the heat ex-changer through the storage tanks, blending tanks and coating asphalt tanks. In the schematic diagram (page 8) we have illustrated the pumps of different sizes. The capacity for each service would be determined by the capacity of the roofing plant.

PUMP RECOMMENDATIONS:

- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP1 Models)
- Steel fitted construction and extra clearances are required depending on viscosity.
- Bronze bushings can be utilized for temperatures up to 232°C (450°F). Carbon graphite is required for temperatures above 232°C.

Note: High temperature graphite may be required for some pump sizes.

Acceptable shaft seals include:

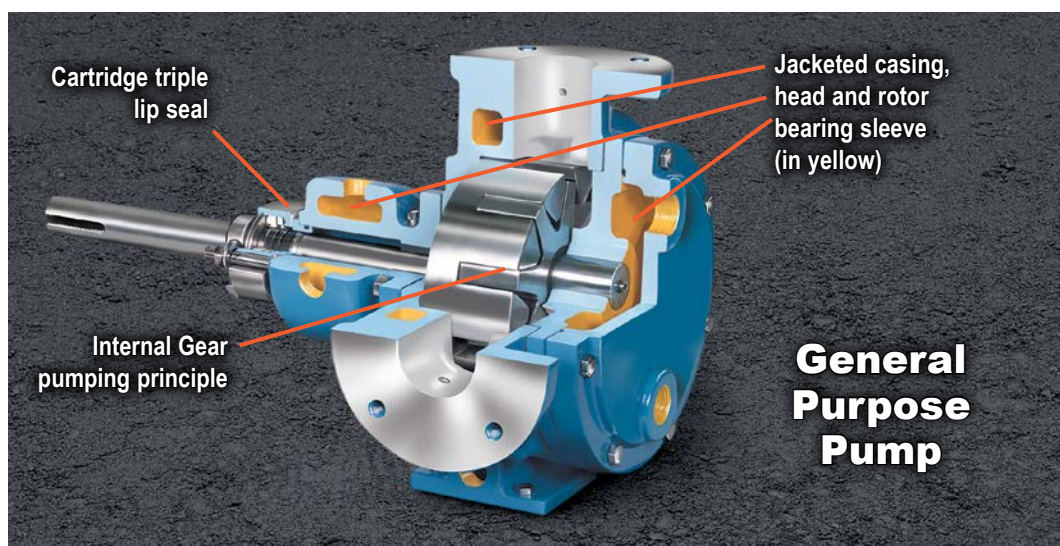
- O-Pro® Cartridge Seal
- Packing
- Cartridge lip seal with quench
- Single metal bellows mechanical seal with hard faces and quench
- Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid

Filled Asphalts are an additional type of asphalt used at roofing products plants that is not encountered at other facilities utilizing asphalt. This asphalt is called coating asphalt and it provides additional waterproofing and a tacky surface for the colored granules to adhere to. This asphalt is made up of up to 60-70% limestone and is very abrasive to pumps.

- 1224A-ASP Series™ / 1324A-ASP Series™ (ASP2 Models)
- Heavy duty, jacketed or non-jacketed as temperature requires
- Limit pump speed to 25% of the maximum rated speed listed in the catalog
- Extra clearances are required per viscosity guidelines
- Hardened steel gears are recommended
- Use tungsten carbide idler bushing and idler pin
- Use abrasion resistant shaft such as hardened steel
- Use abrasion resistant bracket bushing such as hardened cast iron
- **Acceptable shaft seals include:**
 - O-Pro® Cartridge Seal
 - Packing
 - Single metal bellows mechanical seal with hard faces and quench
 - Double metal bellows mechanical seal with hard faces (inboard) and a pressurized barrier fluid

GENERAL PUMP RECOMMENDATION GUIDELINES:

