USMW
PROFESSIONAL SERIES
A US Motor Works Brand

CERTIFIED • OEM QUALITY • RELIABILITY

SUCCESS IN COOLING

FAN CLUTCHES

usmwpro.com

FOREWORD

The purpose of this booklet is to provide a basic overview of a Fan Clutch and information on how to avoid common reasons for Fan Clutch or cooling system problems, and best practices for Fan Clutches replacement and cooling system restoration.

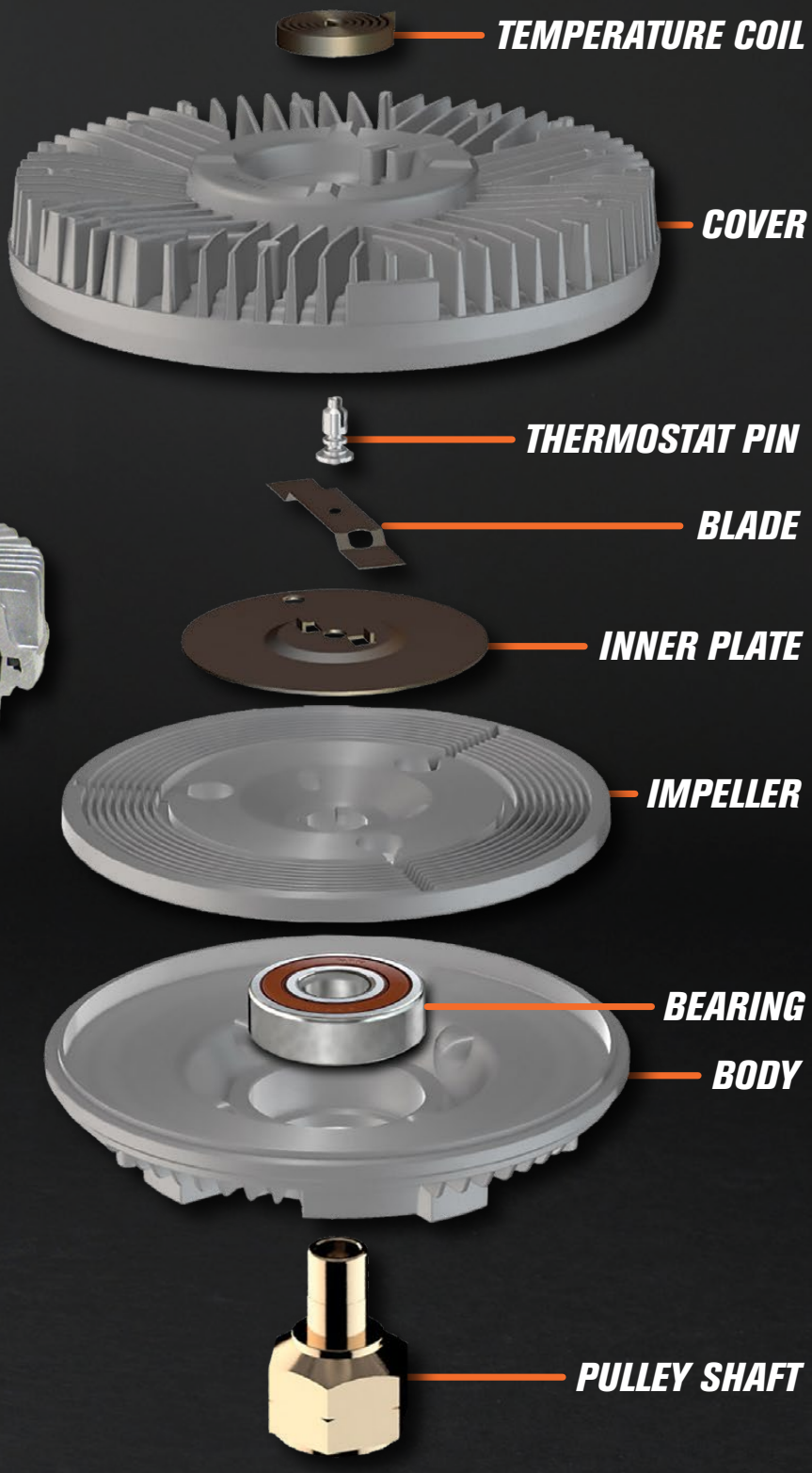
Information in this booklet can also help determine the possible cause and validity of a warranty claims on an automotive and heavy-duty Fan Clutches.

