TWIN DISC INCORPORATED

Owner's Manual

Marine Transmission

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Marine Transmission Owner's Manual

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TWIN DISC INC. Patents

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Parent Company

Twin Disc, Incorporated
4600 21st Street
Racine, Wisconsin 53405
U.S.A.
Phone +1 (262) 554-0640
service@twindisc.com
Website: www.twindisc.com

Subsidiaries

TWIN DISC INTERNATIONAL S.A.
Chausée de Namur, 54
B-1400 Nivelles
Belgium
Phone: +32 (0) 67 887 211
Telefax: +32 (0) 67 887 333
E-mail: tdbelgium@twindisc.com

TWIN DISC (FAR EAST) PTE LTD
6, Tuas Avenue 1
Singapore 639491
Phone: (65) 6267 0800
Telefax: (65) 6264 2080
E-mail: sngenquiry@twindisc.com

TWIN DISC POWER TRANSMISSION (SHANGHAI) CO. LTD
Rm2308, Shartex Plaza
No. 88 Zun Yi Road
Shanghai, China 200336
Phone: +86 (21) 64273212
Phone: +86 (21) 62097626
Telefax: +65 (21) 62097629
Web: www.twindisc.com.cn
E-mail: enquiry@twindisc.com.cn

TWIN DISC PACIFIC PTY LTD HEAD OFFICE – BRISBANE
70B Tradecoast Drive
Eagle Farm QLD 4009
Australia
Phone: +61 (7) 3265-1200
Telefax: +61 (7) 3865-1371
E-mail: info@twindisc.com.au

TWIN DISC PACIFIC PTY LTD – GOLD COAST
L4/1 Boatworks Drive
Coomera QLD 4209
Phone: +61 (7) 5613 3095
E-mail: info@twindisc.com.au

TWIN DISC PACIFIC PTY LTD – PERTH
7 Tomlinson Road
Welshpool WA 6106
Australia
Phone: +61 (8) 9355-3033
Telefax: +61 (8) 9355-4011
E-mail: twindisc.perth@twindisc.com.au

TWIN DISC NICO CO., LTD
1-405-3, Yoshino-cho, Kita-ku
Saitama City, Saitama, 331-0811
Japan
Phone: +81 (48) 652 8069
Telefax: +81 (48) 665 6695
E-mail: info@tdnico.com

ROLLA SP PROPELLERS SA
Via Roncaglia 6
P.O. Box 109
Novazzano, 6883
Switzerland
Phone: +41 (0) 91 695 2000
Telefax: +41 (0) 91 695 2001
E-Mail: info@rolla-propellers.ch

TWIN DISC S.R.L
Via S. Cristoforo 131
40017 S. Matteo Della Decima (BO)
Italy
Phone: +39 051 6819711
Telefax: +39 051 6824234 or 6825814
E-mail: Info.technodrive@twindisc.com

Identification Plate

Transcribe the following information from your unit's nameplate to the illustration below for ease of reference.

- Model Number
- BOM Number
- Ratio
- Serial Number
- Customer Number (if applicable)
- Oil Capacity
- Minimum Oil Pressure When Cruising

Keep this information at hand, and refer to the model number, serial number, and BOM number when requesting any parts and service.

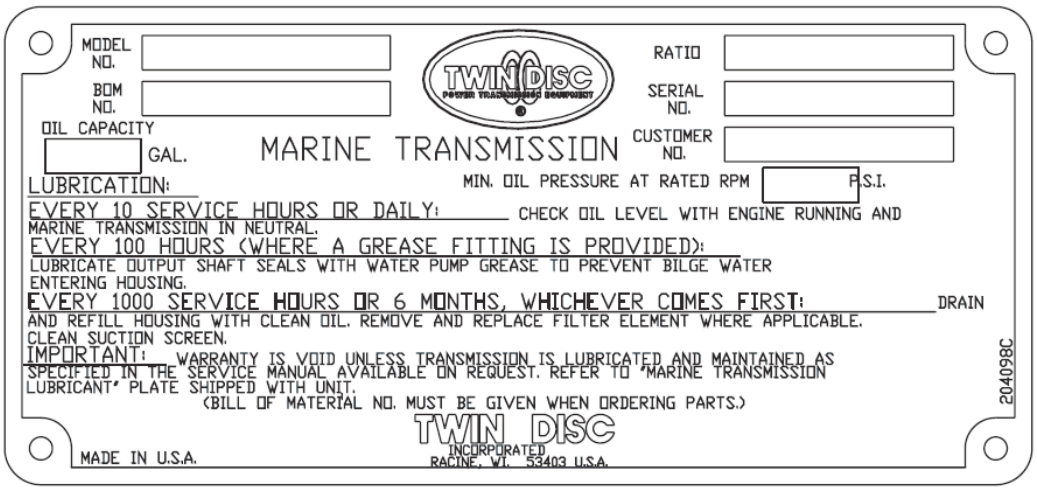

Figure 1. Example of Identification Plate

Lubrication Plate

Fill in the blanks below with the information from your unit's lubrication data plate. Keep this information at hand and refer to it when servicing you transmission.

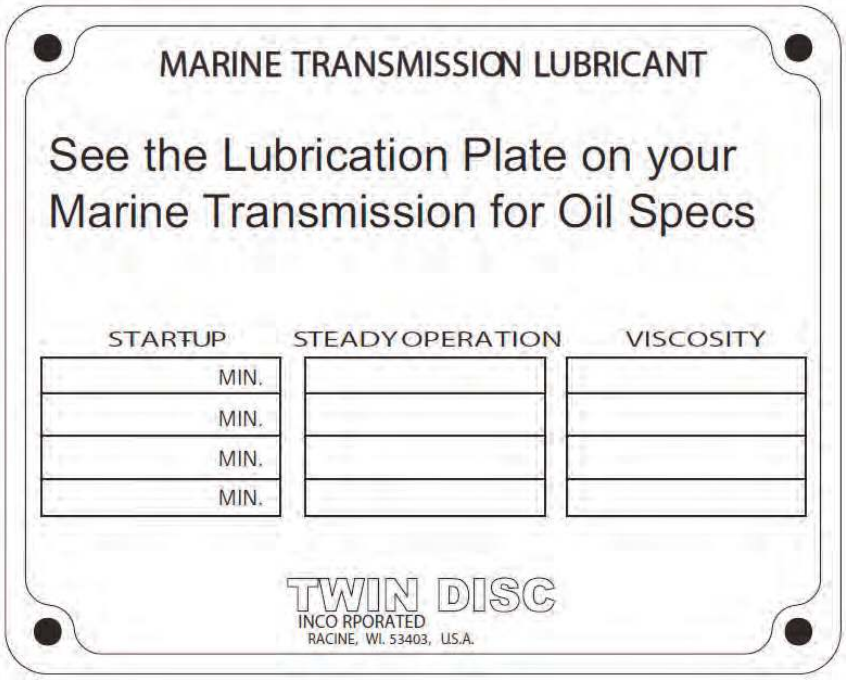

Figure 2. Example of Lubrication Plate

Oil temperature listed is the temperature of the oil entering the heat exchanger.

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Safety

These messages convey important information about **SAFETY**. The safety alert symbol and signal words described below are followed by safety messages and appear throughout this manual.

All personnel must read, understand and follow all safety message instructions prior to operation, maintenance or repair of this unit.

Safety Alert Symbol

This is the safety alert symbol. It is used throughout this manual to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Signal Words

Signal words are used with the safety alert symbol to designate a level of hazard seriousness. The signal words used are **DANGER**, **WARNING**, **CAUTION** and **NOTICE**.

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to address practices not related to physical injury.

All people installing and operating this unit must employ safe operating practices. Twin Disc Incorporated is not responsible for any personal injury resulting from any unsafe and careless use of hand tools, power tools, lifting equipment, or from any unsafe practices during installation and operation.

Because of the possible danger to people or property from accidents that may result from the use of manufactured products, it is important that correct procedures be followed. Products must be used in accordance with the information specified.

Proper installation procedures must be used. Proper safety devices, such as guards, may be required as specified in applicable codes. Safety devices are not provided by Twin Disc Incorporated nor are they the responsibility of Twin Disc Incorporated.

Terms and Definitions

For the purpose of this document, the following terms and definitions apply:

Degree of Hazard and Safety Label

DANGER	Denotes that an extreme intrinsic hazard exists which would result in high probability of death or irreparable injury if proper precautions are not taken.
WARNING	Denotes that a hazard exists which can result in injury or death if proper precautions are not taken.
CAUTION	Denotes a reminder of safety practices or directs attention to unsafe practices which could result in personal injury or damage to the craft or components or to the environment.

Introduction

General Information

This publication provides general operating information for Twin Disc Marine Transmissions. Specific product details and performance characteristics can be obtained by contacting your nearest Twin Disc Authorized Distributor or Service Dealer.

This manual is current at the time of printing. When required, changes are made to reflect advancing technology and improvements in state of the art.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unaccepted maintenance/working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent output shaft rotation. If you require positive neutral (output shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in this manual regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment in the **Preventative Maintenance** section of this manual, as well as **Maintenance Record** charts.

Ordering Parts and Obtaining Services

⚠WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

NOTICE

Do not order parts from the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com/sales-service-locator/]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department of Twin Disc, International S.A., Nivelles, Belgium, or Twin Disc, Incorporated, Racine, Wisconsin, 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

While most Twin Disc marine transmissions are forward/reverse reduction units, some units provide speed-increasing capability. All may be used with standard (left-hand) rotation engines and certain models may be modified to accommodate nonstandard (right-hand) rotation engines. Contact your Twin Disc distributor if you anticipate using nonstandard engines.

NOTICE

Engine direction of rotation is determined by facing the front of the engine (opposite engine flywheel). From this viewpoint, clockwise crankshaft rotation is defined as right-hand rotation.

All current Twin Disc marine transmissions can be operated through either primary or secondary clutch at full-rated horsepower for forward (ahead) propulsion using standard left-hand engines. Contact your Twin Disc distributor for the rated horsepower if you anticipate using nonstandard engines.

NOTICE

The primary clutch has the shortest power path through the transmission. The secondary shaft is driven in opposite rotation by the primary shaft.

Transmission clutches are hydraulically applied using regulated oil pressure. All bearings, clutches and gears are lubricated and cooled with oil.

Construction Features

Oil Pump Drive

For most transmissions, the secondary clutch shaft drives the oil pump.

Lubrication Features

The transmission case serves as the reservoir (sump) for all oil used in the transmission. Bearings and clutches on the primary and secondary shafts are lubricated and cooled through passageways in the shafts. Output shaft bearings are gravity and/or splash lubricated. Some transmissions use pressurized oil spray to lubricate gears and bearings.

Suction Screen

All units have a suction strainer located between the sump and oil pump in the hydraulic circuit. Its purpose is to prevent debris from entering the inlet side of the pump. The suction strainer must be cleaned as a part of every oil change. Consult the illustrations found in **Appendix B** for the suction strainer location on your unit.

Filter Assembly

Many units have an oil filter installed in the system. Some units incorporate a spin-on filter. Other units use a cartridge type filter plumbed into the hydraulic circuit between the pump outlet and the transmission inlet port. Replace oil filter as part of every oil change. Consult the illustrations found in **Appendix B** for the filter location on your unit.

Control Valve

All transmissions utilize a control valve to deliver pressurized oil to the clutches and lubrication circuit. It may be electrically or mechanically actuated.

Accessories

Heat Exchanger, Trolling Valve, Power Take Off, Trailing Pump or monitoring group (See **Appendix A**.)

Specifications

All Twin Disc marine transmissions are equipped with an identification plate. (See sample identification plate at the front of this manual.) In addition to information identifying the unit (i.e. model number, BOM number, ratio, serial number and customer number), the identification plate provides information on oil capacity, minimum cruise oil pressure and oil check/oil change intervals for your particular transmission. All operators of this equipment are responsible to read and apply the information provided on the transmission identification plate.

Oil Recommendations

Oil Viscosity

See your unit's lubrication data plate for type of oil and viscosity recommendations. Transcribe the information from your transmission's lubrication data plate to the sample plate found at the front of this manual for ease of reference.

Oil Pressure and Temperature

⚠ CAUTION

All units have provisions to install oil pressure and oil temperature gauges. Oil pressure gauges are required for all installations. By monitoring "main" oil pressure and temperature, you detect problems before major damage to the unit occurs.

Your unit's identification plate specifies "minimum oil pressure when cruising." This specification is the "main" oil pressure measured with the oil temperature in the normal operating range and engine speed at approximately 2/3 throttle setting. It is suggested that an alarm system be installed to notify the operator in the event that the oil pressure falls below the "minimum pressure when cruising" specification. The nominal operating pressure range, the low pressure alarm setting, and the engine shut-down alarm setting for each MG(X) transmission is provided in **Table 3. Oil Pressure Alarm Settings by Model** in the Troubleshooting section.

If you detect abnormal oil pressure:

1. Verify that the pressure reading is accurate. (Gauges can fail or malfunction.)

2. If gauge is malfunctioning, determine that actual operating pressure is within allowable range before resulting operation.

3. If pressure reading is accurate and pressure is outside of the allowable range, shut down the engine and correct the problem. See troubleshooting procedures in the **Troubleshooting** section of this manual.

NOTICE

If problem cannot be corrected and engine must be shut down, see instructions for windmilling/backdriving and towing in Windmilling, Backdriving, and Towing in the Operation section of this manual.

If unit must be kept in operation to prevent injury to personnel or damage to equipment, operate at lowest power possible until unit can be safely shut down.

Heat Exchanger

The heat exchanger is required to maintain the oil temperature in the hydraulic system within the recommended operating range. Proper oil temperature is maintained by passing coolant through the heat exchanger.

Some models, such as the MG(X)-5300 series and MG(X)-6000 series transmissions, may have an integral heat exchanger. On models with a remote mounted heat exchanger, the heat exchanger should be installed in a location convenient to coolant and marine transmission oil. **See the unit's lubrication plate or the chart in Table 4. Oil Operating Temperature Limits in the Troubleshooting section for the operating oil temperature.**

Oils for Use in Twin Disc Hydraulically Actuated Marine Transmissions

Continuous, Medium, Intermediate and Light Duty Applications

A. Description

- Typical approved oils are: SAE 30W, 40W and 50W.
- Refer to the lubrication plate mounted on the marine transmission for the approved oil types.
- Multi-viscosity oils, synthetic oils or blends of mineral and synthetic oils are not approved for use in the specified applications.

B. Requirements

Oils types listed in **A. Description** must meet the following specifications.

- API CF or ACEA E2.
- Caterpillar TO-2 specifications, Allison C-4 [1] specifications or has been approved by Twin Disc. Consult Twin Disc for oils that have been approved that do not meet Caterpillar TO-2 or Allison C-4 specifications.

⚠ CAUTION

Supplemental additives are not approved for use in marine transmissions and must not be added. Supplemental additives are products manufactured and marketed as "add-ins" to oils to alter the frictional, anti-wear and/or oxidation properties of the oil.

⚠ CAUTION

Avoid oils with spiral bevel and hypoid gear oil type EP additives, especially those with sulphur, phosphorous and chlorine compounds.

⚠ CAUTION

Re-refined oil is acceptable if it is API certified.

C. Operating Temperatures

- SAE 30W and 40W: 66-85 °C (150-185 °F)
- SAE 50W: 80-93 °C (175-200 °F)

D. Cold Start Oils

- Cold start oils must only be used when inability to start with those oil types described in **A. Description**.
- Cold start oils used must meet the requirements described in **B. Requirements**.
- Cold start oils used must have the following viscosities:
  a. Maximum viscosity at -40 °C (-40 °F): 20.0 cSt
  b. Minimum viscosity at 99 °C (210 °F): 7.0 cSt
- The residual of the cold start oil that remains after draining the marine transmission must be compatible with the oil types described in **A. Description**.

- Prolonged use of cold start oils may reduce transmission life.
- Cold start oils must be replaced with oils described in **A. Description** as soon as operating conditions permit.

E. Oil and Filter Change Intervals

- A 1000 hour or every six months (whichever occurs first) oil and filter change interval[2] is suggested as an initial guideline.
- It is the customer's responsibility to determine the correct oil and filter change interval based on local conditions, severity of the operation/duty cycle.
- The oil and filter change intervals can be optimized by the use of an oil analysis. Twin Disc, Incorporated strongly recommends the use of an oil analysis to determine the oil and filter change intervals. See section below in **F. Oil Analysis** for additional information on oil analysis.

F. Oil Analysis

- Oil analysis requires periodic samples to be taken from the operating marine transmission and sent to a laboratory[3] for analysis.
- Oil analysis may be used to determine the oil change intervals; however, it is important that the oil analysis be performed regularly and results analyzed consistently to determine trends.
- The protection of the transmission and oil and filter change intervals can be optimized by monitoring the following parameters of the oil:
  a. Viscosity: ±15% change from the new fluid
  b. Total Acid Number (TAN): +3.0 [4] change from the new fluid
  c. Solids: 2% by volume maximum
  d. Water contamination: 0.2% maximum
  e. Glycol contamination: No trace allowed. If detected, inspect and repair the marine transmission.
  f. Cleanliness per ISO 4406 [5]:
     - Filling of marine transmission: 16/13
     - Maximum level: 18/15

Pleasure Craft Duty Applications

A. Description

- Vessels used in charter service, shared ownership (timeshare), patrol vessels, tournament sport fish vessels, other vessel operating more than 500 hours per year or any kind of commercial service are not considered in this category.
- Typical approved oils are: SAE 30W, 40W, 50W, 5W40 and 15W40.
- Refer to the lubrication plate mounted on the marine transmission for the approved oil types.
- Alternate oil types that are approved for use in pleasure craft duty application, but not listed on the lubrication plate mounted on the marine transmission include multi-viscosity oils, synthetic oils or blends of mineral and synthetic oils.

B. Requirements

The typical approved oil types listed above must meet the following specifications:

- API categories CF, CF-2 or CG-4 or ACEA categories E2 or E7.
- Caterpillar TO-2 specifications, Allison C-4 [1] specifications or has been approved by Twin Disc. Consult Twin Disc for oils that have been approved that do not meet Caterpillar TO-2 or Allison C-4 specifications.
- Valid for private vessels operating less than 500 hours per year.

⚠ CAUTION

Avoid oils with spiral bevel and hypoid gear oil type EP additives, especially those with sulphur, phosphorous and chlorine compounds.

⚠ CAUTION

Re-refined oil is acceptable if it is API certified.

C. Operating Temperatures

- SAE 30W, 40W, 5W40 and 15W40: 66-85 °C (150-185 °F)
- SAE 50W: 80-93 °C (175-200 °F)

D. Cold Start Oils

- Cold start oils must only be used when inability to start with those oil types described in **A. Description**.
- Cold start oils used must meet the requirements described in **B. Requirements**.
- Cold start oils used must have the following viscosities:
  a. Maximum viscosity at -40 °C (-40 °F): 20.0 cSt
  b. Minimum viscosity at 99 °C (210 °F): 7.0 cSt
- The residual of the cold start oil that remains after draining the marine transmission must be compatible with the oil types described in **A. Description**.
- Prolonged use of cold start oils may reduce transmission life.
- Cold start oils must be replaced with oils described in **A. Description** as soon as operating conditions permit.

E. Oil and Filter Change Intervals

- For 15W40: A 500 hour or once a year (whichever occurs first) oil and filter change interval[(2)] is suggested as an initial guideline.
- For 30W, 40W and 50W: A 1000 hour or once a year (whichever occurs first) oil and filter change interval[(2)] is suggested as an initial guideline.
- It is the customer's responsibility to determine the correct oil and filter change interval based on local conditions, severity of the operation/duty cycle.
- The oil and filter change intervals can be optimized by the use of an oil analysis. Twin Disc, Incorporated strongly recommends the use of an oil analysis to determine the oil and filter change intervals. See the **F. Oil Analysis** section for additional information on oil analysis.

Oils for Use in Twin Disc Mechanically Actuated Marine Transmissions

1. Description

- Typical approved oils are SAE 80W90 and 85W140.
- Refer to the lubrication plate mounted on the marine transmission for the approved oil types.

2. Requirements: Oil types listed in **1. Description** must meet one of the following specifications.

    - API-GL-5
    - AGMA mild EP

3. Oil and Filter Change Intervals

    - A 1000 hour oil and filter change interval(2) is suggested as an initial guideline.
    - It is the customer's responsibility to determine the correct oil and filter change interval based on local conditions, severity of the operation/duty cycle.
    - The oil and filter change intervals can be optimized by the use of an oil analysis. Twin Disc, Incorporated strongly recommends the use of an oil analysis to determine the oil and filter change intervals. See the **F. Oil Analysis** section for additional information on oil analysis.

Grease for Use in Twin Disc Marine Transmissions Equipped with Ball Bearings, Roller Bearings, Pilot Bearings, Throwout Bearings and Seals

1. Description

    - Acceptable greases are NLGI grades #0, #1 and #2.
    - Recommended greases include the following
        a. Mobilgrease XHP™ 222
        b. Mobilgrease XHP™ 322 mine

2. Requirements: Grease listed above under "Description" must meet the following specifications.

    - Greases lubricating ball and roller bearings must be approved by the bearing manufacturer.
    - Lithium complex thickened to improved water washout resistance and extreme pressure additives
    - A minimum viscosity of 150 cSt at 40 °C (104 °F)
    - The base oil is either a mineral or synthetic.
    - A minimum operating temperature of 135 °C (275 °F) under continuous use.

3. Recommendations

   - For fretting wear conditions use NLGI grades #0 and #1.
   - Use NLGI grades #0 and #1 if the maximum component temperature is 20 °C (68 °F). Use NLGI grade #2 for higher temperatures.
   - When adding grease to plain bearings and oil seals pump a small amount.
   - When adding grease to ball and roller bearings pump until clean grease appears. Then operate the marine transmission at half of the maximum operating speed for 10 minutes and then wipe away the discharged grease.

4. Grease Intervals: 100 hours or when the boat is docked to prevent bilge water from entering.

Notes:

(1) A list of Allison C-4 approved oils is available from the Allison Transmission website found at www.allisontransmission.com.

(2) Oil change interval hours are accumulated operating hours.

(3) Oil companies can recommend an oil analysis laboratory source.

(4) Milligram of KOH required to neutralize a gram of fluid.

(5) The ISO code system has 28 possible code numbers. The code number for cleanliness is expressed as two numbers. The first number relates to the particles that are larger than 0.005 mm (0.0002 in) in size. The second number relates to the number of particles that are larger than 0.015 mm (0.0005 in) in size.

Operation

Selector Valve

General Description

In this transmission, a selector valve controls the application of primary and secondary clutches. This selector valve can be either a detented, lever-operated mechanical valve or an electric, solenoid-operated valve. The general purpose (GP) control valve coupled with the EC600 electronic control module or EC600 electronic control module is used to place the transmission in neutral, or to engage the primary or secondary clutches in the cruise and troll modes of operation. When either of the clutch engagement positions is selected, the control valve directs high-pressure oil through internal passages to the selected clutch to instantaneously and smoothly engage the clutch. The pressure rate-of-rise, which is controlled by the EC600 control module, provides a rapid and smooth clutch engagement. The control monitors various input signals continuously, and controls the transmission electrical valves accordingly, updating transmission control signals to optimize vessel operation.

Status LEDs

The following table specifies the functionality for LED 1 which provides limited information regarding the operational status of the controller. The word Flash indicates that the LED turns on and off about 5 times per second. The term Flash Code indicates the LED is flashing a three-digit number indicating the nature of the fault.

Table 1. LED 1

LED	Mode	Faults
Red Flash Code	Run, Primary or Secondary supply voltage exceeds 32V or falls below 10.1V	At least one fault is active
Red Steady		No fault is active
Yellow Flash	FST 600 BIT Manual or Display BIT Manual	N/A
Yellow Steady	Bootloader or Startup	N/A
Green 3Hz Flash	Run	*Select Neutral
Green Flash Code	Run	At least one fault is active

LED	Mode	Faults
Green Steady	Run	No fault is active

The following table specifies LED 2 and LED 3 illumination functionality, LED 2 is related to forward functions while LED 3 is related to reverse functions.

Table 2. LED 2 and LED 3

LED	Mode	Coil Status
Red Steady	Manual Override or Controller Neutral	N/A
Yellow Flash	Run	Fill Profile
Yellow Steady	Run	Slip
Green Steady	Run	Engaged
Off	Run	De-energized (i.e., Neutral)

The EC600 basic control module is available either as a Profile Module or an Etroll Module. The Profile Module provides cruise operation only.

⚠ CAUTION

Control Systems that fail to place a mechanical selector valve in detented positions will damage or cause failure of the clutch packs. Manually holding the shift selector out of the detented position will also damage or cause failure of the clutch packs.

⚠ CAUTION

Control systems for units equipped with electric solenoid valves must not permit actuation of both forward and reverse solenoids at the same time.

Safety

Whenever maintenance is performed on the marine transmission or control valve, always make sure that the transmission controls are free and are adjusted properly. Be certain that the transmission range selected at the operator's station places the control valve in the fully detented position for the selection made.

Prestart-up Checks

Prior to starting the engine, check the transmission as follows.

1. Check that there is oil in the transmission.

NOTICE

This check will determine that there is oil in the transmission but will not determine if oil level is correct. Oil level check must be performed with engine operating at low idle with transmission in neutral and oil temperature in operating range. Refer to step 3 under Startup.

2. Check transmission for leaks, cracks and obvious damage.

3. Check mountings for tightness or damage such as cracks. Tighten loose mountings and replace damaged parts.

4. Inspect heat exchanger oil and coolant lines and hoses for leaky connections, kinks, cracks and other damage. Replace damaged lines and/or hoses.

5. Check pressure and temperature gauges where applicable.

6. Inspect driveline and input and output shaft oil seals for signs of leakage. Replace parts as required.

7. Inspect unit identification plate and lubrication plate for looseness and corrosion. Tighten mounting screws that are loose and replace corroded plates.

NOTICE

If you need to replace an identification or lubrication plate, make sure all pertinent information is transferred to the new plate. Failure to do so could result in the loss of important information necessary to obtain parts and service.

Startup

1. Place the transmission control in NEUTRAL.

2. As soon as engine starts, check the transmission oil pressure (oil pressure gauges are required for all installations). Pressure should register within 15 seconds. If no pressure is indicated, stop the engine and determine the cause.

3. Check the oil level as follows.

NOTICE

The oil fill procedure for MG-5055A must be checked when the engine is stopped.

A. MG-5055A Only: Oil level must be checked when the engine is stopped. Fill the oil to the “MAX” mark of the oil dipstick.

All Other Models:

B. Fill the transmission to LOW mark on the dipstick. Run the engine at idle until oil temperature reaches operating range.

C. Continue running at idle and check the oil level with the oil level gauge (dipstick). The level should be at the FULL mark on the gauge. Add or remove oil as necessary to bring the level to the FULL mark on the gauge.

D. Allow the oil to cool to ambient temperature (perhaps overnight). Start the engine and check the oil level while cold at low idle engine speed with the engine in neutral. Make a note of this adjusted cold oil FULL level for future reference. DO NOT OVERFILL.

Normal Operation

1. For maximum service life, make all shifts from NEUTRAL into either FORWARD or REVERSE with engine running at low idle.

2. When a shift range is selected, assure that the control lever is in the fully detented position for the range selected.

3. Monitor transmission oil pressure and temperature. See oil pressure information on identification plate and oil temperature information on lubrication plate.

NOTICE

Sustained operation of the marine transmission with oil temperature outside of normal operating range is not recommended.

4. Shifting Limits:

For all shifts (NEUTRAL into FORWARD or REVERSE, and FORWARD or REVERSE through NEUTRAL into the opposite direction) limit engagement to a maximum of 1000 RPM or 50% of engine speed which ever is lower. Limits for surface drive or dynamic positioning applications may vary. Please contact Twin Disc regarding limits for these applications.

NOTICE

The recommended engine rpms pertain to normal operation only. In an emergency, the owner/operator is expected to employ whatever procedures are necessary to prevent loss of life and reduce damage to property.

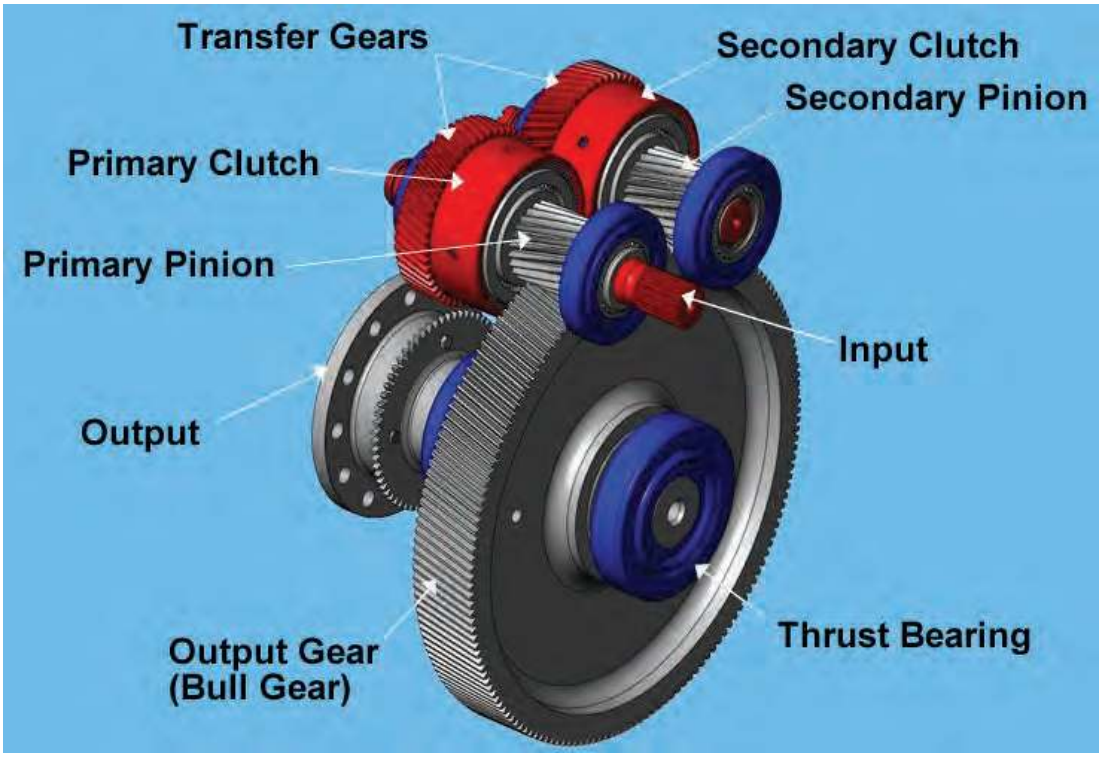


Figure 3. Transmission Gears and Clutch

Forward – Neutral – Reverse

To allow disengagement, forward and reverse propulsion.

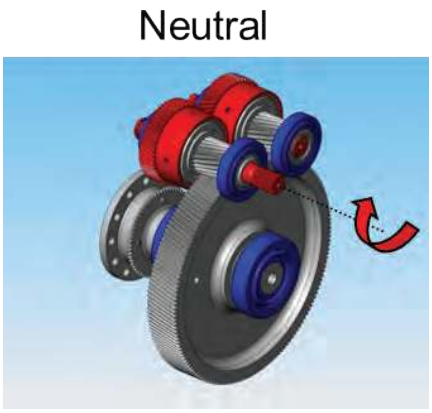


Figure 4. Neutral

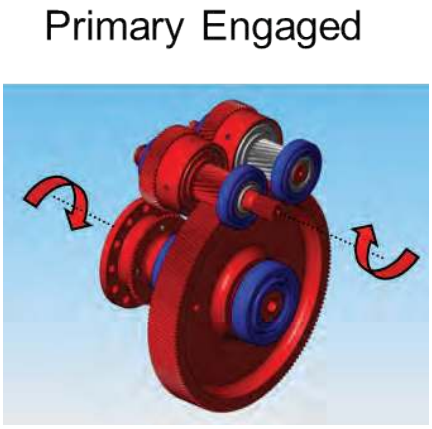


Figure 5. Primary Engaged

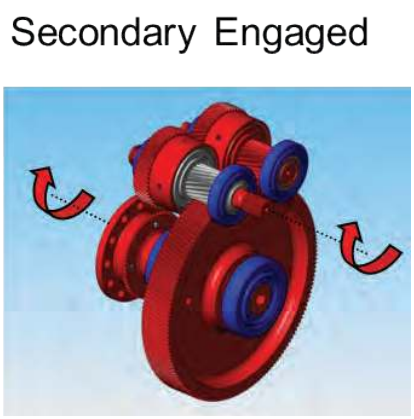


Figure 6. Secondary Engaged

Most engines require a reverse reduction transmission because they rotate counter-clockwise (left hand rotation).

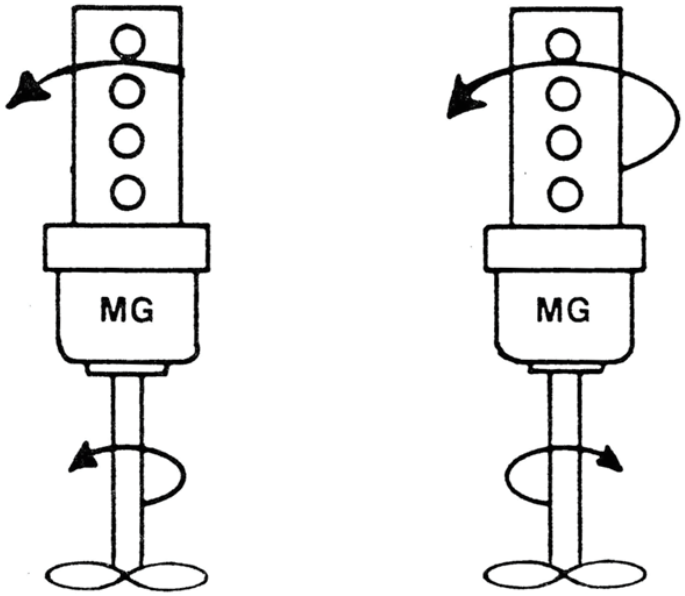


Figure 7. Counter-Clockwise Rotation

Modern marine transmissions have equal ratios and equal rating capacities through primary and secondary shafts.

Propellers turn OUTBOARD for forward propulsion.

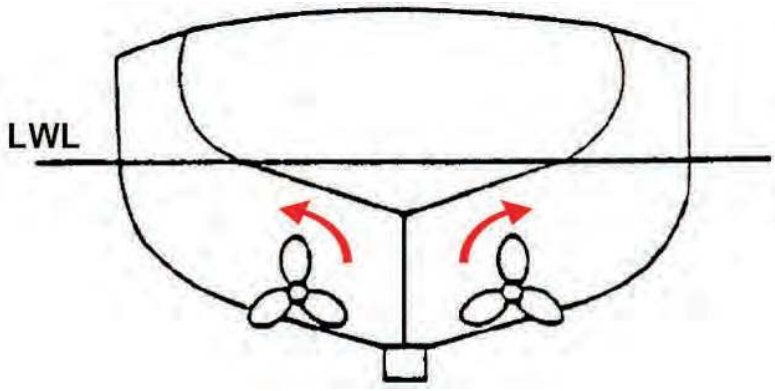


Figure 8. Propellers Turning Outboard

Port Side Transmission

Secondary Shaft Clutch = FORWARD

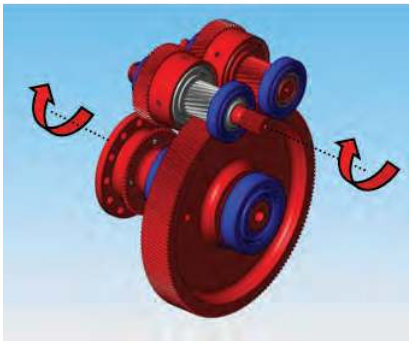


Figure 9. Secondary Shaft Clutch (Forward)

Starboard Side Transmission

Primary Shaft Clutch = FORWARD

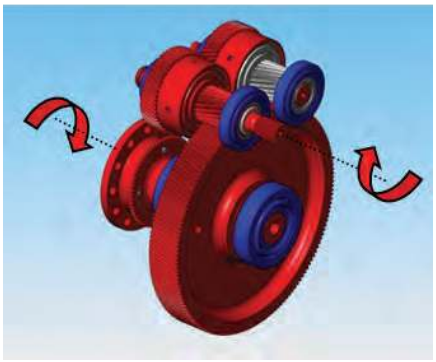


Figure 10. Primary Shaft Clutch (Forward)

Propellers turn INBOARD for forward propulsion

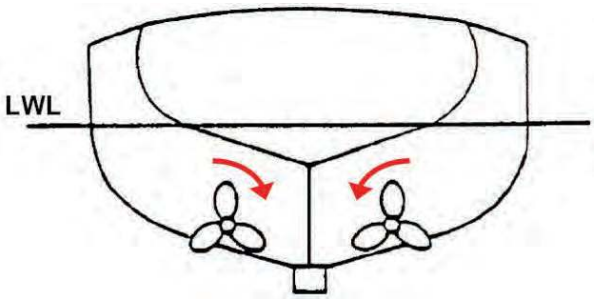


Figure 11. Propellers Turning Inboard

Port Side Transmission

Primary Shaft Clutch = FORWARD

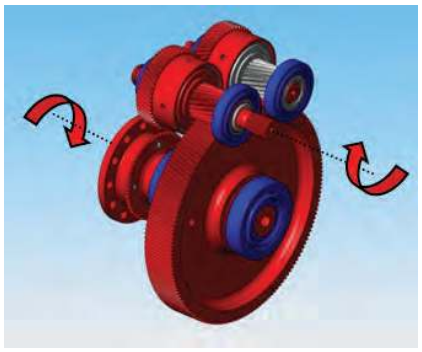


Figure 12. Primary Shaft Clutch (Forward)

Starboard Side Transmission

Secondary Shaft Clutch = FORWARD

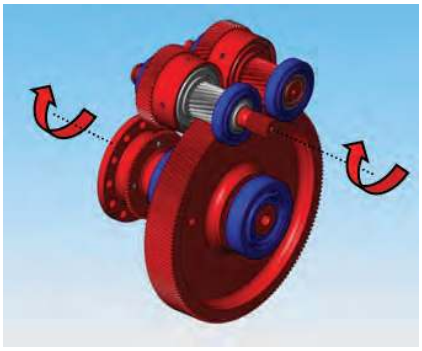


Figure 13. Secondary Shaft Clutch (Forward)

Operation in Dirty or Debris-filled Waters

Operation in waters that contain debris such as logs, ropes, or cables must be done cautiously. Throttle the engine back to near idle to prevent damage to the propellers, drivelines, and transmissions.

⚠ WARNING

Getting a rope (or similar object) caught in the propeller, or "propeller strikes" can cause serious damage to the Marine Transmission. If the vessel gets a rope (or similar object) caught in the propeller, or the propeller strikes an object, the engine should be shut down and a visual inspection of the Marine Transmission should be conducted. If in doubt, the transmission should not be operated. Follow the towing or back-driving procedures outlined in the manual to reach port. Continued operation of the transmission after getting a rope (or similar object) caught in the propeller, or a severe propeller strike may cause further damage to the transmission and place the safety of vessel and crew in jeopardy.

Operation with Optional Trolling Valve

General

Trolling valves are available as optional equipment for most Model MG-XXXX Twin Disc marine transmissions. An ETROLL control module is available for Model MG(X)- XXXX Twin Disc marine transmissions. The trolling valve allows reducing and controlling propeller speed below that normally attained when operating the engine at low idle. Examples of operations requiring such slow speeds are trolling or movement through "no wake" restricted areas.

Most trolling valves can be used with the selector valve in either the forward or reverse position. Actuating the trolling valve reduces applied clutch pressure, which allows the clutch to slip and reduce propeller speed.

Operating Limits

Trolling is a vessel movement in a specific direction and therefore limits are only required for maximum engine speed with a single clutch engaged. For all marine transmission models, except for the MG-5055 series, limit trolling to a maximum of 1000 RPM or 50% of engine speed which ever is lower. Limits for surface drive or dynamic positioning applications may vary. Please contact Twin Disc regarding limits for these applications.

⚠ CAUTION

For MG-5055 series transmission, the maximum engine speed in trolling is 1100 rpm or 40% of full load engine speed, which ever is lower. Failure to obey this operating limit can result in major damage to marine transmission components, which can cause an unsafe operating condition to occur. Unsafe operating conditions could result in loss of vessel damage, and/or loss of property and/or life.

NOTICE

Additional cooling may be required for applications involving surface piercing propellers. Twin Disc should be contacted for all inquiries involving this application. Trolling valve performance may be affected by operating oil temperature. Additional cooling is not required when in the trolling mode but trolling valve performance can be affected by operating oil temperature. In some cases a thermostatic bypass valve is recommended to maintain operating oil temperature at desired level.

Normal Operation – Trolling Mode

The following is the normal procedure for engaging and operating a marine transmission when trolling mode is to be used.

1. Shift transmission selector to NEUTRAL.

2. Reduce engine rpm to low idle.

3. Move trolling valve control lever out of detented NO TROLL position to MAXIMUM TROLL (slowest vessel speed) position.

4. Move transmission selector lever to desired direction of travel.

5. Adjust trolling valve lever setting (and if necessary, engine rpm) up to specified limit to attain desired vessel speed.

⚠ CAUTION

Do not exceed specified maximum engine speed while operating in TROLL mode. To do so will result in excessive clutch heat buildup and possible clutch failure.

WARNING

Set the trolling valve in the detented NO TROLL position when docking the vessel or when operating in congested areas. Failure to do so could result in sluggish response to power changes or shift reversals and loss of necessary control of vessel speed and direction of travel.

NOTICE

Do not attempt to use a marine transmission equipped with a trolling valve as a "power dividing" device. Attempts to use a trolling valve equipped transmission for such a purpose at engine speeds above the limits specified will result in clutch failures.

6. To return to NO TROLL operation:

    a. Set the engine speed to IDLE.

NOTICE

Moving the trolling valve control lever to the NO TROLL position while engine speed is at the high limit for trolling operations will cause an abrupt change in propeller (and vessel) speed. Reducing engine speed to idle before selecting NO TROLL will result in a smoother transition to NO TROLL operation.

    b. Move the trolling valve control lever to the detented NO TROLL position.

    c. Resume normal no troll operation.

WARNING

Make sure that the trolling valve cable control system is adjusted properly. The trolling valve control lever on the transmission must be in the detented NO TROLL position when the control at the operator's station is moved into the NO TROLL position. Failure to do so could result in inadequate response to power and/or direction changes, endangering personnel and equipment.

Windmilling, Backdriving, and Towing

Backdriving occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller. This is sometimes referred to as windmilling. The propeller shaft is rotating components in the marine transmission. Locking the propeller shaft in place will prevent backdriving.

Situations where backdriving may occur:

- Vessel being towed for any reason.
- Multiple-transmission vessel with one or more engines shut down while under way.
- Sailboat under way with auxiliary engine shut down.
- Vessel tied up or docked in heavy current.

Most current Twin Disc production marine transmissions (with the exceptions that follow) can be backdriven in the situations listed. Vessel speed under all towing or backdriving conditions must not exceed the normal propulsion speed of the vessel.

The following backdriving (towing) options are applicable to all transmissions except MG-5170 series, MG-5300 series, MG-5600 series, and all MG-6000 series (without the optional trailing pump). For these transmissions, only the instructions in b and c are applicable.

You need to employ only one of the following methods:

⚠ WARNING

Do not exceed normal vessel speed during backdriving. If oil sump temperature exceeds 100 °C, damage will occur to internal components. If oil temperature increases to 100 °C, reduce temperature either by reducing backdriving speed, or supplying additional cooling with water fl ow or by idling the engine.

A. Start the engine and operate the marine transmission in neutral at normal fluid pressures for five minutes, doing this once every eight hours. Maintain the backdriven marine transmission's oil level at the FULL mark on the dipstick.

B. Lock the propeller shaft to prevent rotation.

C. Add a trailing pump to the lube circuit. See the hydraulic system prints for more details on auxiliary pump specifications for the applicable transmission or contact your Twin Disc distributor.

D. In the case of an inoperable engine, or pump failure, where pressure lubrication of the transmission is not possible; plug the dipstick tube and completely fill the transmission with oil. Prior to backdriving or towing, drain the oil down to FULL oil level. Repeat this process every eight hours.

Emergency Operation

Mechanical Stop on Failed Torsional Coupling

⚠ CAUTION

Limit operation to 50 percent of maximum engine speed or a maximum of 1000 rpm, whichever is lower, to avoid additional costly damage to transmission internal components.

Many torsional couplings used with Twin Disc transmissions have mechanical stops to allow power to be transmitted to the transmission in the event of a coupling failure. Continued operation at high power levels could result in costly damage to the transmission internal components. In the event of a torsional coupling failure, return to a safe harbor immediately to initiate repair or replacement of the failed coupling.

Electric Selector Manual Override

If, for transmission fitted with electric selector, an electrical power interruption occurs, the electric selector can be overridden. Manual override is accomplished differently depending on the type of solenoid. There are two methods: Solenoid with built-in manual override, or the manual override plug.

Method 1: Solenoid with Built-in Manual Override

Solenoids that have a built-in manual override can be identified by a round nut with two flats cut into it. Removing the round nut exposes a knurled knob. Pushing and turning the knob counterclockwise activates the manual override.

When the solenoid is manually overridden, that clutch will be engaged any time the engine is running. Returning the knurled knob to its previous position restores electric control.

⚠ WARNING

Once the solenoid is manually overridden, the transmission cannot be shifted to neutral, or into the opposite gear.

Shut down the engine and place the vessel under tow before entering any congested area or dock area.

Failure to do so will endanger the safety of the crew and vessel as well as other people and vessels in the area.

Method 2: Manual Override Plug

When solenoids do not have a built-in manual override feature, a manual override plug is available. To override the solenoids at the time of an electrical power interruption, the appropriate solenoid must be removed and replaced with the override plug.

When the solenoid is manually overridden, that clutch will be engaged any time the engine is running.

Installation of Override Plug

1. Stop the engine.

⚠ WARNING

Once the solenoid is manually overridden, the transmission cannot be shifted to neutral, or into the opposite gear.

Shut down the engine and place the vessel under tow before entering any congested area or dock area.

Failure to do so will endanger the safety of the crew and vessel as well as other people and vessels in the area.

2. Locate and remove the stored manual override plug from the selector valve body for use in step 4.

NOTICE

The location of the stored plug varies on different models.

3. Determine which clutch should be engaged (primary or secondary clutch) and remove the appropriate solenoid.

4. Install the override plug in place of the removed solenoid.

⚠ CAUTION

The selected clutch is engaged whenever the engine is running. If the vessel is going in the wrong direction, stop the engine and remove the override plug. Reinstall the removed solenoid, then repeat the above procedure with the opposite solenoid.

