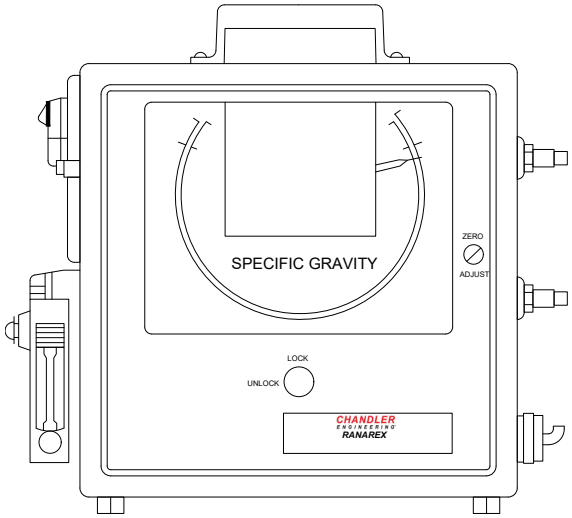
AMETEK®
PROCESS INSTRUMENTS

USER MANUAL

388 Ranarex Portable Gas Gravitometer



PN RI-212, Rev. L

To obtain a PDF of this manual, visit our Products page at www.ametekpi.com.

Contents

Important Safety Warnings, Cautions, and Notes

WARNINGS, CAUTIONS, and NOTES contained in this manual emphasize critical instructions as follows:

Important information that should not be overlooked.

An operating procedure which, if not strictly observed, may result in personal injury or environmental contamination.

An operating procedure which, if not strictly observed, may result in damage to the equipment.

Electrical Safety

Up to **2 kV** may be present in the analyzer housings. Always shut down power source(s) before performing maintenance or troubleshooting. Only a qualified electrician should make electrical connections and ground checks.

Any use of the equipment in a manner not specified by the manufacturer may impair the safety protection originally provided by the equipment.

H_2S Warning

High Concentrations of H_2S are extremely hazardous to personnel. The Ranarex Gas Gravitometer with sour gas protection provides physical protection for the Ranarex Gas Gravitometer only. Precautions should be taken to protect personnel and all local safety regulations concerning hazardous gases should be followed. Do not use the Ranarex Gas Gravitometer in any enclosed space or in any area where the concentration of H_2S may exceed 10 ppmv for any length of time. Failure to do so can result in serious harm or death.

Grounding

Instrument grounding is mandatory. Performance specifications and safety protection are void if instrument is operated from an improperly grounded power source.

Verify ground continuity of all equipment before applying power.

Warning Labels

These symbols may appear on the instrument to alert you of existing conditions.

Protective Conductor Terminal
(BORNIER DE L'ECRAN DE PROTECTION)
Schutzerde

Caution – Risk of electric shock
(ATTENTION – RISQUE DE DÉCHARGE ÉLECTRIQUE)
Achtung – Hochspannung Lebensgefahr

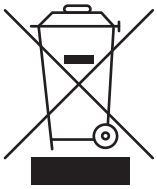
Caution – Refer to accompanying documents
(ATTENTION – SE RÉFERER AUX DOCUMENTS JOINTS)
Achtung – Beachten Sie beiliegende Dokumente

CAUTION – Hot Surface
(ATTENTION – SURFACE CHAUDE)
Achtung – Heiße Oberfläche

Environmental Information – WEEE

This AMETEK product contains materials that can be reclaimed and recycled. In some cases the product may contain materials known to be hazardous to the environment or human health. In order to prevent the release of harmful substances into the environment and to conserve our natural resources, AMETEK recommends that you arrange to recycle this product when it reaches its "end of life".

Waste Electrical and Electronic Equipment (WEEE) should never be disposed of in a municipal waste system (residential trash). The Wheelie Bin marking on this product is a reminder to dispose of the product properly after it has completed its useful life and been removed from service. Metals, plastics, and other components are recyclable and you can do your part by doing one of the following steps:



- When the equipment is ready to be disposed of, take it to your local or regional waste collection administration for recycling.
- If you need further assistance in recycling your AMETEK product, contact us through our Customer Support page at www.ametekpi.com/customersupport/aftermarket.

Overview

388 Ranarex Portable Gas Gravitometer

The Ranarex Gas Gravitometer measures the specific gravity (SG) of gases as compared to air. For many industrial process gases there is a definite connection between the analysis of the gas mixture and its specific gravity. When the specific gravity is involved in the analysis of the total mixture, or when the instruments are used with orifice metering in gas volume, they are graduated in specific gravity. When the gravimetric principle can be applied, Ranarex Gas Gravitometer excel over more complex and costly analyzers in total performance.