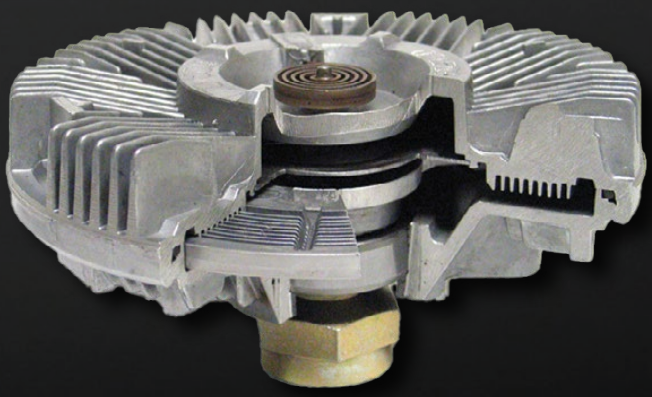
TABLE OF CONTENTS

FAN CLUTCHES

Fan clutches are critical cooling system components designed to regulate airflow across the radiator and maintain proper engine temperature. The fan clutch is responsible for controlling the operation of the engine's cooling fan by engaging or disengaging it based on temperature and airflow needs. A typical fan clutch consists of several key components: Pulley Shaft, Temperature Coil, Clutch Body filled with silicone fluid, Bearing Assembly, Blade, Impeller, Thermostat Pin, Inner Plate, and Cover. These components work together to ensure the fan operates only when necessary, reducing drag on the engine and improving fuel efficiency.

WHAT COMPONENTS AND MATERIALS MAKE UP A FAN CLUTCH?





The cross-section of the fan clutch above illustrates how all the components fit and function together to form a complete, operating assembly.

TYPES OF FAN CLUTCHES

- **THERMAL**
- **NON-THERMAL**
- **ELECTRIC**

See page 4 to learn about each style of Fan Clutch.

TYPES OF FAN CLUTCHES

THERMAL FAN CLUTCHES

A thermal fan clutch operates according to engine temperature using a bi-metallic thermostatic coil that responds to the heat coming through the radiator. When temperatures rise, the clutch increases silicone fluid flow inside the unit, causing the fan to spin faster; when temperatures drop, the clutch partially disengages to reduce drag. This adaptive operation improves cooling efficiency, reduces noise, and enhances fuel economy, making thermal clutches a popular choice in modern vehicles that require responsive and efficient cooling under varying load and weather conditions.

NON-THERMAL FAN CLUTCH

A non-thermal fan clutch engages the cooling fan based on engine RPM rather than temperature, using internal springs and friction components to increase fan speed as engine speed rises. Because it does not rely on heat-sensitive mechanisms, it provides consistent, reliable airflow and is commonly found in older or heavy-duty applications where constant cooling is preferred. While it lacks efficiency compared to temperature-controlled designs and may run more than necessary in cooler conditions, its simple construction, durability, and cost-effectiveness make it a dependable option in demanding environments.

ELECTRIC FAN CLUTCHES

An electric fan clutch uses electronic control from the engine control module (ECM) to precisely regulate fan speed based on input from sensors that monitor coolant temperature, engine load, and A/C pressure. Unlike mechanical clutches, it responds instantly and independently of engine RPM, providing highly efficient, targeted cooling. This design improves fuel economy, reduces noise, and maintains optimal engine temperature, making electric fan clutches ideal for newer diesel engines, commercial vehicles, and applications requiring strict thermal management to meet performance and emissions standards.