5. Store the removed solenoid where the override plug was stored until repairs are performed.

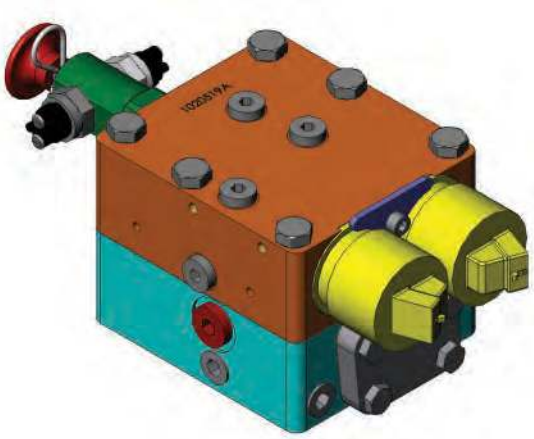


Figure 14. General Purpose (GP) Selector Valve

Figure 15. Manual Override Valve

Preventative Maintenance

General Maintenance

NOTICE

A chart is provided in the front of the manual to record the dates/hours that maintenance procedures are performed.

Oil Level Check

Check oil level daily or every 10 hours of engine operation. Check with engine running at low idle and with marine transmission in neutral. Check the oil level with the transmission oil temperature in normal operating range. See Section 3.3, Start-Up.

Lubrication

If your unit is equipped with a lubrication fitting, grease the oil seals at the output end of the transmission output shaft through the lubrication fitting with water pump grease. See the illustrations in Section 6.2 for location of the lubrication fitting. Apply grease approximately every 100 hours when boat is docked. No other lubrication is required.

NOTICE

Preferred grease is one with lithium soap, NLGI consistency #2 for component temperatures above 20° C (68° F).

Filter and Oil Change Interval

With a new transmission, change the oil and filter element within first 50 hours of operation. Change oil and filter element after each 1000 hours of operation, or six months, whichever comes first. Change the oil more frequently if conditions warrant.

For a rebuilt transmission, check the suction screen and filter element after eight hours of operation. Look for lint or other material that may collect from rags or towels used in the parts cleaning process. Look for chips or shavings particularly if the transmission has had a problem that caused debris in the system. (For units with spin-on filters, this will require cutting the filter element apart to access the element core.) If the filter is clean, install a new filter element and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service, or more often if conditions warrant.

NOTICE

Situations involving debris in the hydraulic system will require that heat exchangers and all connecting lines and hoses be thoroughly cleaned. If the heat exchanger cannot be disassembled, or if it cannot be assured that all debris is removed, the heat exchanger should be replaced.

Draining

Drain the transmission by removing the oil drain plug from the rear/bottom of the transmission. See the illustrations in Section 6.2 or service literature for your transmission for location of transmission and filter drain plugs.

NOTICE

Dispose of used oil and oil filters in accordance with federal, state or local laws. Exercise precautions to prevent environmental contamination during any transmission servicing procedure.

Filling

1. Remove the breather or the oil fill closure from the top of transmission case.

2. Pour new oil through breather or closure opening. Fill with recommended clean oil, taking necessary precautions to prevent entry of dirt or debris. (See lubrication plate on transmission and information transcribed to the front of this manual for additional oil information.)

Oil Capacity

See the transmission lubrication plate. Capacity given will be the internal quantity required to fill the transmission to its proper level, but may not include the quantity to fill the external hoses and heat exchanger. Check oil level per Section 3.3, Start-Up.

Heat Exchanger Check

Heat exchangers furnished by Twin Disc to be used for salt water applications have anodes installed at the inlet and outlet heads. Check these anodes every 30 to 90 days, depending on factors such as coolant conditions, pH factor, and salinity. If over one half of the rod is disintegrated, replace it to assure effective protection. Excessive corrosion of the anode indicates electrolytic action. Make a careful inspection to determine if this action is caused by a short circuit or an external grounded electric current. If either of these conditions is found, do what is required to correct it to avoid frequent replacement of the anodes. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If the anodes are corroded with foreign material, use a wire brush to clean them.

Suction Strainer

Remove and clean the suction strainer at every oil change or sooner if necessary. See illustrations in Section 6.2 for the location of the suction strainer for your transmission.

Flexible Input Coupling

Do not obstruct the flywheel housing vents, which will prevent the free flow of air for cooling the coupling. Life of the coupling may be reduced if the ambient temperature of the air around the coupling is outside the operating range. Operating air temperatures above -6°C (22°F) and below 82°C (180°F) must be maintained. If possible, visually inspect the coupling after the first 100 hours of operation, and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. These conditions affect the life of the coupling element. If coupling access is restricted, inspection may be possible only at engine overhaul or whenever the transmission is separated from the engine. On such units, frequently check the flywheel housing vents. An accumulation of residue at the vents is an indication of coupling deterioration, which can occur from a variety of causes. If an accumulation of residue is found, inspect to determine the cause.

Bearing Inspection and Replacement

At the engine overhaul interval, or more frequently, inspect all transmission bearings and replace as necessary.

Overhaul Interval

Overhaul the transmission at the same time the engine is overhauled.

Storage Maintenance Procedures

It is sometimes necessary to store Twin Disc transmissions or boats equipped with Twin Disc components. In order to prevent corrosion damage, the following procedures are recommended:

Short Term Storage (Less than One Year)

Transmission installed in a boat on an engine that can be run (boat is in the water).

1. To the extent possible, store boat in a location that minimizes exposure to the elements.

2. Prior to storage, drain the oil and refill to FULL level on the dipstick with recommended new oil. Install a new filter, if applicable. After changing the oil and filter, run the engine long enough to bring the oil to operating temperature. Operate the transmission in all ranges. Shut the engine down.

3. Use only recommended oils to maintain proper levels. Do not use preservative-type oils.

4. Every three months, check the oil level and availability of coolant. Start the engine and run at approximately 1000 rpm to bring the oil temperature up to normal operating range, running the engine at least five minutes. When the transmission oil reaches the normal operating temperature range, set the engine speed to the shift speed range for your transmission and shift into each range. Shut the engine down.

5. Drain and refill with recommended oil and change filters, if applicable, prior to returning unit to regular service.

6. Before returning the transmission to service, check the condition of the anodes in the heat exchanger according to Section 4.1.E.

Long Term Storage (More than One Year)

Transmission installed in a boat where the engine cannot be run (boat is out of the water).

1. Use standard recommended oil for the following procedures:
    a. Once each year, remove dipstick and plug dipstick tube.
    b. Completely fill the transmission with oil.
    c. Rotate the output shaft at least five revolutions.
    d. Partially drain oil, reinstall dipstick, and then drain the oil down to the FULL mark on the dipstick.
2. Seal breather, dipstick tube and all other openings with waterproof tape.
3. Grease exposed members that are subject to corrosion.
4. Every three months rotate output shaft four or five revolutions.
5. Tag transmission to show date it was placed in storage and current status relating to storage procedure.
6. To remove from storage and place in regular service:
    a. Remove waterproof tape from breather, dipstick tube and all openings.
    b. Drain oil and remove oil filter.
    c. Install new oil filter and fill transmission with new recommended oil to FULL mark on dipstick.
    d. Replace anodes in heat exchanger.

Heat Exchanger Storage

When storing a heat exchanger, oil and water ports must be kept sealed. Heat exchangers stored during cold weather must have the water chamber drained to prevent freezing. Take precautions to prevent damage from freezing and corrosion.

Maintenance Record

MODEL NUMBER_____ **SERIAL NUMBERS** _____
DATE PLACED IN SERVICE _____ **DATE/HOURS AT OVERHAUL** _____

Check Oil Level	Grease Oil Seals (if applicable)	Change Oil and Filter	Clean Suction Strainer	Check Heat Exchanger	Check Input Coupling
Daily	*Every 100 hours*	*New, 50 hours; then, every 1000 hours. Rebuilt – 8 hours, then 1000 hours. Or every 6 months, whichever comes first.*	*New, 50 hours; then, every 1000 hours. Rebuilt – 8 hours, then 1000 hours.*	*Every 30 to 90 days.*	*First 100 hours, then every 2000 hours.*

MODEL NUMBER_____ **SERIAL NUMBERS** _____
DATE PLACED IN SERVICE _____ **DATE/HOURS AT OVERHAUL** _____

Check Oil Level	Grease Oil Seals (if applicable)	Change Oil and Filter	Clean Suction Strainer	Check Heat Exchanger	Check Input Coupling
Daily	*Every 100 hours*	*New, 50 hours; then, every 1000 hours. Rebuilt – 8 hours, then 1000 hours. Or every 6 months, whichever comes first.*	*New, 50 hours; then, every 1000 hours. Rebuilt – 8 hours, then 1000 hours.*	*Every 30 to 90 days.*	*First 100 hours, then every 2000 hours.*

NOTES

Troubleshooting

Troubleshooting Tables

The following charts are intended as a guide for determining the cause of problems that could be encountered and the corrective actions for those difficulties.

The transmission is one part of a complete propulsion system. Problems before the transmission (in the engine) or after the transmission (in the output shaft or propeller) can cause problems to develop in the transmission. It is important that the entire propulsion system be considered when transmission problems are encountered.

Note that there are two separate charts on the following pages.

- Troubleshooting charts for standard MG Marine Transmissions
- Troubleshooting charts for MG(X) Series of Marine Transmissions

NOTICE

Troubleshooting assistance, as well as maintenance, repair and parts service is available from your Twin Disc distributor or service dealer.

NOTICE

For troubleshooting information for EC600 Basic and Advance controllers, please reference the System Operation and Maintenance Manual, document number 1041264.

Standard MG Chart 1		
Symptom	**Cause**	**Remedy**
1. Low main oil pressure	1-1. Engine idle speed too low.	1-1. Raise engine speed to correct idle setting. Re-check main oil pressure.
	1-2. Partially clogged oil strainer	1-2. Remove and clean oil strainer.
	1-3. Stuck pressure regulation piston in selector valve.	1-3. Disassemble the selector valve and clean the piston.
	1-4. Worn or broken piston rings on clutch shafts or clutch pistons.	1-4. Remove the collector and inspect piston rings. Replace damaged piston rings.
	1-5. Damaged or worn oil pump assembly.	1-5. Pump is not serviceable. Replace damaged or worn oil pump assembly.
	1-6. Incorrect linkage adjustment to control valve.	1-6. Adjust linkage so that control valve stem is indexed by correct detent.
	1-7. Clogged or plugged orifice in orifice plate.	1-7. Remove orifice plate cover. Clean parts.
	1-8. Shimming required between inner and outer springs and rate-of-rise piston.	1-8. Shim as required.
2. No main oil pressure, or low pressure at control valve tap.	2-1. Oil level low.	2-1. Check and correct oil level.
	2-2. Oil pump suction strainer plugged.	2-2. Remove and clean strainer.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive broken.	2-4. Disassemble and repair as required.
	2-5. Regulating valve stuck in open position.	2-5. Remove, disassemble, clean, and repair the regulating valve.
	2-6. Oil pump defective.	2-6. Replace oil pump.
	2-7. Leaking heat exchanger has caused oil to be lost overboard.	2-7. Replace heat exchanger.
3. High main oil pressure.	3-1. Regulating valve stuck.	3-1. Remove and clean regulating valve. Check valve operation before reinstallation.
	3-2. Verify location of test port.	3-2. Use recommended oil.

Standard MG Chart 2		
Symptom	**Cause**	**Remedy**
4. High temperature.	4-1. Improper oil level.	4-1. Check oil level and fill or drain to the proper level with approved oil.
	4-2. Fault heat exchanger.	4-2. Inspect, and repair or replace the heat exchanger, if necessary.
	4-3. Air leak on suction side of pump.	4-3. Inspect for and correct cause of leak on suction side of pump.
	4-4. Control valve malfunction.	4-4. Inspect, and repair or replace control valve.
	4-5. Clutches slipping.	4-5. Check clutch apply oil pressure. If the pressure is normal, remove, disasseble, and repair the slipping clutch. If pressure is low, replace the proportional valve, and service the transmission oil filter.
	4-6. Bearing failure.	4-6. Overhaul the marine transmission.
5. Excessive transmission noise.	5-1. Misfiring engine.	5-1. Repair the engine.
	5-2. Improper alignment.	5-2. Check the alignment of engine and transmission output flange to the propeller shaft. Correct as necessary.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional the coupling.
	5-4. Worn or damaged input coupling.	5-4. Remove marine transmission. Replace the coupling if worn or damaged.
	5-5. Damaged propeller.	5-5. Repair propeller.
	5-6. Worn or damaged gears.	5-6. Overhaul marine the transmission.
	5-7. Bearing failure.	5-7. Overhaul marine the transmission.

Standard MG Chart 3		
Symptom	**Cause**	**Remedy**
6. No neutral. Neutral selected, but boat continues to move.	6-1. Control valve incorrectly indexed. 6-2. Worn seal rings. 6-3. Broken or faulty clutch linkage. 6-4. Clutch plates warped.	6-1. Check and adjust control linkage. 6-2. Check clutch apply pressure. Replace seal rings as necessary. 6-3. Repair control linkage. 6-4. Overhaul unit and replace clutch plates.
7. Harsh engagement.	7-1. Engine speed too high. 7-2. Orifice plate ball in control valve not seating properly. 7-3. Regulating piston or rate-of-rise piston stuck.	7-1. Reduce engine speed to correct shift speed. 7-2. Remove orifice plate cover. Clean parts. Replace parts if necessary. 7-3. Disassemble control valve. Clean parts. Replace parts if necessary.
8. Low lube oil pressure.	8-1. Air leak on suction side of pump. 8-2. Pump suction strainer plugged. 8-3. Lube relief valve stuck open. 8-4. Damaged piston rings. 8-5. Pump output too low.	8-1. Inspect and correct cause of suction leak. 8-2. Remove, clean, inspect, and install the suction screen. 8-3. Remove and clean or replace parts as necessary. Check operation before reinstallation. 8-4. Replace damaged piston rings. 8-5. Replace pump.
9. Oil escaping from breather.	9-1. Oil level too high. 9-2. Incorrect type of oil.	9-1. Correct oil level. 9-2. Drain and refill with recommended type of oil.

MG(X) Series Chart 1		
Symptom	**Cause**	**Remedy**
1. Low main oil pressure	1-1. Engine idle speed too low. 1-2. Partially clogged oil strainer 1-3. Contamination on pilot relief valve seat. 1-4. Contamination in main valve cartridge. 1-5. Broken piston rings on clutch shaft(s). 1-6. Damaged or worn oil pump assembly.	1-1. Raise engine speed. 1-2. Remove and clean oil strainer 1-3. Disassemble the pilot relief valve and clean. Service the transmission oil filter. 1-4. Clean or replace the main valve cartridge, and service the transmission oil filter. 1-5. Remove the collector and inspect piston rings. 1-6. Replace damaged or worn oil pump assembly (pump is not serviceable).
2. No oil pressure or erratic low pressure at control valve.	2-1. Oil level low. 2-2. Oil pump suction strainer plugged. 2-3. Air leak on suction side of pump. 2-4. Pump drive failed. 2-5. Regulating valve stuck in open position. 2-6. Oil pump failed. 2-7. Leaking heat exchanger has caused oil to be lost overboard.	2-1. Check and correct oil level . 2-2. Remove and clean oil strainer. 2-3. Correct cause of air leak. 2-4. Disassemble and repair as required. 2-5. Remove, disassemble, clean, and repair the valve. 2-6. Replace oil pump. 2-7. Replace heat exchanger.
3. High main oil pressure.	3-1. Regulating valve stuck. 3-2. Wrong oil type.	3-1. Remove and clean regulating valve. 3-2. Drain and refill with recommended oil type.

MG(X) Series Chart 2		
Symptom	**Cause**	**Remedy**
4. High Temperature.	4-1. Incorrect oil level (high or low).	4-1. Check oil level. Drain, or fill to correct oil level with recommended oil.
	4-2. Air leak on suction side of pump.	4-2. Determine and correct the cause of the suction leak.
	4-3. Failed heat exchanger (if used).	4-3. Inspect, clean, repair, or replace heat exchanger.
	4-4. Blockage in heat exchanger line restricting flow of oil or cooling water through heat exchanger.	4-4. Clear or replace blocked line.
	4-5. Clutch is slipping.	4-5. Check clutch-apply oil pressure. If pressure is normal, remove, disassemble, and repair slip ping clutch. If oil pressure is not in the correct range, determine the cause and repair as described in troubleshooting sections 1, 2, and 3. Sequence valve may need to be replaced.
	4-6. Bearing failure.	4-6. Overhaul the transmission.
5. Excessive noise.	5-1. Gear rattle from torsional vibration.	5-1. Raise the low idle setting.
	5-2. Misfiring engine.	5-2. Repair the engine.
	5-3. Incorrect alignment.	5-3. Check the alignment of the engine and transmission, and the transmission output flange to the propeller shaft. Eliminate any misalignment.
	5-4. Damaged propeller.	5-4. Replace the propeller.
	5-5. Worn or damaged input coupling.	5-5. Remove the transmission. Replace the coupling if worn or damaged.
	5-6. Worn or damaged gears.	5-6. Overhaul the transmission.
	5-7. Bearing failure.	5-7. Overhaul the transmission.

MG(X) Series Chart 3		
Symptom	**Cause**	**Remedy**
6. No neutral	6-1. Clutch plates warped.	6-1. Remove clutch plates. Overhaul unit.
	6-2. Disengaged clutch has apply pressure.	6-2. Replace proportional valve. Service transmission oil filter.
7. Harsh engagement or no engagement	7-1. Faulty proportional valve.	7-1. Replace proportional valve.
	7-2. Faulty temperature sensor (if equipped).	7-2. Replace temperature sensor.
	7-3. Profile generator defective or out of adjustment.	7-3. Replace profile generator. Adjust if proper equipment is available.
	7-4. Faulty sequence valve.	7-4. Replace sequence valve.
8. Low lube oil pressure.	8-1. Pump output flow too low.	8-1. Replace pump.
	8-2. Pump suction strainer plugged.	8-2. Remove, clean, inspect, and reinstall the suction screen.
	8-3. Air leak on suction side of pump.	8-3. Inspect and correct cause of suction leaks.
	8-4. Lube relief valve malfunction.	8-4. Remove and clean or replace parts as necessary.
	8-5. Broken piston rings.	8-5. Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high.	9-1. Adjust oil level.
	9-2. Wrong type of oil.	9-2. Draw and refill with recommended oil.
10. Low clutch-apply pressure	10-1. Low main pressure.	10-1. See Paragraph 1.
	10-2. Defective proportional valve.	10-2. Replace proportional valve.
	10-3. Low voltage to profile generator.	10-3. Verify that green (voltage supply) light, and red (clutch energized) lights are bright.
	10-4. Internal clutch leakage.	10-4. Rebuild transmission.

Oil Pressure Alarm Settings by Model

Table 3. Oil Pressure Alarm Settings by Model

Model	Pv(4) Valve Pressure Nominal			Low Pressure Alarm			Engine Shutoff Alarm		
	psi	kPa	bar	psi	kPa	bar	psi	kPa	bar
MG-5050 Series	320	2205	22.1	290	2000	20	270	1860	18.6
MG-5061 Series	320	2205	22.1	290	2000	20	270	1860	18.6
MG(X)-5065 Series	390	2690	26.9	340	2345	23.5	320	2205	22.1
MG-5075 Series	340	2345	23.5	310	2135	21.4	290	2000	20.0
MG(X)-5075 Series	340	2345	23.5	330	2275	22.8	310	2135	21.4
MG-5082 Series	340	2345	23.4	310	2135	21.4	290	2000	20.0
MG(X)-5086 Series	340	2345	23.5	330	2275	22.8	310	2135	21.4
MG-5091 Series	230	1585	15.9	200	1380	13.8	180	1240	12.4
MG-5091 Series	270	1860	18.6	240	1655	16.6	220	1515	15.2
MG(X)-5095 Series	270	1860	18.6	240	1655	16.6	220	1515	15.2
MG(X)-5096A	350	2415	24.1	330	2275	22.8	310	2135	21.4
MG(X)-5114 Series	250	1725	17.3	230	1585	15.9	220	1515	15.2
MG(X)-5126A	350	2145	24.1	330	2275	22.8	310	2135	21.4
MG(X)-5135 Series	270	1860	18.6	250	1725	17.3	230	1585	15.9
MGX-5146 Series	300	2070	20.7	270	1860	18.6	250	1725	17.2
MG(X)-5147 Series	300	2070	20.7	270	1860	18.6	250	1725	17.2
MG(X)-516	250	1725	17.3	220	1515	15.2	205	1415	14.2
MG(X)-5170DC	250	1725	17.3	220	1515	15.2	205	1415	14.2
MG(X)-5202SC Series, MG(X)-5204SC Series, MG(X)-5222DC	250	1725	17.3	230	1585	15.9	215	1480	14.8
MG(X)-5225DC	250	1725	17.3	230	1585	15.9	215	1480	14.8
MG(X)-5321DC	290	2000	20.0	280	1930	19.3	265	1825	18.3
MG-5600	250	1725	17.3	240	1655	16.6	220	1515	15.2
MG-5600	290	2000	20.0	230	1585	15.9	210	1450	14.5
MG(X)-5600	250	1725	17.3	240	1655	16.6	230	1585	15.9
MG(X)-5600DR	290	2000	20.0	280	1930	19.3	260	1795	18.0
MG-6449 Series	355	2450	24.5	330	2275	24.8	310	2135	21.4
MG-6449 Series	385	2655	26.6	360	2480	24.8	340	2345	23.4
MG(X)-6598 Series	350	2415	24.2	300	2070	20.7	280	1930	19.3
MG(X)-6599 Series	350	2415	24.2	300	2070	20.7	280	1930	19.3
MG-6600DC	355	2450	24.5	330	2275	22.8	310	2135	21.4
MG-6600DC	350	2415	24.1	320	2205	22.1	300	2070	20.7
MG(X)-6620 Series	350	2415	24.2	300	2070	20.7	280	1930	19.3
MG(X)-6690SC	350	2415	24.2	340	2345	23.5	330	2275	22.8
MG(X)-6848SC	350	2415	24.2	340	2345	23.5	330	2275	22.8
MG-6984 Series	355	2450	24.5	330	2275	22.8	310	2135	21.4
MG(X)-61000SC	350	2415	24.2	330	2275	22.8	310	2135	21.4
MG(X)-61242 Series	355	2450	24.5	330	2275	22.8	310	2135	21.4
MG(X)-61500SC	350	2415	24.2	320	2205	22.1	300	2070	20.7
MG(X)-61500SC-HL & -HR	350	2415	24.2	320	2205	22.1	300	2070	20.7
MG(X)-62000SC-HL & -HR	350	2415	24.2	320	2205	22.1	300	2070	20.7
MG(X)-62500SC-HL & HR	350	2415	24.1	320	2205	22.1	300	2070	20.7

Oil Operating Temperature Limits

Table 4. Oil Operating Temperature Limits

Model	SAE 30				SAE 40			
	Minimum		Maximum		Minimum		Maximum	
	°C	°F	°C	°F	°C	°F	°C	°F
MG-5050 Series	65	150	85	185	80	175	93	200
MG-5061 Series	65	150	85	185	80	175	93	200
MG(X)-5065 Series	65	150	85	185	65	150	85	185
MG-5075 Series	65	150	85	185	65	150	85	185
MG(X)-5075 Series	65	150	85	185	65	150	85	185
MG-5082 Series	65	150	85	185	65	150	85	185
MG(X)-5086 Series	65	150	85	185	65	150	85	185
MG-5091 Series	65	150	85	185	65	150	85	185
MG(X)-5095 Series	65	150	85	185	65	150	85	185
MG(X)-5114 Series	65	150	85	185	65	150	85	185
MG(X)-5126A	65	150	85	185	65	175	99	210
MG(X)-5135 Series	65	150	85	185	80	175	93	200
MG(X)-5145 Series	65	150	85	185	80	175	93	200
MGX-5146 Series	65	150	85	185	80	175	99	210
MG(X)-5147 Series	65	150	85	185	80	175	93	200
MG(X)-516	65	150	85	185	65	150	85	185
					SAE 50			
					°C	°F	°C	°F
MG(X)-516 (continued)					80	175	93	200
	SAE 40				SAE 50			
	°C	°F	°C	°F	°C	°F	°C	°F
MG(X)-5170DC	65	150	85	185	80	175	93	200
MG(X)-5202SC Series, MG(X)-5204SC Series, MG(X)-5147DC	65	150	85	185	80	175	93	200
MG(X)-5225DC	65	150	85	185	80	175	93	200
MG(X)-5321DC	65	150	85	185	80	175	93	200
MG(X)-5600	65	150	85	185	80	175	93	200
MG(X)-5600DR	65	150	85	185	80	175	93	200
MG-6449 Series	65	150	93	200				
MG(X)-6598 Series	65	150	93	200				
MG-6600DC	65	150	93	200				
MG(X)-6599 Series	65	150	93	200				
MG(X)-6620 Series	65	150	93	200				
MG(X)-6650SC	65	150	85	185	80	175	93	200
MG(X)-6690SC	65	150	85	185	80	175	93	200
MG(X)-6848SC	65	150	85	185	80	175	93	200
MG-6984 Series	65	150	93	200				
MG(X)-61000SC	65	150	85	185	80	175	93	200
MG-61242 Series	65	150	93	200				
MG(X)-61500SC	65	150	85	185	80	175	93	200
MG(X)-61500SC-HL & HR	65	150	85	185	80	175	93	200
MG(X)-62000SC- HL & HR	65	150	85	185	80	175	93	200
MG(X)-62500SC-HL & HR	65	150	85	185	80	175	93	200

NOTICE

For reference only. Please consult your local Twin Disc authorized distributor for up-to-date information.

NOTES

Appendix A

Accessories and Optional Equipment

Optional accessories are available for use with Twin Disc marine transmissions. Contact your local Twin Disc distributor for specific information on items to fit your transmission and the procedures for installation.

The following items are available for all units:

1. Oil Temperature Gauges – Used to monitor transmission sump oil temperature. Scales are calibrated in Celsius and Fahrenheit ranges.

2. Oil Pressure Gauges – Used to monitor main (clutch apply) oil pressure. Scales are calibrated in kilopascal and pound-force-per-square-inch ranges. The use of oil pressure gauges is required for all installations.

3. Output Shaft Companion Flanges – Used to connect the transmission output flange with the vessel propeller shaft and possible shaft break.

4. Hub to Fit Flexible Input Couplings – Provides the connection between the engine-driven coupling and the transmission input shaft.

5. Trolling Valves – Used to reduce propeller speed below what can be obtained by operating the engine at low idle (e.g. trolling operations and operating in no-wake areas).

6. Filter by-pass indicator switch - to announce when filter needs to be changed.

7. Switches and transducers - for monitoring oil pressures, speeds, and oil temperatures.

8. Heat Exchangers – Use to control and maintain hydraulic system oil temperature at the proper level. Thermostatic bypass valves are available for use where needed. Contact your Twin Disc distributor for specific cooling information and recommendations to fit your transmission installation.

The following options and accessories are available for use where needed. Contact your Twin Disc distributor for specific cooling information on items compatible with your transmission installation.

1. Front-Mount Power Takeoffs – Used to drive a variety of items such as pumps, compressors, and generators. Equipped with spring-loaded clutches housing one or two driving plates. Available in a variety of SAE housing sizes and plate diameters.

2. Clutch Controlled Power Takeoffs – Lever actuated or hydraulically applied clutch models are available.

3. Live Power Takeoffs – Provides live power to accessories at all times the engine is running.

4. Electric Solenoid Valves – Used to select FORWARD, NEUTRAL, or REVERSE. Available in 12 and 24-volt DC power configurations. Must be mated with a control system for selection of the desired range.

5. Flexible Input Coupling – Used to reduce gear rattle caused by input vibrations.

6. Trailing Pump – Used to supply oil pressure for lubrication during windmilling or backdriving situations.

Appendix B

Marine Transmission Illustrations

The following illustrations are representative of Twin Disc Marine Transmissions. These illustrations show the general locations of the following components and other important components.

- Oil Fill
- Oil Level Gauge
- Oil Drain
- Breather
- Suction Strainer
- Oil Out To Heat Exchanger
- Oil In From Heat Exchanger
- Main Pressure Port
- Primary Shaft Clutch Solenoid
- Secondary Shaft Clutch Solenoid
- Manual Override Valve

To find the illustration that matches your transmission model, look up the model number from the list on the following pages and go to the referenced pages listed.

NOTICE

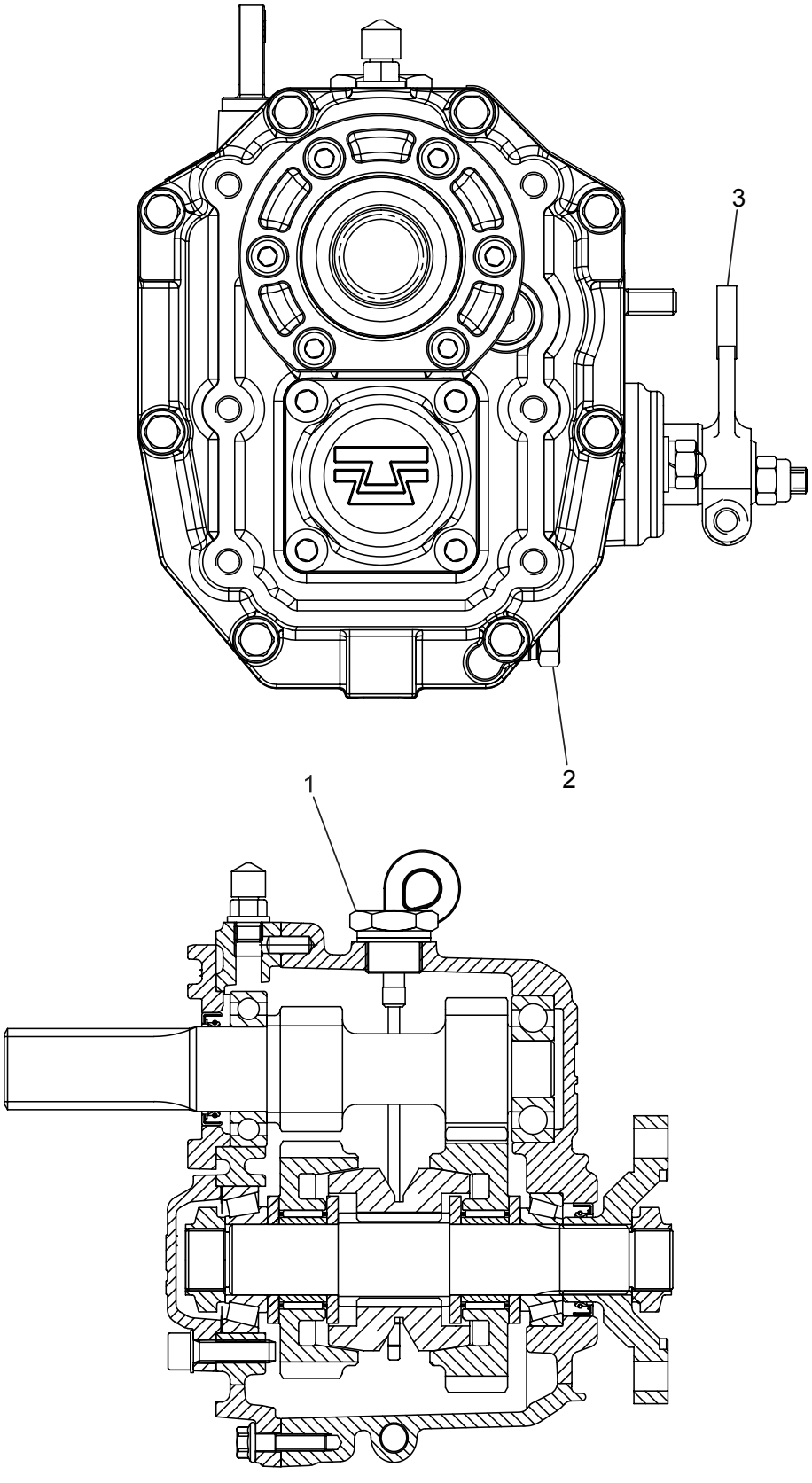
The illustrations identified are accurate for the general location of features; however, they may not be an exact depiction of all design variations. If more specific information is needed on your marine transmission's features, please refer to your service manual.

- ☐ MG-340 57-58
- ☐ MG-360 59-60
- ☐ MG-5005A.....61-62
- ☐ MG-5012SC 63-64
- ☐ MG-5020SC 65-66
- ☐ MG-5025A.....67-68
- ☐ MG-5050A.....69-70
- ☐ MG-5050RV 71-72
- ☐ MG-5050SC 73-74
- ☐ MG-5061A.....75-76
- ☐ MG-5061SC 77-78
- ☐ MG-5065A.....79-80
- ☐ MG-5065SC 81-82
- ☐ MGX-5065SC.....83-84
- ☐ MG-5075A.....85-86
- ☐ MG-5075IV.....87-88
- ☐ MG-5075SC 89-90
- ☐ MGX-5075A.....91-92
- ☐ MGX-5075IV 93-94
- ☐ MGX-5075SC.....95-96
- ☐ MG-5082A.....97-98
- ☐ MG-5082SC 99-100
- ☐ MG(X)-5086A, MGX-5086A 101-102
- ☐ MG(X)-5086SC 103-104
- ☐ MG-5091DC.....105-106
- ☐ MG-5091SC 107-108
- ☐ MGX-5095SC.....109-110
- ☐ MG(X)-5096A 111-112
- ☐ MGX-5114A..... 113-114
- ☐ MG(X)-5114DC 115-116
- ☐ MG(X)-5114IV, MGX-5114IV 117-118

- ☐ MG(X)-5114RV....119-120
- ☐ MG(X)-5114SC....121-122
- ☐ MGX-5114SC....123-124
- ☐ MG(X)-5126A, MGX-5126A....125-126
- ☐ MG(X)-5135A, MGX-5135A....127-128
- ☐ MG(X)-5135RV, MGX-5135RV....129-130
- ☐ MG(X)-5135SC, MGX-5135SC....131-132
- ☐ MG(X)-5136A, MGX-5136A....133-134
- ☐ MG(X)-5136RV, MGX-5136RV....135-136
- ☐ MG(X)-5136SC, MGX-5136SC....137-138
- ☐ MG(X)-5146A....139-140
- ☐ MG(X)-5146RV....141-142
- ☐ MG(X)-5146SC....143-144
- ☐ MG(X)-5147A, MGX-5147A....145-146
- ☐ MG(X)-516, MGX-516....147-148
- ☐ MG(X)-5170DC, MGX-5170DC....149-150
- ☐ MG(X)-5202SC, MGX-5202SC....151-152
- ☐ MG(X)-5204SC, MGX-5204SC....153-154
- ☐ MG(X)-5222DC, MG(X)-5225DC....155-156
- ☐ MGX-5222DC, MGX-5225DC....157-158
- ☐ MG(X)-5321DC, MGX-5321DC....159-160
- ☐ MG-540....161-162
- ☐ MG-5600....163-164
- ☐ MGX-5600....165-166
- ☐ MG(X)-5600DR, MGX-5600DR....167-168
- ☐ MG-6449A....169-170
- ☐ MG-6449RV....171-172
- ☐ MGX-6598DC....173-174
- ☐ MGX-6599A....175-176
- ☐ MGX-6599RC....177-178
- ☐ MGX-6599SC....179-180

- ☐ MG-6600DC.....181-182
- ☐ MGX-6620A.....183-184
- ☐ MGX-6620RV.....185-186
- ☐ MGX-6620SC.....187-188
- ☐ MGX-6690SC, MG(X)-6690SC, MGX-6848SC, MG(X)-6848SC ..189-190
- ☐ MG-6984A.....191-192
- ☐ MG-6984RV 193-194
- ☐ MG-6984SC 195-196
- ☐ MGX-61000SC.....197-198
- ☐ MG-61242A.....199-200
- ☐ MG-61242RV 201-202
- ☐ MG-61242SC 203-204
- ☐ MGX-61500SC.....205-206
- ☐ MGX-61500SC-HL, MGX-62000SC-HL.....207-208
- ☐ MGX-61500SC-HR, MGX-62000SC-HR.....209-210
- ☐ MGX-62500SC-HL/HR.....211-212

MG-340

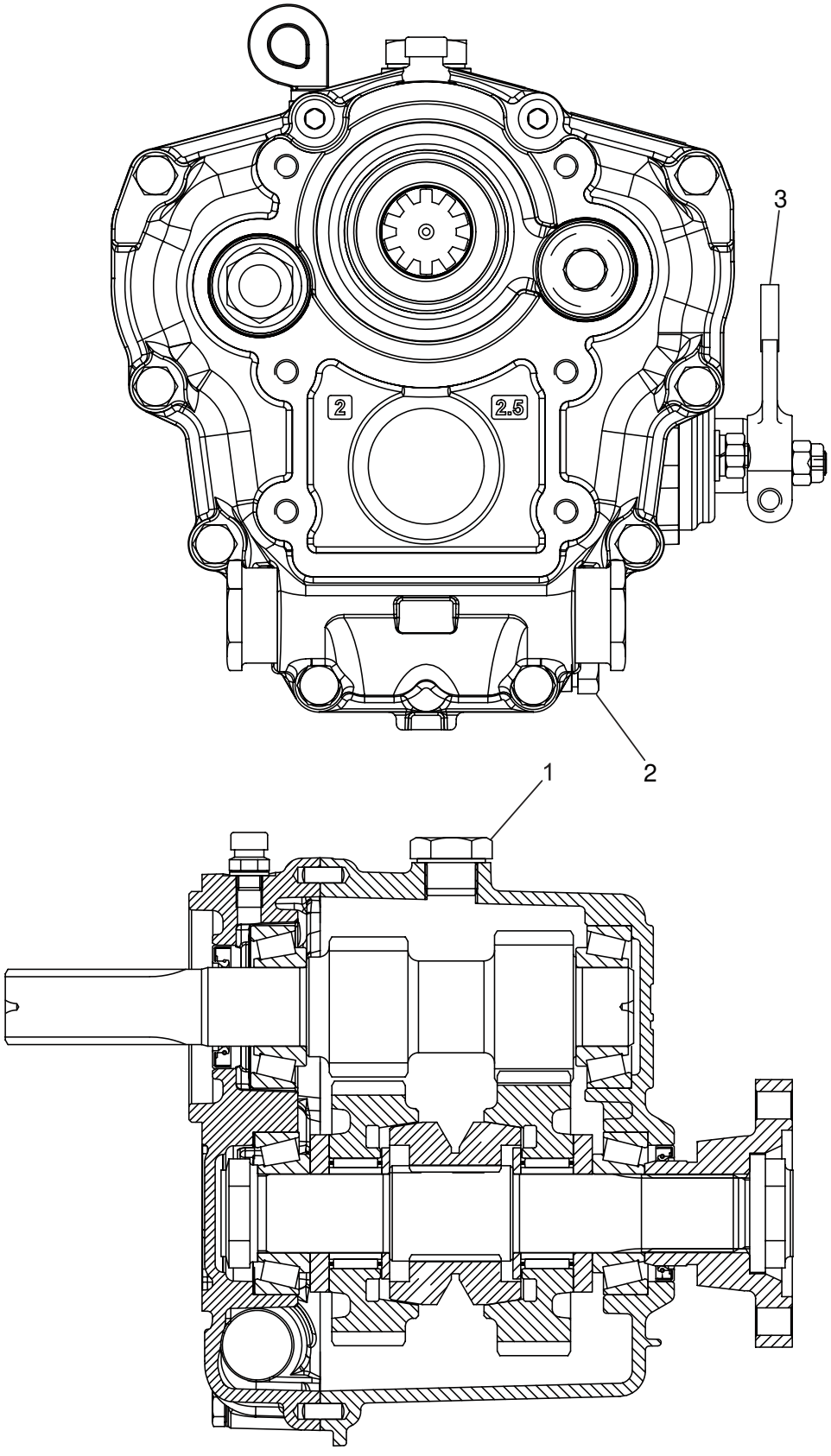


101317501A

MG-340 Callout List

Callout	Component
1	Oil fill port
2	Oil drain
3	Control valve selector lever

MG-360

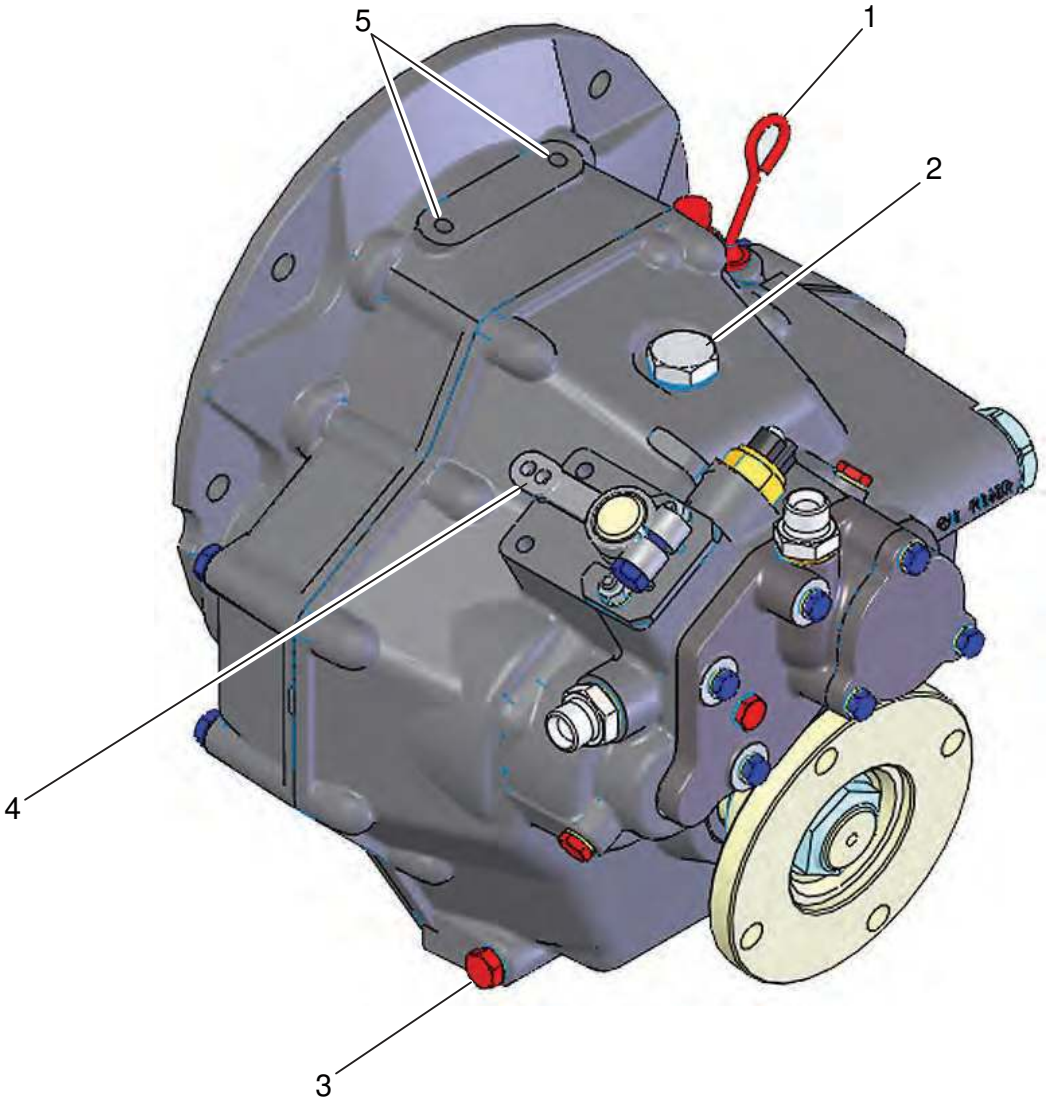


101319X05A

MG-360 Callout List

Callout	Component
1	Oil fill port
2	Oil drain
3	Control valve selector lever

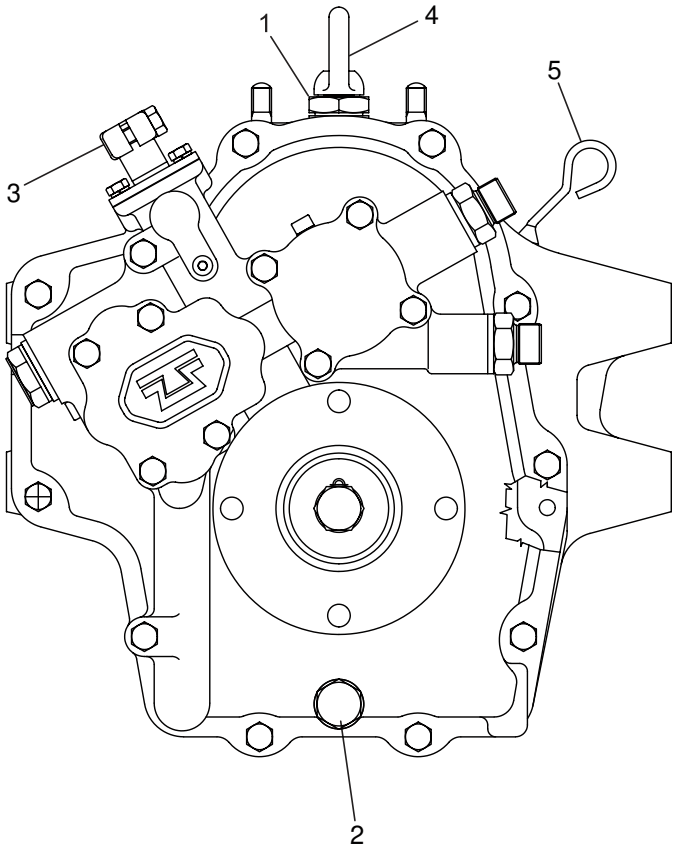
MG-5005A



MG-5005A Callout List

Callout	Component
1	Oil level gauge
2	Oil fill port
3	Oil drain plug
4	Control valve selector lever
5	Holes for lifting

MG-5012SC

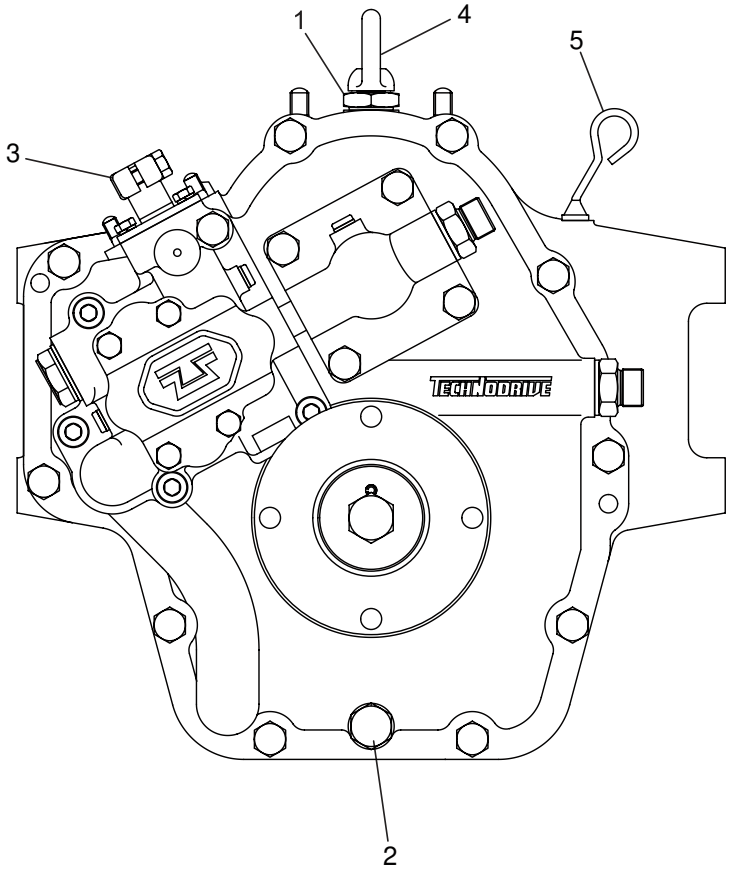


1013079B

MG-5012SC Callout List

Callout	Component
1	Oil fill port
2	Oil drain plug
3	Control valve selector lever
4	Holes for lifting
5	Oil level gauge