Theory of Operation

The Ranarex principle and design are simple. The chassis of the Gravitometer forms two (2) cylindrical, gas-tight measuring chambers; each has a separate inlet and outlet connection. In each chamber there is an Impeller Wheel and an Impulse Wheel, both with axial vanes. These wheels are mounted on separate shafts. An electric motor and drive belt rotate the impellers at the same speed and in the same direction. The impellers draw a continuous flow of air into their respective chambers. They spin the gas and air against the vanes of the corresponding Impulse Wheels. As the spinning gas and air impinge against the vanes, they create torques on the Impulse Wheels that are proportional to the density of the gas and of the air.

These torques are transmitted from the chambers to two (2) external measuring wheels. A flexible tape is wrapped on the Measuring wheel rims in the crossed direction so that the torque creates two (2) opposing forces. The measuring wheels are restrained from continuous rotation, but a difference between the torques allows limited motion of the entire system. The measuring system divides the torque of the gas by the torque of the air. This is the same ratio as the density of the gas divided by the density of the air which is the specific gravity.

The rim of the gas Measuring wheel is contoured so that it rotates through equal angles for equal changes in specific gravity. The uniform motion of the gas Measuring wheel is transmitted by a link to the readout elements; these can be either an indicator, a recorder, an electronic transmitter, or high/low contacts. To ensure accuracy, the gas sample and the Reference air must be measured at ambient temperature, at barometric pressure, and at equal humidity content (either humidified or dry).

Zero Position – Reference Air Only

Figure 1-1.1 shows the position of the Cam and Reference Wheel when the Reference air is admitted into both measuring chambers. In this case, the Impeller Wheel torques are equal. Because of this condition and the linear profile of the cam, the graduated dial is calibrated to indicate 1.000. An Air Dryer is built into the Gravitometer to dry incoming ambient air for use as the Reference air.

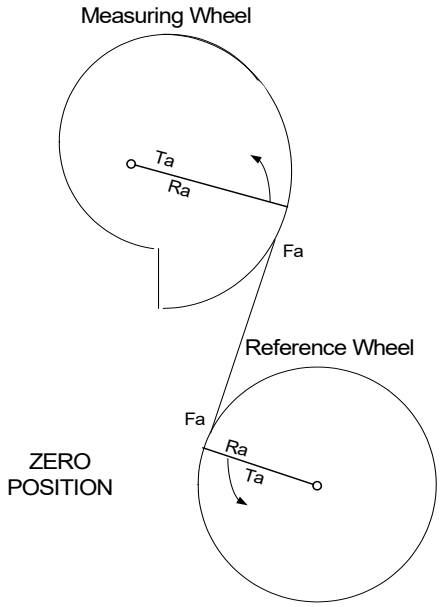


Figure 1-1.1.
Zero position, Reference air only.

Reading Position – Unknown Gas and Reference Air

Figure 1-1.2 shows the position of the Cam and Reference Wheels when an unknown gas is admitted to the upper chamber, and Reference air is admitted into the lower chamber. The lighter gas (in the upper chamber) creates a smaller torque than the air in the lower chamber. As a result, the cam will rotate until the cam radii allows the opposing torques to balance. The cam rotation is calibrated to indicate the ratio of the torques, or relative density.

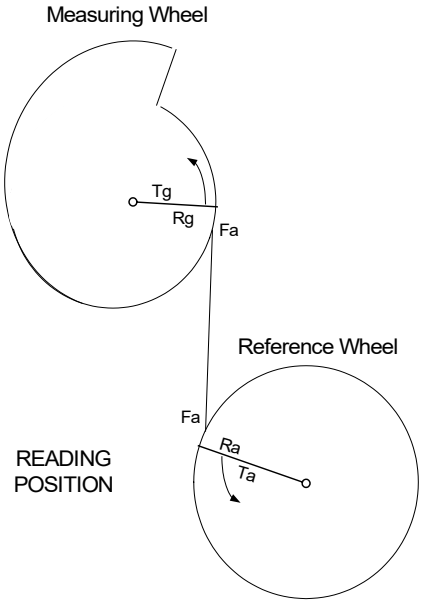


Figure 1-1.2.
Reading position, unknown gas.