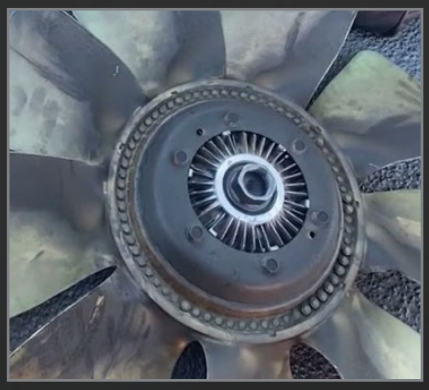
FAN CLUTCHES WITH MOLDED FAN DESIGNS

Fan clutches paired with molded fan designs offer a highly efficient and reliable cooling solution by combining precise clutch control with lightweight, aerodynamically optimized fan blades. Molded fans–often made from durable, heat-resistant composite materials–are engineered for consistent blade shape, improved airflow, and reduced vibration compared to traditional metal fans. When used with a fan clutch, these molded designs provide smoother, quieter operation and enhanced cooling performance, engaging only when needed to reduce engine load and improve fuel efficiency. Their precise manufacturing also ensures excellent balance and long-term durability, making molded fan and clutch combinations a preferred choice in many modern automotive and heavy-duty cooling systems.

COMMON FAILURE MODES & CAUSES

Fan clutch failures are most often the result of mechanical wear, improper installation, system misalignment, or– in the case of electronic units–electrical control faults. The examples shown on pages 5 and 6 highlight the verified and most frequently encountered causes of failure within fan clutch assemblies.

SILICONE FLUID LEAK



Wear of the primary seal, housing damage, or long-term thermal cycling allows silicone fluid to escape from the clutch housing. Reduced fluid volume limits torque transfer inside the clutch, resulting in weak or delayed engagement, poor cooling at idle, and eventual overheating.

DAMAGED OR IMBALANCED FAN BLADE

Bent, cracked, or non-OEM fan blades create rotational imbalance. Excess vibration transfers into the clutch bearing, resulting in premature wear, seal damage, and reduced service life. Use of incorrect fan blade weight or pitch is a major contributor to early failures.

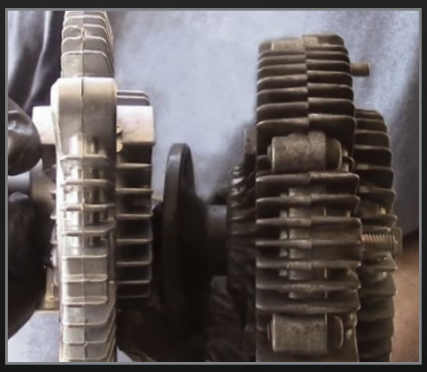
IMPROPER INSTALLATION OR SYSTEM MISALIGNMENT

Incorrect bolt torque, improper tightening sequence, cross-threaded hubs, or misaligned pulleys place side-loading on the clutch shaft. Over-tightened belts apply additional radial load. These conditions accelerate bearing failure, damage seals, and cause wobble, noise, or leaks.

BEARING WEAR OR FAILURE

Excessive belt tension, pulley misalignment, vibration, contamination, or natural aging degrade the bearing. Bearing wear causes shaft wobble and seal damage, leading to fluid leakage, noise, vibration, and complete clutch failure.

INCORRECT OR MISMATCHED FAN CLUTCH TYPE



Using the wrong clutch type, incorrect vehicle application, or a fan blade incompatible in weight or pitch causes improper engagement, continuous slipping, or overload. The mismatch leads to poor cooling performance and premature mechanical failure. Fan clutches and fan blades are directional, it is crucial to use the correct fan clutch and fan blade in every application. USMW fan clutches always follow the OEM specifications.