MG-5020SC

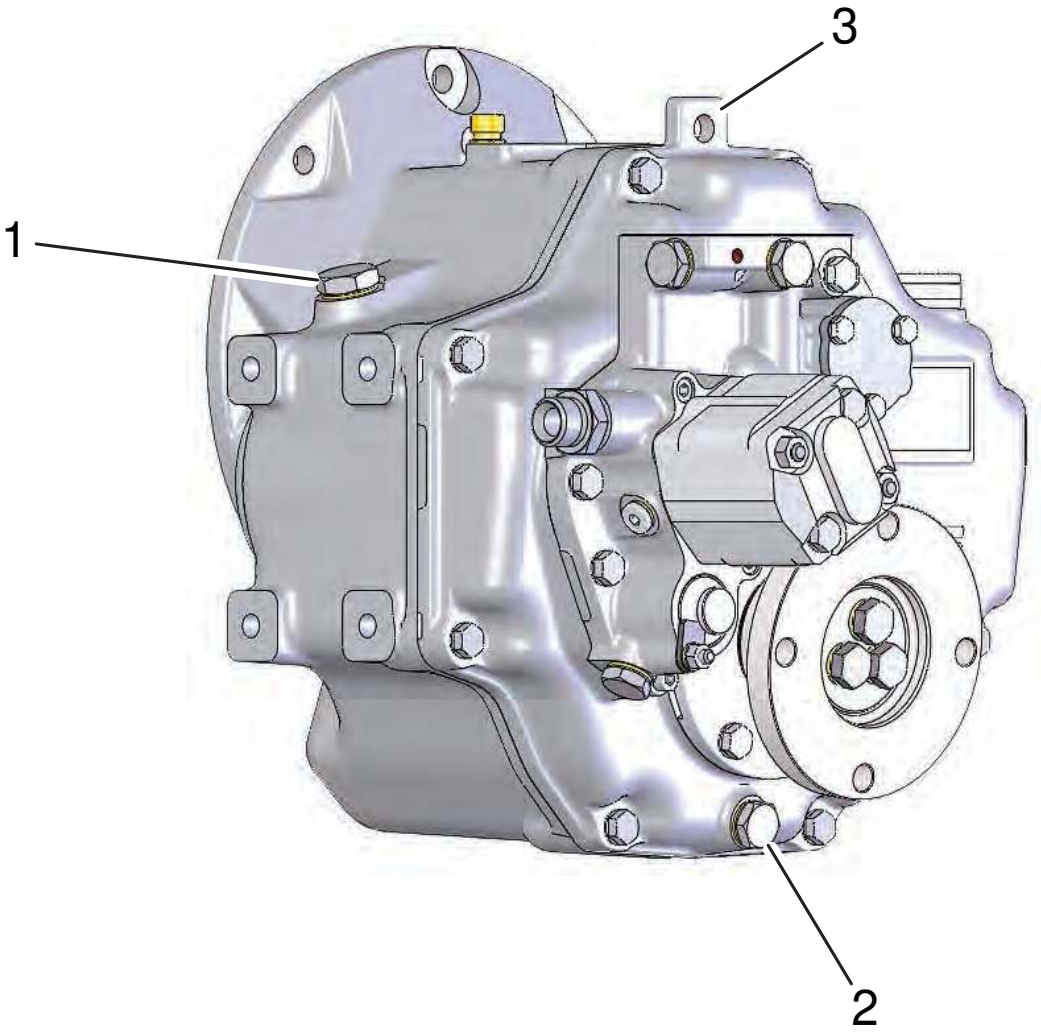


1013049B01

MG-5020SC Callout List

Callout	Component
1	Oil fill port
2	Oil drain plug
3	Control valve selector lever
4	Holes for lifting
5	Oil level gauge

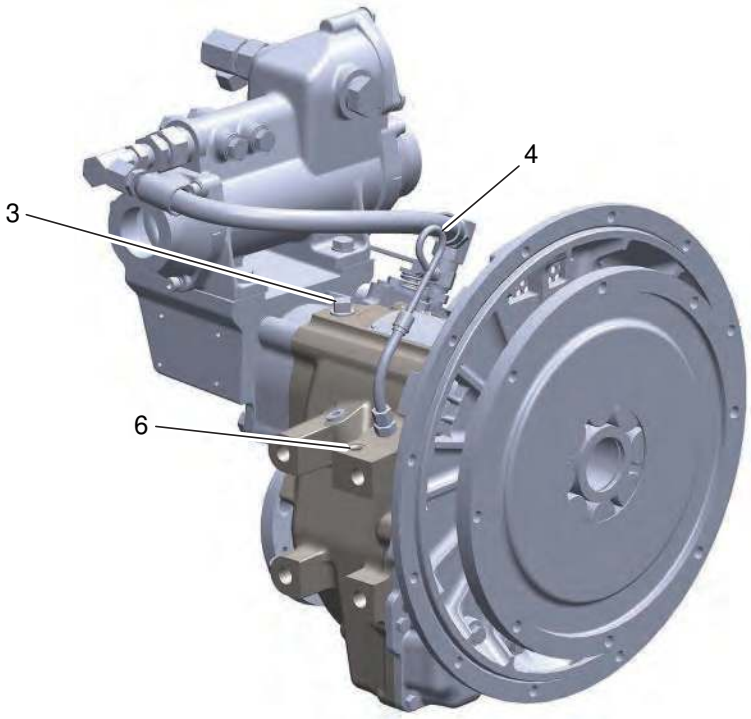
MG-5025A

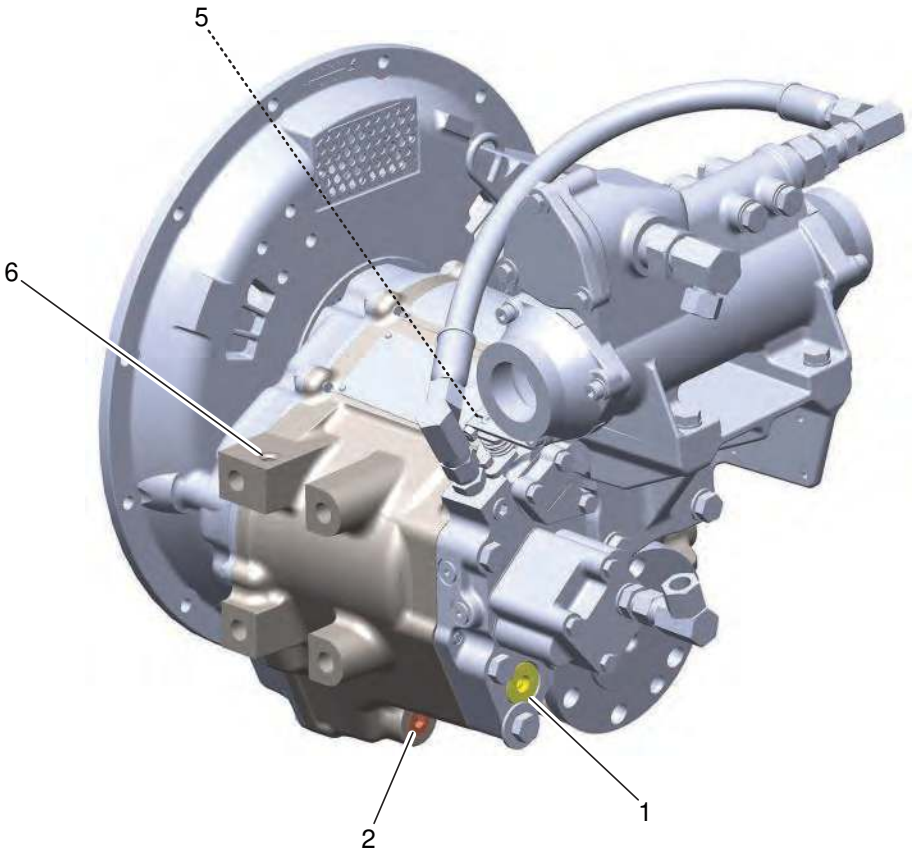


MG-5025A Callout List

Callout	Component
1	Oil fill port
2	Oil drain plug
3	Holes for lifting

MG-5050A

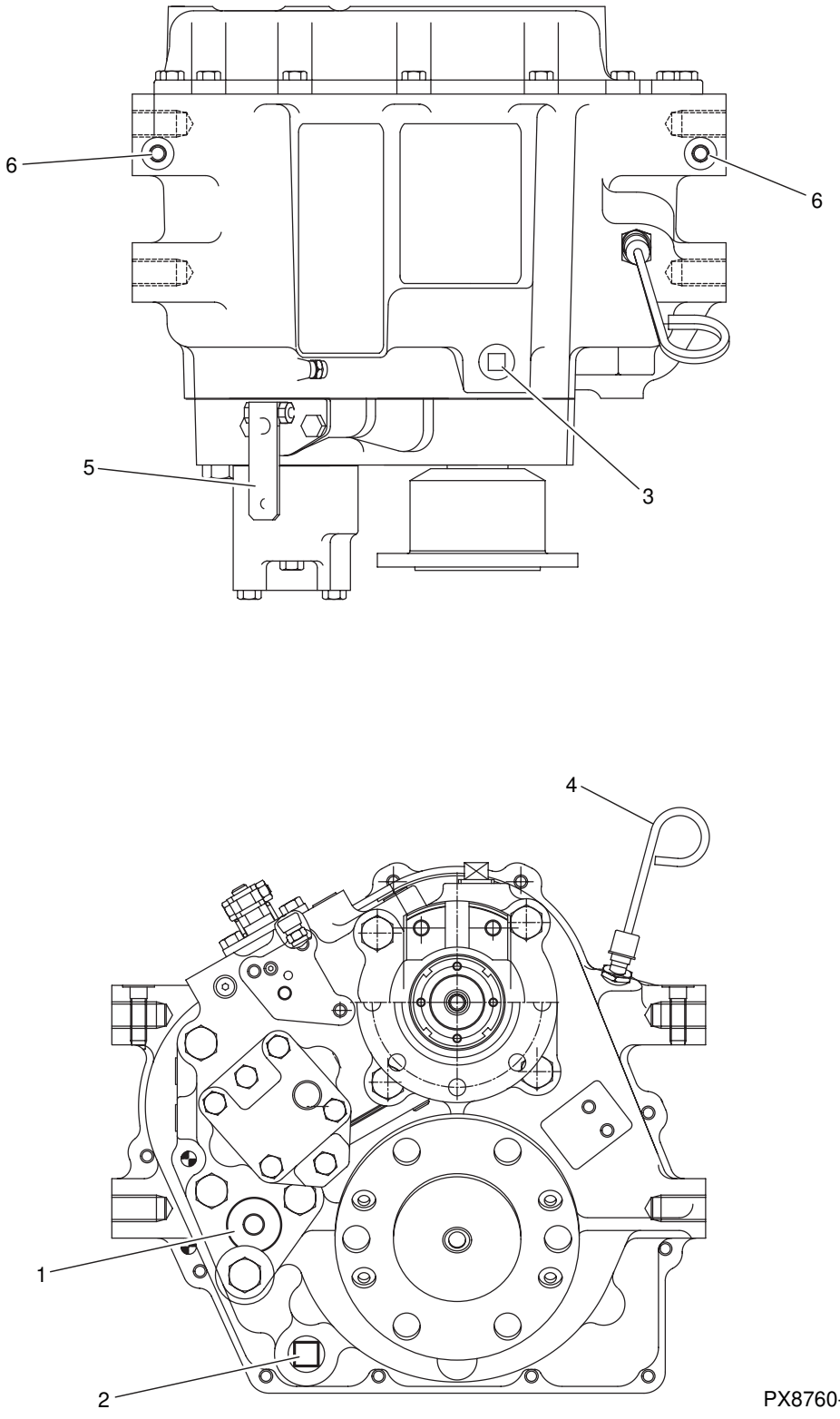




MG-5050A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Oil level gauge
5	Control valve selector lever
6	Holes for lifting

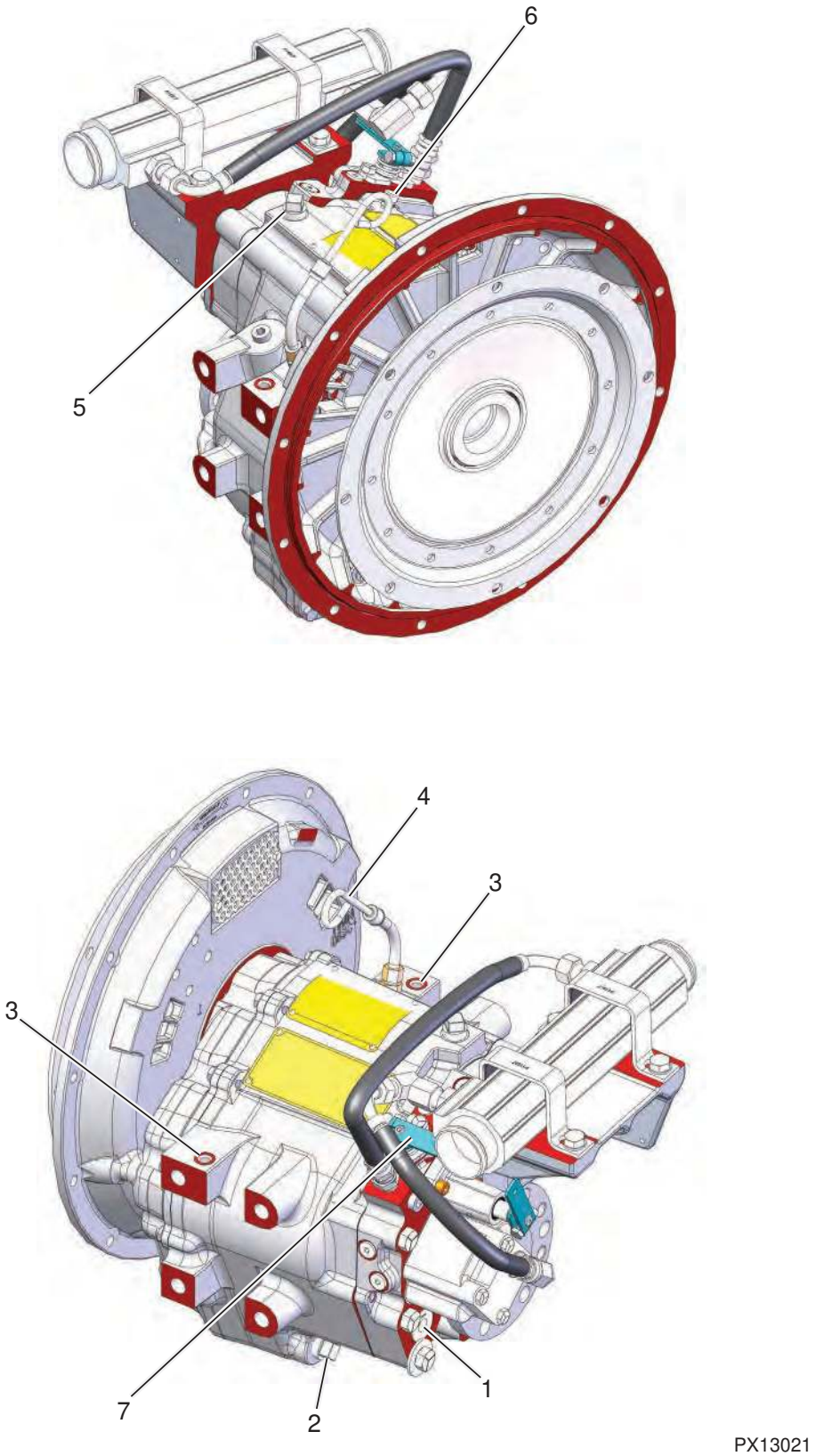
MG-5050RV



MG-5050RV Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Oil level gauge
5	Control valve selector lever
6	Holes for lifting

MG-5050SC

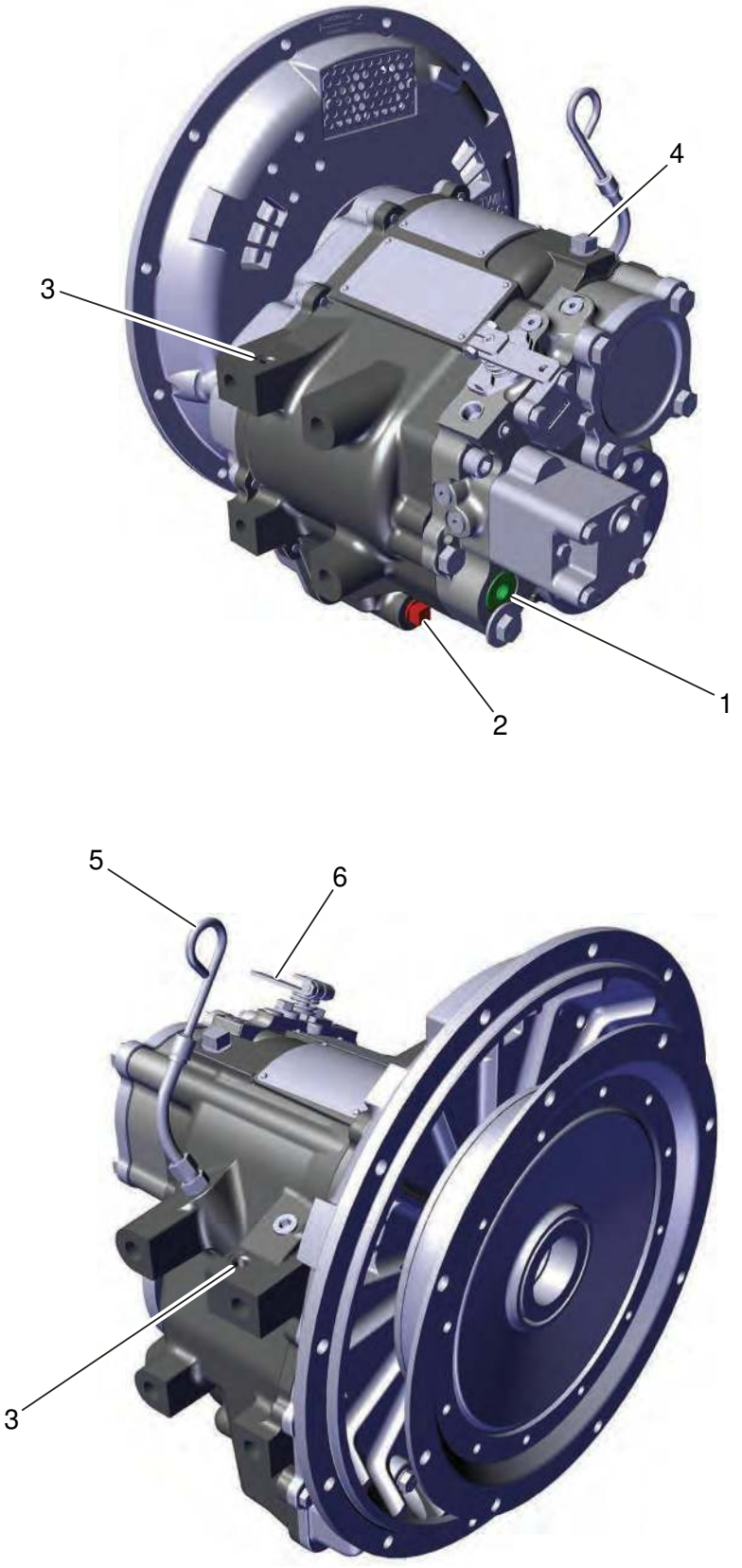


PX13021

MG-5050SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Eyebolt holes for lifting
4	Oil level gauge
5	Oil fill port
6	Breather
7	Control valve selector lever

MG-5061A

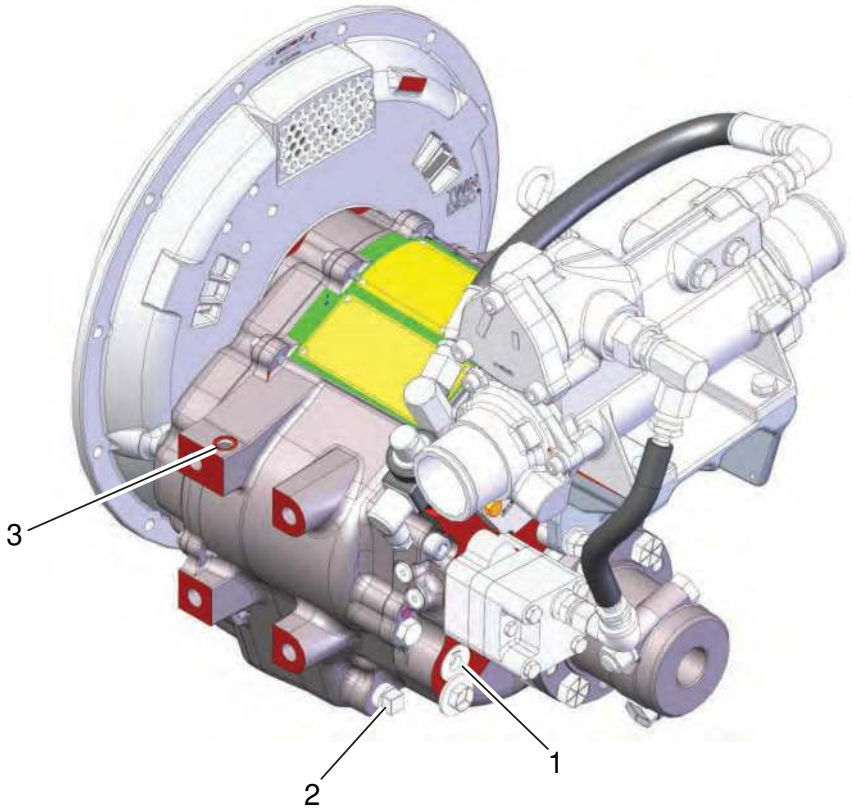


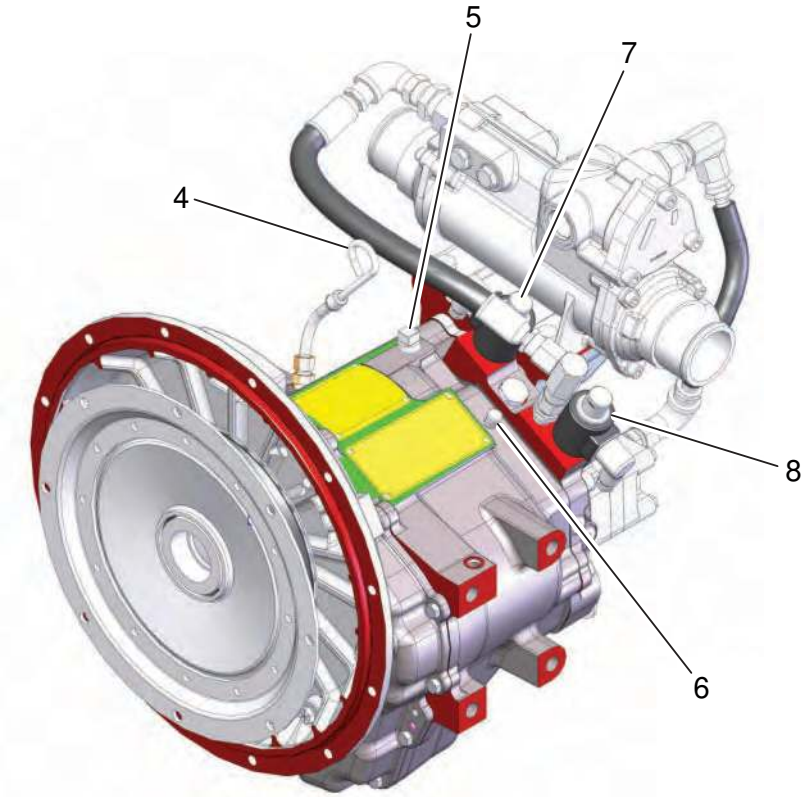
1026225

MG-5061A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Oil fill port
5	Oil level gauge
6	Control valve selector lever

MG-5061SC



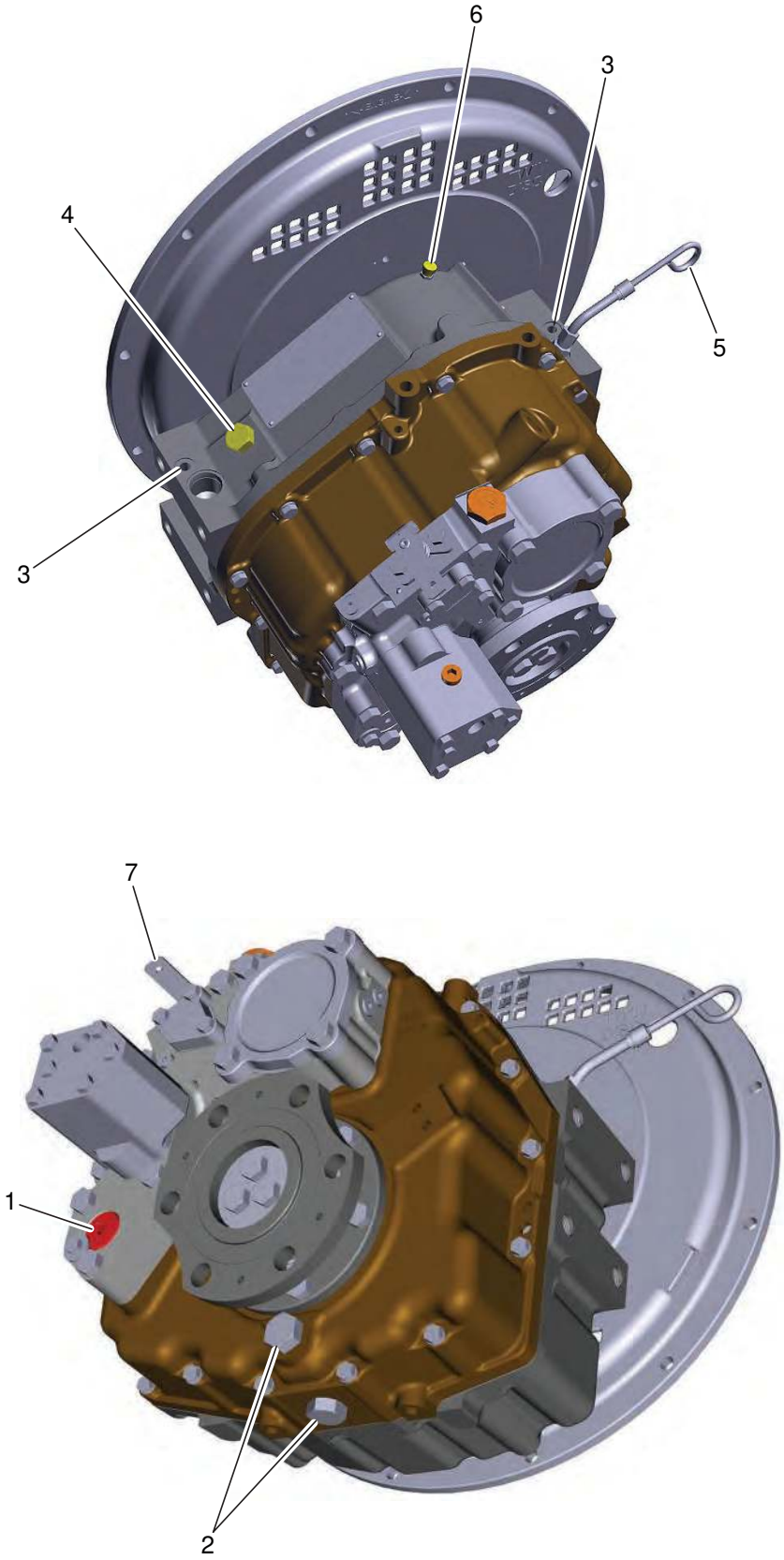


1026328

MG-5061SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Eyebolt holes for lifting
4	Oil level gauge
5	Oil fill port
6	Breather
7	Primary solenoid
8	Secondary solenoid

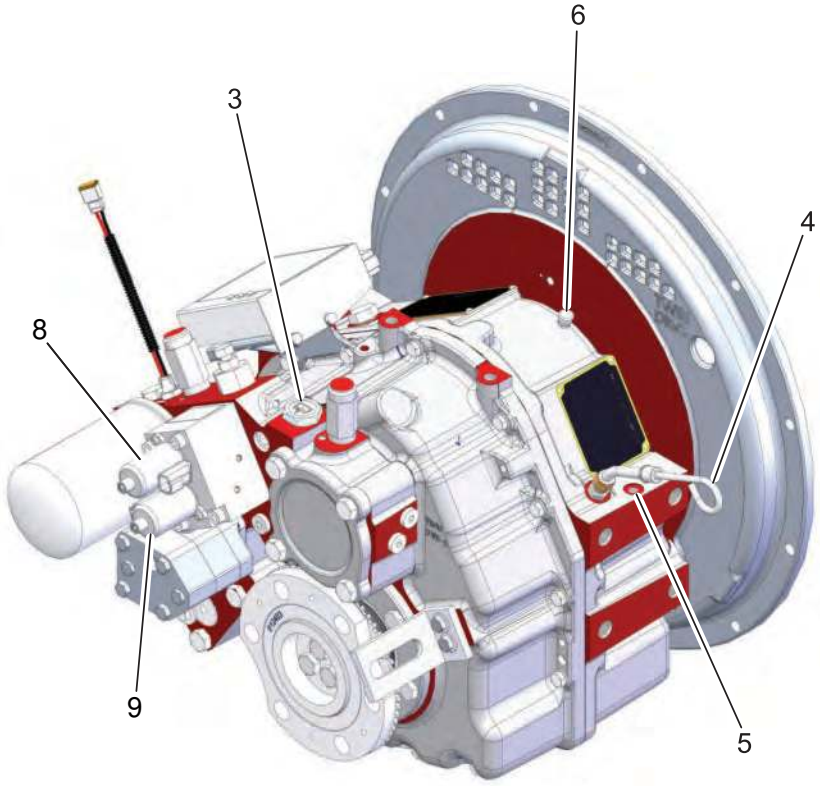
MG-5065A

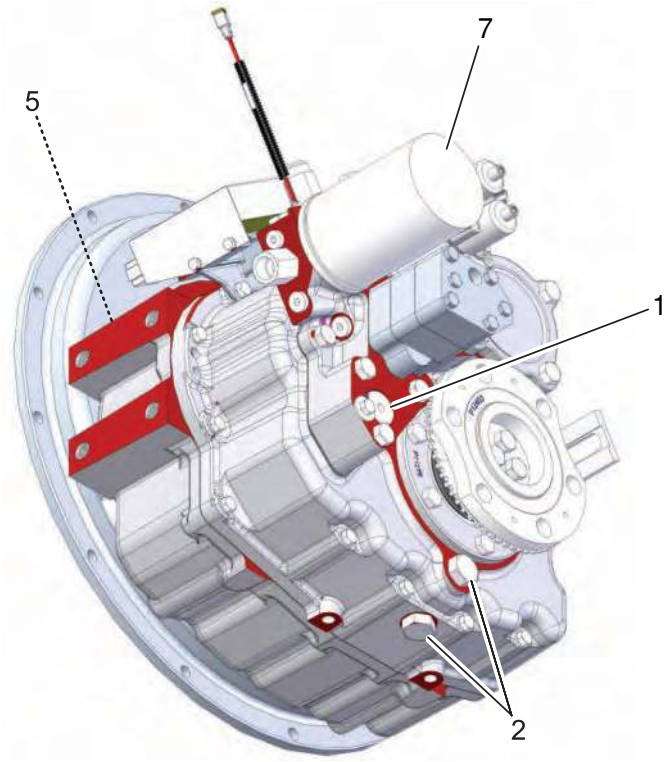


MG-5065A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil fill port
5	Oil level gauge
6	Breather
7	Control valve selector lever

MG-5065SC



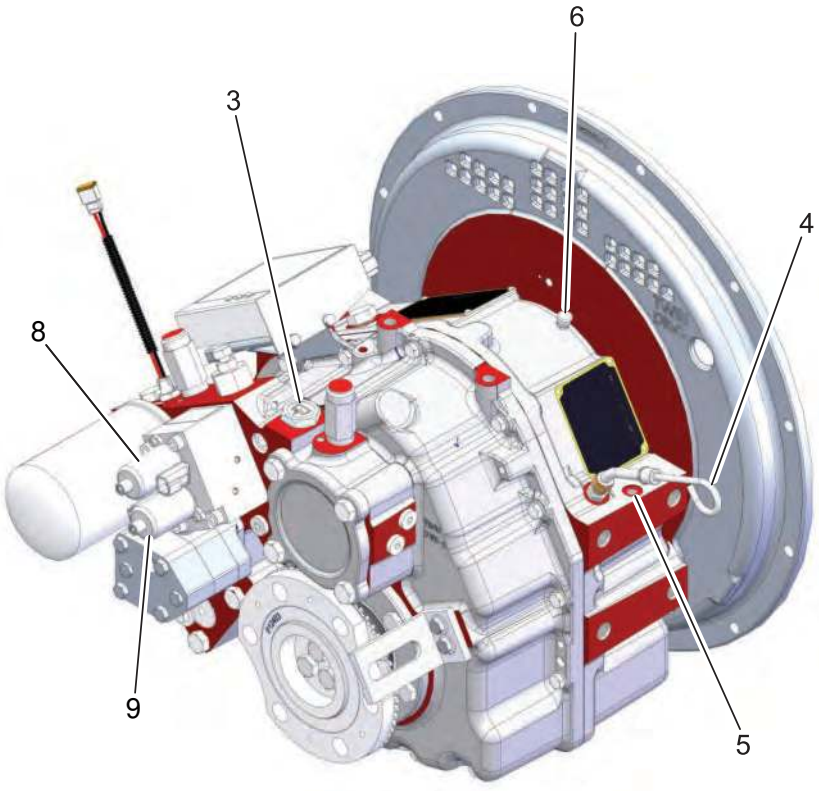


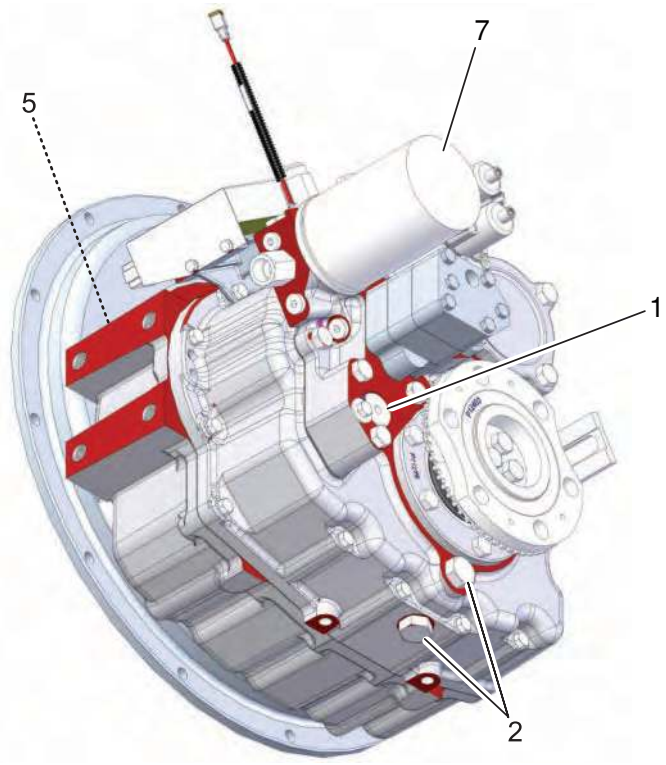
1026371

MG-5065SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil fill port
4	Oil level gauge
5	Holes for lifting
6	Breather
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-5065SC



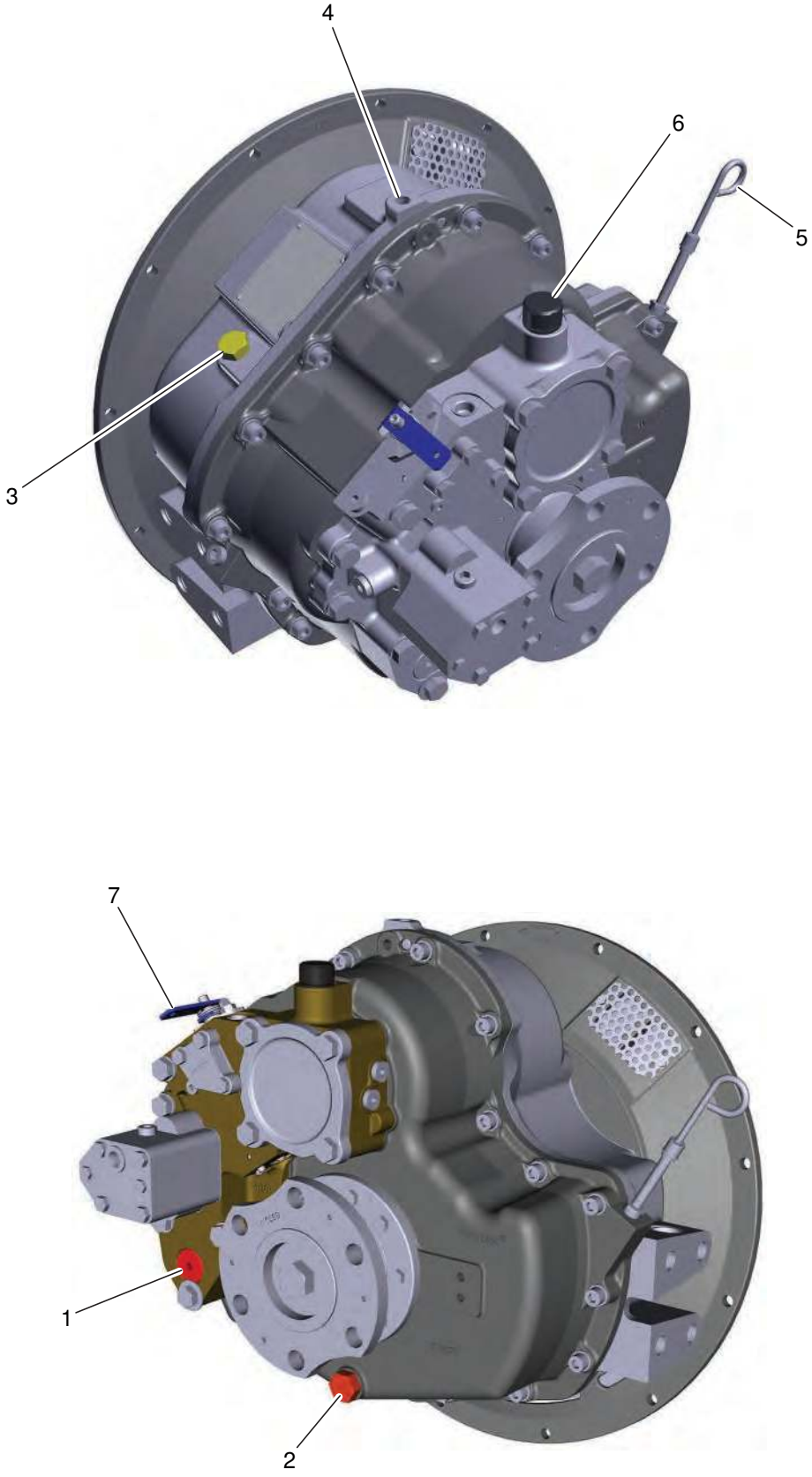


1026371

MGX-5065SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil fill port
4	Oil level gauge
5	Holes for lifting
6	Breather
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

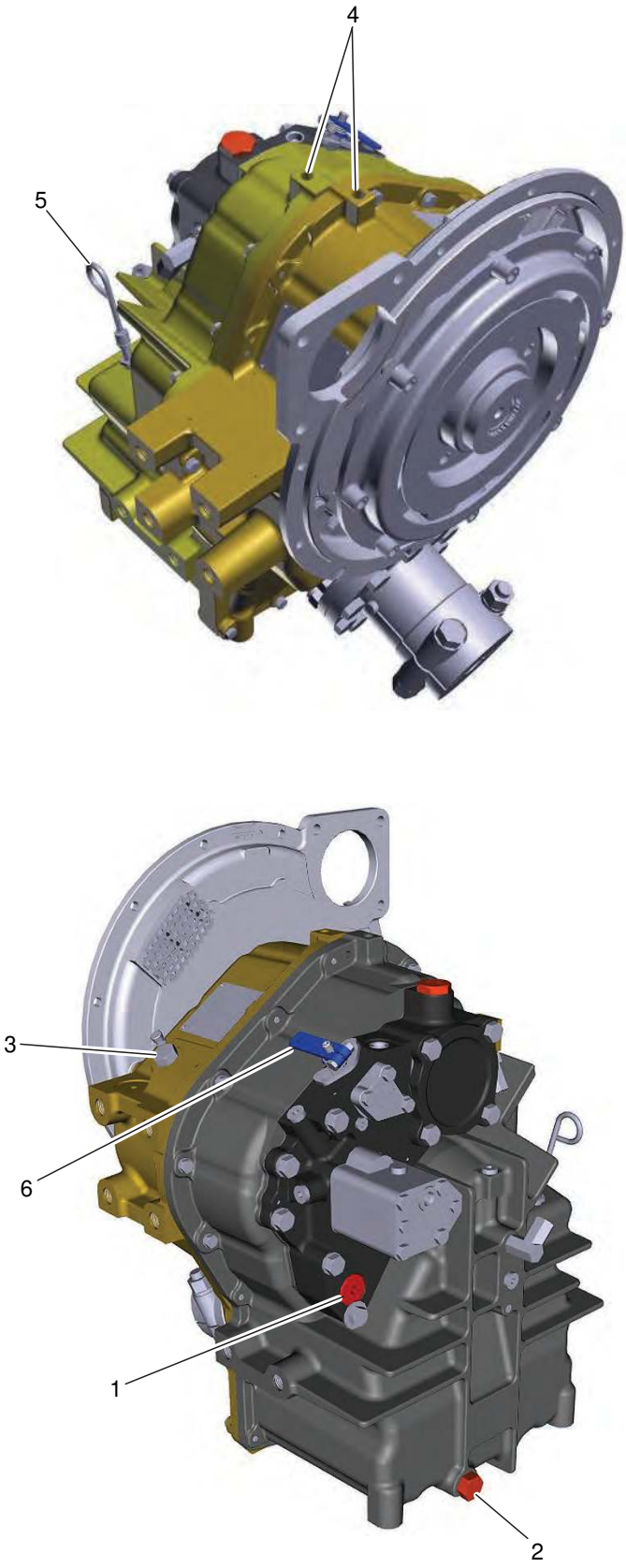
MG-5075A



MG-5075A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Holes for lifting
5	Oil level gauge
6	Breather
7	Control valve selector lever

MG-5075IV

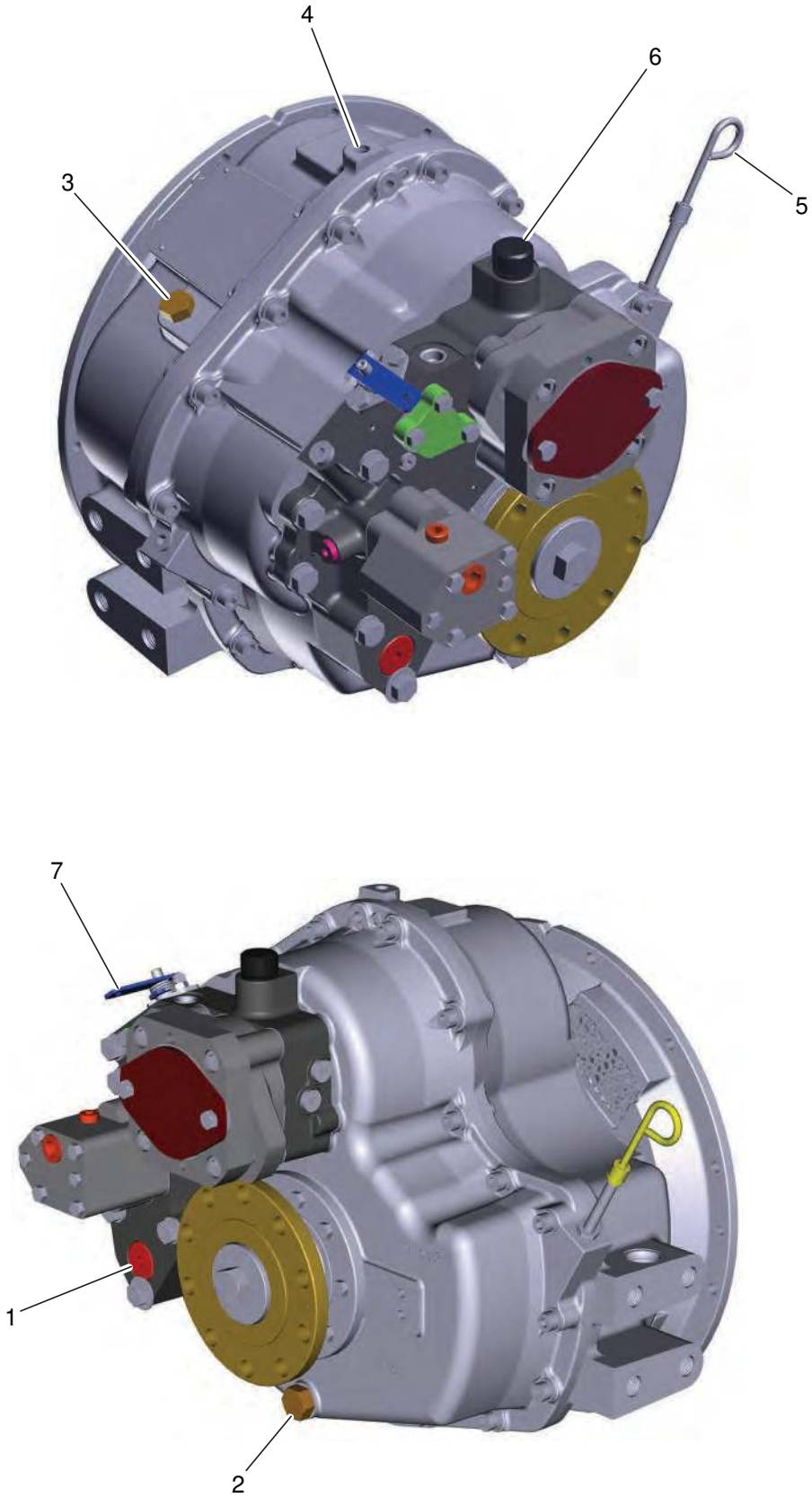


PX13054

MG-5075IV Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Holes for lifting
5	Oil level gauge
6	Control valve selector lever