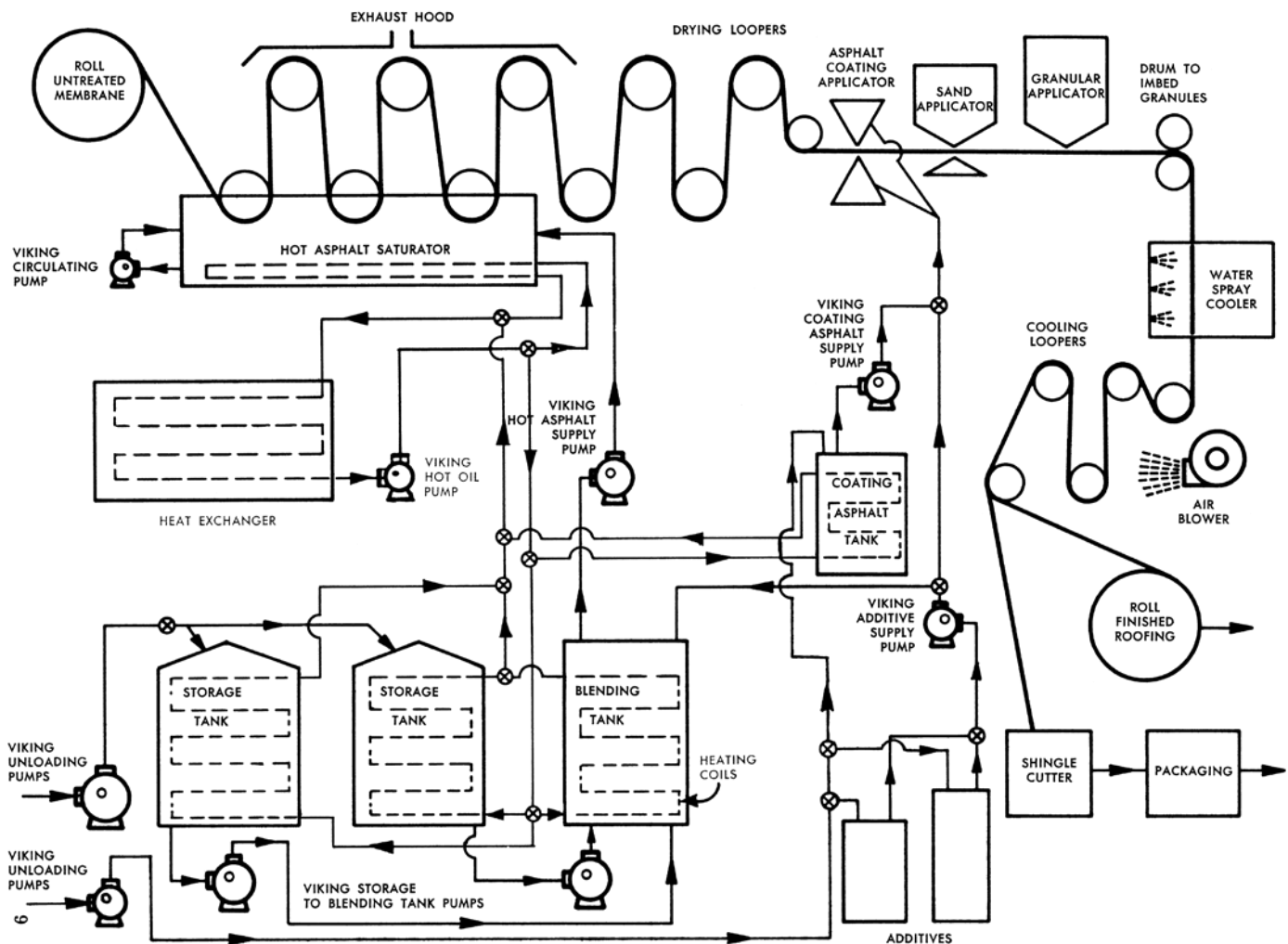
- Use general purpose pumps for applications of up to 5 bar (75 psi). Above 5 bar, heavy duty pumps should be used.
- Pump heating options include steam, hot oil, and electric tracing. Steam and hot oil can be applied directly in integral jacketed components of the pump (bracket, head, casing and relief valve) or indirectly with stainless steel tubing wrapped around the pump.
- O-Pro® Cartridge Seal, packing, lip seals, and mechanical seals are options for shaft sealing. All seal types have startup, pre-heating requirements to ensure that the seal and shaft are not damaged by cold solid asphalt. Seal quenches or barrier fluids are recommended with any lip seals or mechanical seals option.



- Pumps may be driven by V-belt, gearbox or gearmotor. V-belt drives allow for the belt to slip at startup until residual solid asphalt heats into liquid and the pump is able to turnover freely. Bearing pillow blocks are required on the drive shaft for V-belt driven general purpose pumps.

Heating the pump at start-up is required to ensure that any residual asphalt is in liquid form in the pump gear mesh area

and in the packing or seal area. See pump heating options above. On initial startup of new pumps with mechanical seals venting of the seal chamber is recommended to ensure liquid reaches the seal faces. Insure proper precautions are in place to prevent the spraying of hot asphalt when venting the seal chamber.