AGE OR NORMAL WEAR

Over time, internal components naturally degrade. Silicone fluid thickens or thins, springs lose tension, and bearings lose lubrication. This reduces engagement capability and cooling efficiency, eventually resulting in failure.

USMW PROFESSIONAL SERIES
A US Motor Works Brand

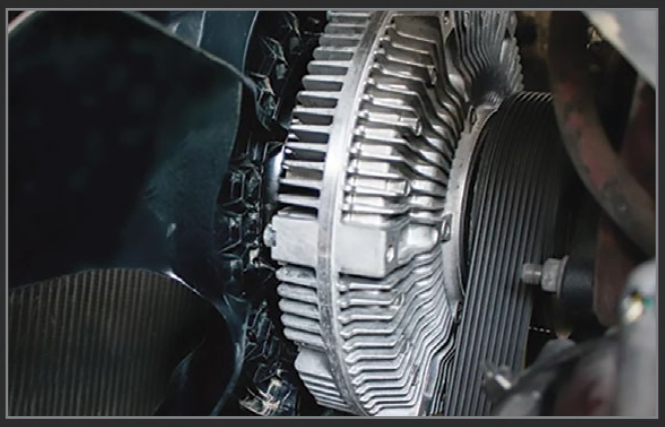
CERTIFIED • OEM QUALITY • RELIABILITY

ELECTRIC FAN CLUTCH COMMON FAILURES

ELECTRICAL CONNECTOR OR HARNESS ISSUES

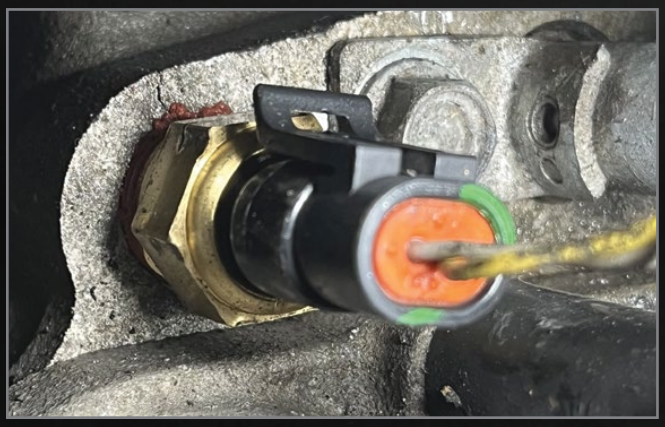
Corroded terminals, loose pins, broken wires, or damaged connectors can interrupt the PWM or voltage signal sent to the fan clutch. When the clutch doesn't receive a clean, consistent signal, it may engage improperly–or fail to operate altogether.

INTERNAL ELECTRONIC CONTROL MODULE FAILURE



Heat, vibration, moisture intrusion, or internal short circuits can damage the electronic control module integrated into the fan clutch. A failed module prevents proper PWM response, causing full lockup, no engagement, or intermittent operation.

FAULTY TEMPERATURE SENSOR OR PCM SIGNAL INPUT



Incorrect data from the coolant temperature sensor, A/C pressure sensor, or PCM logic fault leads to inaccurate fan command signals. This results in fan over-engagement, under-engagement, erratic operation, or "no-engage" conditions.

THERMAL OVERLOAD OF ELECTRONIC COMPONENTS

Excess engine compartment heat, restricted airflow, or extended high-load towing/hauling conditions overheat internal electronics. Thermal stress degrades circuit components, reducing fan clutch response accuracy or triggering module shutdown.