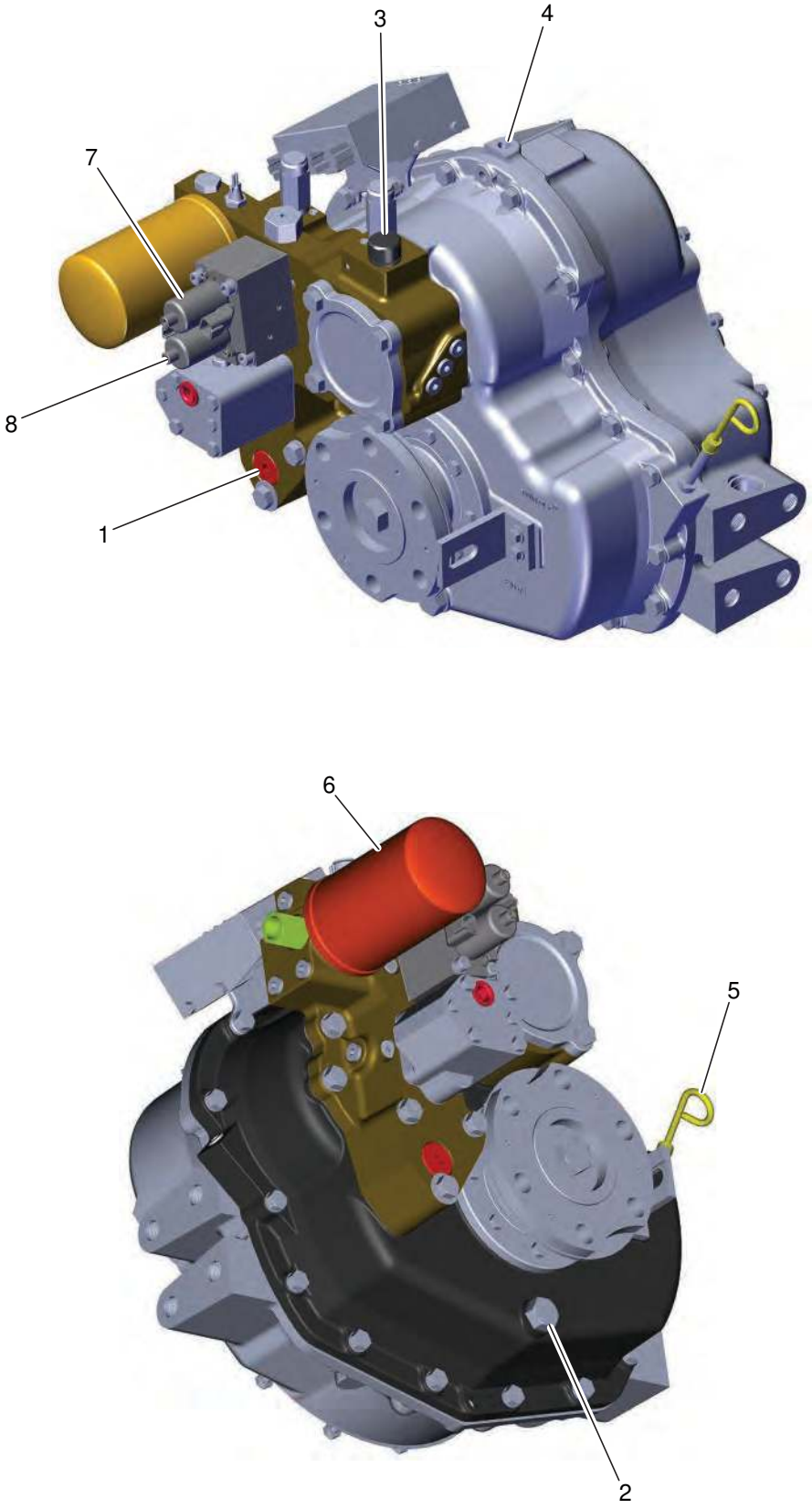
MG-5075SC



MG-5075SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Holes for lifting
5	Oil level gauge
6	Breather
7	Control valve selector lever

MGX-5075A

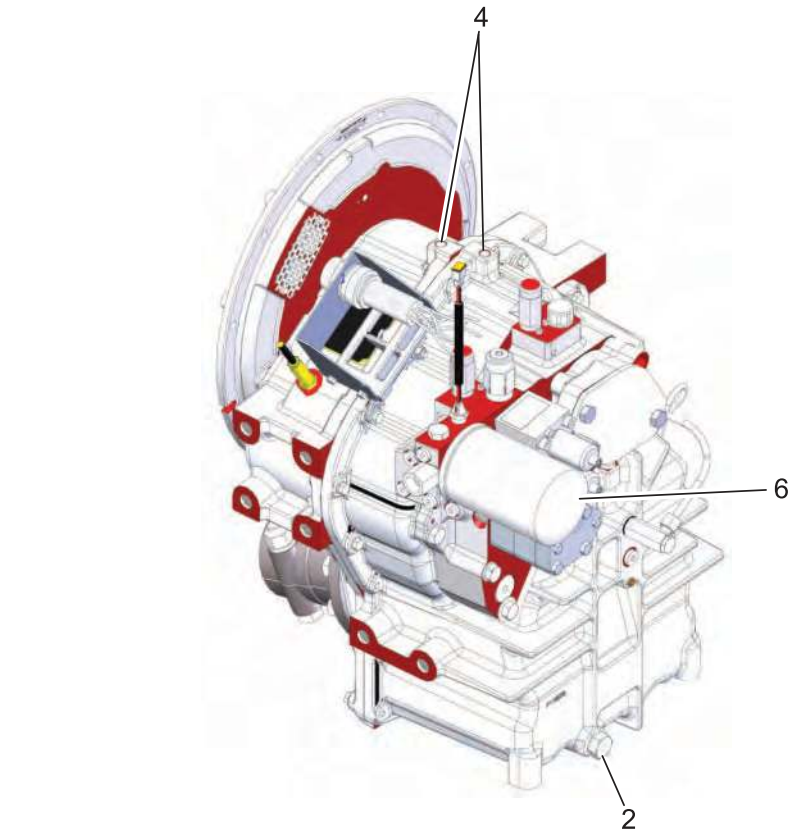


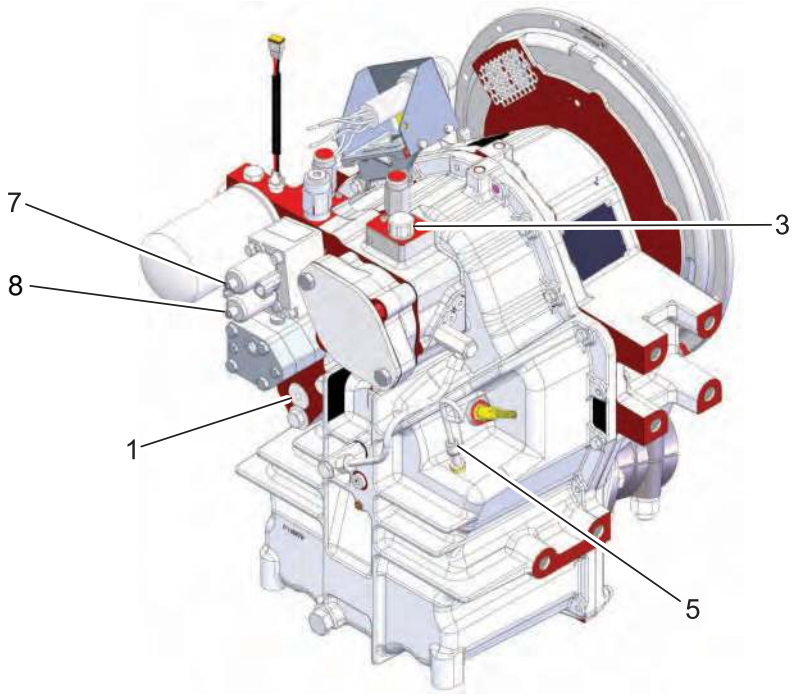
PX1031577D

MGX-5075A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Breather and oil fill port
4	Holes for lifting
5	Oil level gauge
6	Oil filter
7	Primary solenoid
8	Secondary solenoid

MGX-5075IV



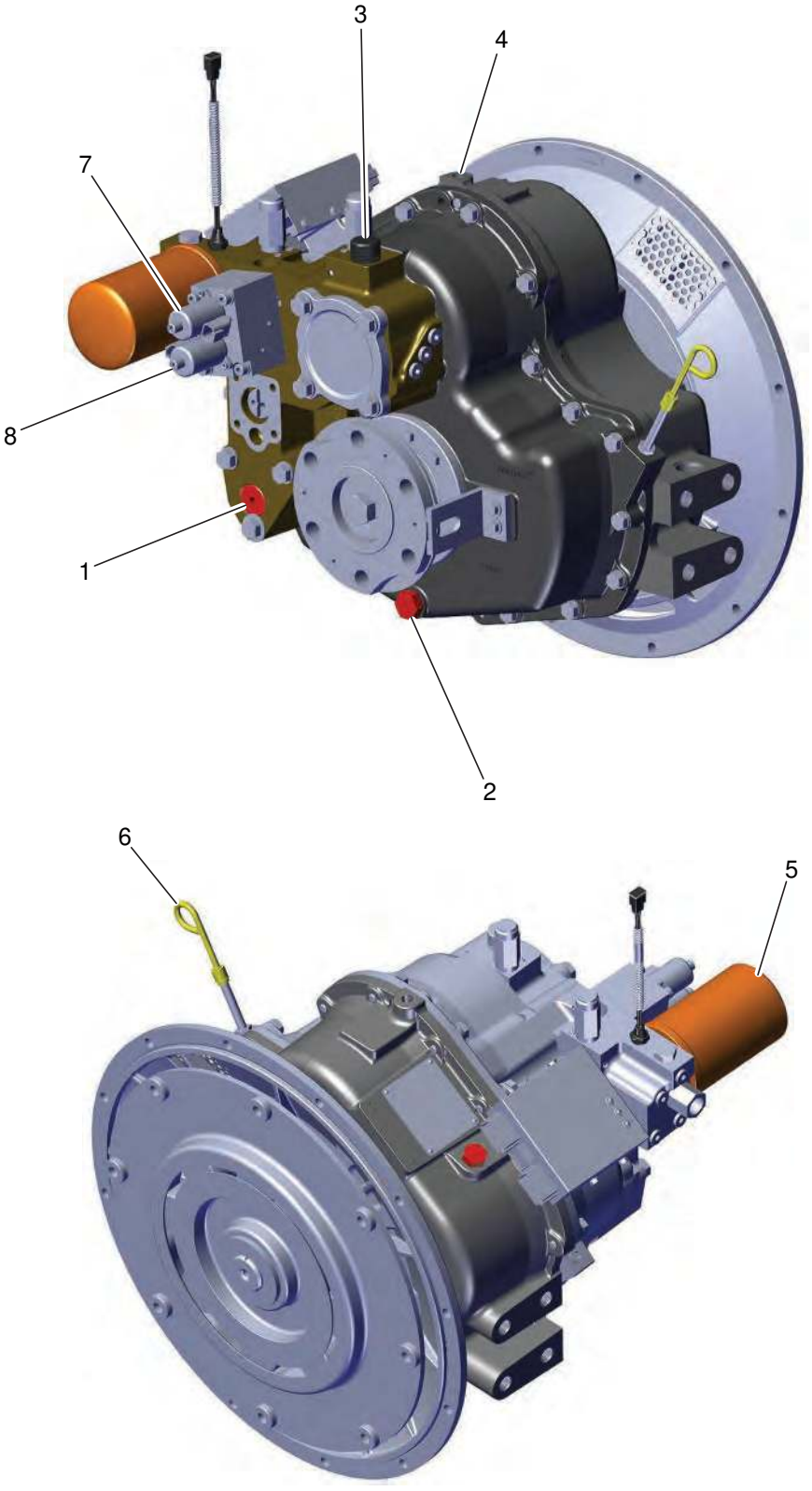


1026838C

MGX-5075IV Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Breather and oil fill port
4	Holes for lifting
5	Oil level gauge
6	Oil filter
7	Primary solenoid
8	Secondary solenoid

MGX-5075SC

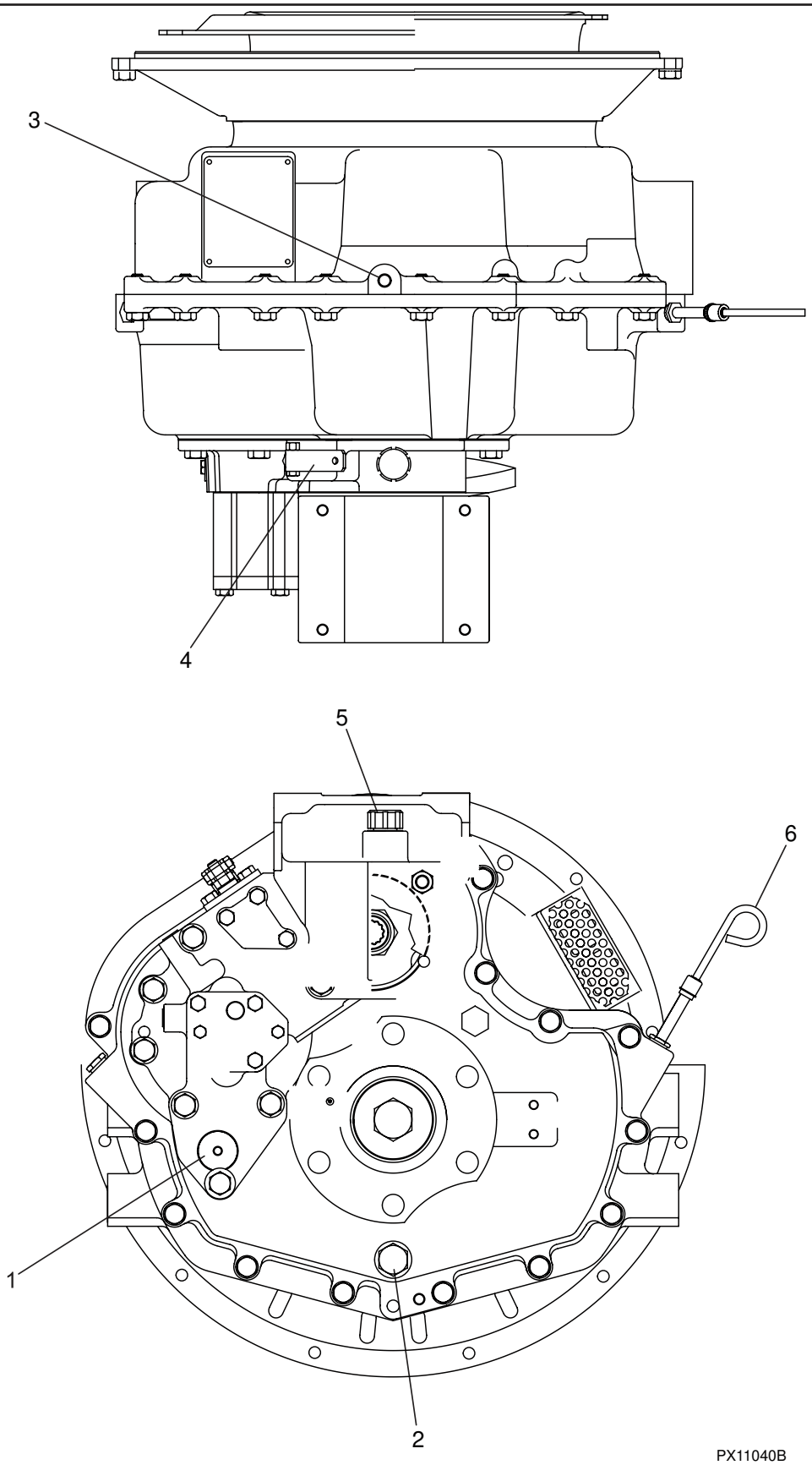


PX13174A

MGX-5075SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Breather and oil fill port
4	Holes for lifting
5	Oil level gauge
6	Oil filter
7	Primary solenoid
8	Secondary solenoid

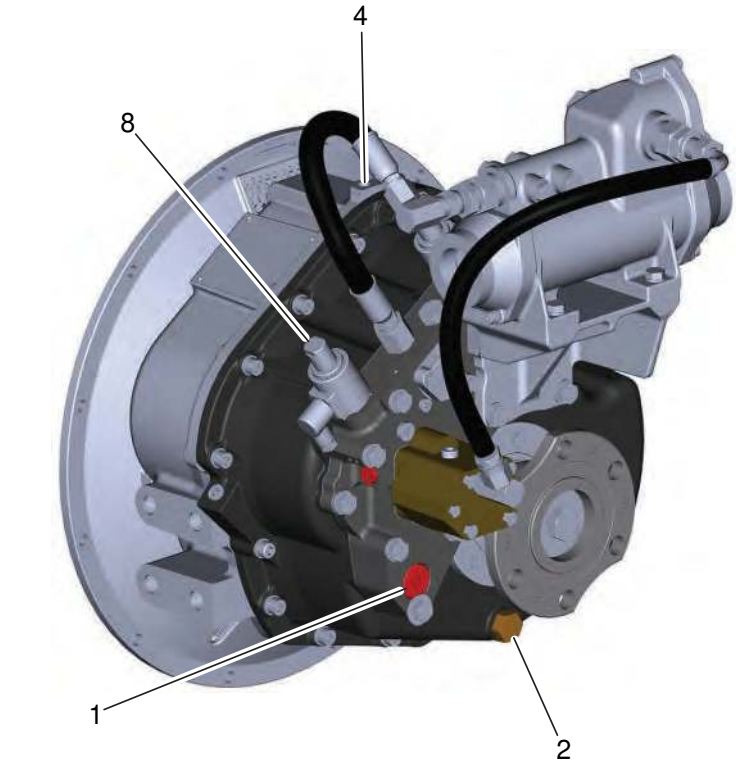
MG-5082A

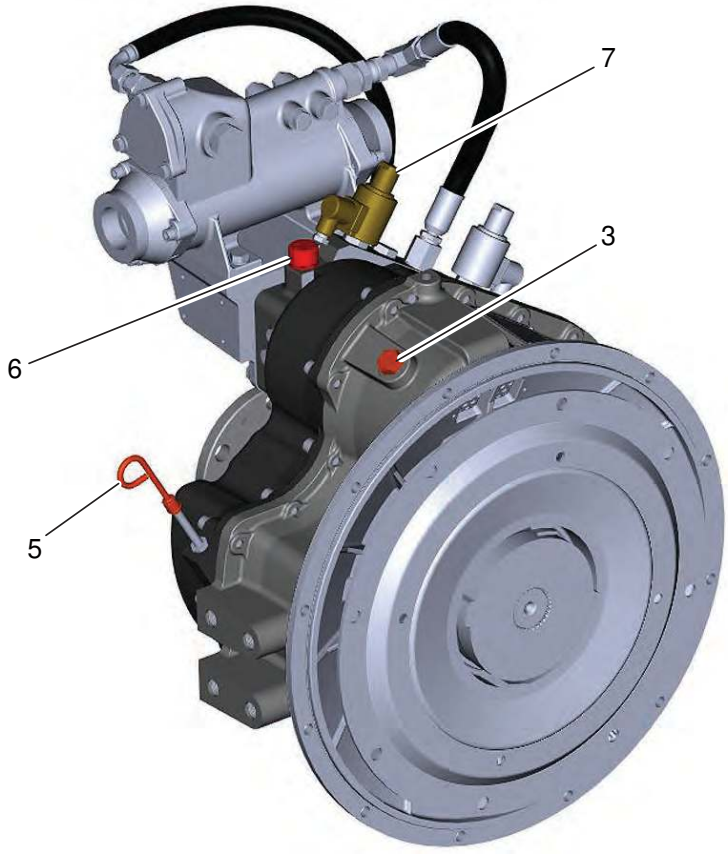


MG-5082A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Control valve selector lever
5	Breather and oil fill port
6	Oil level gauge

MG-5082SC



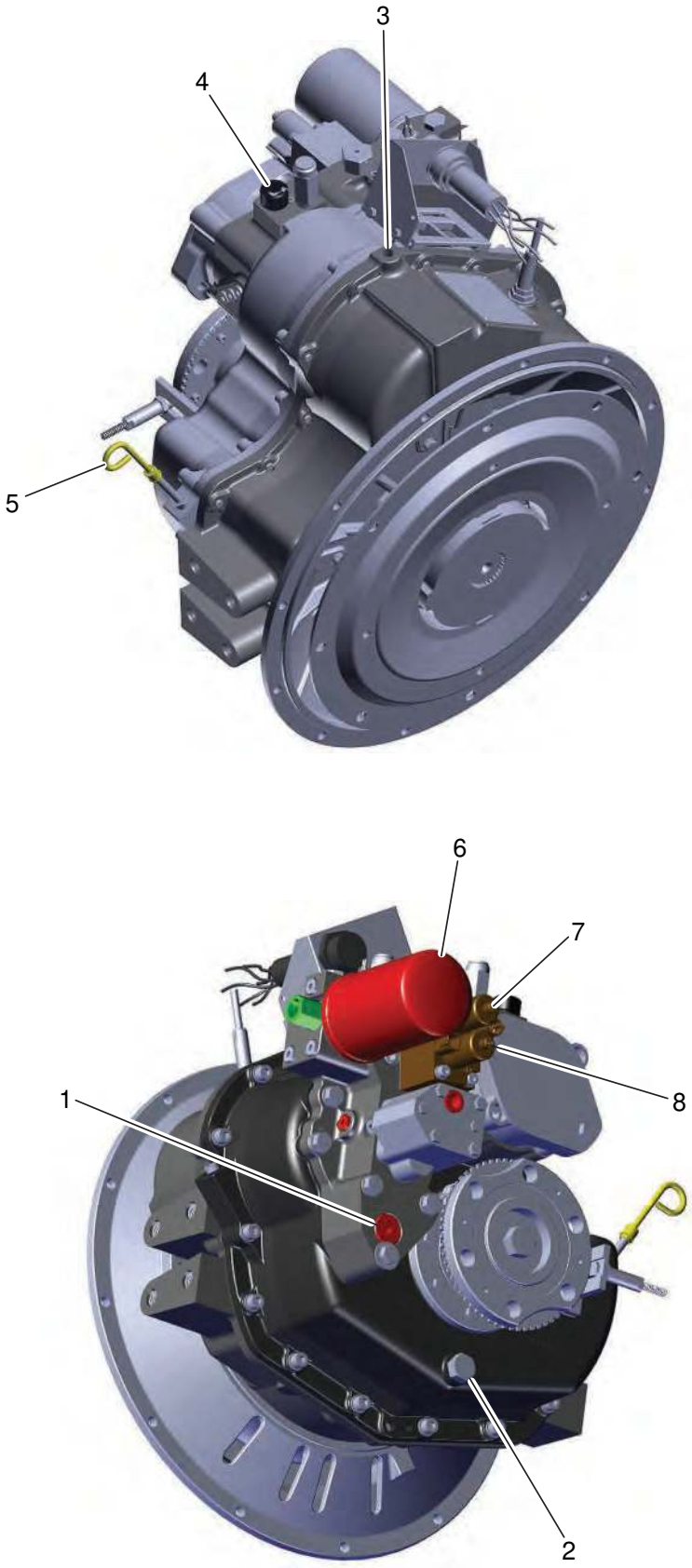


PX1038304C

MG-5082SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Oil fill port
4	Holes for lifting
5	Oil level gauge
6	Breather
7	Primary solenoid
8	Secondary solenoid

MG(X)-5086A, MGX-5086A

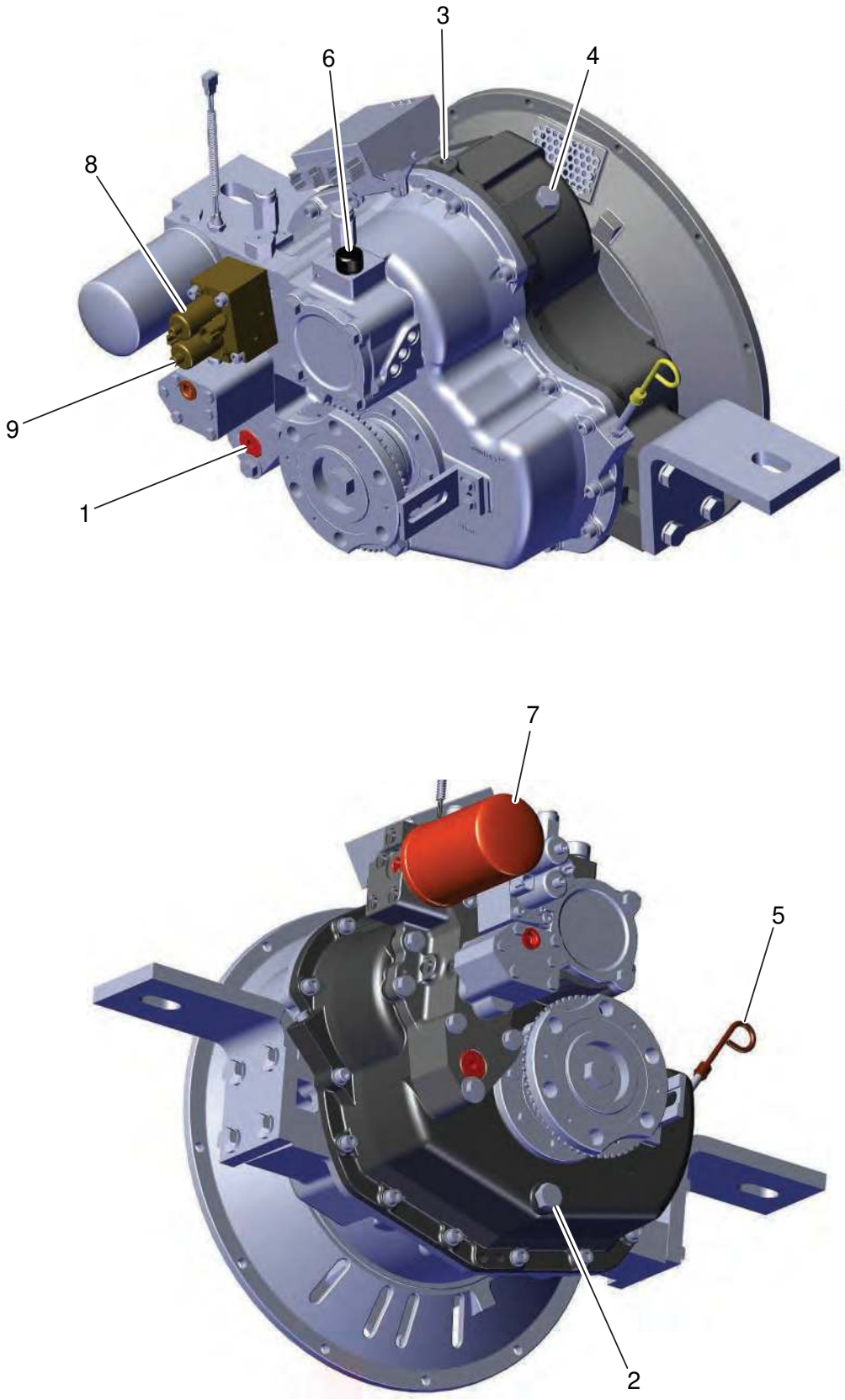


PX13064E

MG(X)-5086A, MGX-5086A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Breather and oil fill port
5	Oil level gauge
6	Oil filter
7	Primary solenoid
8	Secondary solenoid

MG(X)-5086SC

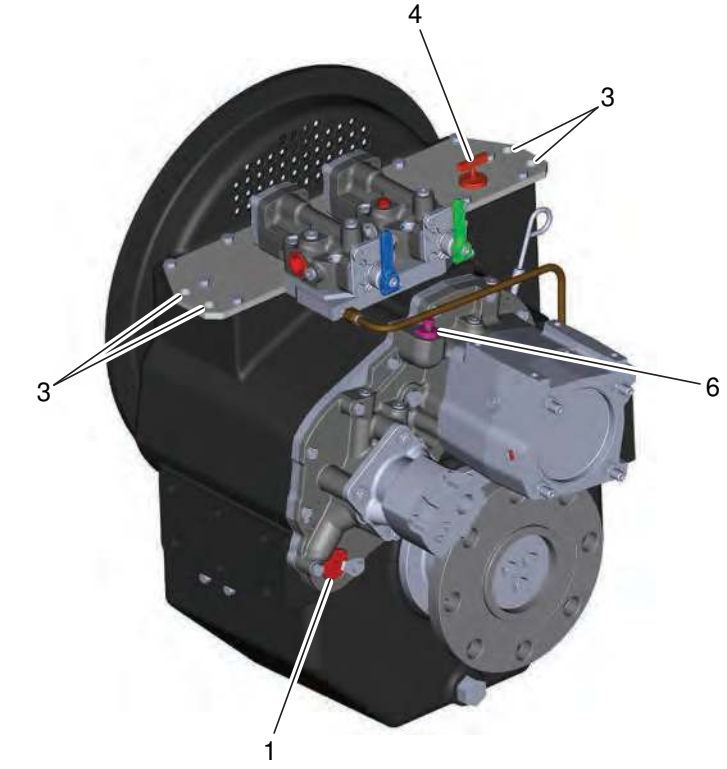


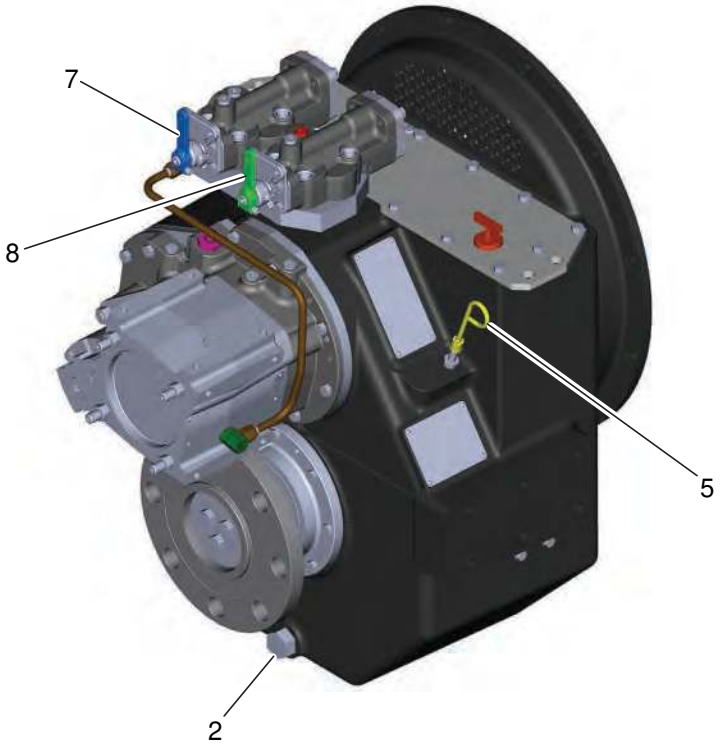
PX13382A

MG(X)-5086SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil fill port
5	Oil level gauge
6	Breather
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG-5091DC



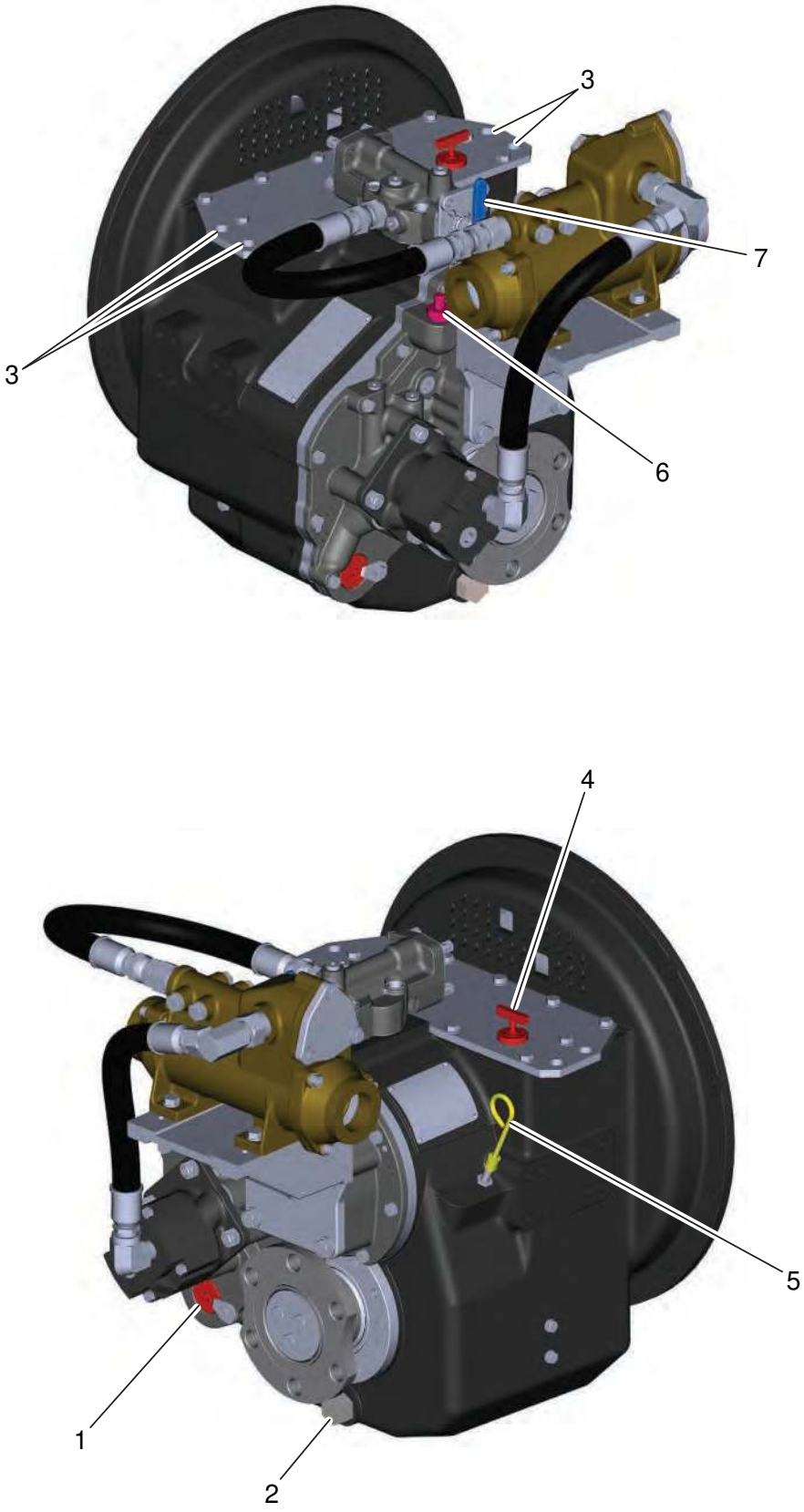


1026877E

MG-5091DC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil fill port
5	Oil level gauge
6	Breather
7	Control valve selector lever
8	Control valve selector lever

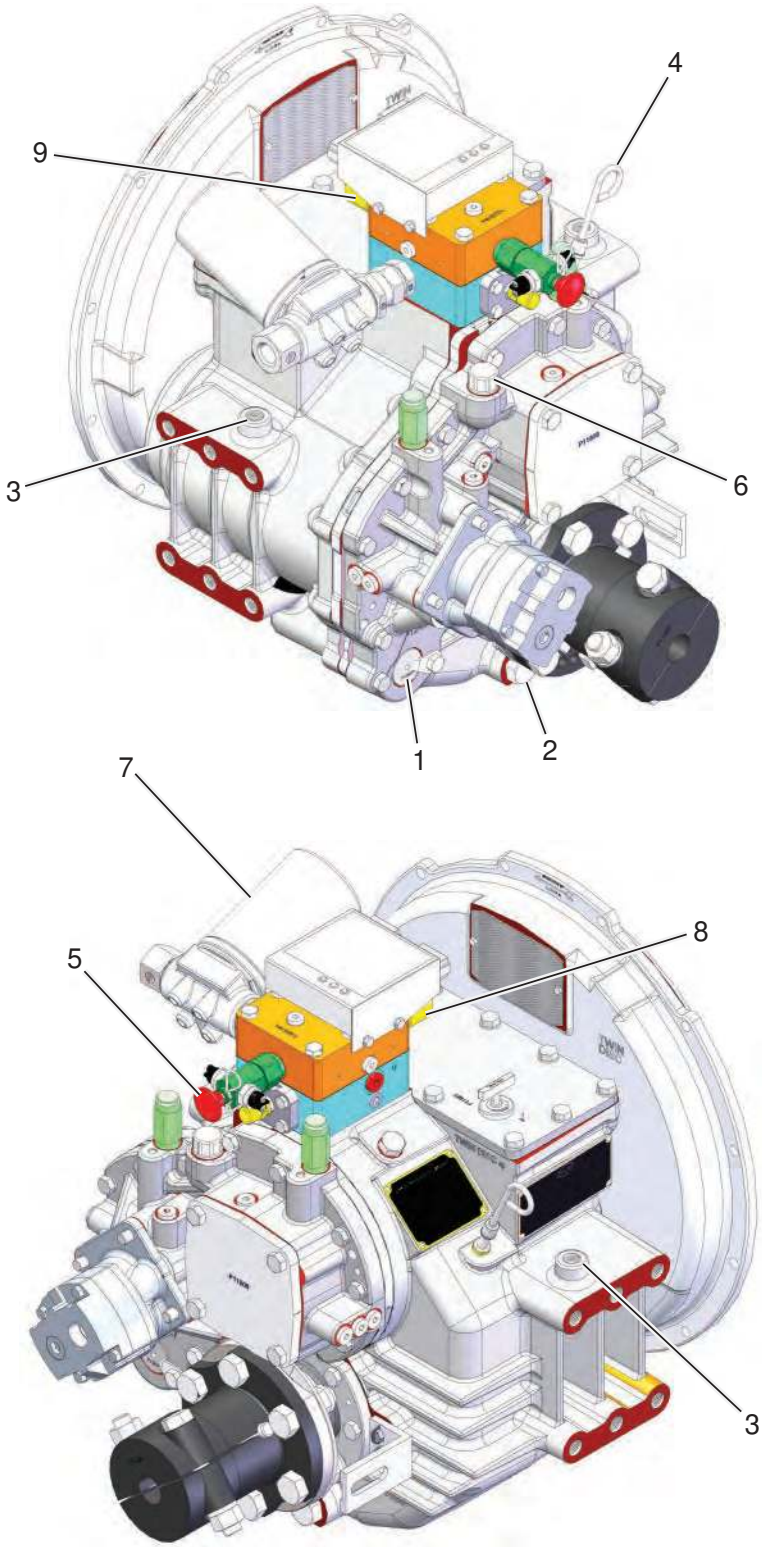
MG-5091SC



MG-5091SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil fill port
5	Oil level gauge
6	Breather
7	Control valve selector lever

MGX-5095SC

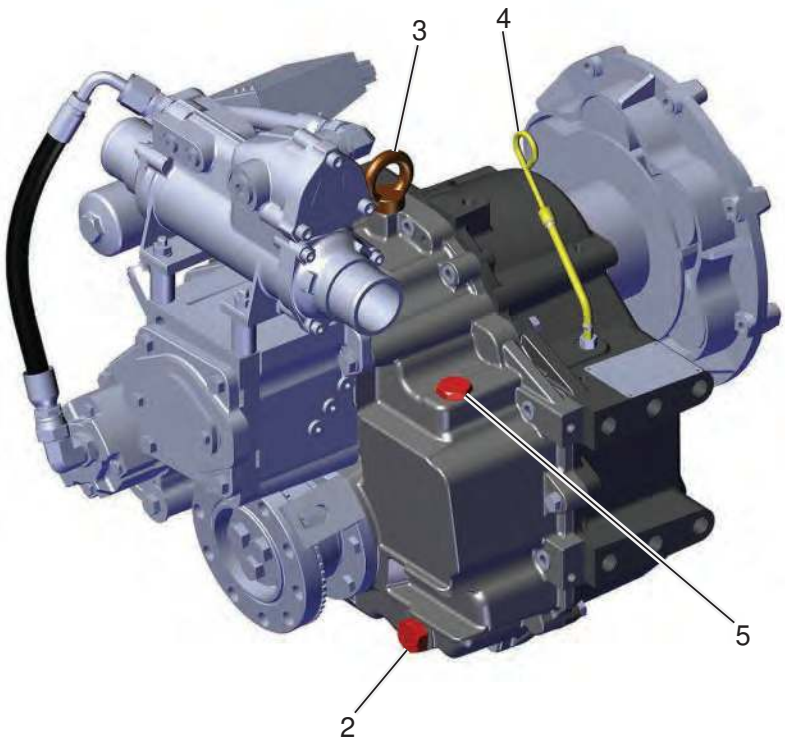


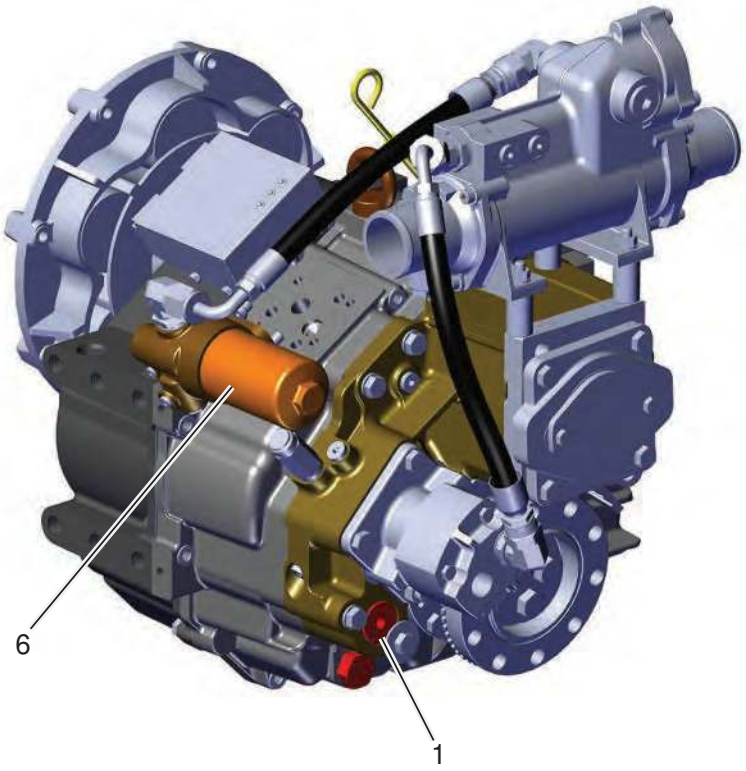
PX13023

MGX-5095SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil level gauge
5	Manual override valve
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5096A



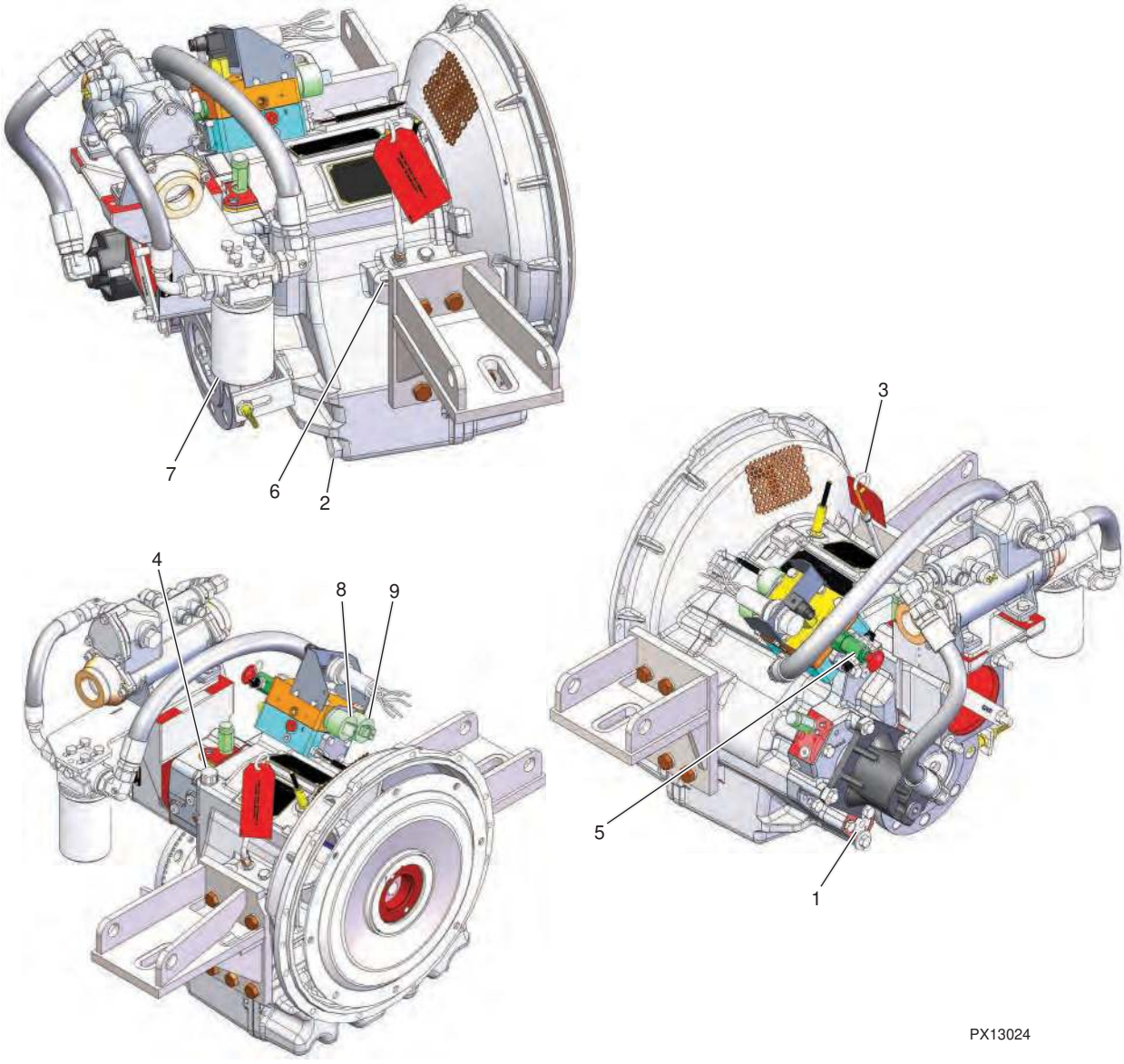


PX12820B

MG(X)-5096A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Oil level gauge
5	Oil fill port
6	Oil filter