1224A-ASP SERIES™ & 1324A-ASP SERIES™ ASPHALT PUMPS

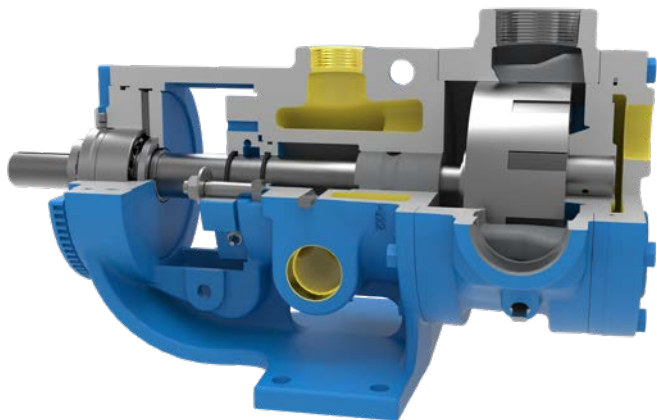
ASP1 MODELS:

The ASP1 model asphalt pumps build upon Viking's proven robust, heavy duty design that has been used for decades of successful asphalt transfer by adding shaft seal leak prevention through use of Viking's O-Pro® Cartridge seal, which utilizes a double O-ring design with grease lubrication to provide a robust seal preventing process fluid from leaking out of the pump. The ASP1 models use bronze bushings and are best for clean, non-abrasive liquids.

ASP2 MODELS:

The ASP2 model asphalt pumps are designed for abrasive applications such as the filled asphalts used by manufacturers of asphalt roofing and sealants. These pumps are ideally suited for liquids with concentrations of small but hard particles. The ASP2 model pumps offer shaft leak prevention with Viking's O-Pro® Cartridge seal. These pumps utilize hard parts in key wear areas, combined with unique designs and operating practices to reduce abrasive wear for longest life. The hardened parts include:

- Tungsten carbide idler bushing & idler pin
- Hardened steel rotor, idler, & shaft,
- Hardened cast iron bracket bushing.



K1224A-ASP1

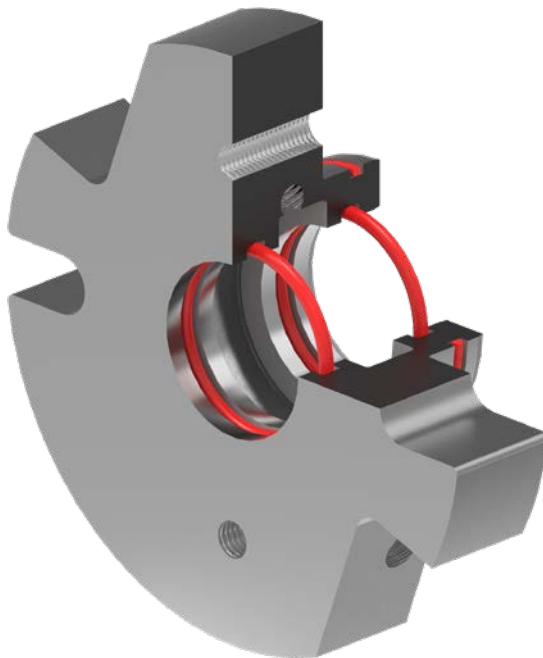
O-PRO® CARTRIDGE SEALS

LEAK PREVENTION WITH O-PRO® CARTRIDGE SEAL:

Viking's O-Pro® Cartridge seal prevents leakage along the shaft for increased cleanliness, decreased clean up costs, and reduced fall hazards. Asphalt has traditionally been sealed with packing, which must continuously leak to stay lubricated. Prior alternative sealing methods include mechanical seal options that are prone to catastrophic failure and often require an external seal support system for asphalt service. Viking's O-Pro® Cartridge seal avoids the issues common to packing and mechanical seals by using O-rings to seal externally on the bracket and internally on the shaft. These O-rings in combination with a lubricating grease provide a robust seal, keeping process fluid from leaking out of the pump. The O-Pro® Cartridge seal can be easily repaired or retrofitted without pump disassembly and is the standard seal offering on our ASP Series asphalt pumps.

RETROFITABILITY:

Existing K-RS size Universal Series pumps can be retrofitted to utilize the O-Pro® Cartridge seal without pump disassembly. Seal kits are available with all parts needed for the conversion. If shafts are worn, new rotor/shafts may be required for conversion to ensure sealing and are not included in the kits.



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