SYMPTOMS & DIAGNOSIS

FAN CLUTCH SYMPTOMS

A failing or faulty fan clutch can cause several noticeable issues, and catching these early is key to an accurate diagnosis, effective repair, and long-term engine reliability. Here are the most common symptoms:

1. **Engine overheating at low speed or when stopped**
   This is the most common sign of fan clutch failure. At highway speeds, the vehicle's forward motion pushes enough air through the radiator to cool the engine. At idle or in traffic, however, the engine relies heavily on the fan clutch to pull air through the radiator. If the clutch doesn't engage, airflow is drastically reduced, and the engine can quickly overheat.
2. **Insufficient cabin heat in winter**
   This can happen when the fan clutch fails in the opposite way–by seizing. A seized fan runs constantly, preventing the engine from warming up properly. A cold engine produces less heat for the heater core, leaving you with weak cabin heat during colder months.
3. **Excessive fan noise at higher speeds**
   A seized fan clutch can also cause loud roaring or whooshing noises, especially during acceleration. Because the fan is locked on, it spins at engine speed even when not needed. Over time, this can damage the fan bearings, flex the blades enough to contact the radiator or shroud, or even shatter plastic fan blades.
4. **Fan spinning freely after the engine is shut off**
   A fan that continues to spin more than it should may indicate a weak or worn clutch. Loss of silicone fluid inside the clutch is a common cause If enough fluid leaks out, the clutch can no longer provide proper resistance or engagement.
5. **Poor A/C performance at low speeds (optional but commonly included)**
   Since the engine fan also helps cool the A/C condenser, a weak or non-engaging fan clutch can lead to warm A/C when idling or driving slowly.

HOW TO DIAGNOSE AND CHECK THE FAN CLUTCH

With the engine off, you can perform several quick checks:

1. **Spin the fan**
   Most mechanical fan clutches should offer moderate resistance. If it free-spins more than about three full rotations, the clutch may be worn out. If it's difficult or impossible to spin, the bearing could be seized.
2. **Check for play or wobble**
   Gently move the fan forward and backward. Any noticeable wobble–generally more than ¼ inch–or a clicking sensation can indicate worn bearings. This can become dangerous if ignored.
3. **Inspect for silicone fluid leaks**
   Fan clutches rely on heavy silicone oil for proper engagement. If you see oily residue around the clutch body, the fluid may be leaking out, weakening the clutch and leading to eventual failure.
4. **Observe fan engagement behavior**
   As the engine warms up, a thermal fan clutch should engage at a certain temperature, which you can usually hear as an increase in fan noise and airflow. Torque-limiting clutches disengage at higher engine speeds to reduce drag. An optical tachometer can be used to confirm fan speed changes: look for a sudden increase in fan RPM as engine temperature rises.
5. **Use a scan tool for electronic clutches**
   Vehicles with electronically-controlled fan clutches require diagnostic equipment to monitor commanded fan engagement, temperature sensor data, and related fault codes. Incorrect sensor readings or wiring issues can mimic clutch failure.

WHY FAN CLUTCH HEALTH MATTERS

Internal combustion engines generate significant heat, which the cooling system must keep within a safe range. Proper operating temperature improves performance, fuel economy, and heater output. Too much heat, however, can destroy seals, warp heads, degrade oil, and in extreme cases cause catastrophic engine failure.

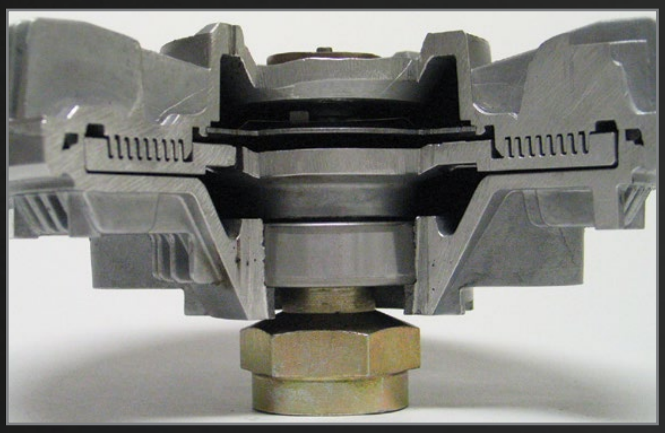
If your fan clutch is failing, it's important to replace it promptly to prevent serious engine damage.