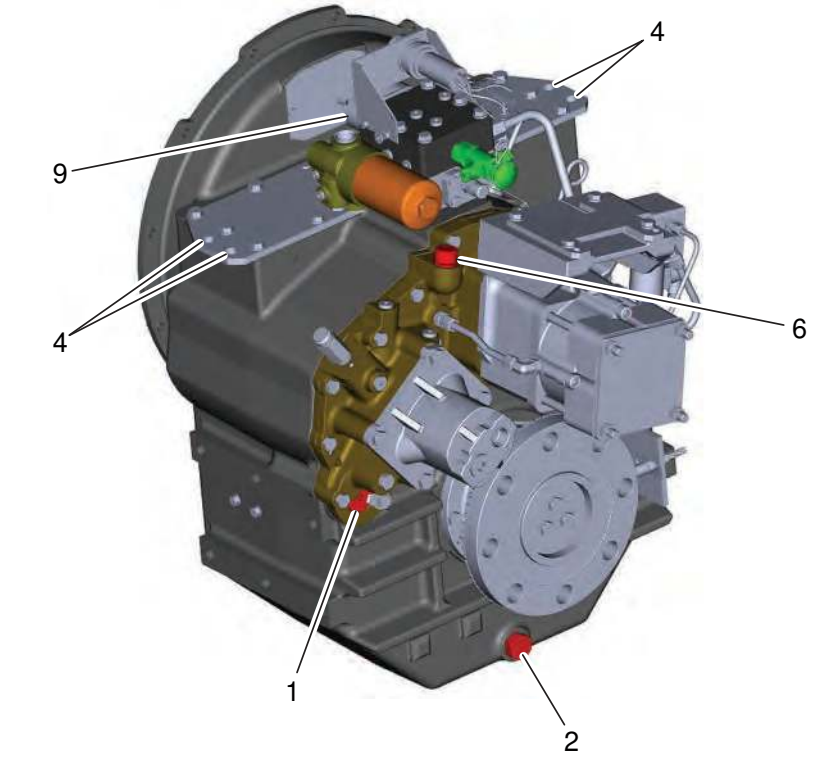
MGX-5114A

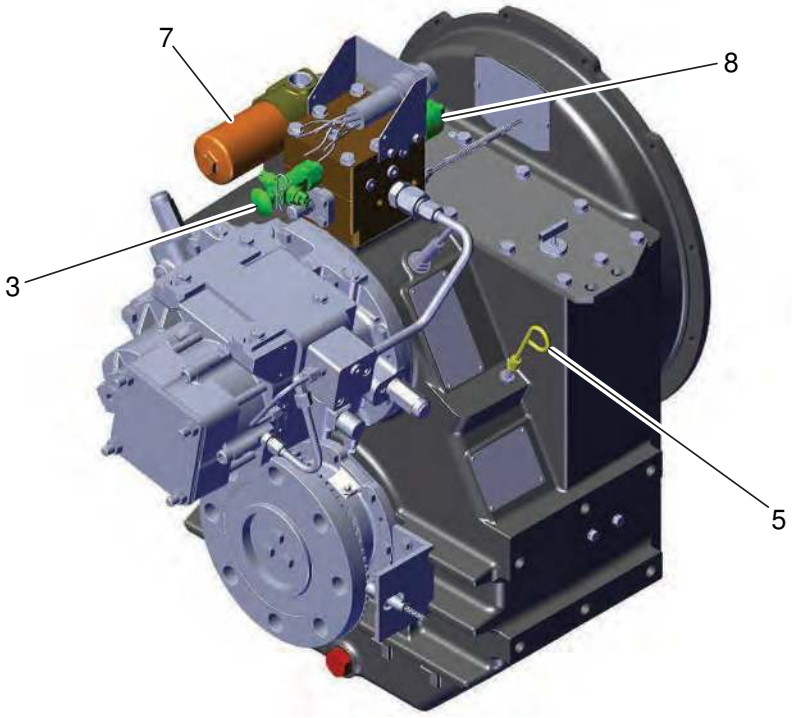


MGX-5114A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil level gauge
4	Breather and oil fill port
5	Manual override valve
6	Holes for lifting
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5114DC



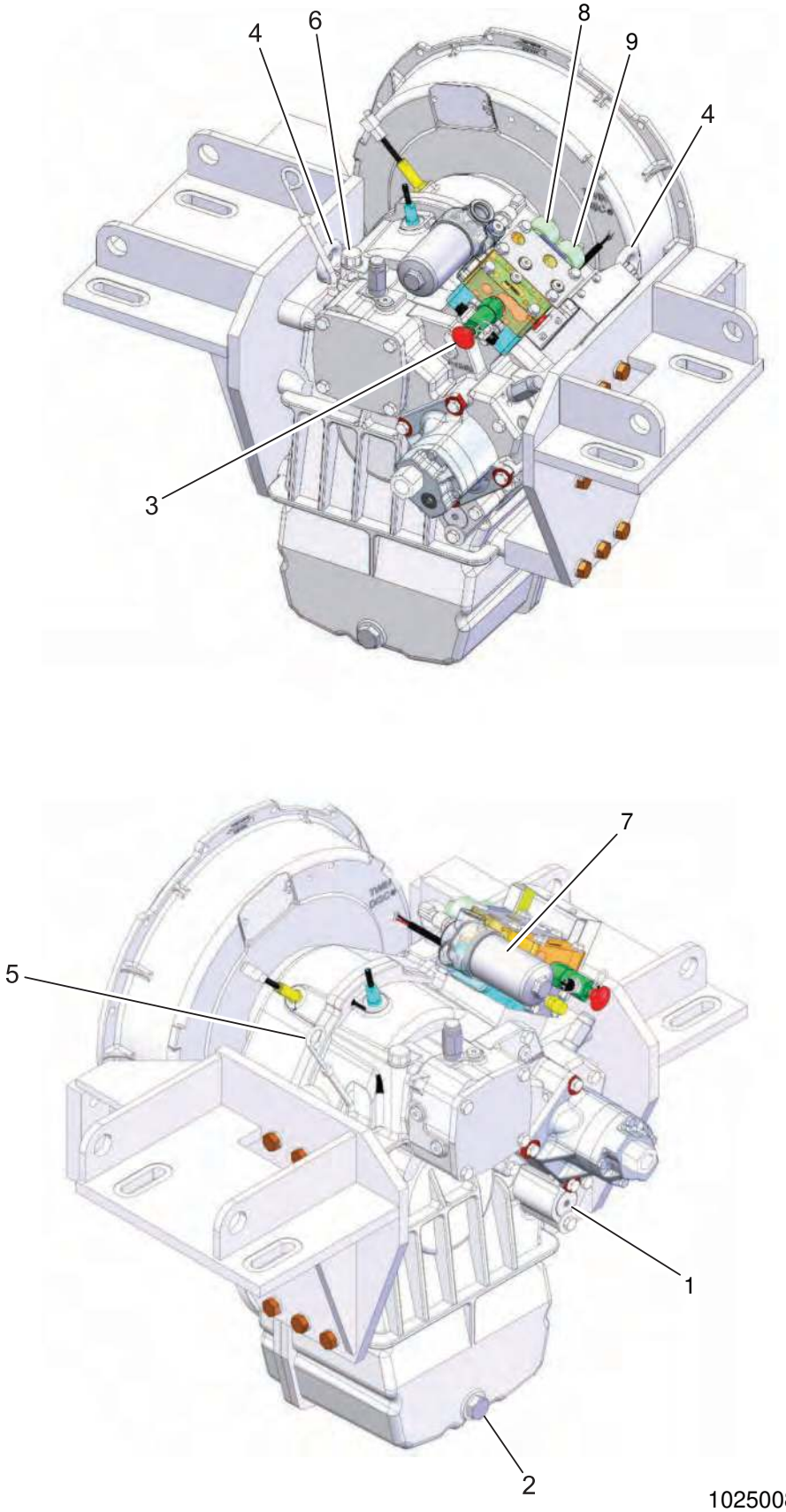


PX13298A

MG(X)-5114DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

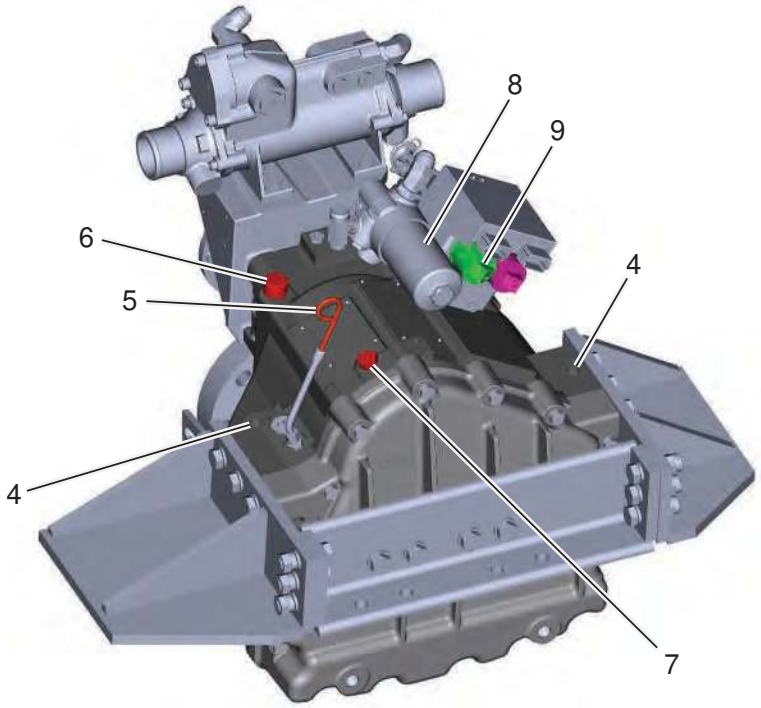
MG(X)-5114IV, MGX-5114IV

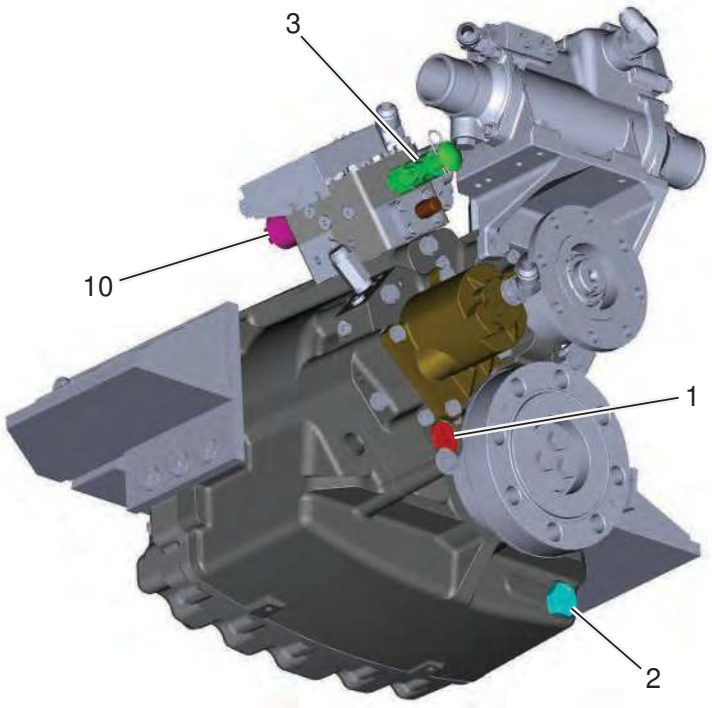


MG(X)-5114IV, MGX-5114IV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil filter
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5114RV



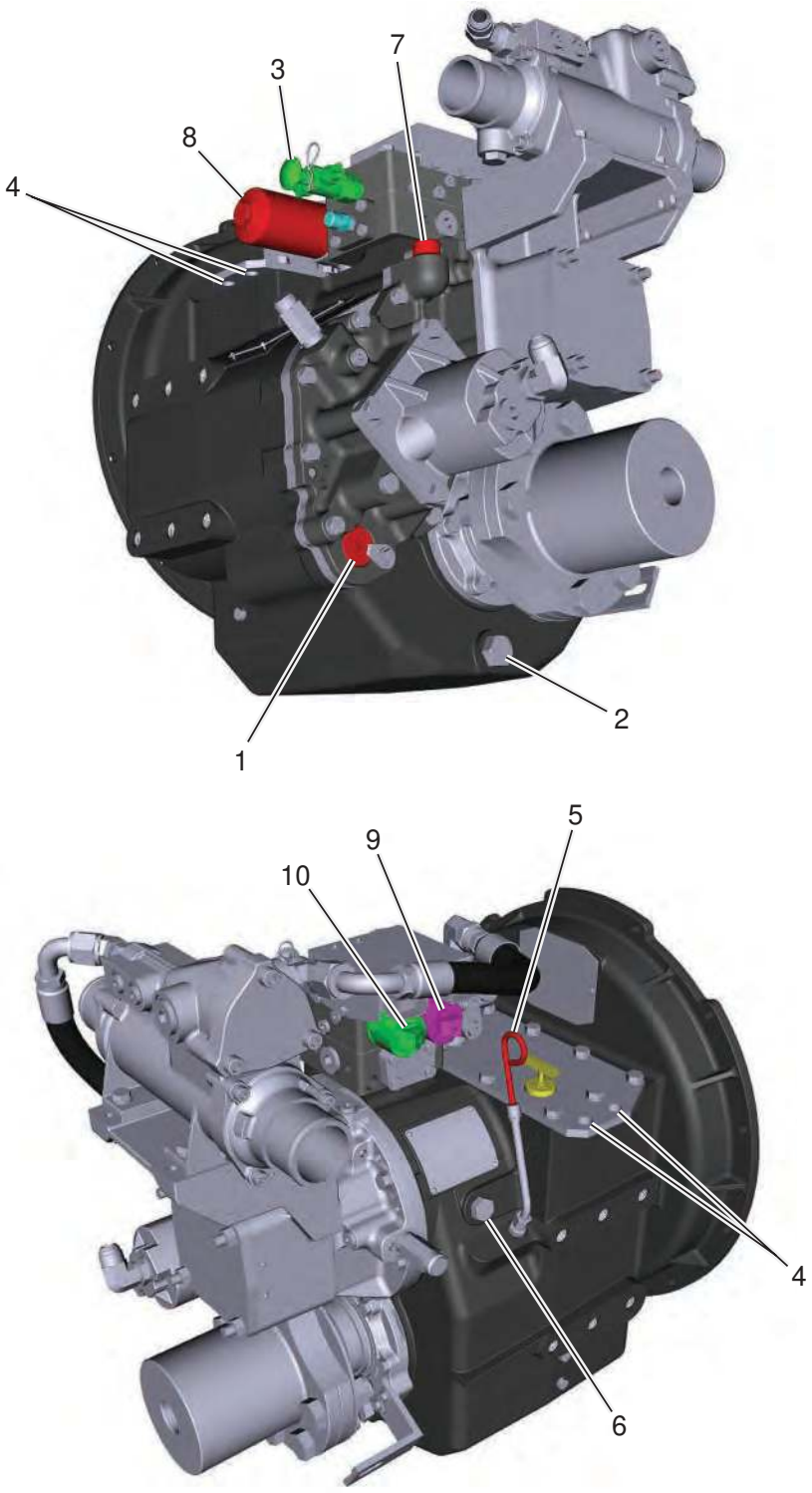


PX13365A

MG(X)-5114RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather
7	Oil fill port
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MG(X)-5114SC

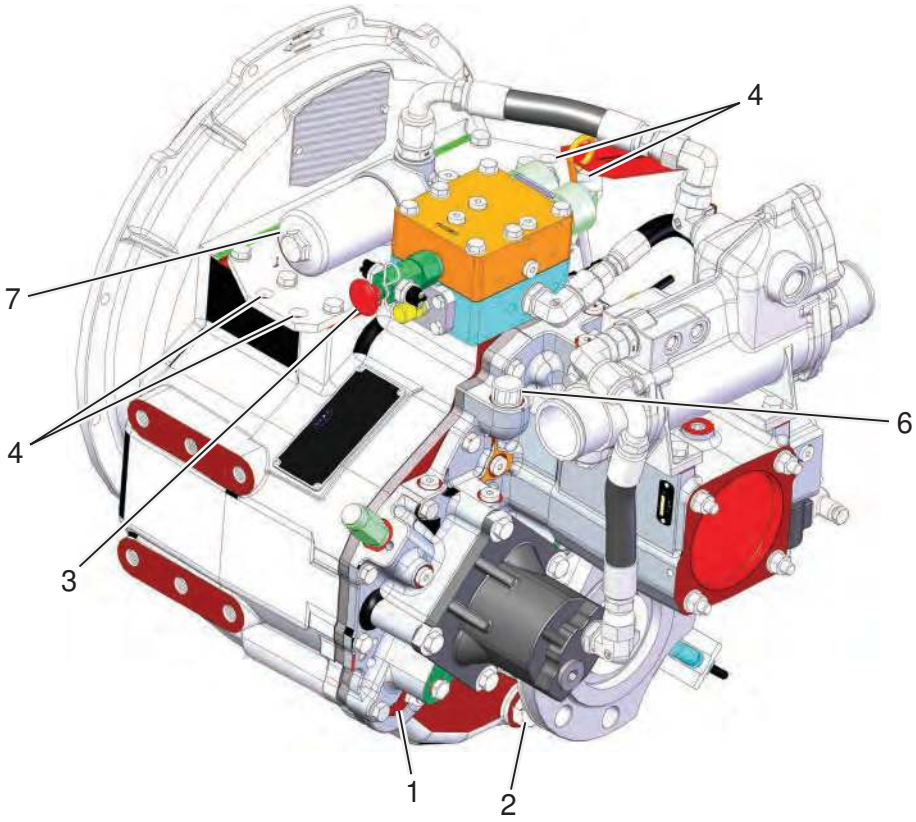


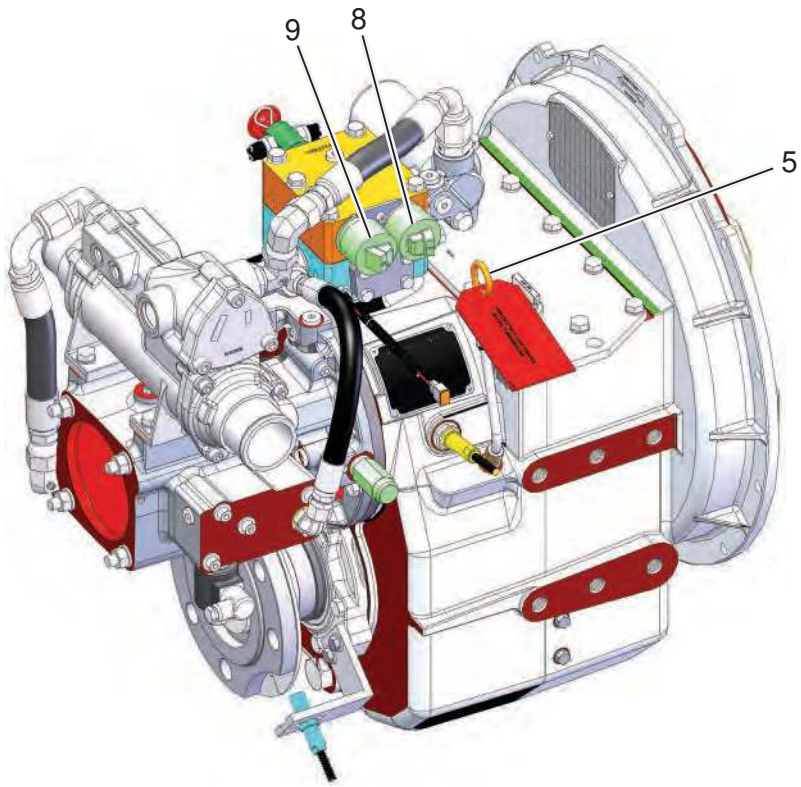
PX13254

MG(X)-5114SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Oil fill port
7	Breather
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MGX-5114SC



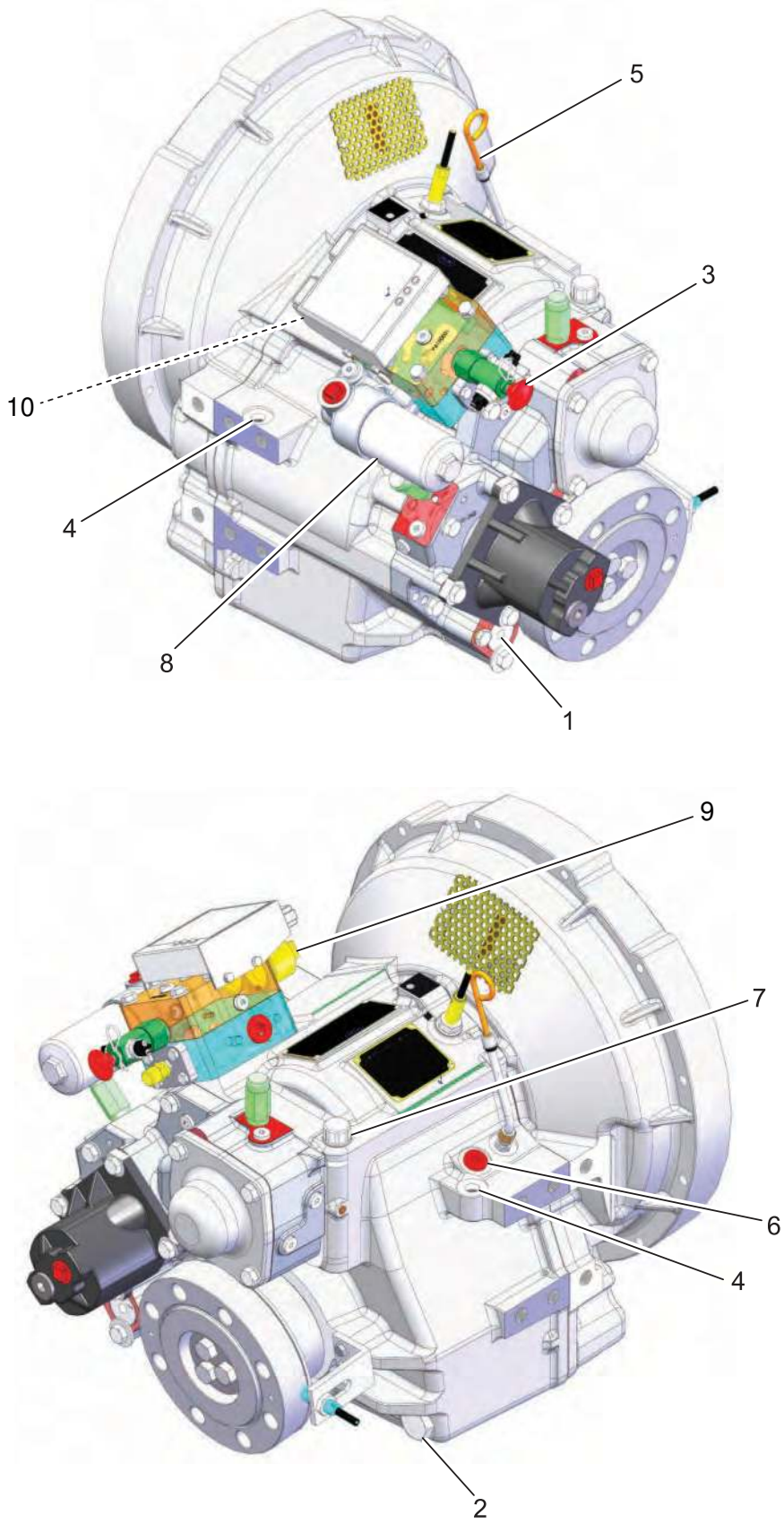


PX13025

MGX-5114SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

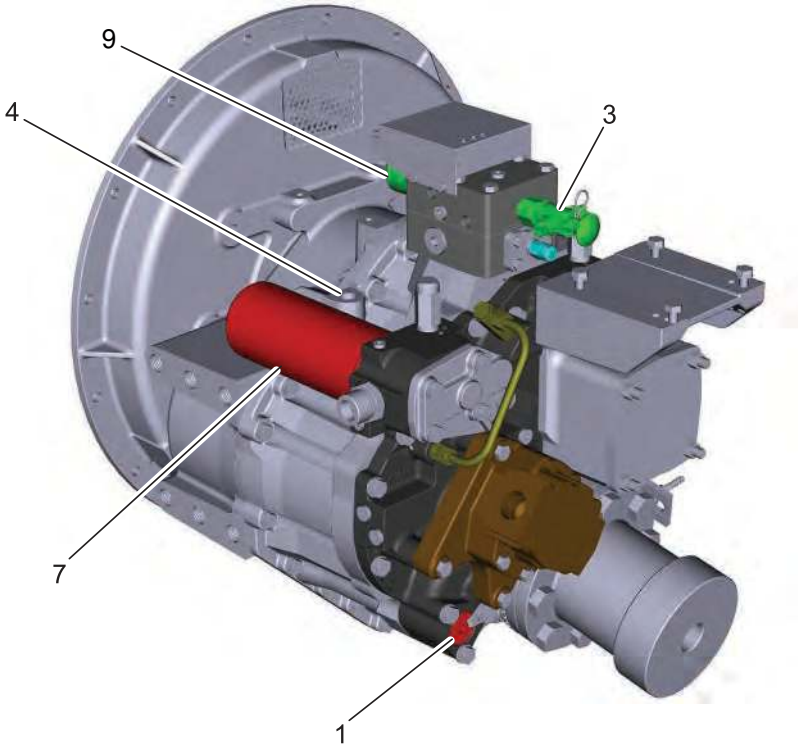
MG(X)-5126A, MGX-5126A

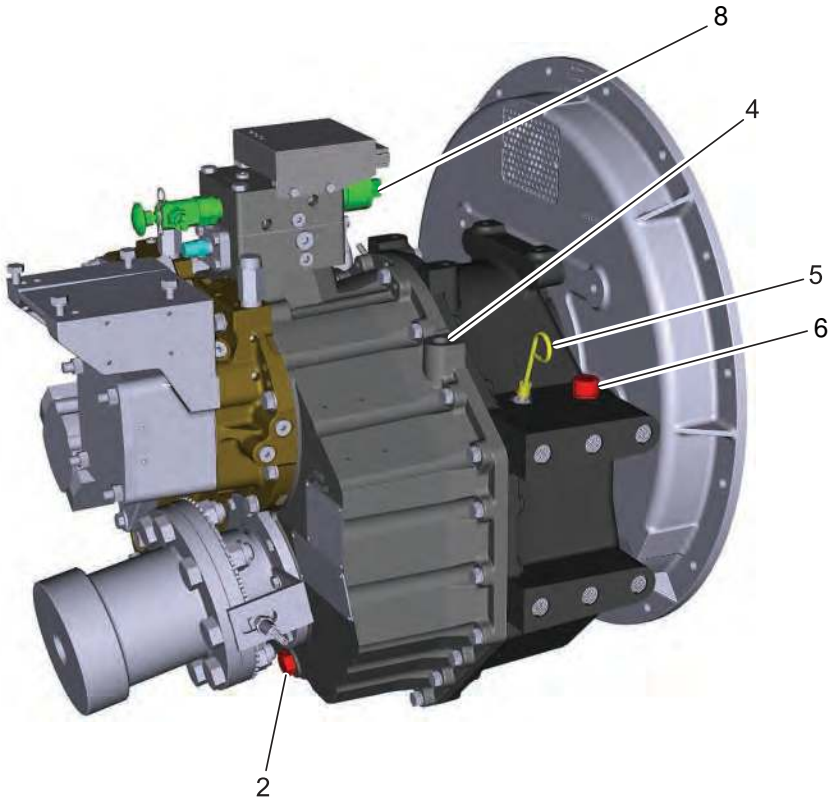


MG(X)-5126A, MGX-5126A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Oil fill port
7	Breather
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MG(X)-5135A, MGX-5135A



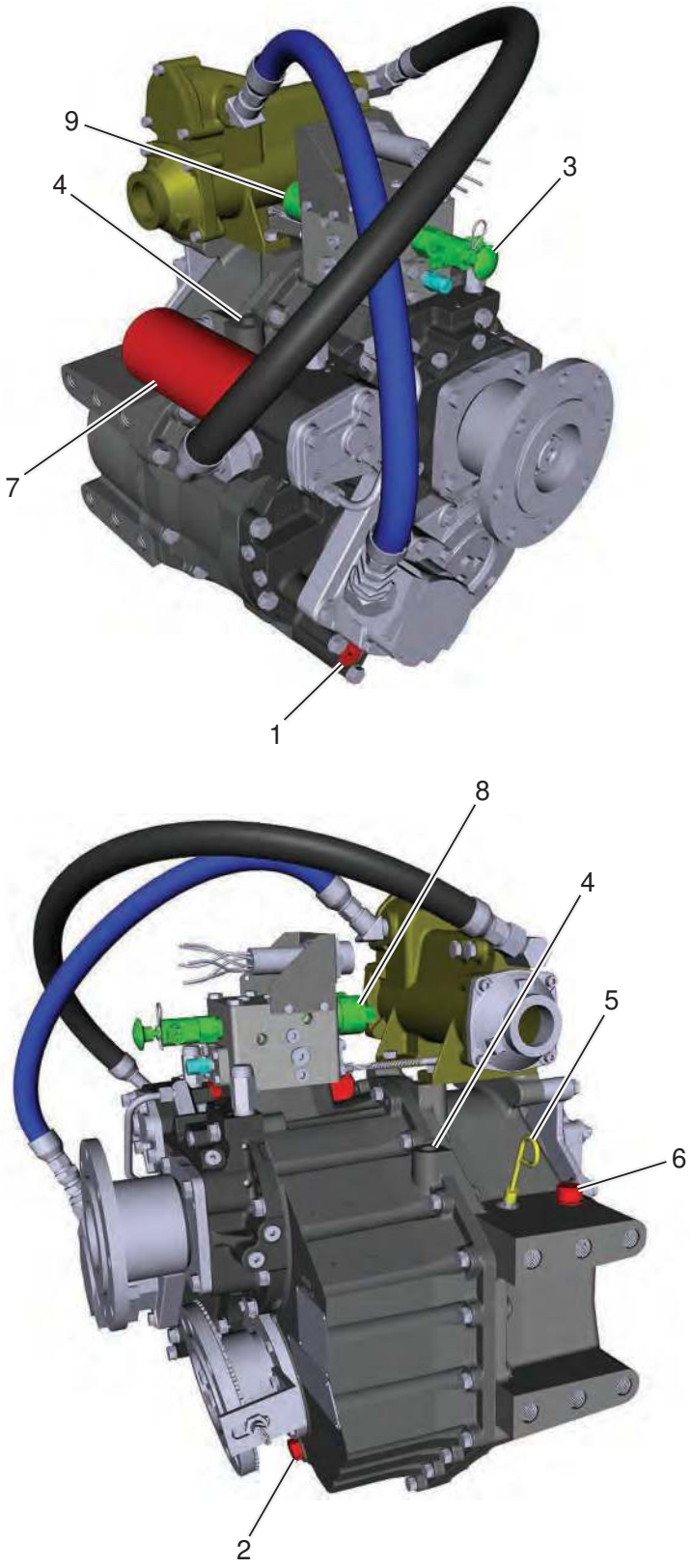


1025702

MG(X)-5135A, MGX-5135A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

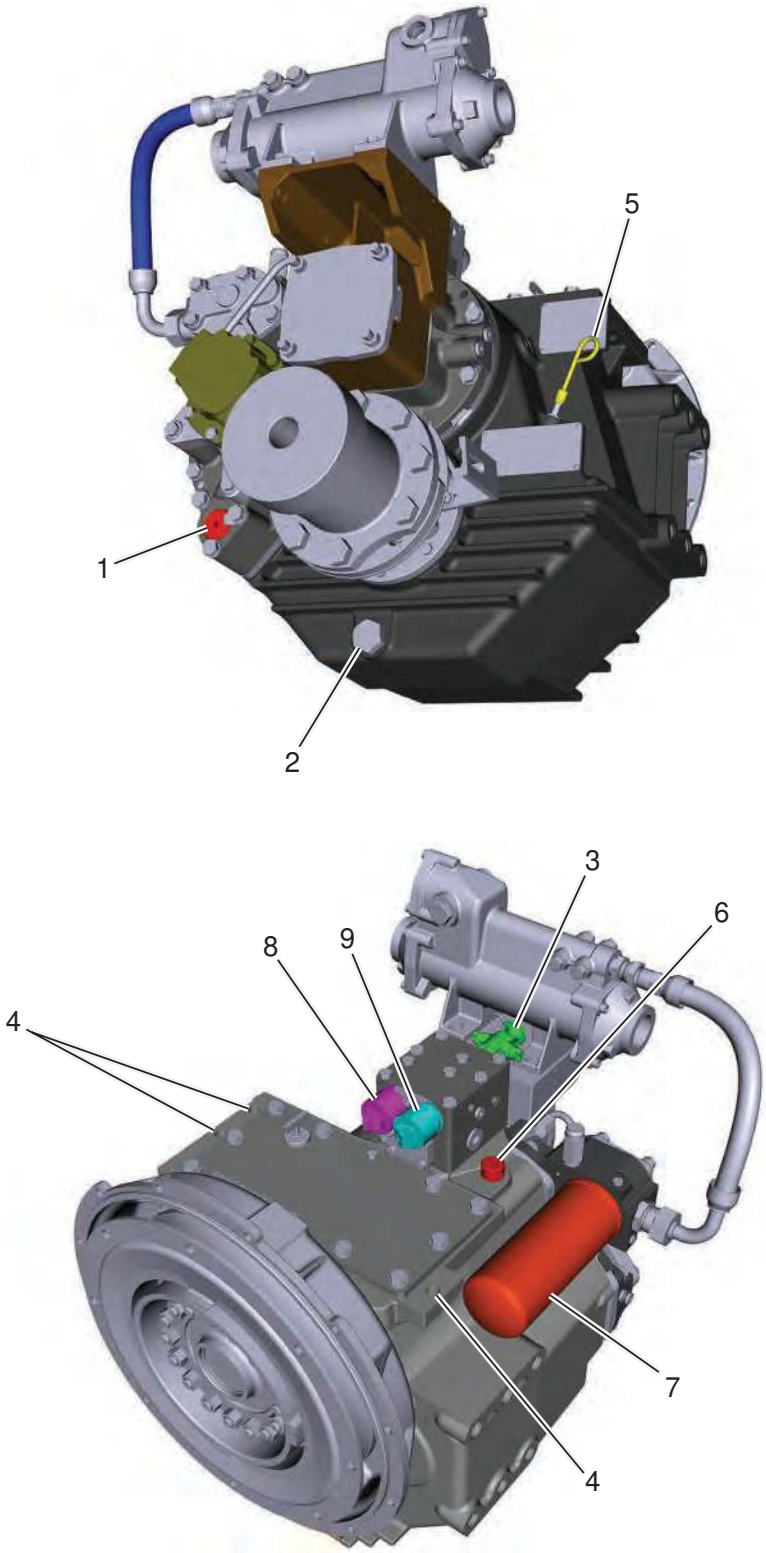
MG(X)-5135RV, MGX-5135RV



MG(X)-5135RV, MGX-5135RV Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5135SC, MGX-5135SC

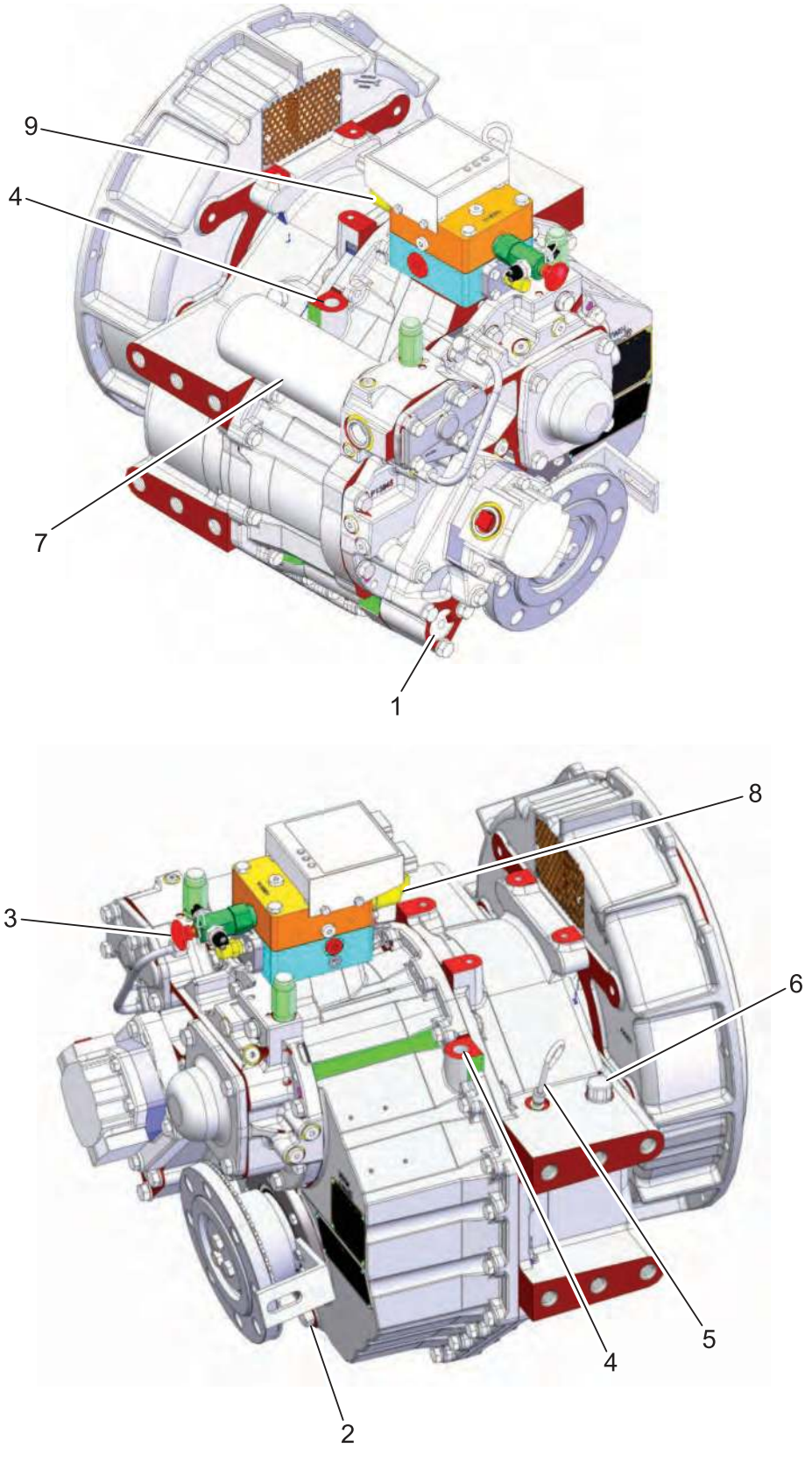


1026089B

MG(X)-5135SC, MGX-5135SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Holes for lifting
4	Oil level gauge
5	Manual override valve
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

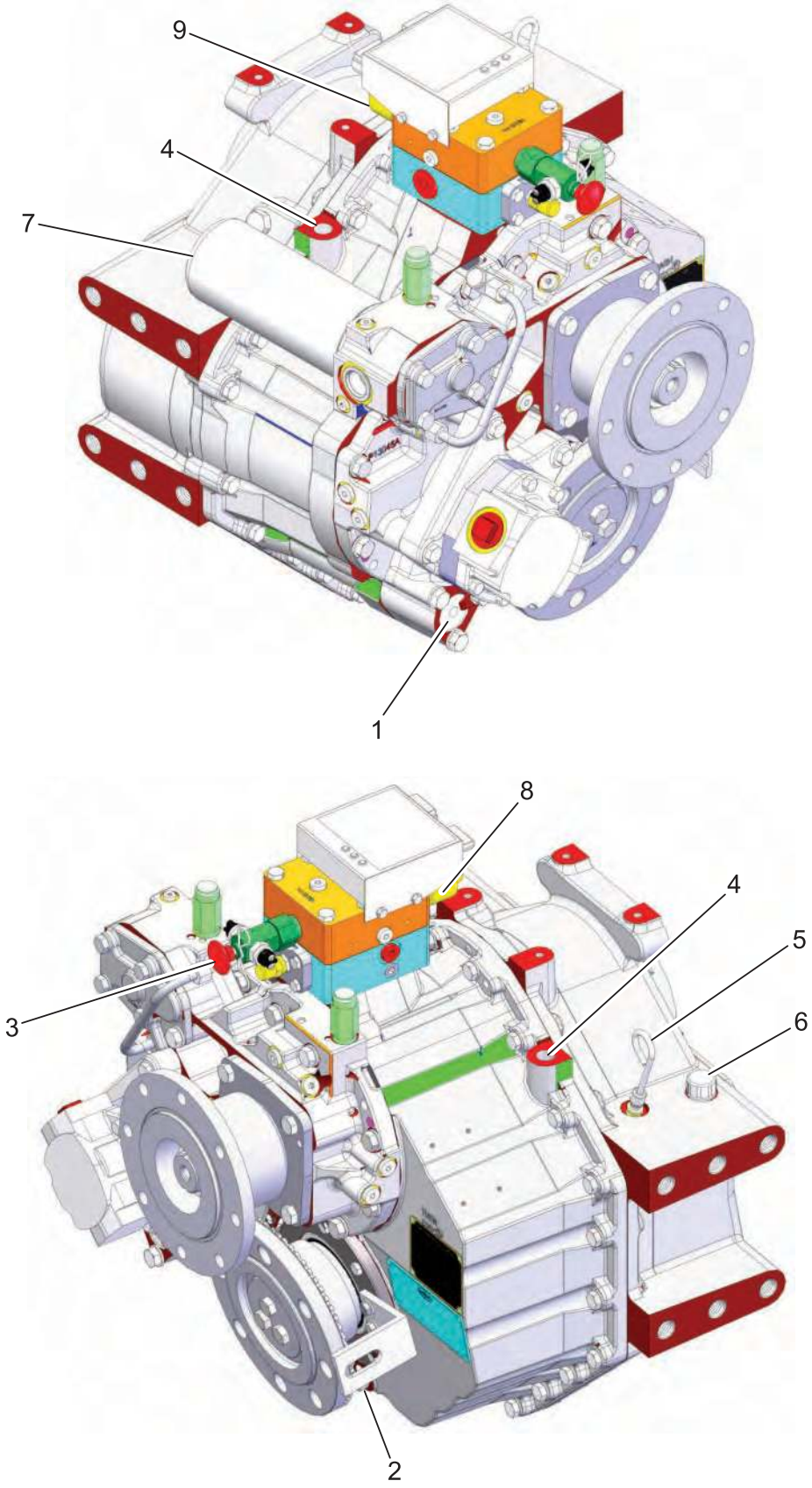
MG(X)-5136A, MGX-5136A



MG(X)-5136A, MGX-5136A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

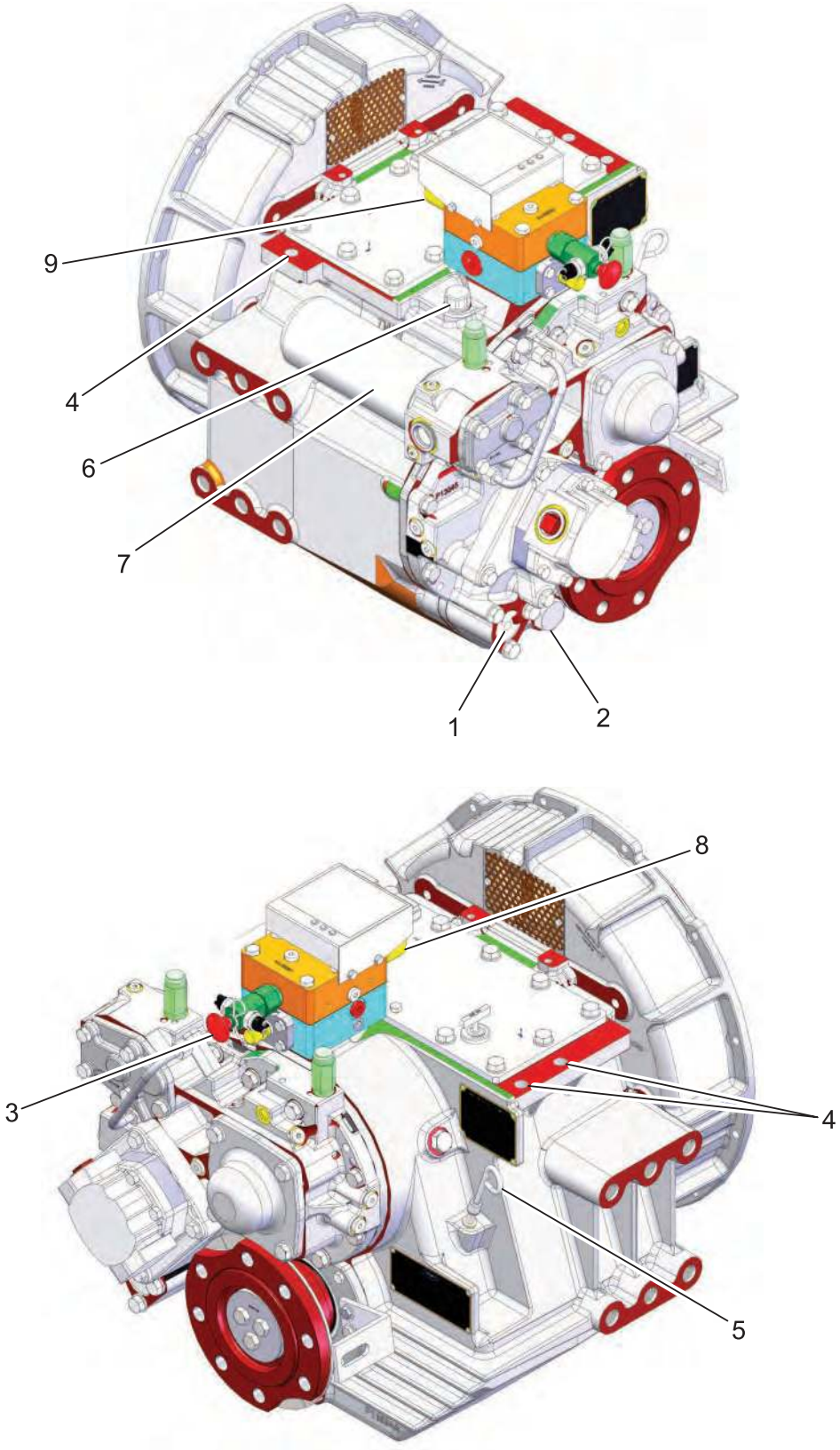
MG(X)-5136RV, MGX-5136RV



MG(X)-5136RV, MGX-5136RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5136SC, MGX-5136SC