For additional information, including reasons to choose a **USMW Professional Series** fan clutch and why upgrading your vehicle with a **Max Cooling Kit** (Fan Clutch with water pump) at the same time is crucial, refer to pages 8 and 9.

USMW PROFESSIONAL SERIES
A US Motor Works Brand
CERTIFIED • OEM QUALITY • RELIABILITY

KEY FEATURES OF USMW FAN CLUTCHES

PREMIUM COMPONENTS



USMW Professional Series fan clutches are engineered with uncompromising quality. Every application is carefully designed and rigorously tested to meet or exceed original equipment standards. Through advanced research, precision engineering, and the use of premium materials, our fan clutches deliver exceptional durability, reliability, and performance–making them among the most trusted products on the market today.

HIGH LOAD BEARINGS

High-load bearings play a vital role in both the performance and longevity of a fan clutch. By increasing load capacity, these bearings offer greater durability and improved resistance to wear, helping the clutch withstand demanding operating conditions and extending its overall service life. We use a high quality bearing from top manufacturers that are made with double seals.

PRECISION CNC MACHINING

CNC-machined surfaces on a fan clutch deliver precise, consistent fitment with all mating components. This high level of accuracy helps the clutch operate smoothly and efficiently, while also creating uniform sealing surfaces that reduce the risk of leaks. The result is a more dependable, longer-lasting cooling system component.

IMPROVED SHAFT DESIGN

An improved shaft design brings multiple advantages that boost durability and performance. Its high-strength construction and increased load capacity allow it to handle the intense forces generated during fan operation. Smooth shaft surfaces help reduce stress concentrations that can lead to fatigue or failure, while the optimized design lowers overall material stress throughout the assembly. An interference fit ensures solid, full-surface contact for added stability, and the staked-end feature provides strong anti-rotation protection. Together, these enhancements create a more secure, reliable, and long-lasting fan clutch system.

DO THE JOB ONCE, DO THE JOB RIGHT

DID YOU KNOW?

The fan clutch is one of the most commonly overlooked components in your vehicle's cooling system. Even though it plays a crucial role in regulating engine temperature, it's easy to forget about. Because the fan clutch is mounted directly to the water pump, both parts run the same miles and endure the same wear and tear. When a new water pump is installed but the old fan clutch is reused, the worn clutch can place extra strain on the new pump–often leading to noisy operation, overheating issues, or even premature pump failure.

THE SOLUTION

For reliable cooling performance and longer-lasting repairs, replace both parts at the same time with a MAX Cooling Kit.

WHAT IS A MAX COOLING KIT?

To protect your investment and ensure your cooling system works as it should, it's best to replace both the fan clutch and water pump at the same time. A MAX Cooling Kit makes this simple by including both components in one convenient, matched package. By installing a MAX Cooling Kit, you get parts that are designed to work together, improving cooling performance, reducing the likelihood of early part failure, and helping your engine run more efficiently and reliably. That means less time in the repair bay, lower labor costs, and ultimately more money saved for you.

Scan this QR code to Check out this informative video to see why MCK is the smart choice.

USMW PROFESSIONAL SERIES
A US Motor Works Brand

CERTIFIED • OEM QUALITY • RELIABILITY

WARRANTY EXCLUSIONS

USMW Professional Series a brand of US Motor Works, LLC warrants products to be free from defects in material and manufacturing, under normal use and service.

NORMAL WEAR AND TEAR

MODIFICATIONS

The following descriptions and images are indications of damage caused by improperly maintained systems and modifications and are not covered under the fan clutch warranty.

Normal Wear and Tear: Fan clutches are designed to wear over time. Their eventual failure is considered routine maintenance rather than a manufacturing defect, and is therefore not covered.

Modifications: Any modifications made to the fan clutch are not covered.

Improper Installation: Any issues caused by incorrect installation–such as improper torque on mounting bolts or failure to follow recommended procedures–will void the warranty.