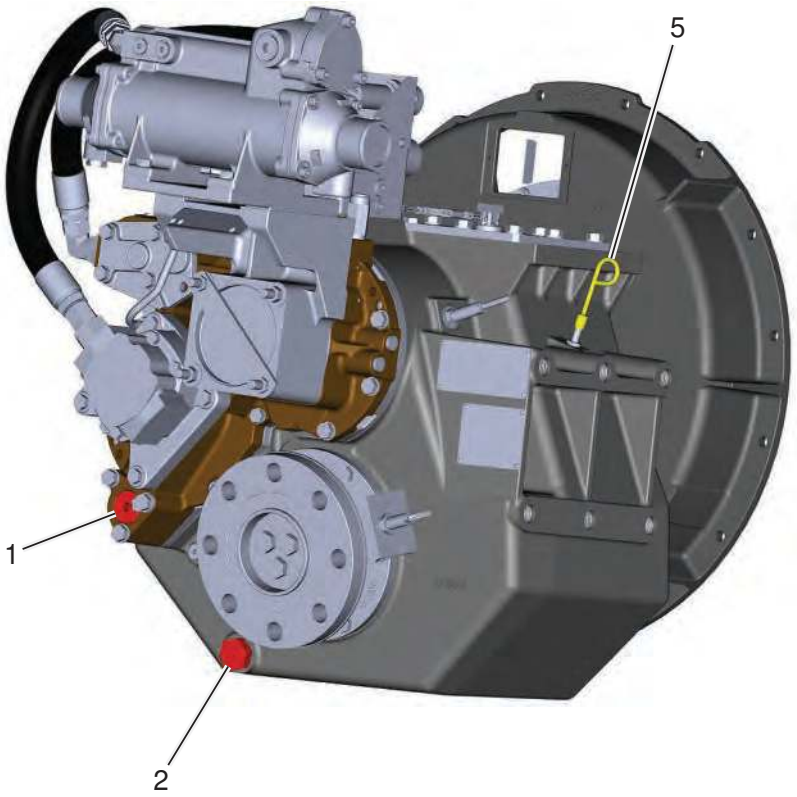


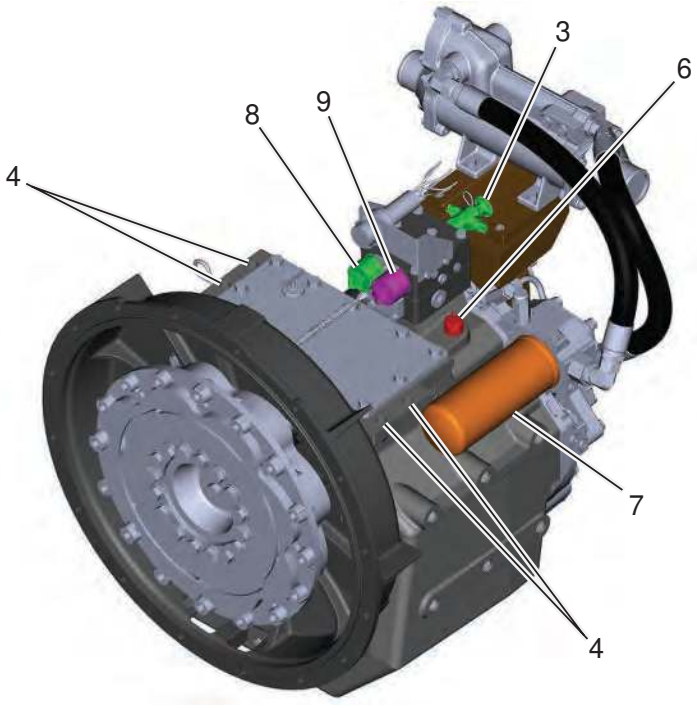
1027608

MG(X)-5136SC, MGX-5136SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5146A



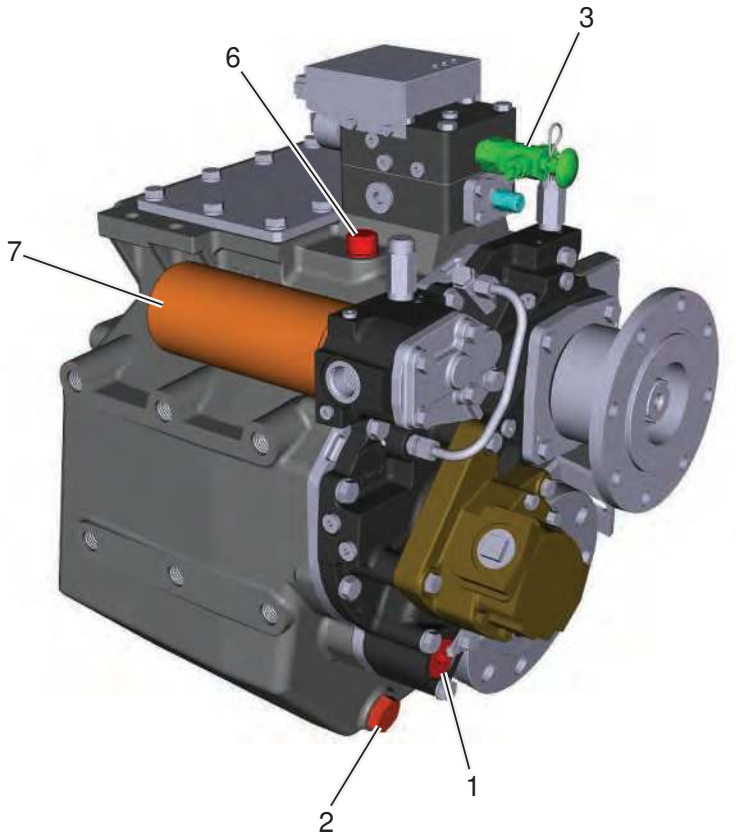


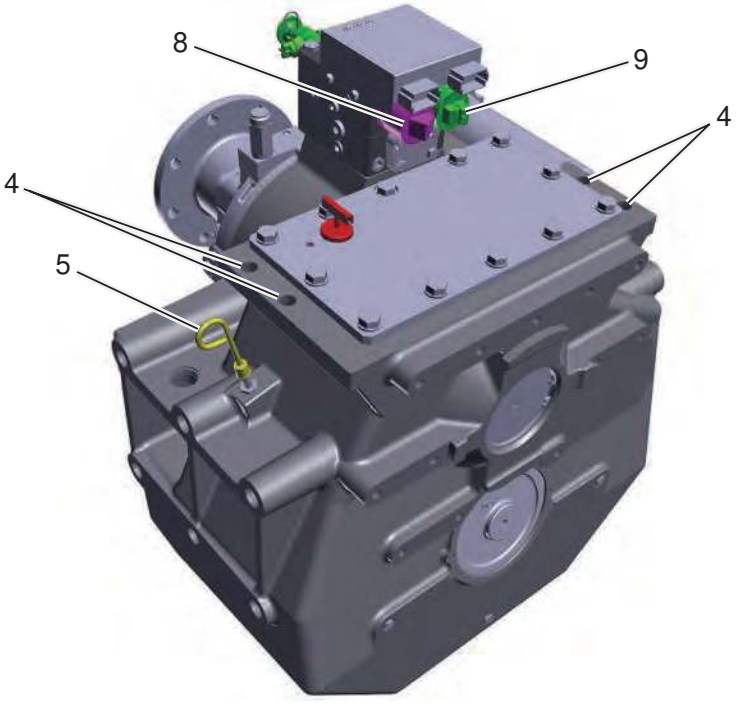
1027597D

MG(X)-5146A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5146RV



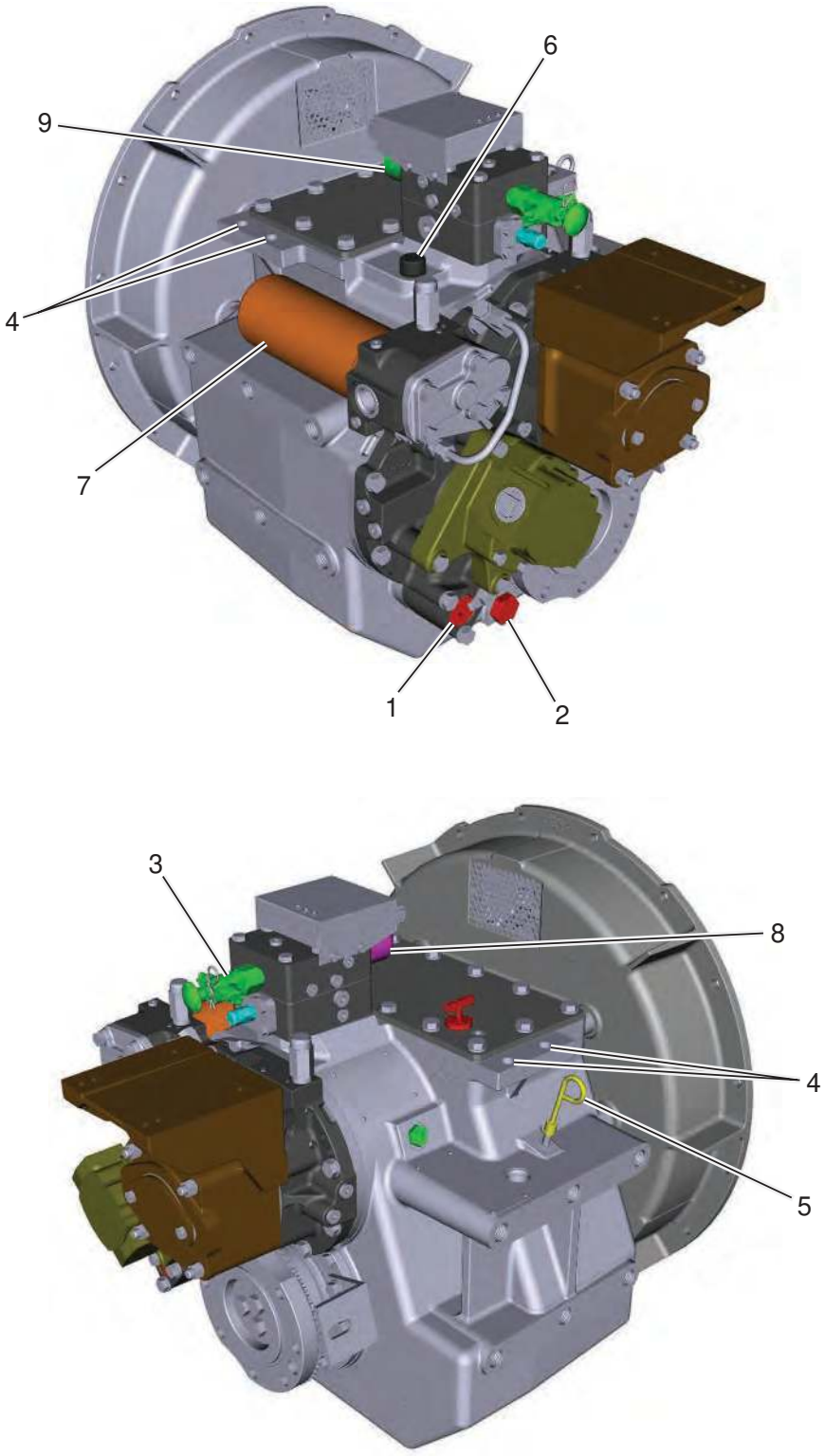


1027741

MG(X)-5146RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain Plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5146SC

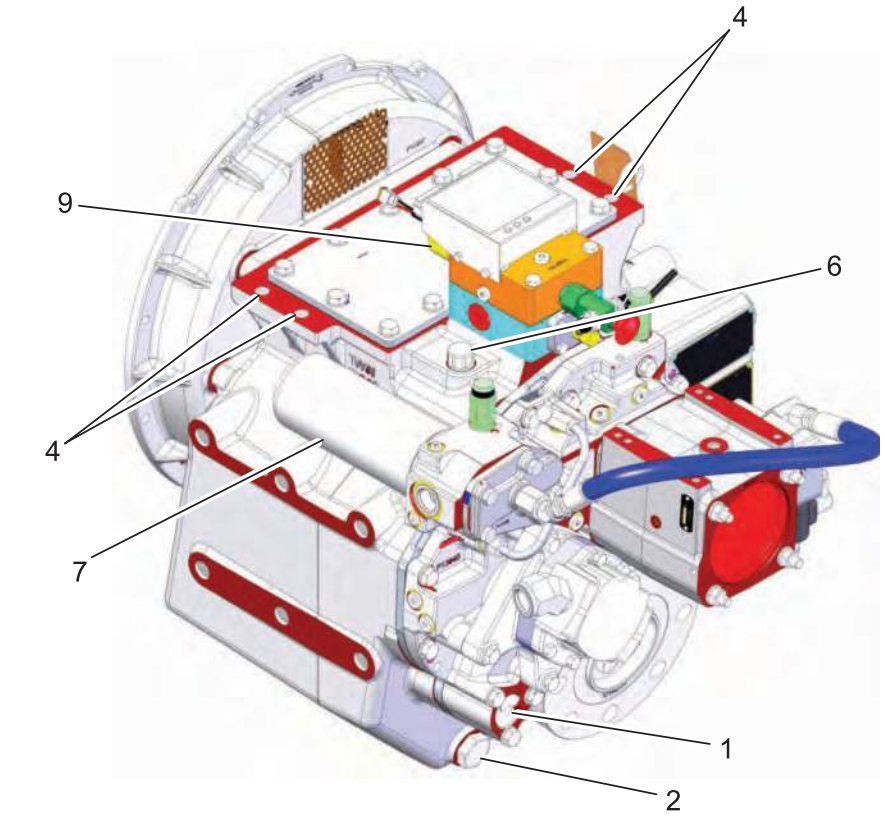


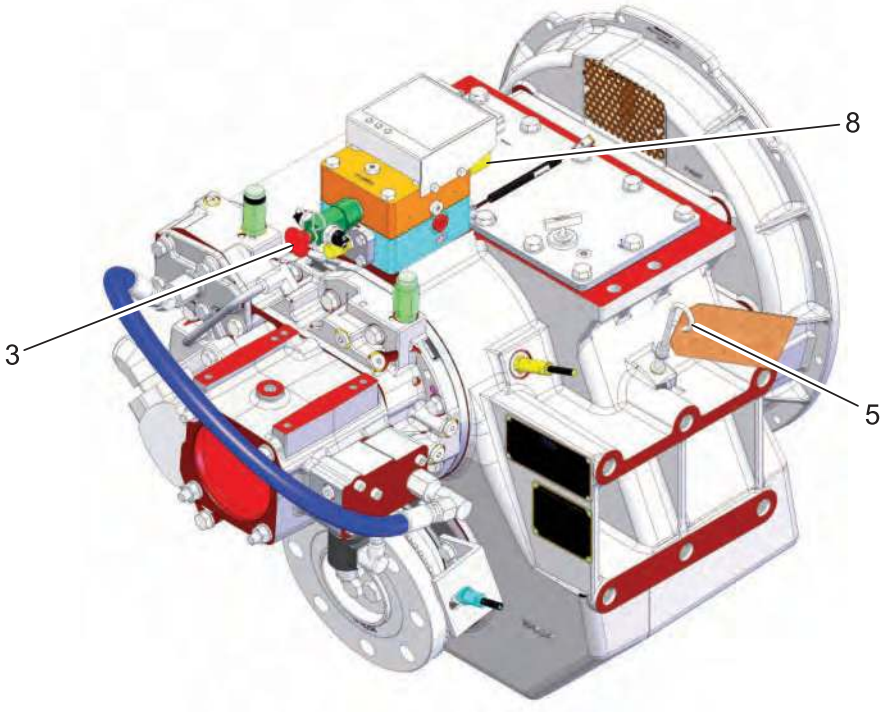
1027662A

MG(X)-5146SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5147A, MGX-5147A



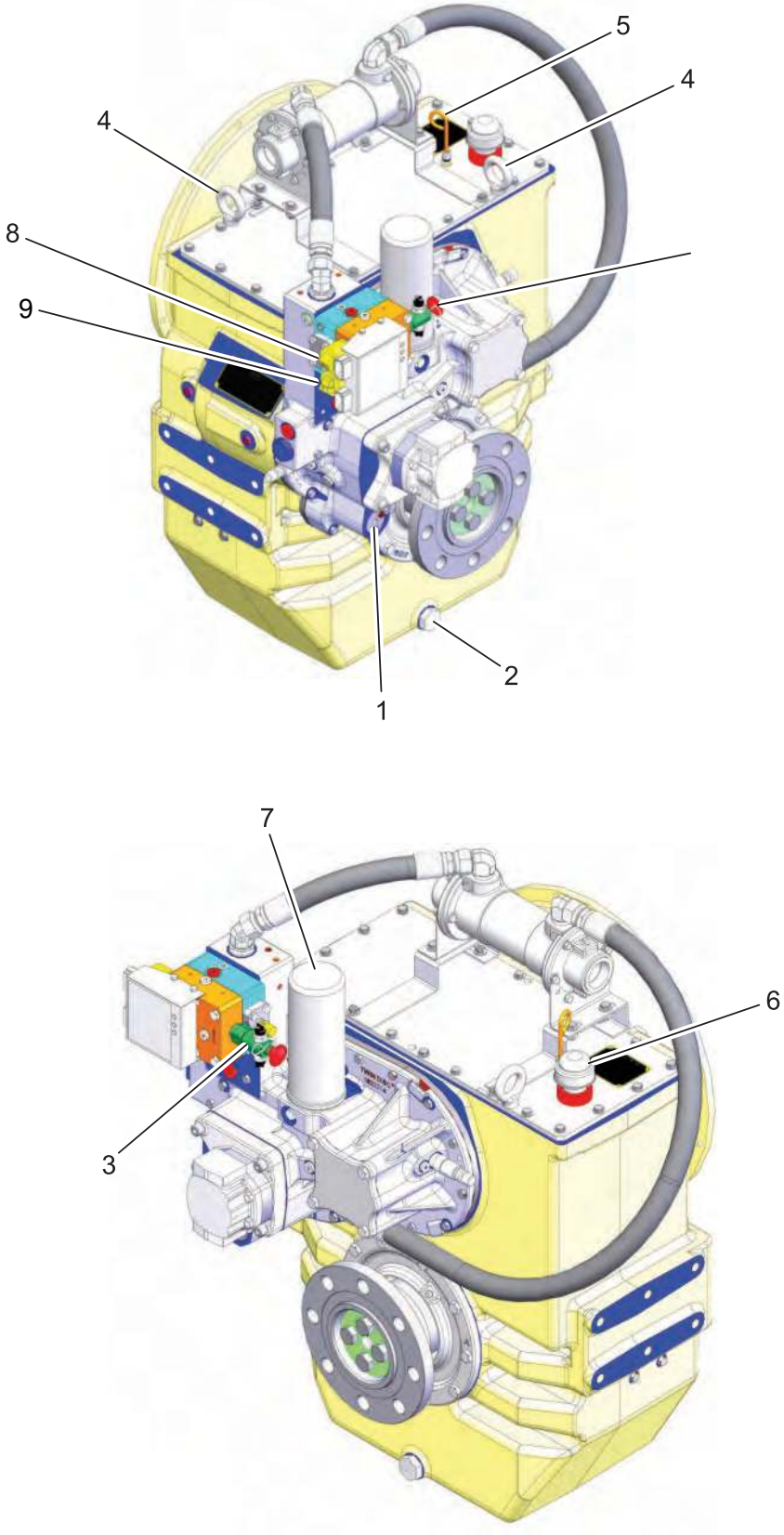


1025920

MG(X)-5147A, MGX-5147A Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

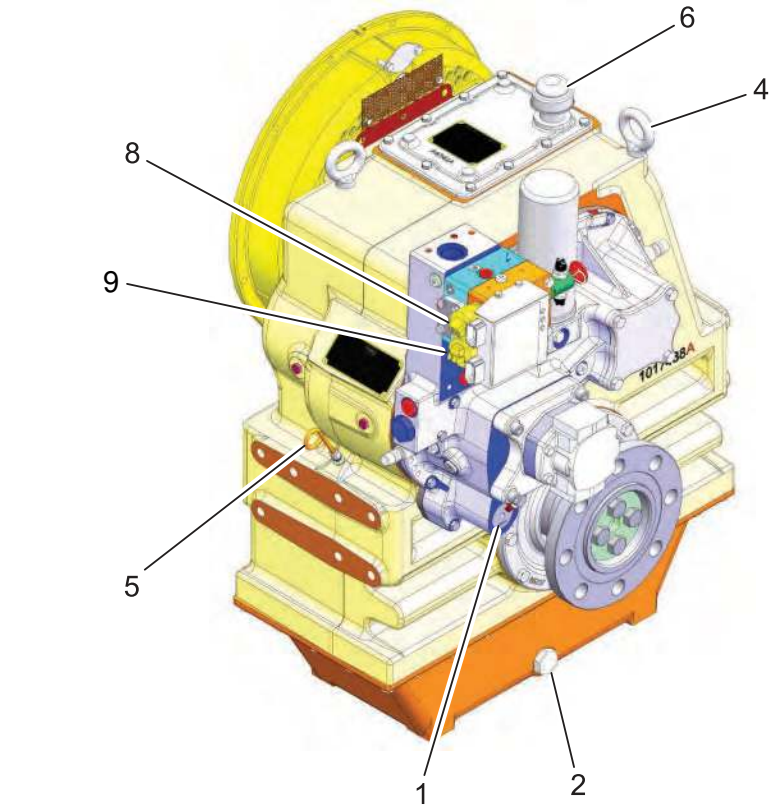
MG(X)-516, MGX-516

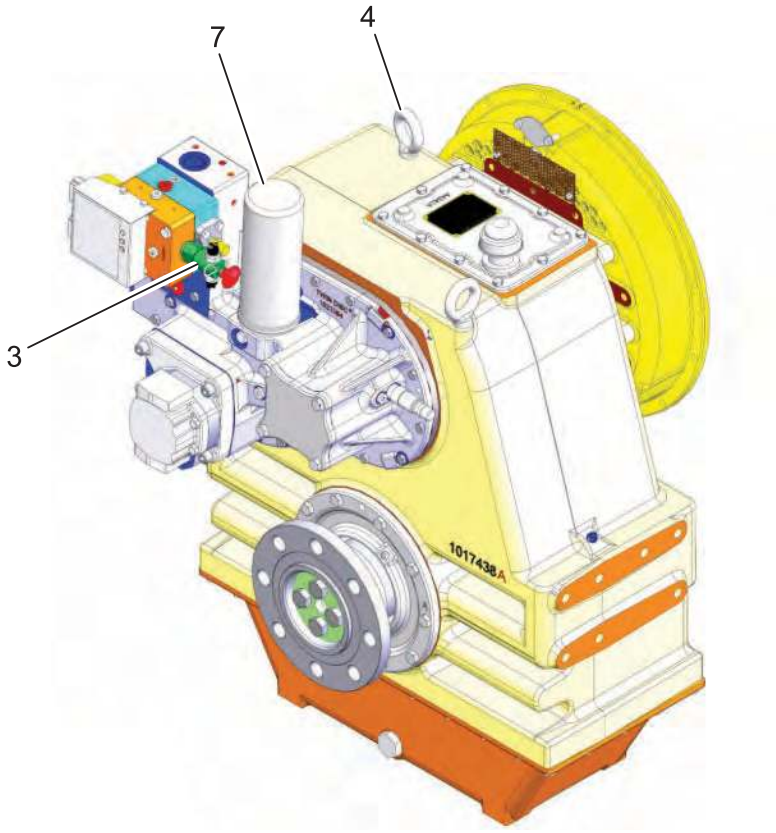


MG(X)-516, MGX-516 Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5170DC, MGX-5170DC



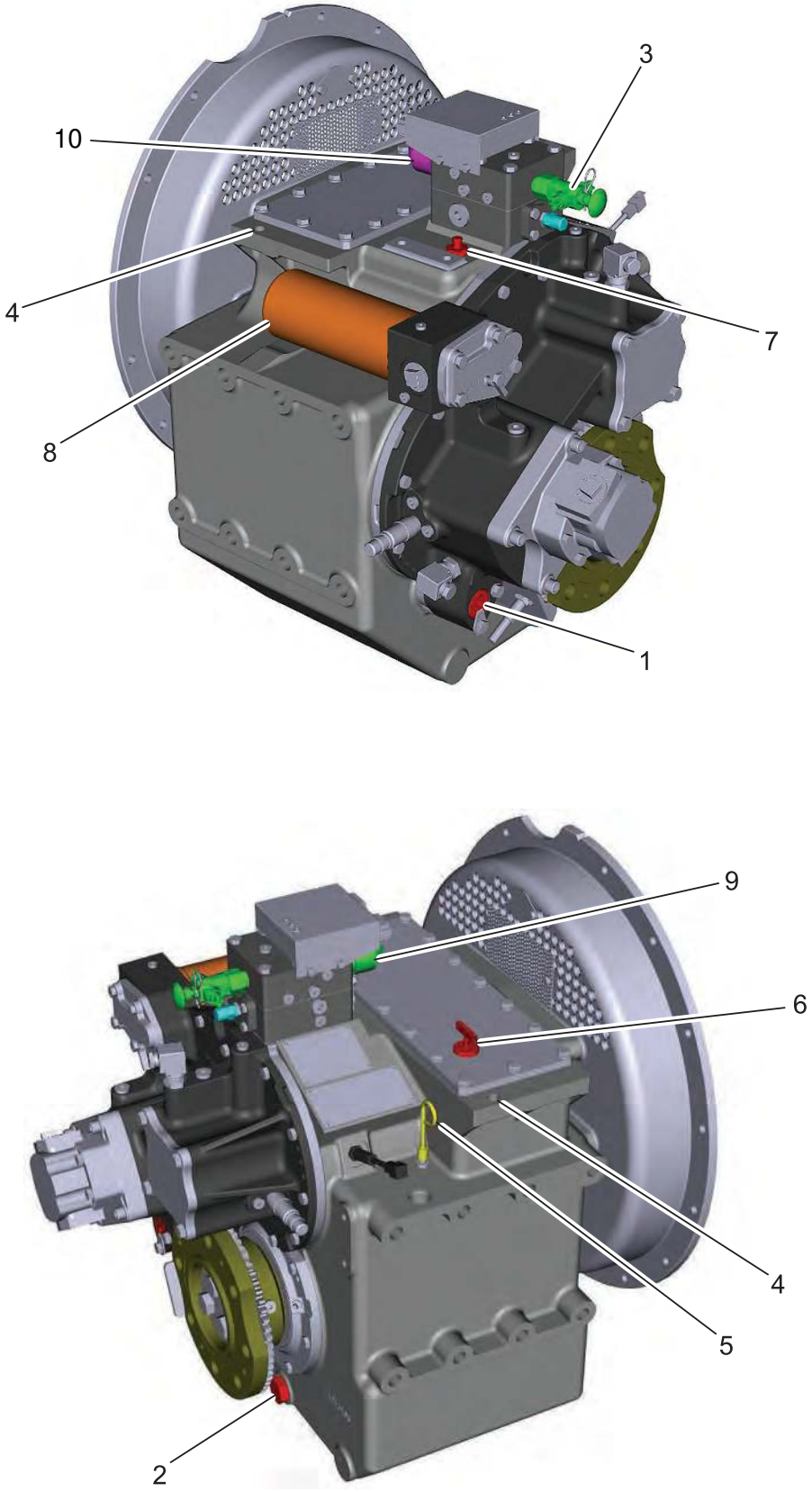


1026199A

MG(X)-5170DC, MGX-5170DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5202SC, MGX-5202SC

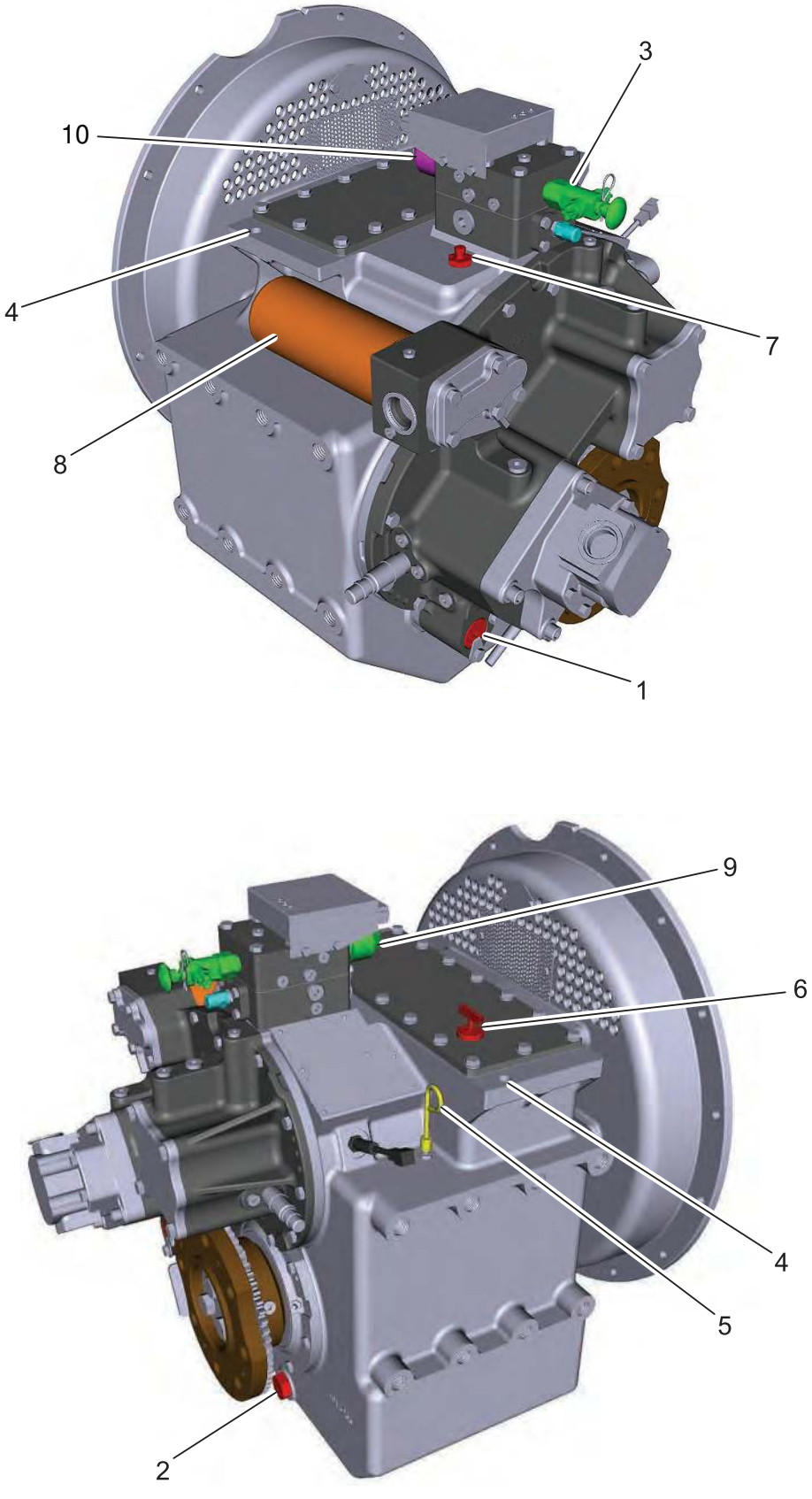


1026322A

MG(X)-5202SC, MGX-5202SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Oil fill port
7	Breather
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

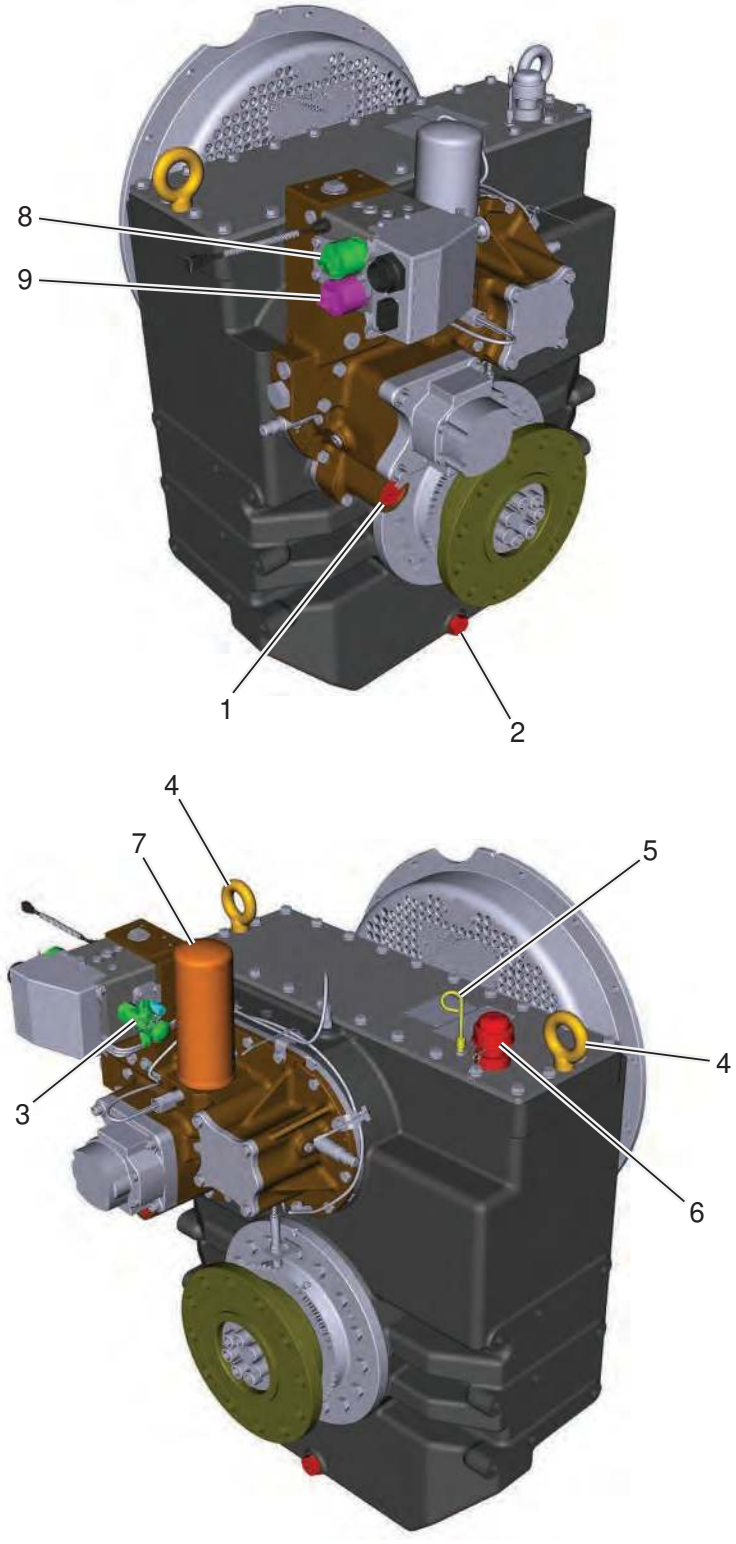
MG(X)-5204SC, MGX-5204SC



MG(X)-5204SC, MGX-5204SC Callout List

Callout	Component
1	Suction screen
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Oil fill port
7	Breather
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MG(X)-5222DC, MG(X)-5225DC

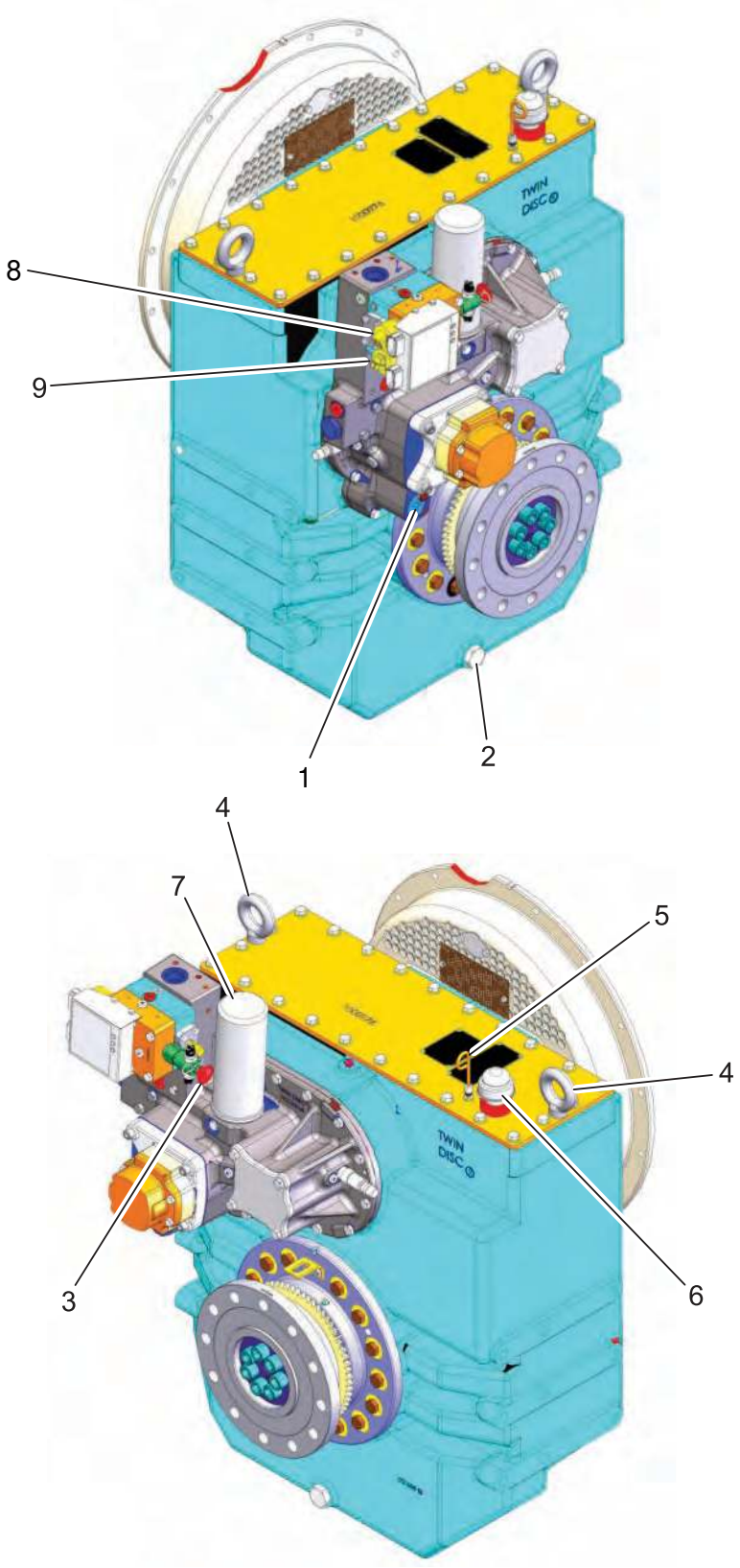


1025541E

MG(X)-5222DC, MG(X)-5225DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-5222DC, MGX-5225DC

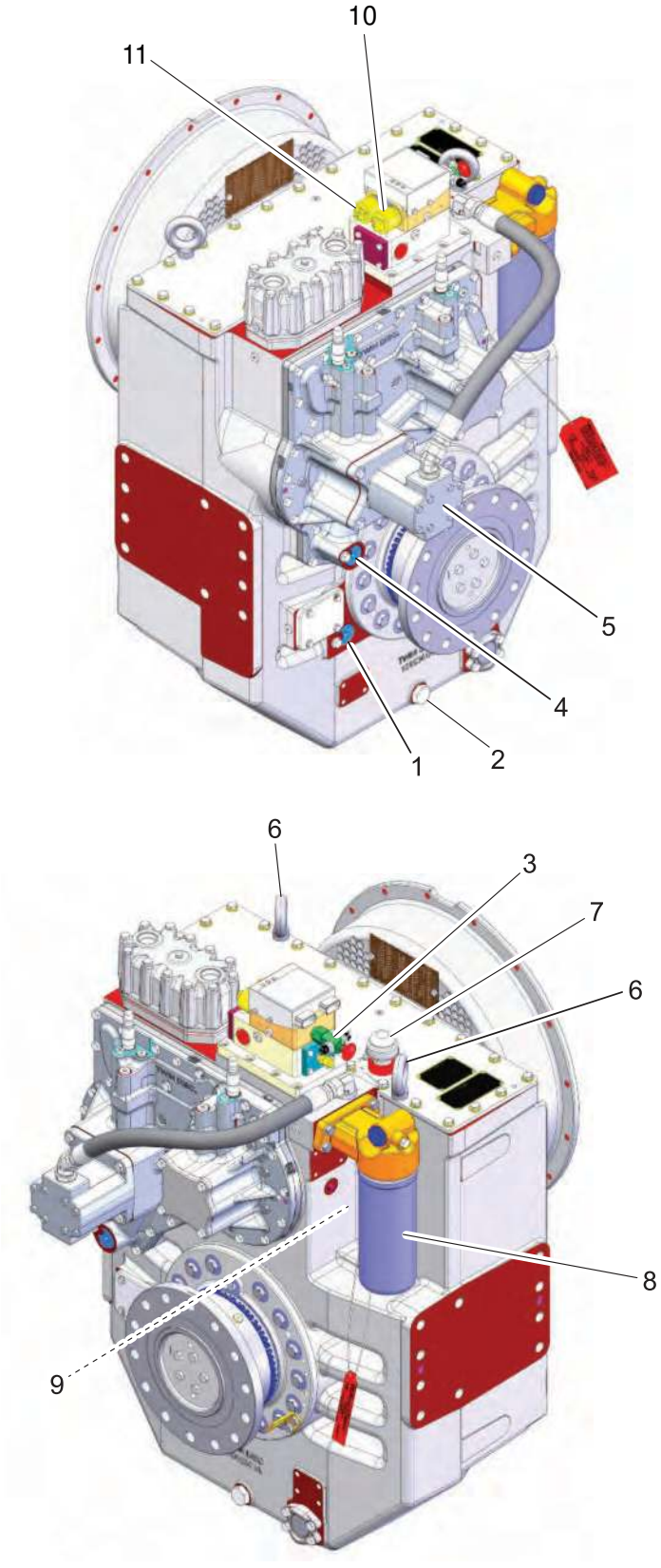


1025541C

MGX-5222DC, MGX-5225DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MG(X)-5321DC, MGX-5321DC

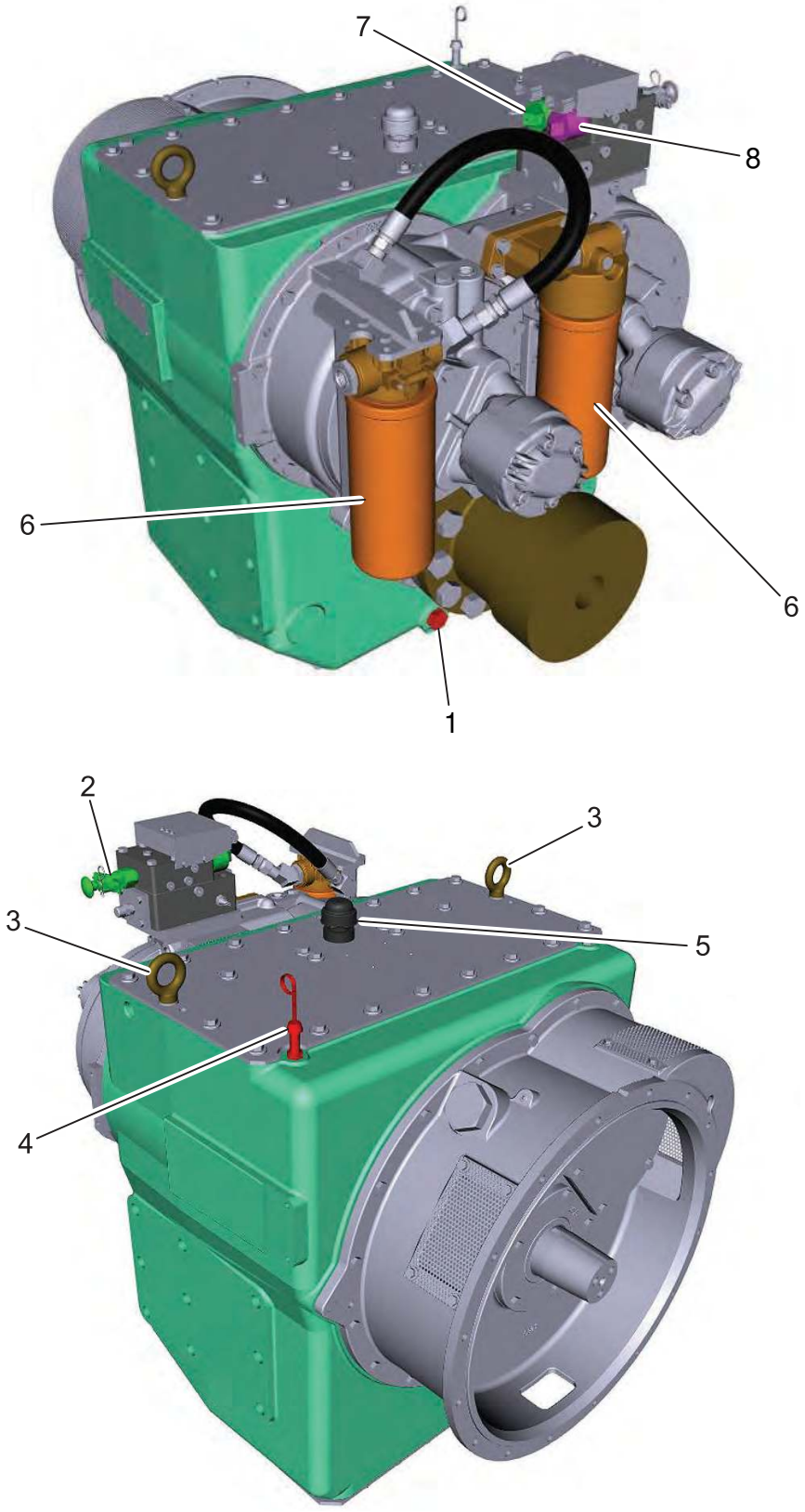


1026064

MG(X)-5321DC, MGX-5321DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Trailing pump
6	Holes for lifting
7	Breather and oil fill port
8	Oil filter
9	Oil level gauge
10	Primary solenoid
11	Secondary solenoid

MG-540

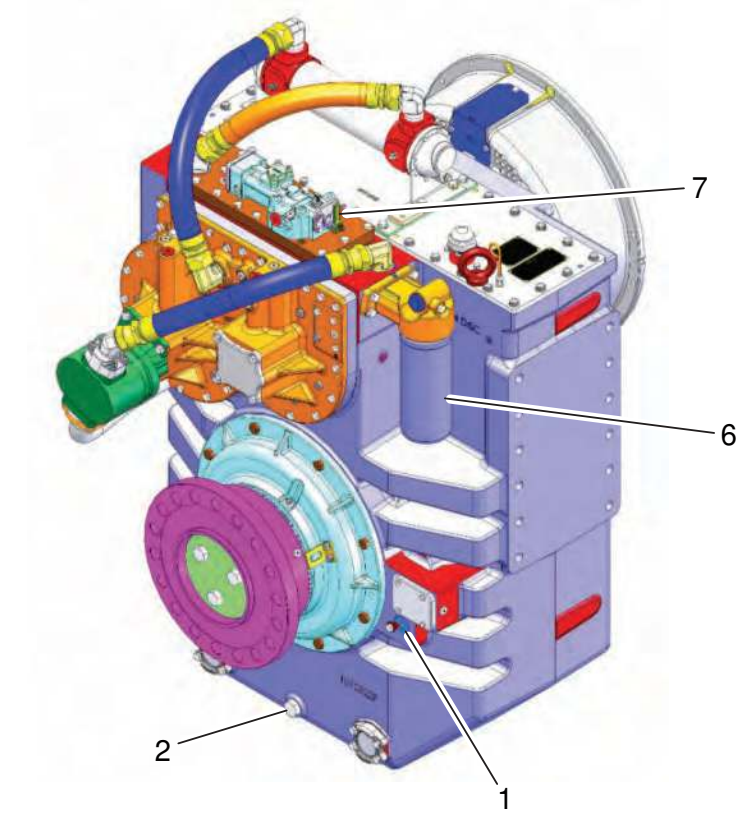


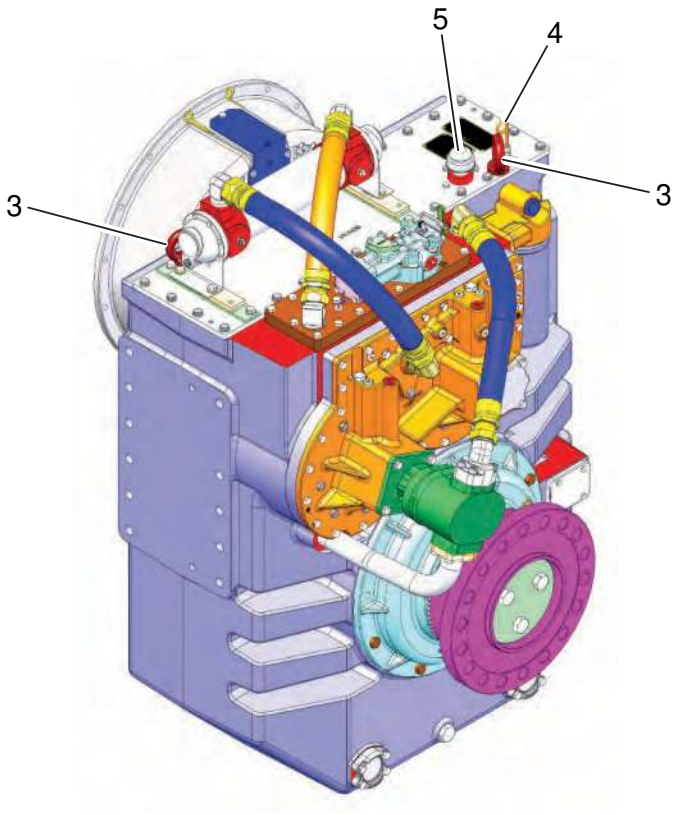
1025552

MG-540 Callout List

Callout	Component
1	Oil drain plug
2	Manual override valve
3	Holes for lifting
4	Oil level gauge
5	Breather and oil fill port
6	Oil filter
7	Primary solenoid
8	Secondary solenoid

MG-5600



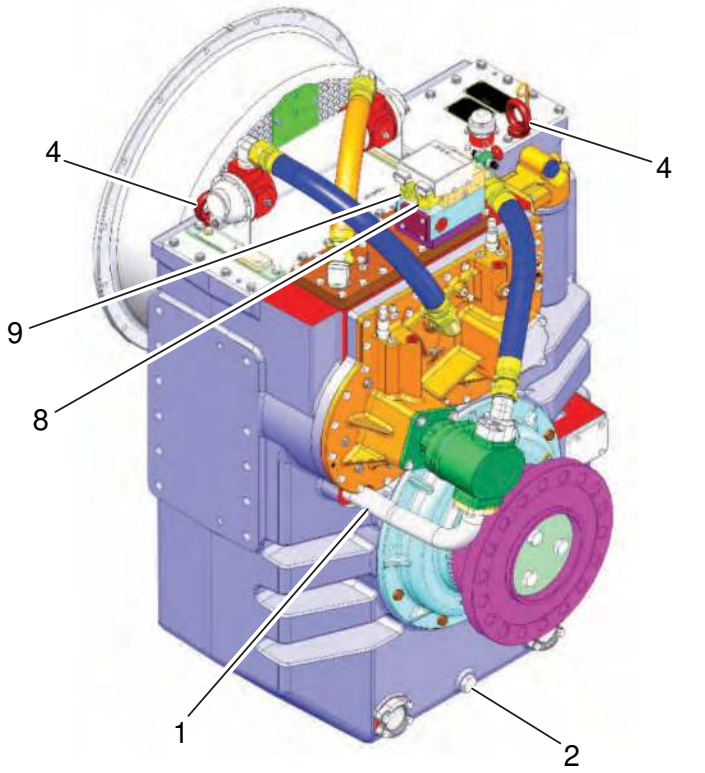


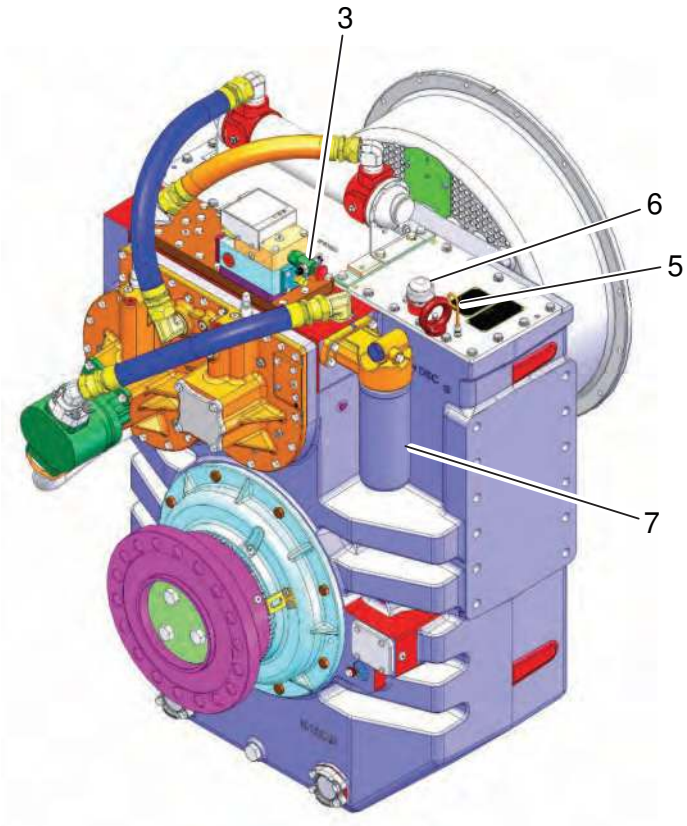
1024594A

MG-5600 Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Oil level gauge
5	Breather and oil fill port
6	Oil filter
7	Control valve selector lever

MGX-5600



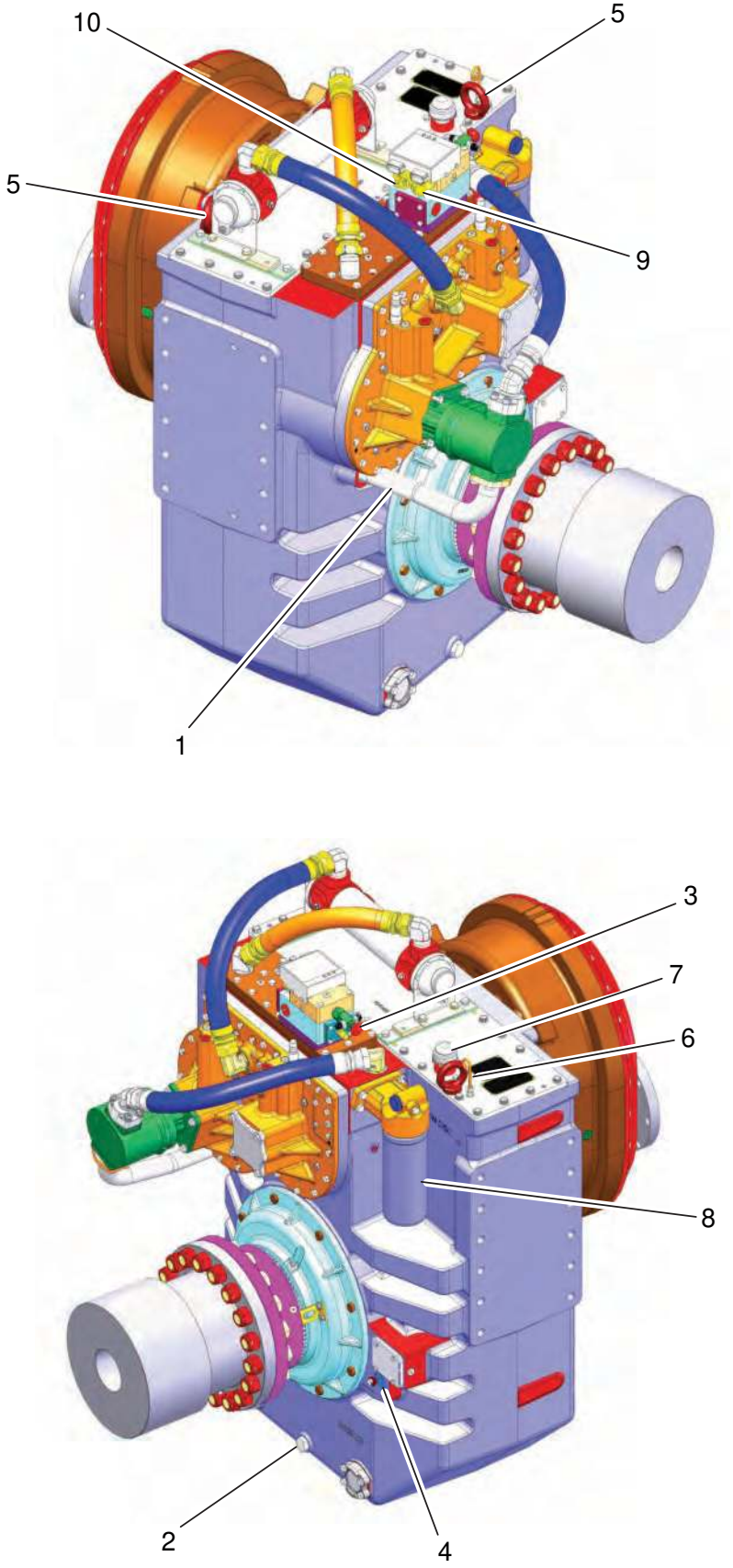


1024597

MGX-5600 Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

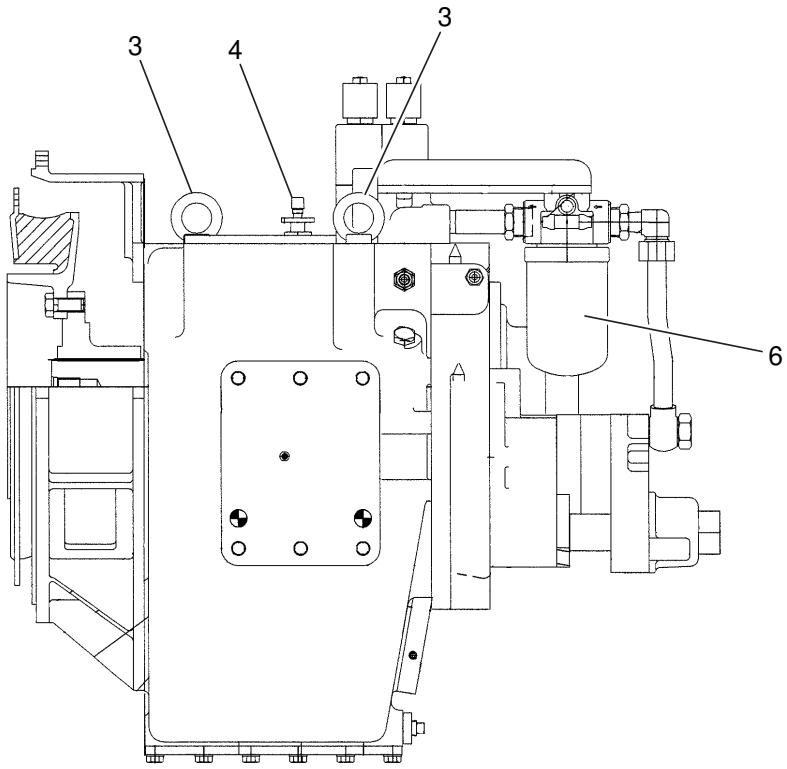
MG(X)-5600DR, MGX-5600DR

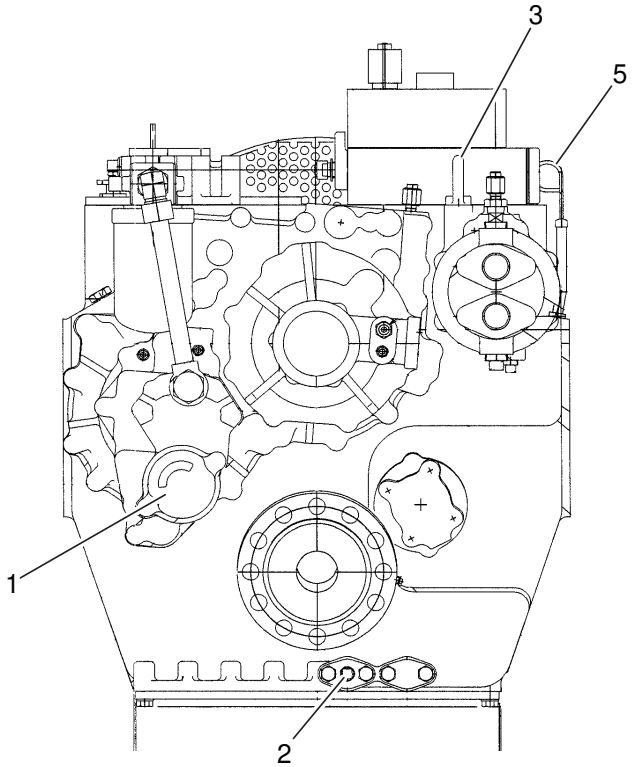


MG(X)-5600DR, MGX-5600DR Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Holes for lifting
6	Oil level gauge
7	Breather and oil fill port
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MG-6449A



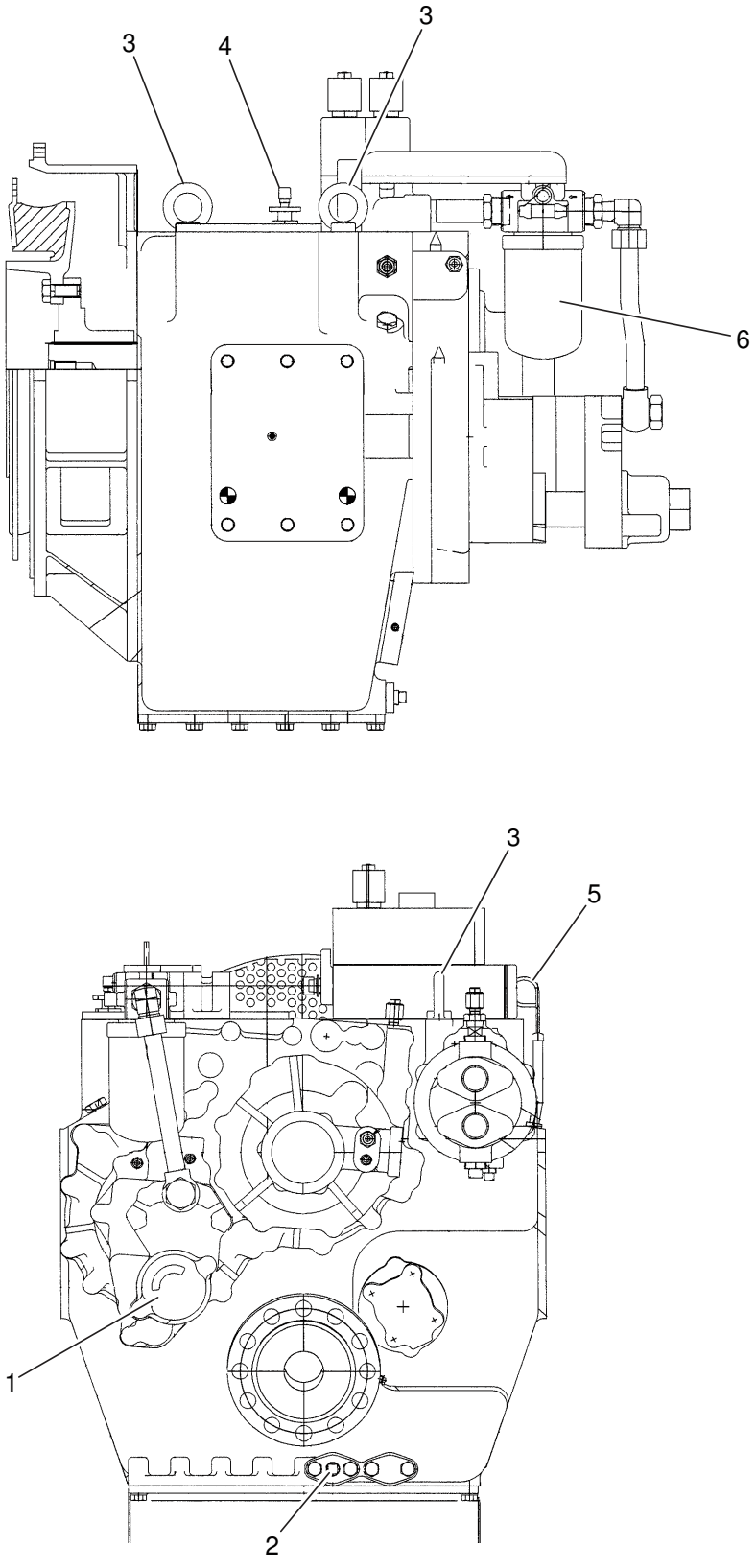


737423

MG-6449A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Breather and oil fill port
5	Oil level gauge
6	Oil filter

MG-6449RV

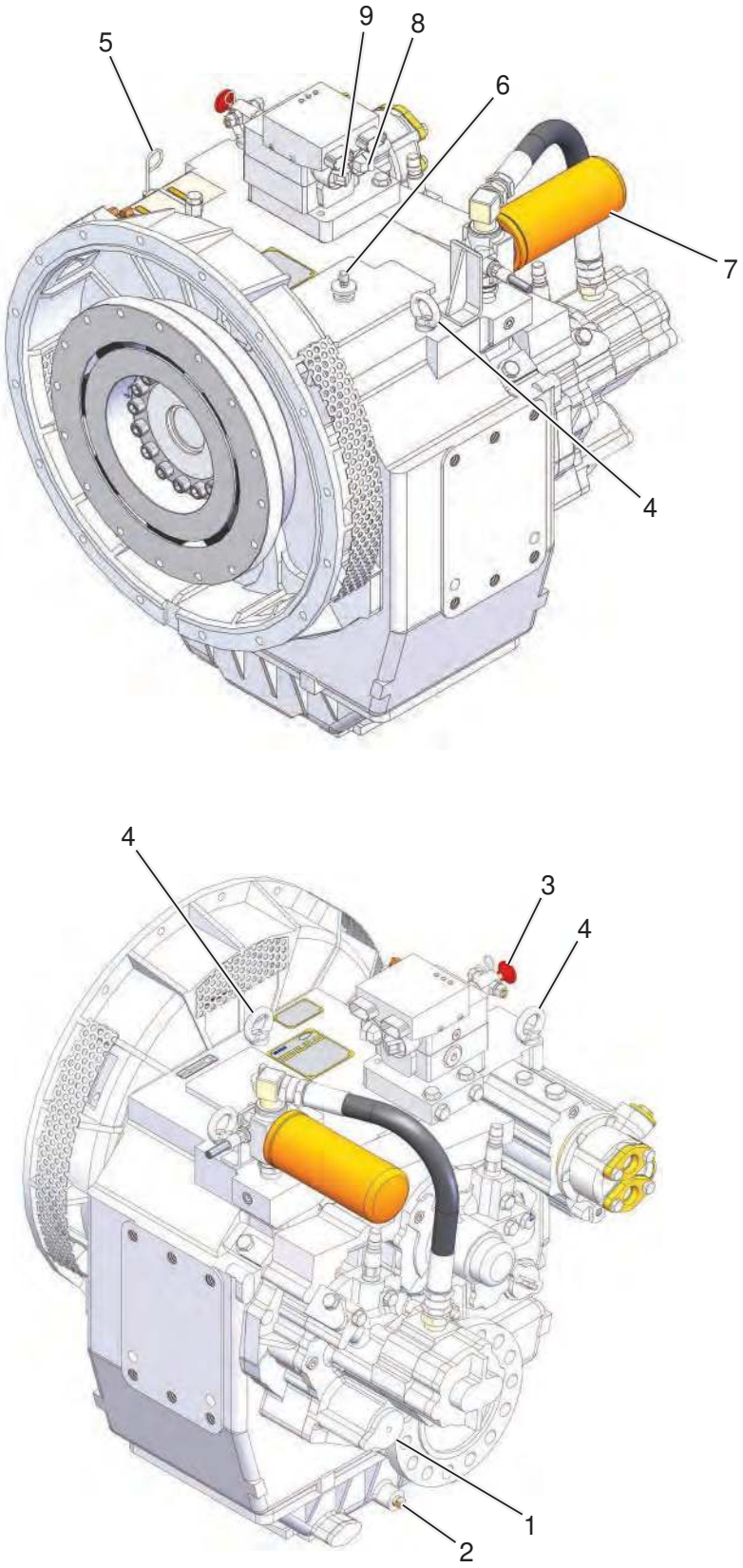


737423

MG-6449RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Breather and oil fill port
5	Oil level gauge
6	Oil filter

MGX-6598DC

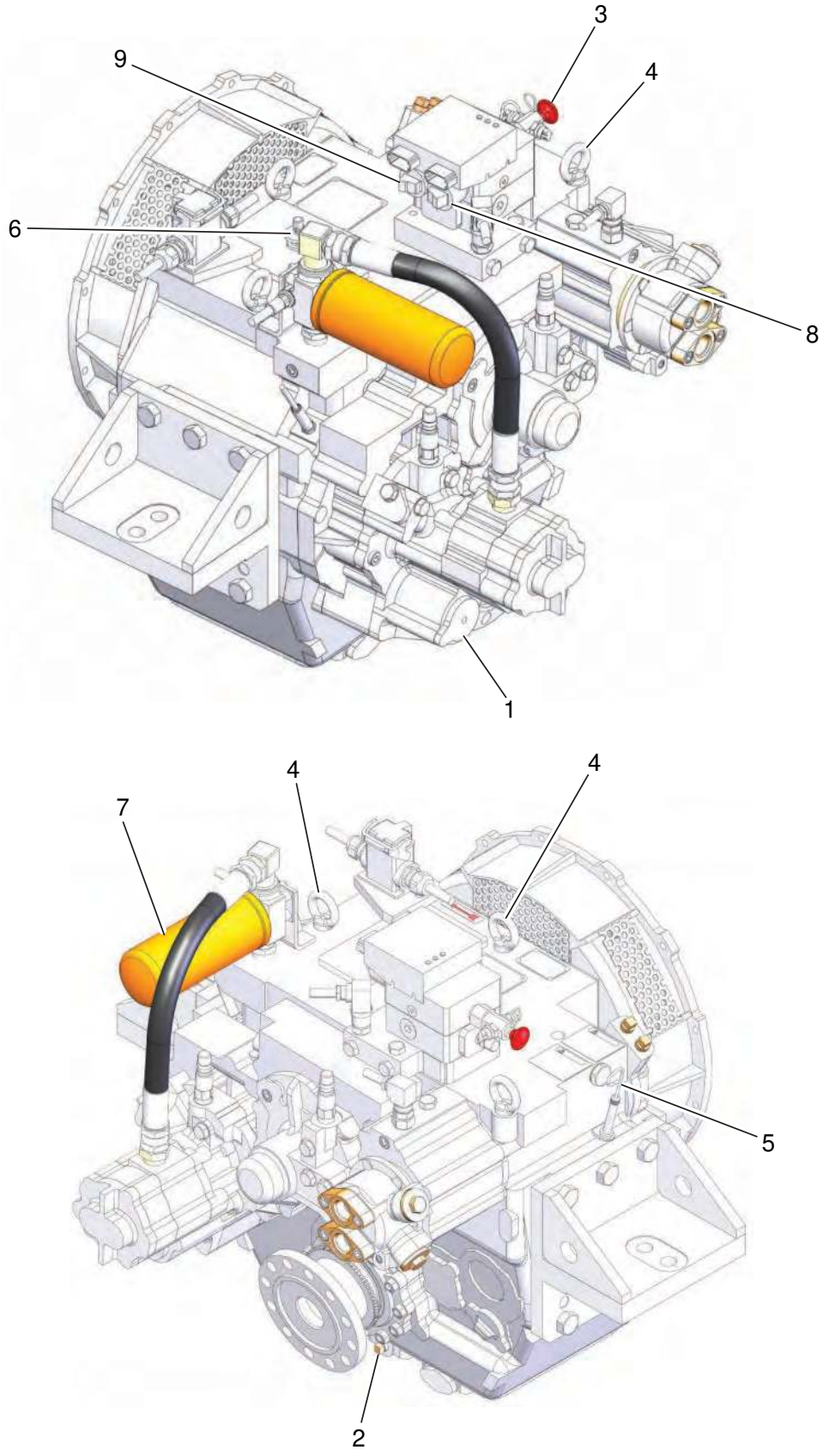


P72402

MGX-6598DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

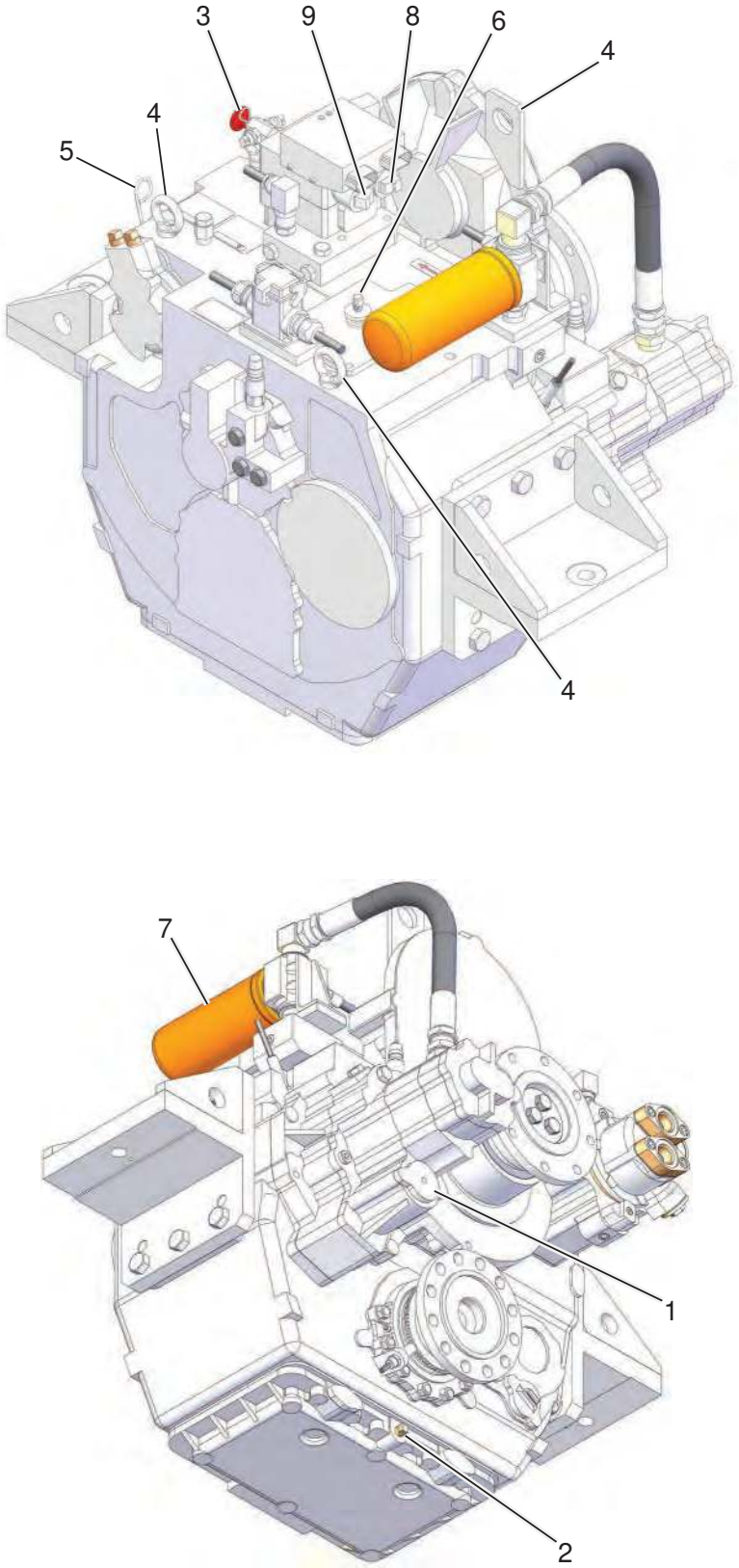
MGX-6599A



MGX-6599A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-6599RV

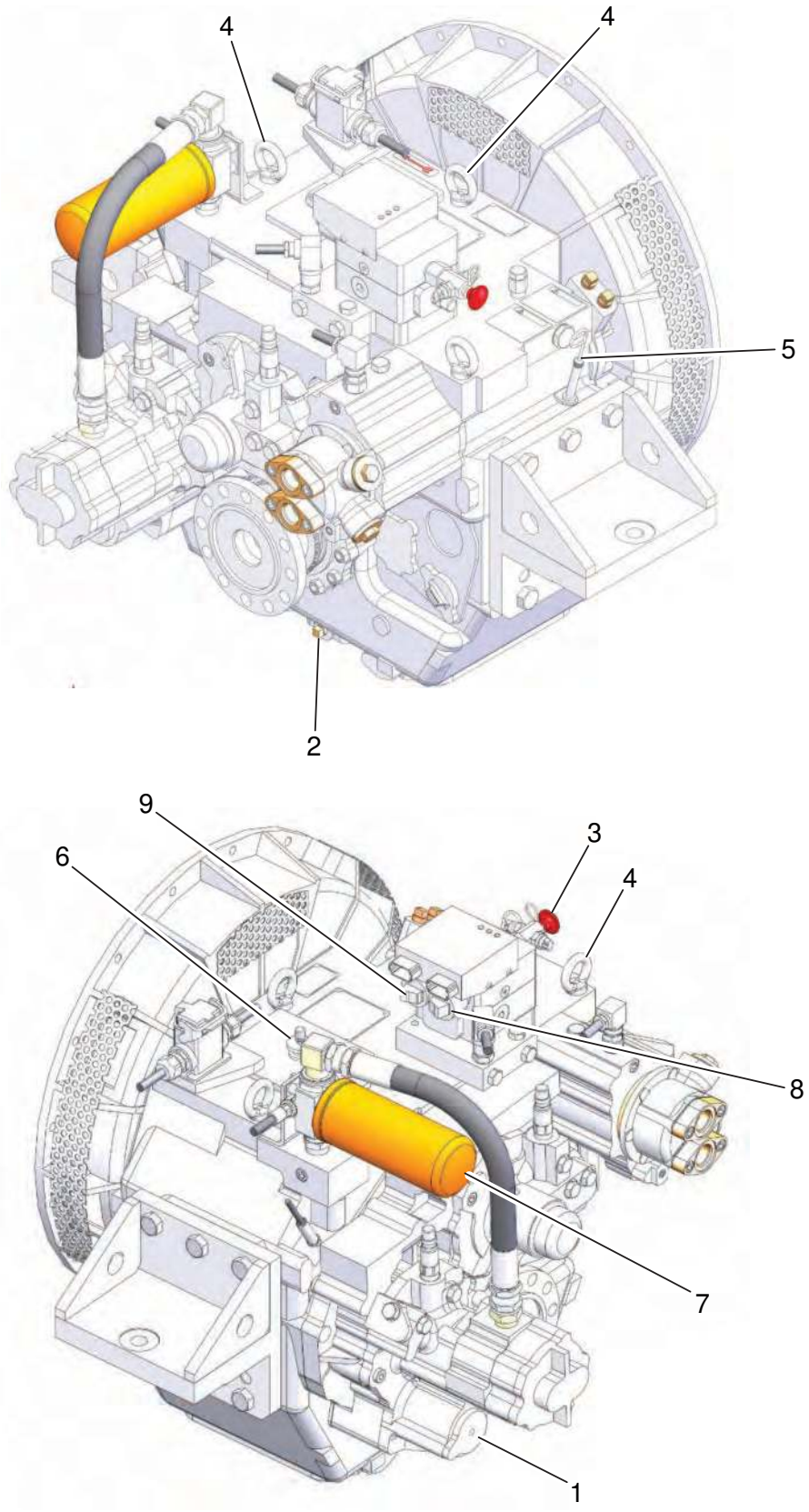


P72279

MGX-6599RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-6599SC

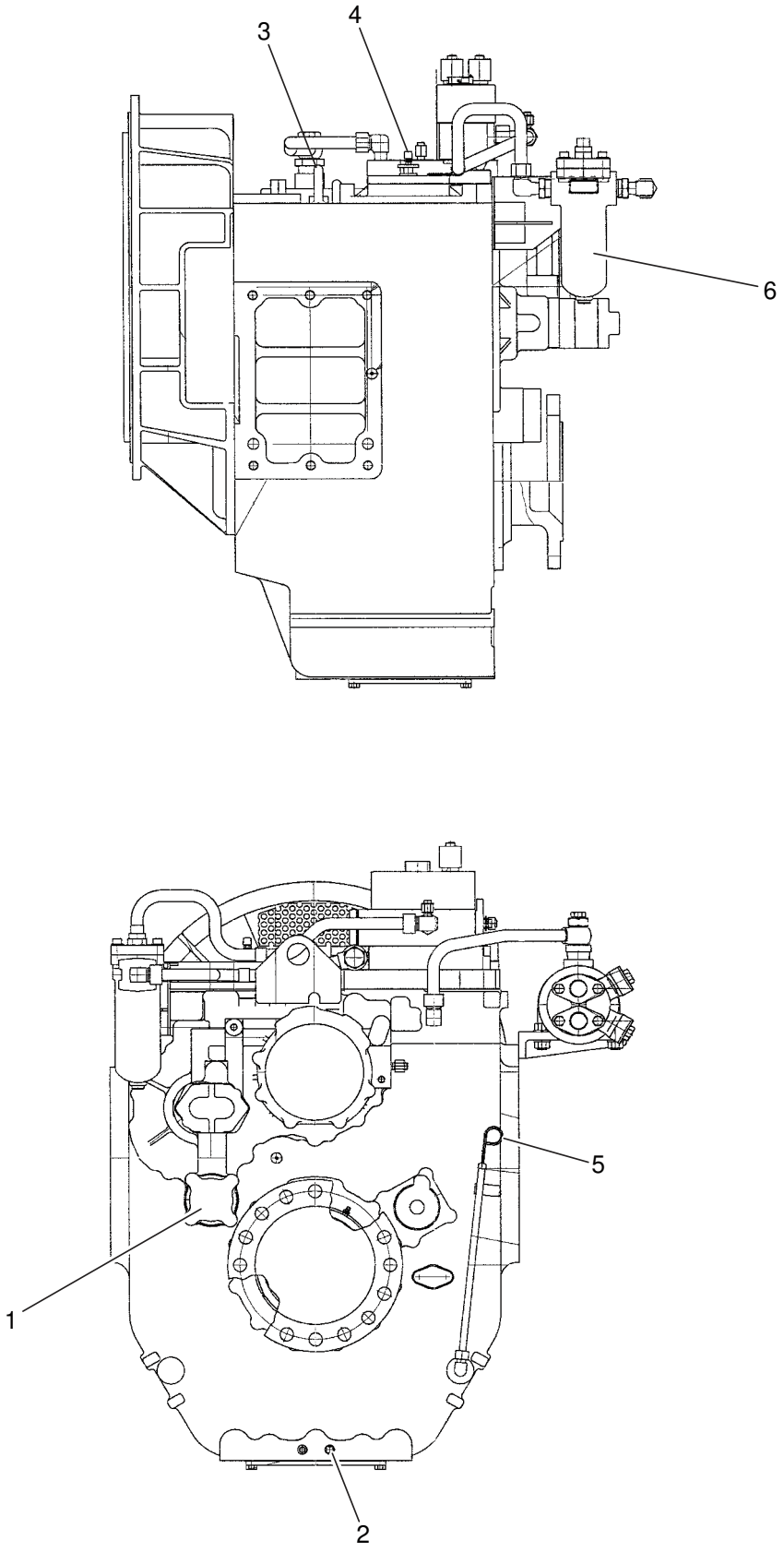


P72278

MGX-6599SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

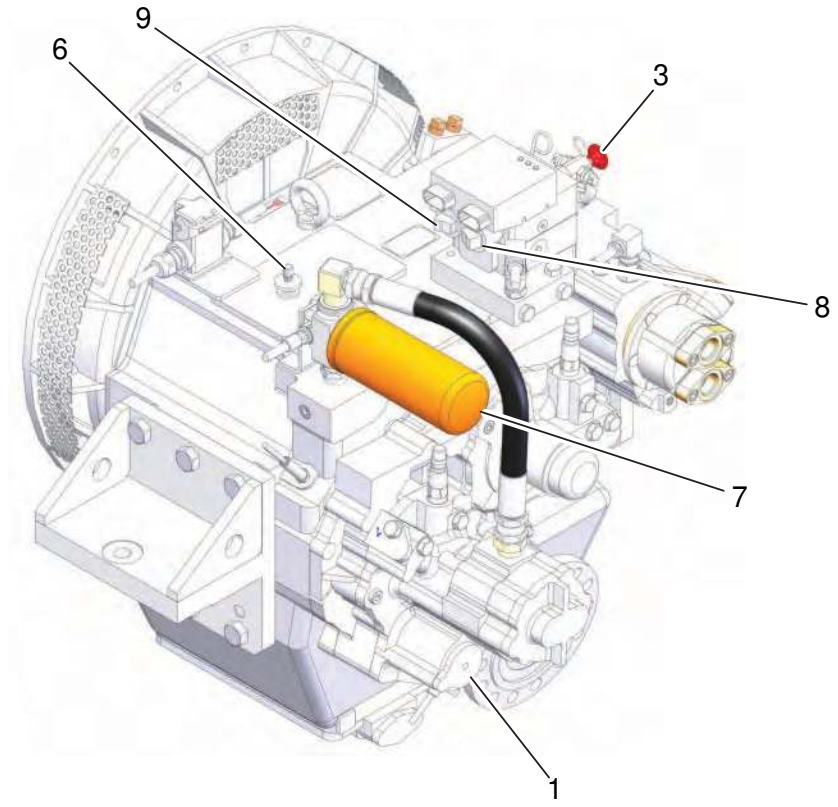
MG-6600DC

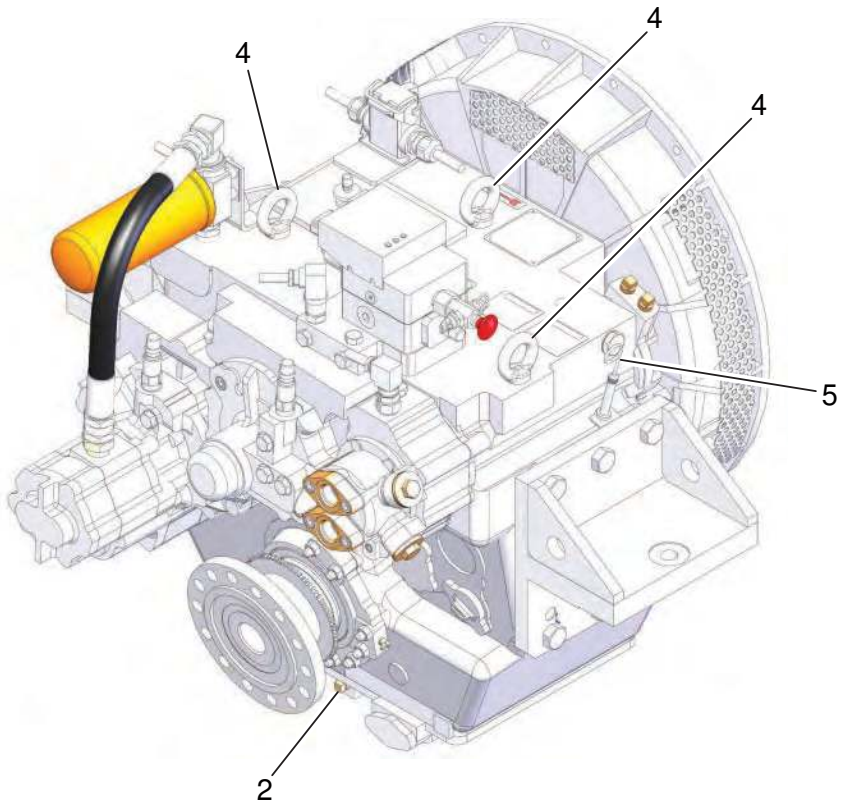


MG-6600DC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Holes for lifting
4	Breather and oil fill port
5	Oil level gauge
6	Oil filter