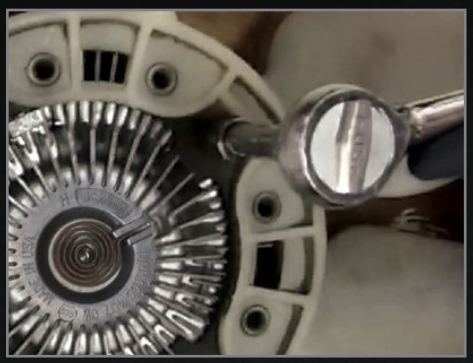
External or Impact Damage: Damage from foreign objects, impacts, or anything that interferes with the clutch's ability to rotate freely is not covered.

Parts Corrosion: Failures caused by contamination within the air, hydraulic, or coolant systems are excluded from warranty coverage.

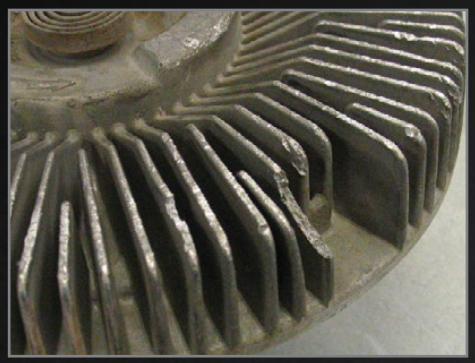
Misuse or Related System Problems: Excessive cycling due to faults in other vehicle systems, or damage resulting from the use of an unapproved fan blade, will void the warranty.

Use of Non-Approved Parts: Installing aftermarket or incompatible components with the fan clutch can void the warranty.

Insufficient Maintenance: Failure to perform necessary maintenance or related repairs will result in loss of warranty coverage.



IMPROPER INSTALLATION: OVER TORQUE



EXTERNAL OR IMPACT DAMAGE

PARTS CORROSION

COOLING SYSTEM OVERVIEW

AIR COOLED TRANSFER SYSTEM

FAN BLADES, FAN CLUTCHES, & ELECTRIC FANS assists in moving the air that allows the heat exchange to happen between the radiator and the coolant. A fan clutch should be replaced when installing a new water pump.

COOLANT CONTAINMENT SYSTEM

RADIATOR & CAP Radiator Caps have seals that help the radiator build up pressure for the circulation of the coolant. The Cap also acts as a release valve that opens when the pressure or temperature of the coolant exceeds a certain point to prevent damage to the radiator or hoses.

COOLANT collects the heat from the engine and transfers it out of the engine through a heat exchange at the radiator. Coolant also prevents freezing and protects engine components from corrosion.

THERMOSTATS restrict or allow coolant motion as needed through specified temperature regulation.

COOLANT CONVEYANCE SYSTEM

WATER PUMPS push the coolant through the engine.

HOSES are the plumbing used to carry coolant between the engine and radiator.

BELTS provide the rotation required for many engine components.

TIMING BELTS synchronize valves and rotate water pumps in many applications.

TENSIONERS maintain the correct amount of belt force throughout operation and help protect other engine components such as the power steering pump from stress and fatigue.

USMW PROFESSIONAL SERIES
A US Motor Works Brand
CERTIFIED • OEM QUALITY • RELIABILITY

Corporate Manufacturing and Distribution Center
14722 Anson Ave., Santa Fe Springs, CA 90670

Performance Division
3901 Medford St., Los Angeles, CA 90063

Mid West Fulfillment Center
3161 Heartland Dr., Liberty Mo 64068

OSC – East Coast
1600 Cross Pointe way, #B, Duluth, GA 30097

Mexico Manufacturing and Distribution Center
Transformacion # 102
Parque Industrial Las Torres,
Santa Catarina, N.L., MX CP66367

Ph: 562-404-0488

Fax: 562-404-8770

usmotorworks.com