MGX-6620A



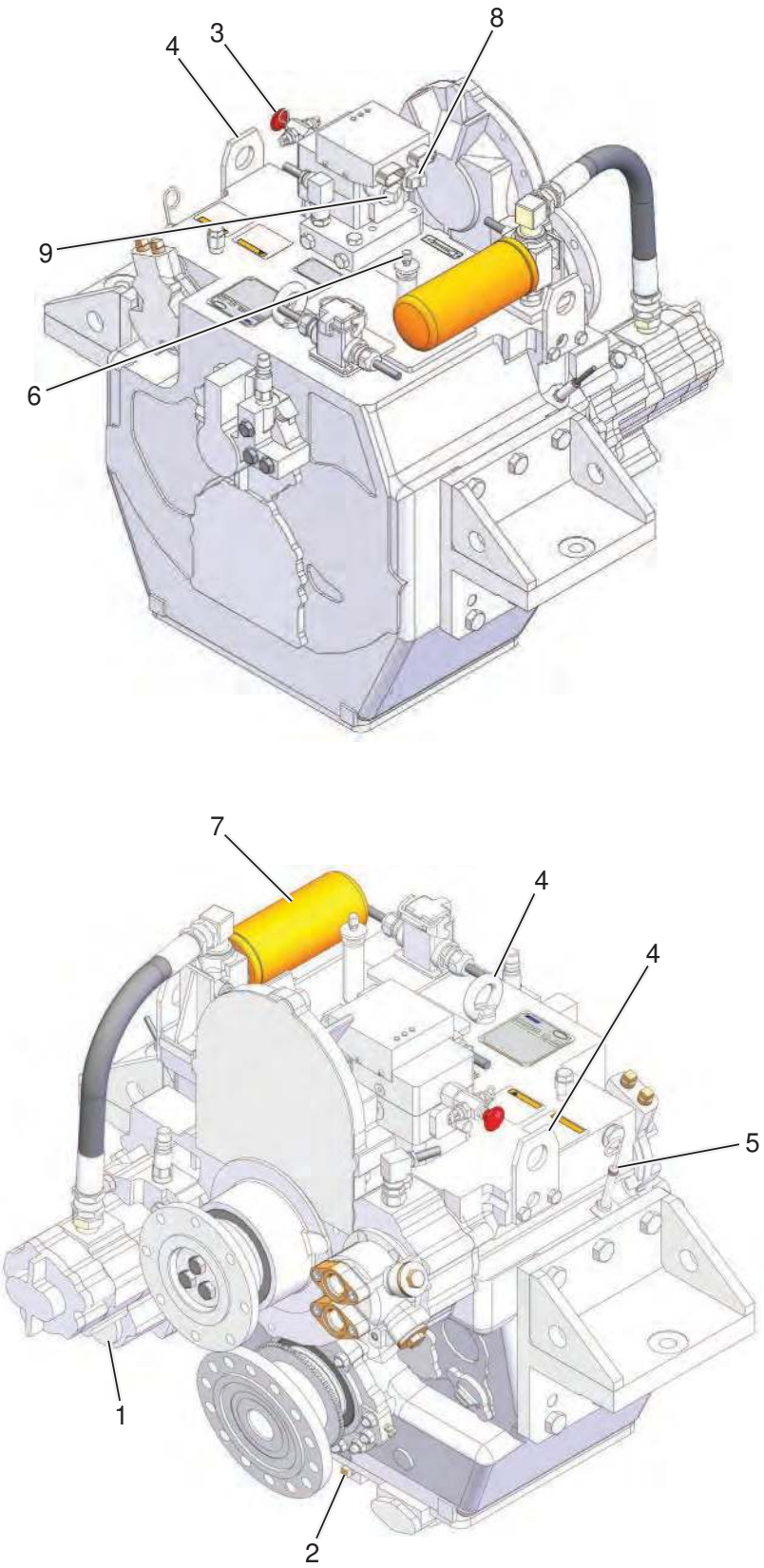


P72274

MGX-6620A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-6620RV

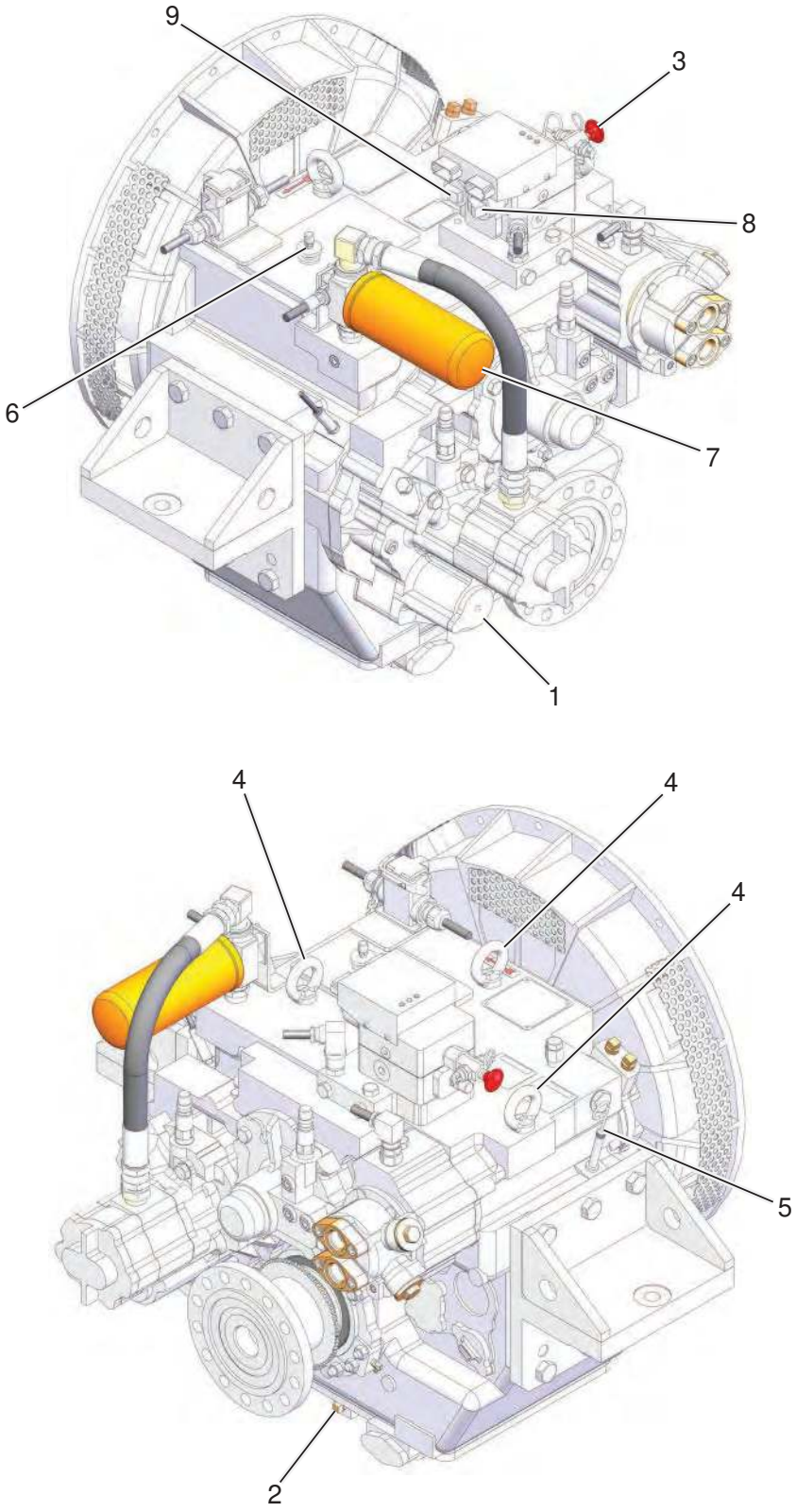


P72281

MGX-6620RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-6620SC

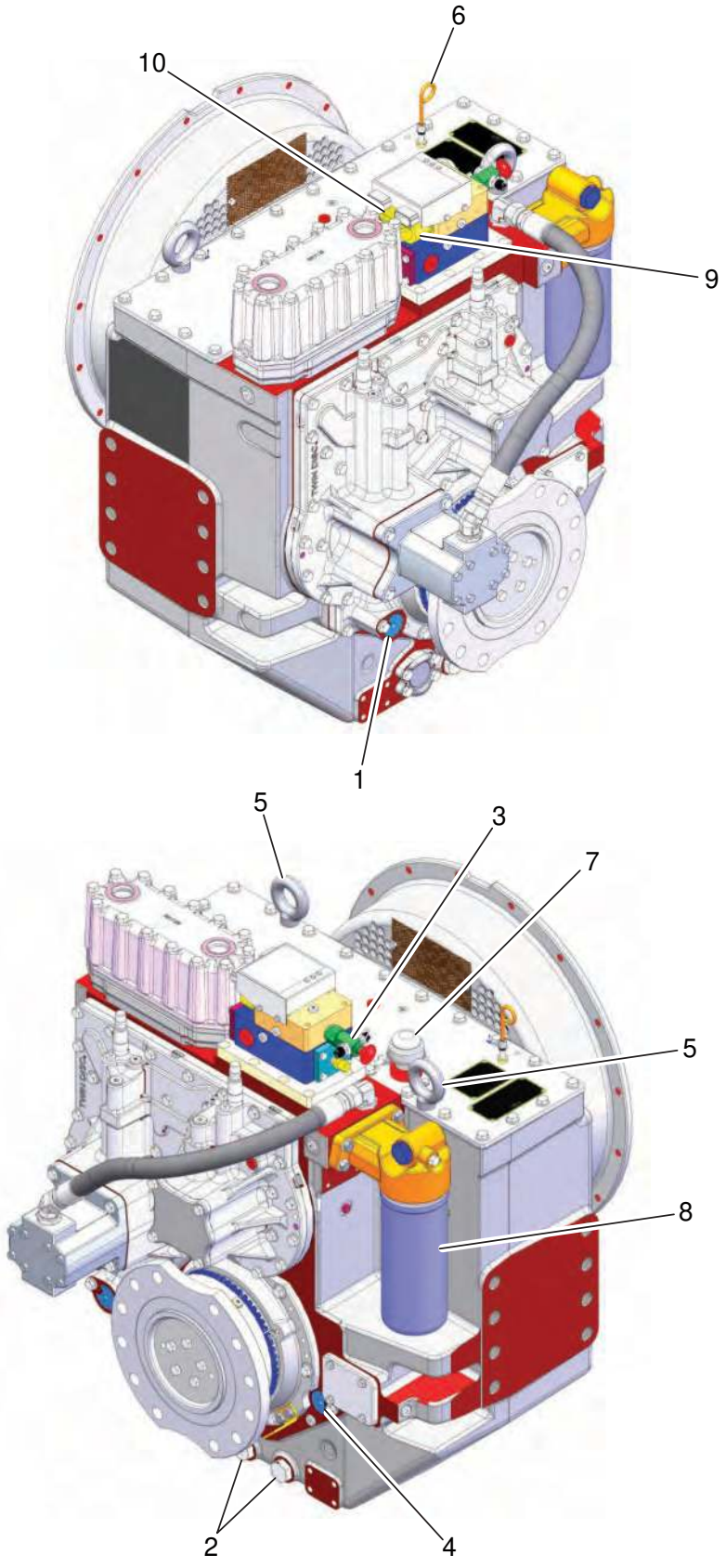


P72280

MGX-6620SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

MGX-6690SC, MG(X)-6690SC, MGX-6848SC, MG(X)-6848SC

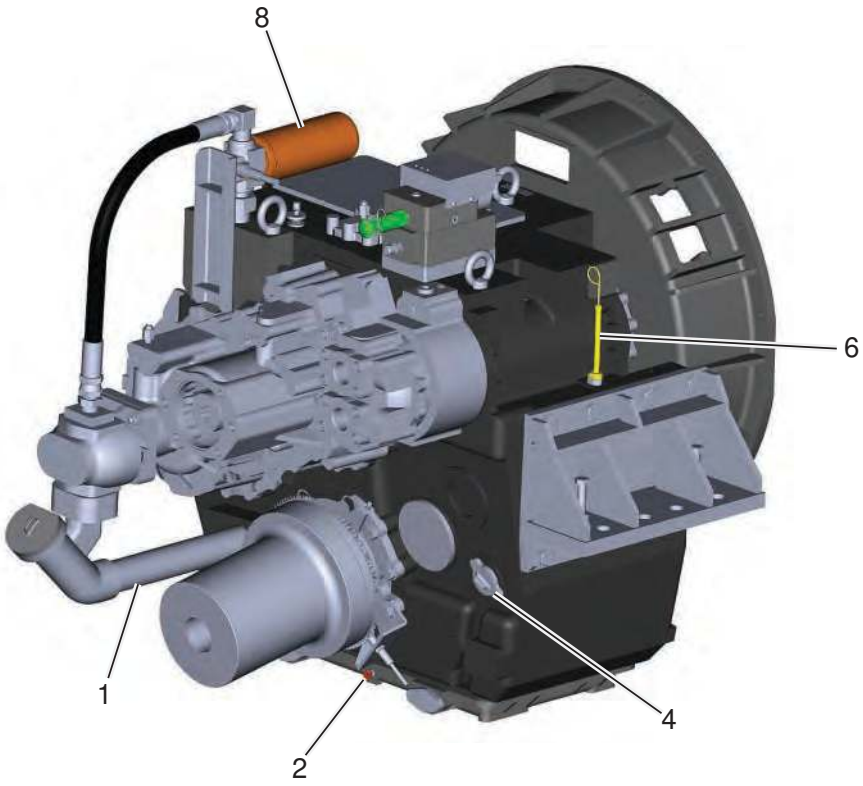


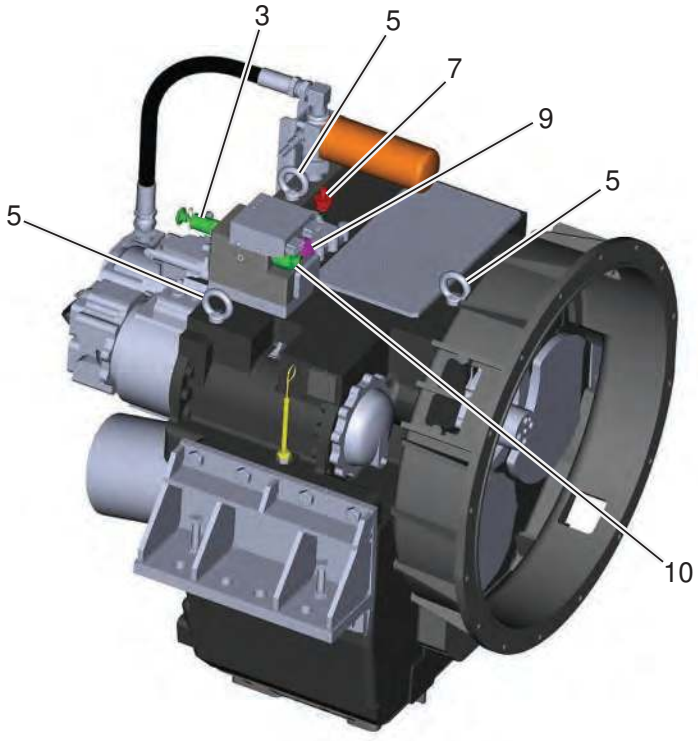
1025142D

MGX-6690SC, MG(X)-6690SC, MGX-6848SC, MG(X)-6848SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Holes for lifting
6	Oil level gauge
7	Breather and oil fill port
8	Oil filter
9	Primary soneloid
10	Secondary solenoid

MG-6984A



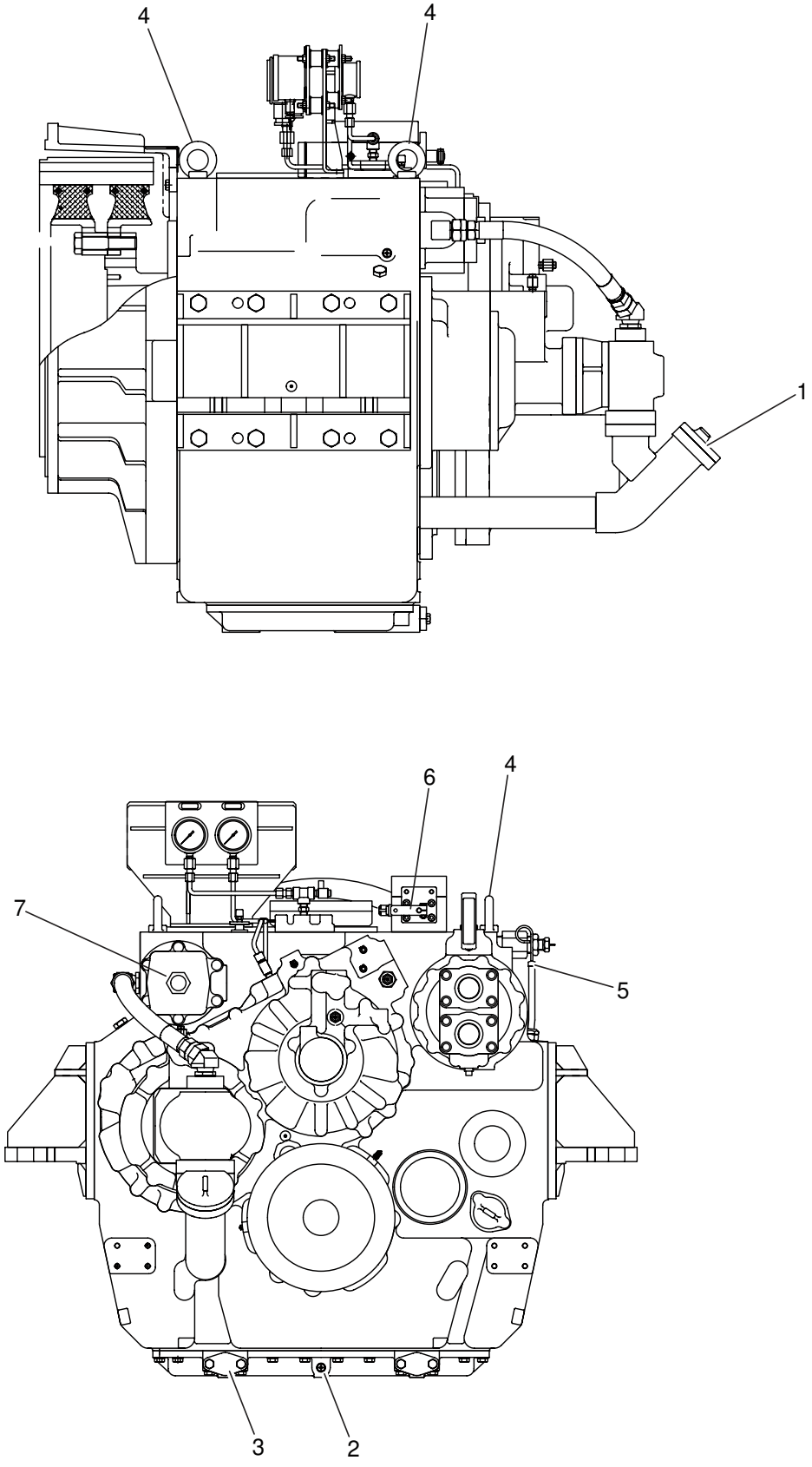


P72795A

MG-6984A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Holes for lifting
6	Oil level gauge
7	Breather and oil fill port
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

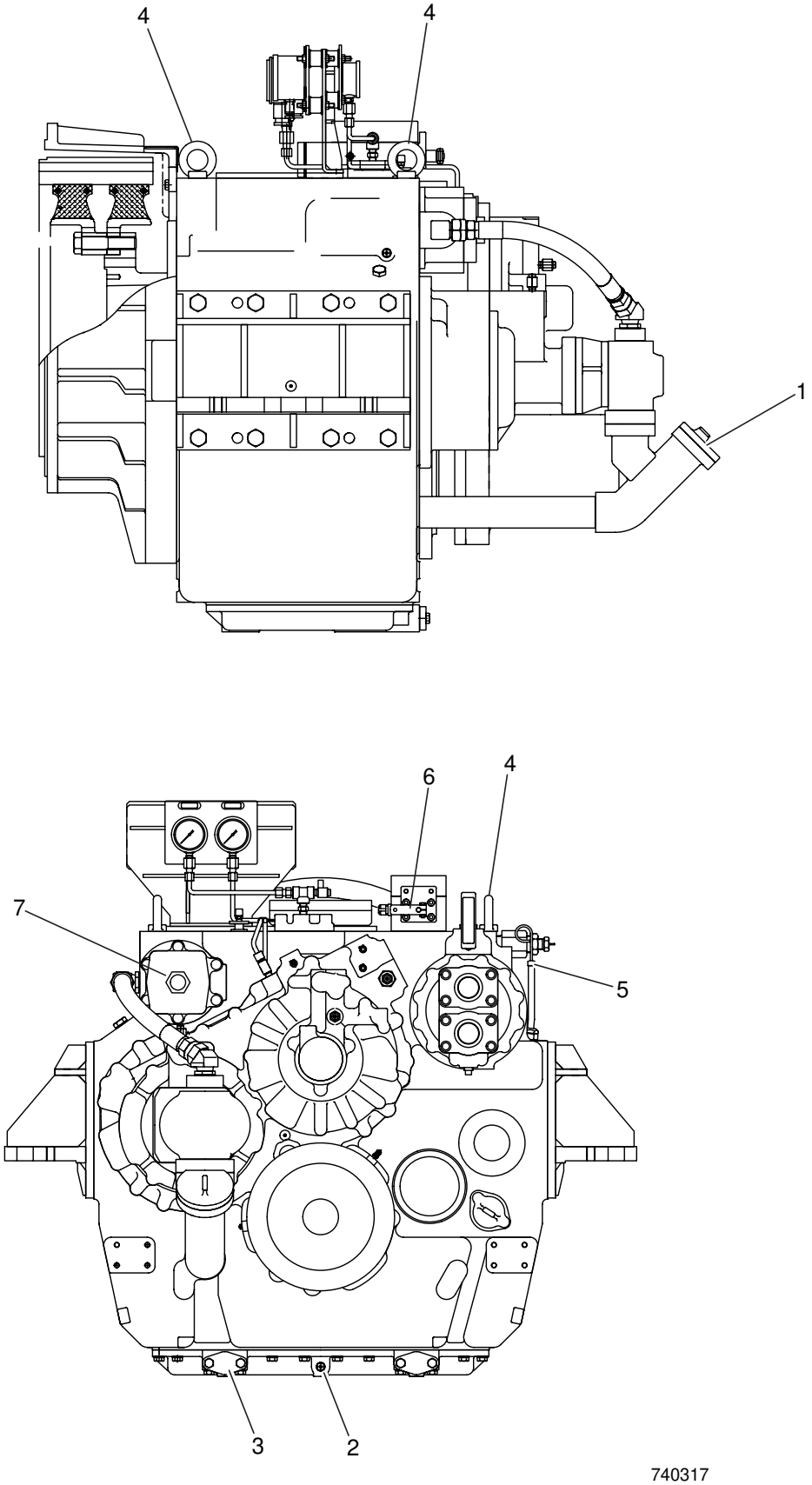
MG-6984RV



MG-6984RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil drain flange
4	Holes for lifting
5	Oil level gauge
6	Control valve selector lever
7	Oil filter

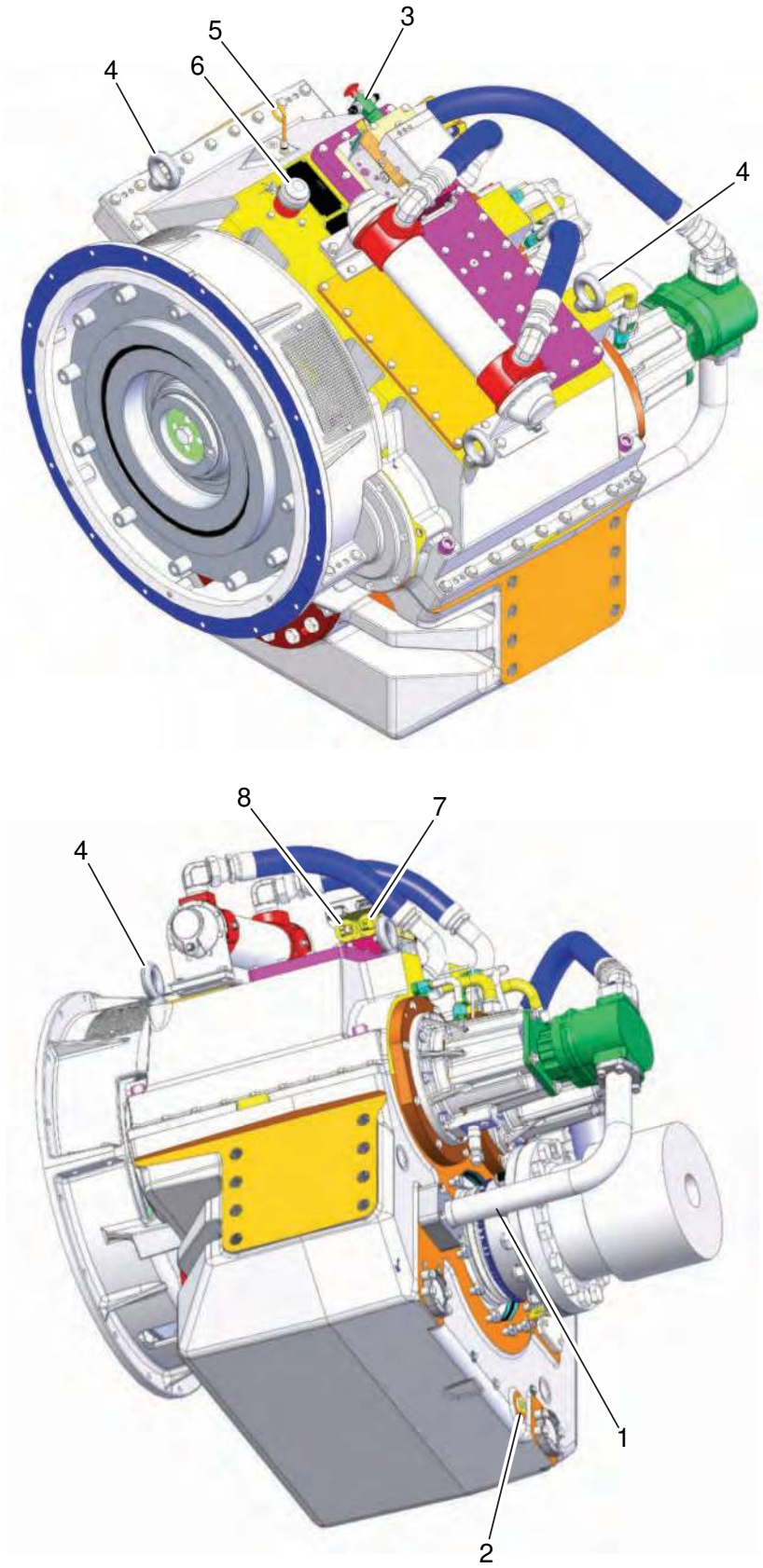
MG-6984SC



MG-6984SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil drain flange
4	Holes for lifting
5	Oil level gauge
6	Control valve selector lever
7	Oil filter

MGX-61000SC



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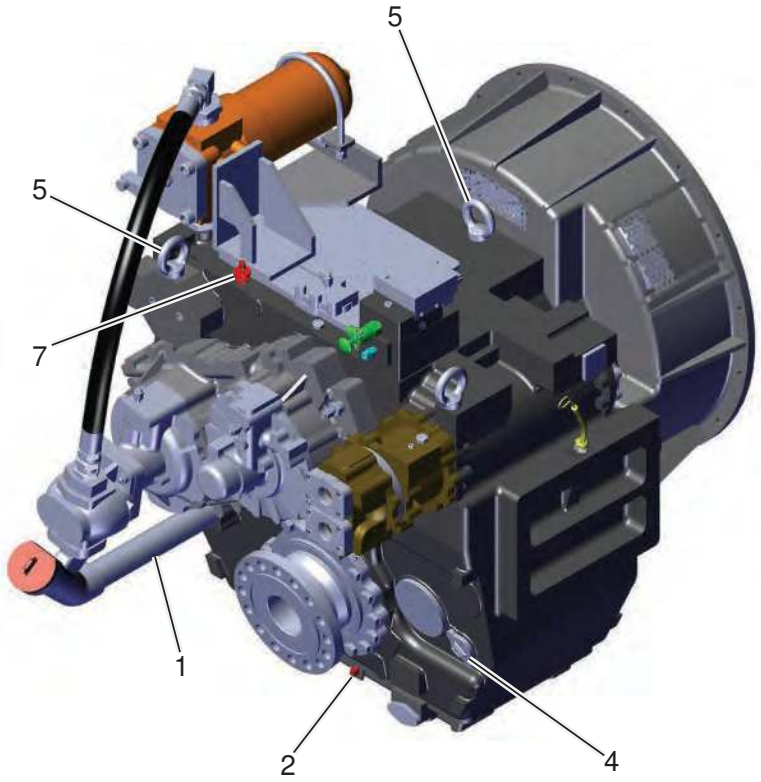
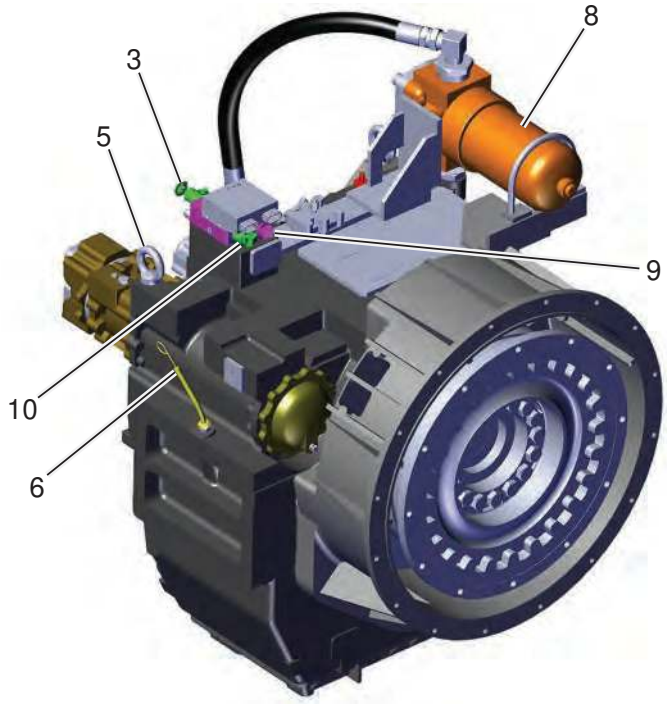
MGX-61000SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Primary solenoid
8	Secondary solenoid

MG-61242A





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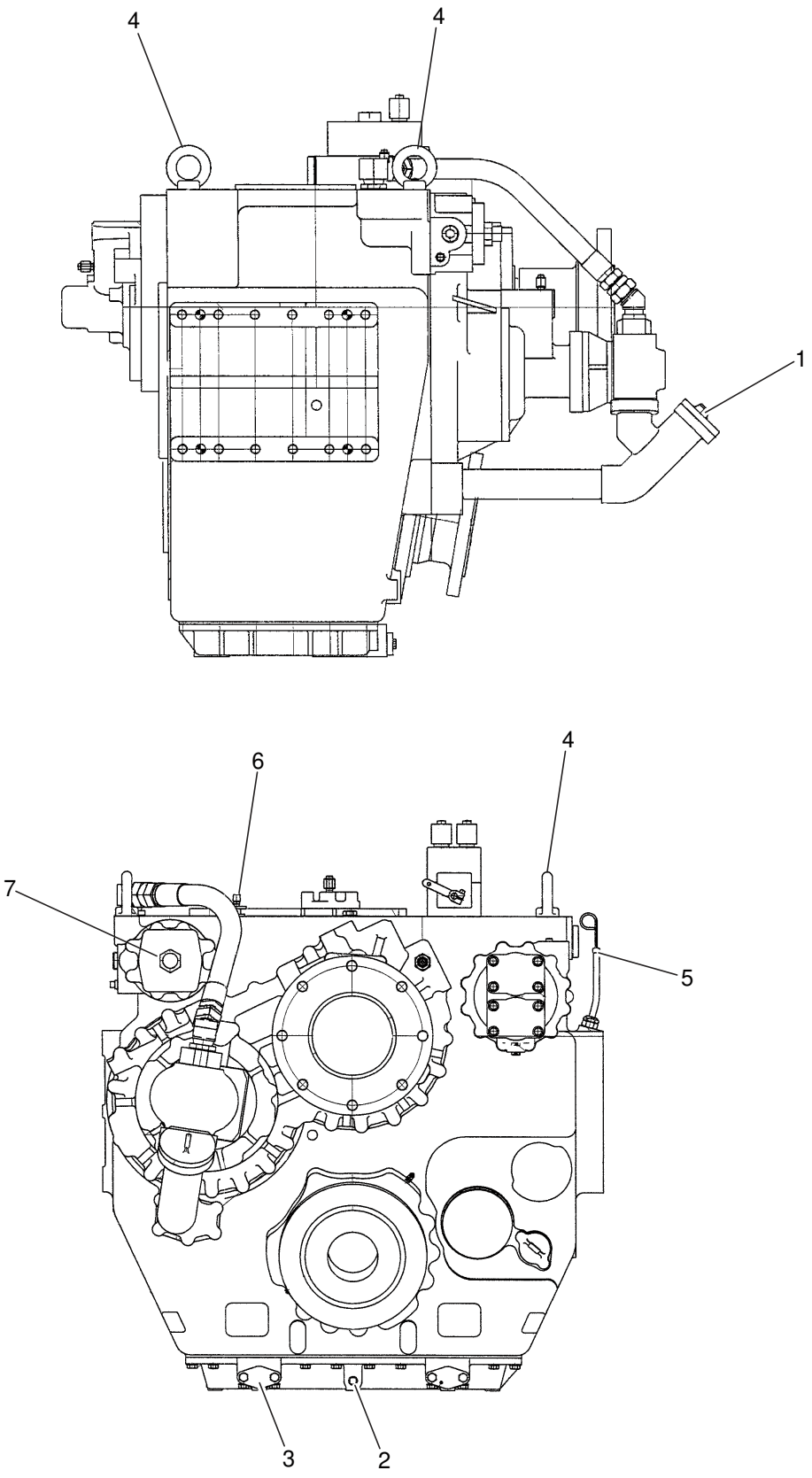
MG-61242A Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Holes for lifting
6	Oil level gauge
7	Breather and oil fill port
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

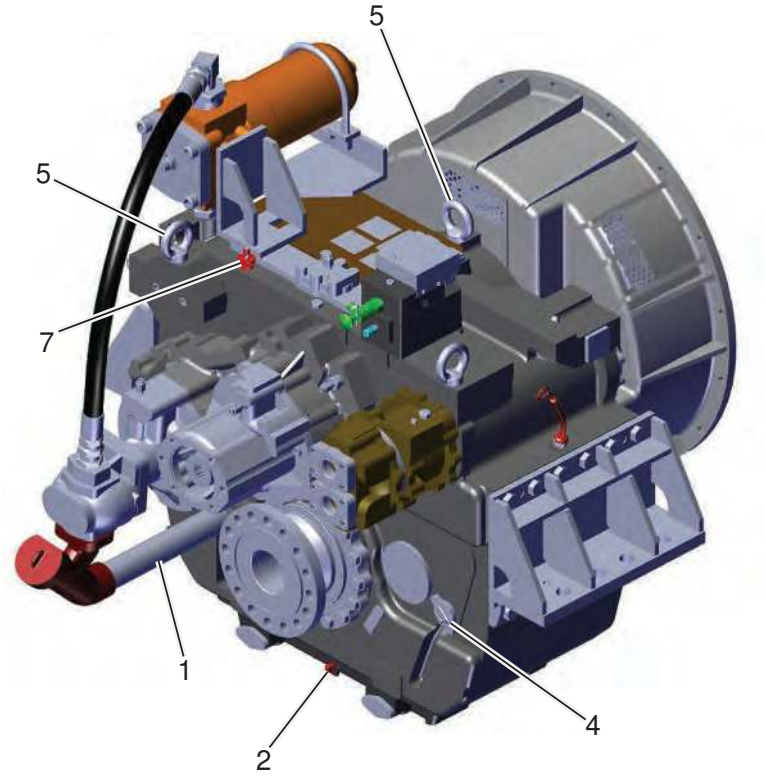
MG-61242RV

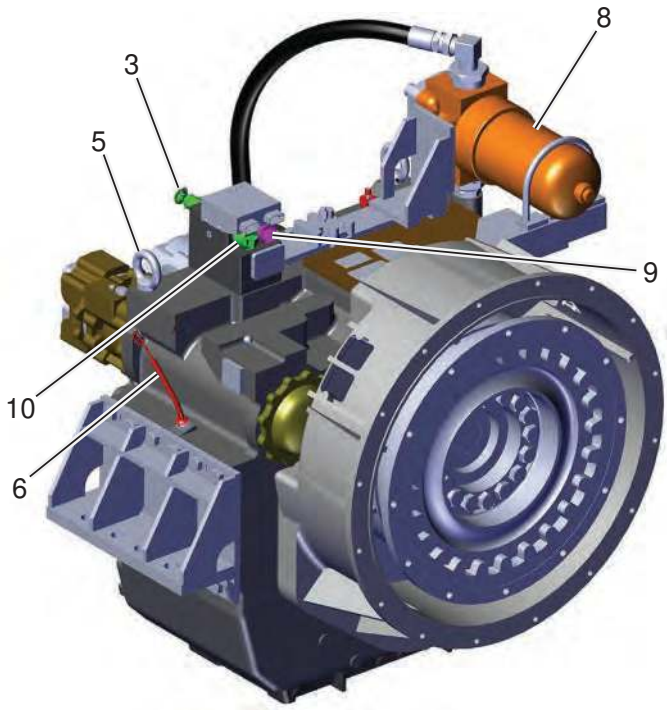


MG-61242RV Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Oil drain flange
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter

MG-61242SC





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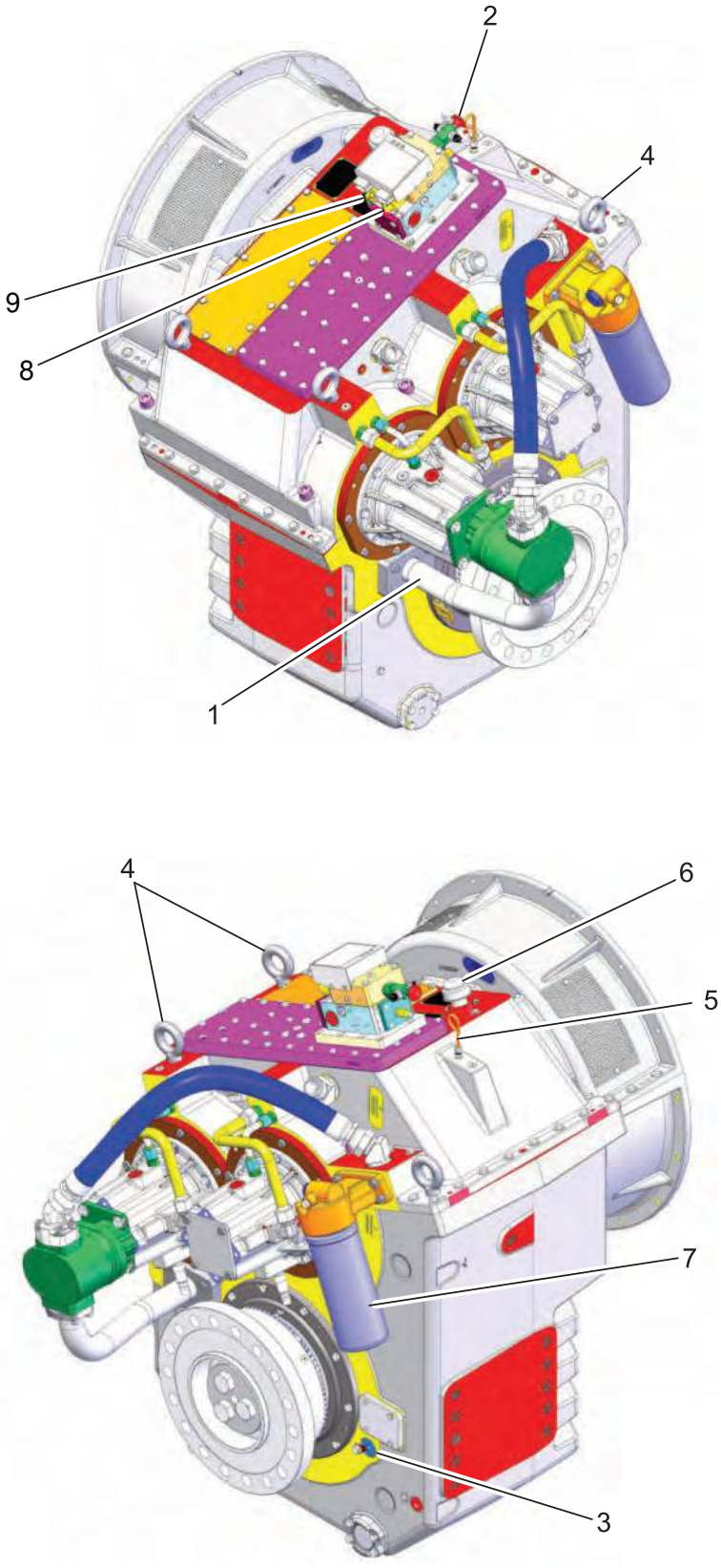
MG-61242SC Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Holes for lifting
6	Oil level gauge
7	Breather and oil fill port
8	Oil filter
9	Primary solenoid
10	Secondary solenoid

MGX-61500SC



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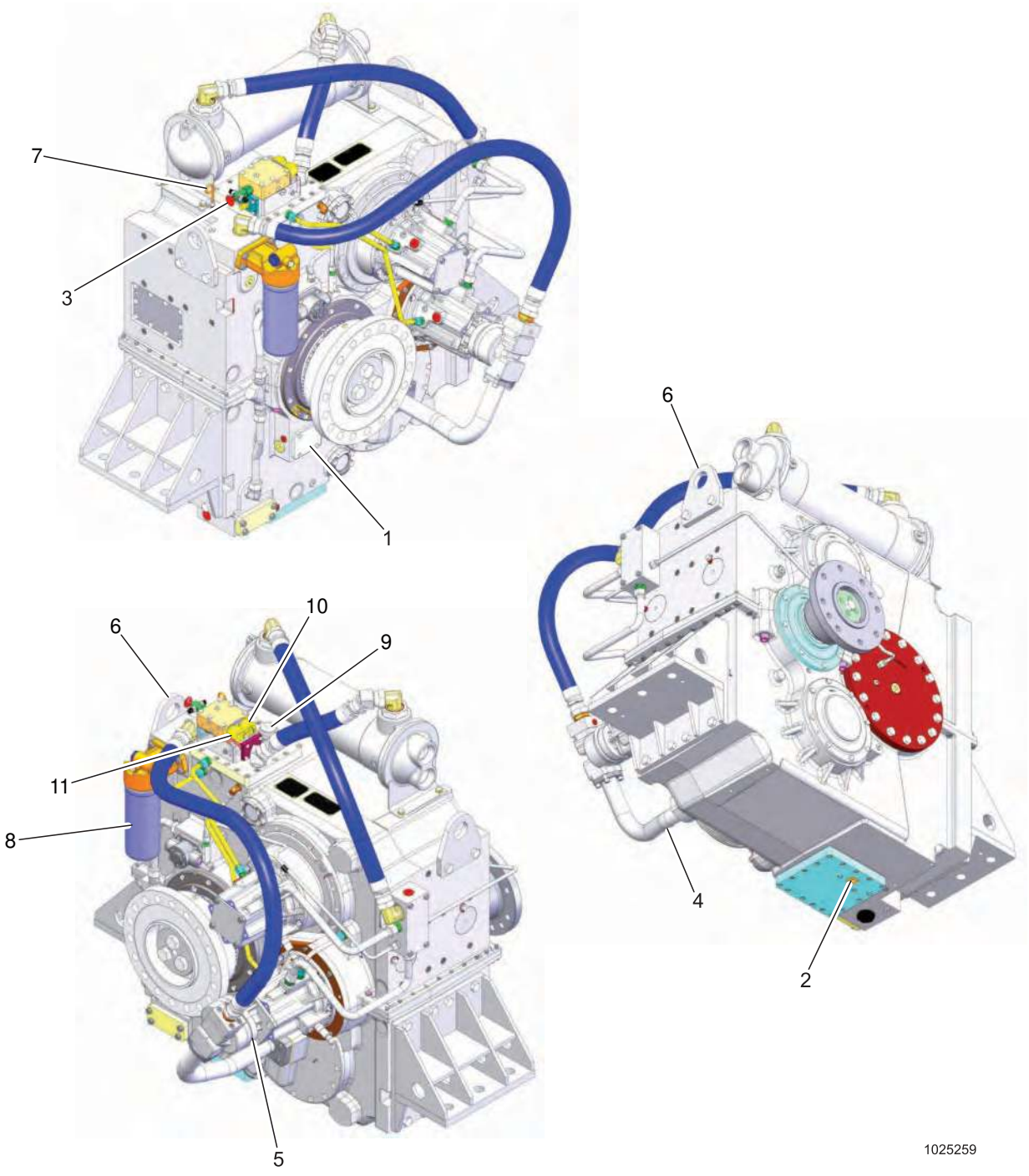
MGX-61500SC Callout List

Callout	Component
1	Oil strainer
2	Manual override valve
3	Trailing strainer
4	Holes for lifting
5	Oil level gauge
6	Breather and oil fill port
7	Oil filter
8	Primary solenoid
9	Secondary solenoid

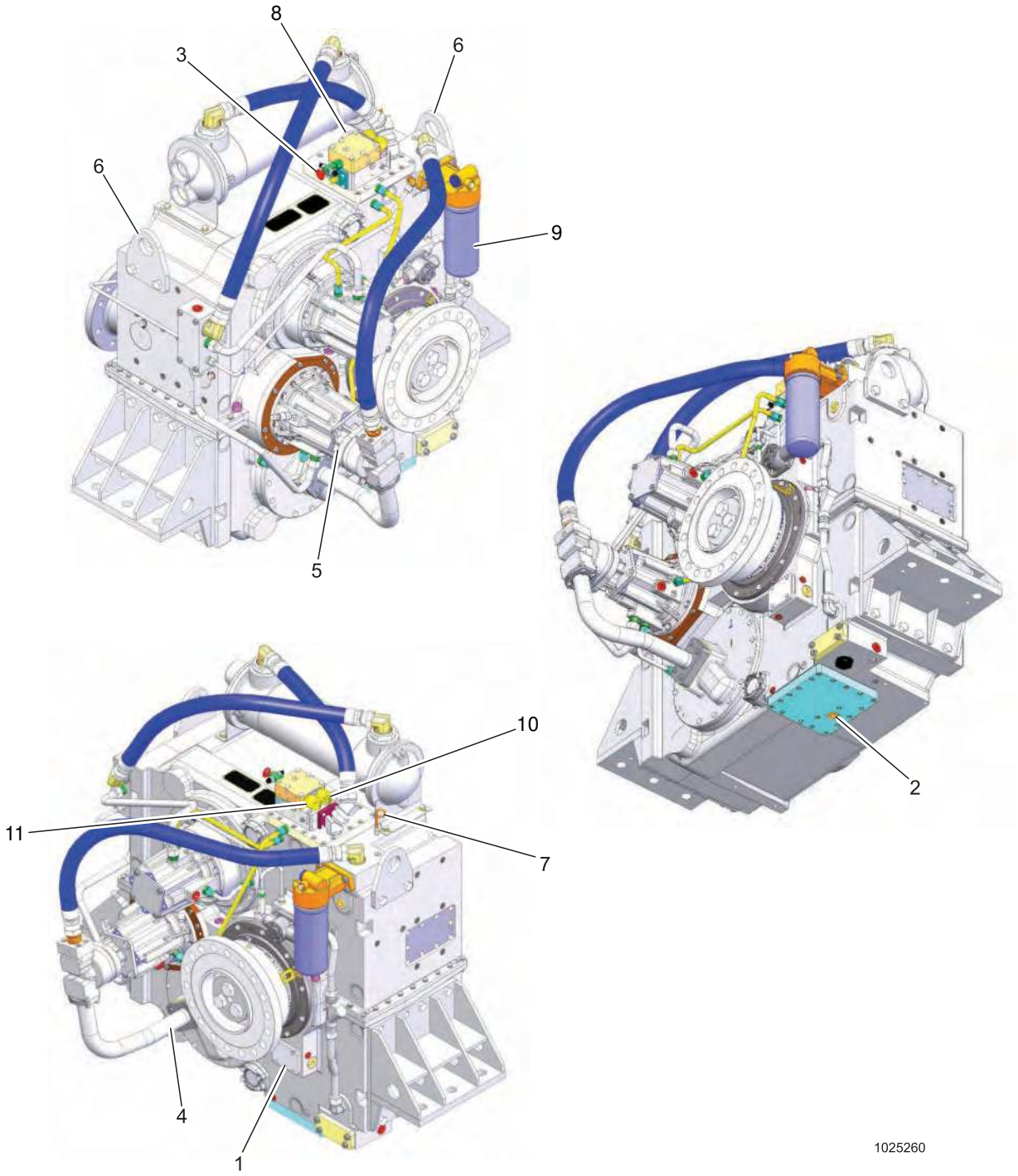
MGX-61500SC-HL, MGX-62000SC-HL



MGX-61500SC-HL, MGX-62000SC-HL Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Trailing pump
6	Holes for lifting
7	Oil level gauge
8	Oil filter
9	Breather and oil fill port
10	Primary solenoid
11	Secondary solenoid

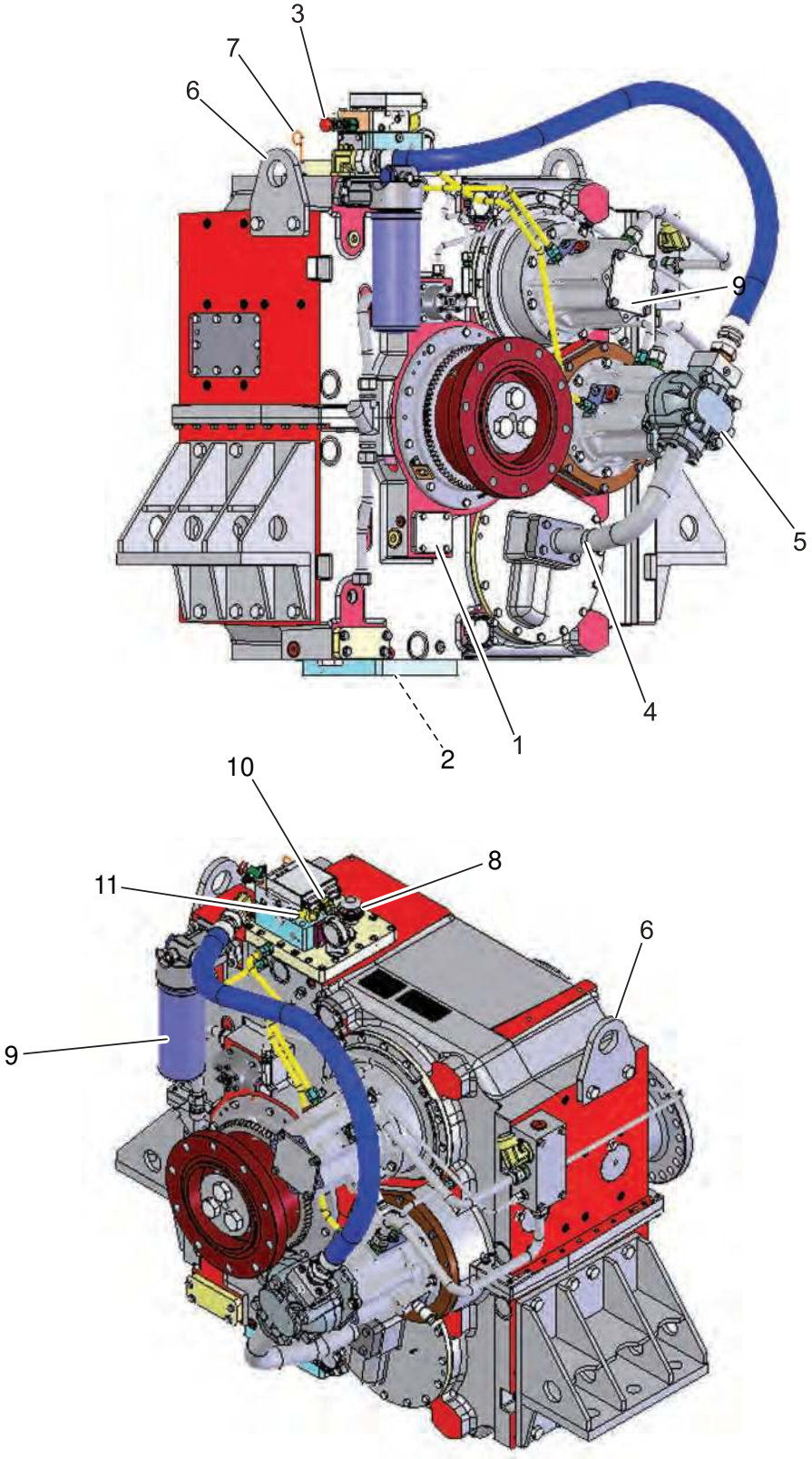
MGX-61500SC-HR, MGX-62000SC-HR



MGX-61500SC-HR, MGX-62000SC-HR Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Trailing pump
6	Holes for lifting
7	Oil level gauge
8	Breather and oil fill port
9	Oil filter
10	Primary solenoid
11	Secondary solenoid

MGX-62500SC-HL/HR



62500SC-HL

MGX-62500SC-HL/HR Callout List

Callout	Component
1	Oil strainer
2	Oil drain plug
3	Manual override valve
4	Trailing strainer
5	Trailing pump
6	Holes for lifting
7	Oil level gauge
8	Breather and oil fill port
9	Oil filter
10	Primary solenoid
11	Secondary solenoid

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