Measuring Relative Density

The Ranarex Gravitometer measures relative density in accordance with the definition: "The ratio of the density of the gas, under observed conditions of pressure and temperature, to the density of dry air at the same pressure and temperature."

To measure relative densities above 1.000, the unknown gas is admitted to the lower chamber and the dry Reference air is admitted to the upper chamber. The principle of operation is the same. The graduated dial has two (2) Scales. The inner (RED) Scale is used for relative densities below 1.000 and the outer (BLACK) Scale is used for relative densities above 1.000.

Because of the nature of the Gravitometer design, pressures and temperatures of the gas and Reference air are equalized. Any changes in pressure, temperature, and motor speed affect both torques equally. Since the torques produce opposing forces, the effects of varying pressure, temperature and motor speed are cancelled.

Selector Valve

The Gravitometer is equipped with a Selector Valve that is used to direct the gas sample and dry Reference air to the correct chambers. The three (3) valve positions are used for:

- Checking the instrument Zero.
- Measuring gas relative densities below 1.000
- Measuring gas relative densities above 1.000.

Motor

The motor is designed for operation on 115 VAC/230 VAC, ±10 %, 50/60 Hz. When the Gravitometer is used in an area where AC power is not available, an optional DC-AC Inverter can be used to convert the DC voltage supplied by an automobile alternator or other DC source to the correct AC voltage.

The unit can be operated from the floor, a workbench, or hung from the wall and operated from a standard AC power supply or from a 12-Volt vehicle battery using a DC-AC Inverter.

Options

The available options for use with the Ranarex Gas Gravitometer include:

- DC-AC Power Inverter: 12 VDC to 115 VAC or 230 VAC.
- Selectable AC power, 115/230 VAC.
- Alodyne treatment for sour gas applications.

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Installation and Start-Up

The use and operation of this analyzer must be in accordance with all of the end user and local regulatory standards and procedures. There are no operator-serviceable components inside the analyzer. Refer servicing to qualified personnel.

Before powering up the analyzer, review and follow all safety information in this chapter. This information describes procedures to follow to avoid personal injury and/or damage to the equipment. ***All regulatory agency and company safety procedures for your jurisdiction must be followed.***

Pre-Installation Requirements

Storage Prior to Installation

If the analyzer is stored for any period of time prior to installation, store the equipment in an environment where it is not subject to dripping or splashing liquids, corrosive gases, high humidity, or excessive heat or cold. Recommended storage conditions include:

Temperature: -20 °C–60 °C (-4 °F–140 °F)

Relative Humidity: Maximum 95 %, non-condensing

Failure to comply with these storage conditions will void your warranty.

Uncrating and Inspecting the Ranarex Gas Gravitometer

The Ranarex Gas Gravitometer and its accessories were tested and inspected before the analyzer was shipped from the factory. Carefully uncrate the analyzer, remove any packing material and check for damage. If any damage is found, notify AMETEK as soon as possible and notify the shipper.

The Ranarex Gas Gravitometer weighs approximately 23 kg (50 lb). Use caution when lifting it from its crate.

Accessories shipped with the standard 115 VAC or 230 VAC Ranarex Gas Gravitometer include:

- (1) Electric cord (6 feet), 18-gauge cable with male and female plugs.
- (1) 1-1/4 lb can of Silica Gel.
- (1) Filling funnel.
- (1) 388 Ranarex Portable Gas Gravitometer *User Manual* (Part No. RI-212).

Additional accessories shipped with the Ranarex Gas Gravitometer when it will be powered using a 12-Volt DC battery (unless excluded by the customer):

- (1) Ranarex DC-AC Power Inverter (12 VDC to 115 VAC or 230 VAC).
- (2) Battery cables (16 feet) 12-gauge wire with battery clips.

The "DC-AC Power Inverter" instructions are included in this chapter.

Mechanical Installation

Read this entire section before beginning installation of the Ranarex Gas Gravitometer. Failure to do so, and/or use of the analyzer in a manner not specified in this manual, may impair the protection against fire, electrical shock, and personal injury originally provided by this equipment.

Location and Environment

The Ranarex Gas Gravitometer should not be near hot or cold objects. You must allow at least 5" (12.7 cm) of clearance on the left side and 3" (2.6 cm) on the right side for making connections and for normal operating functions.

Permanent Mounting

If the instrument will be permanently mounted, it must be secured with (4) 1/4-20 machine screws (not provided). The screws mount through the holes in the Gravitometer base. See Figure 2-1 for mounting dimensions and the location of the mounting holes.

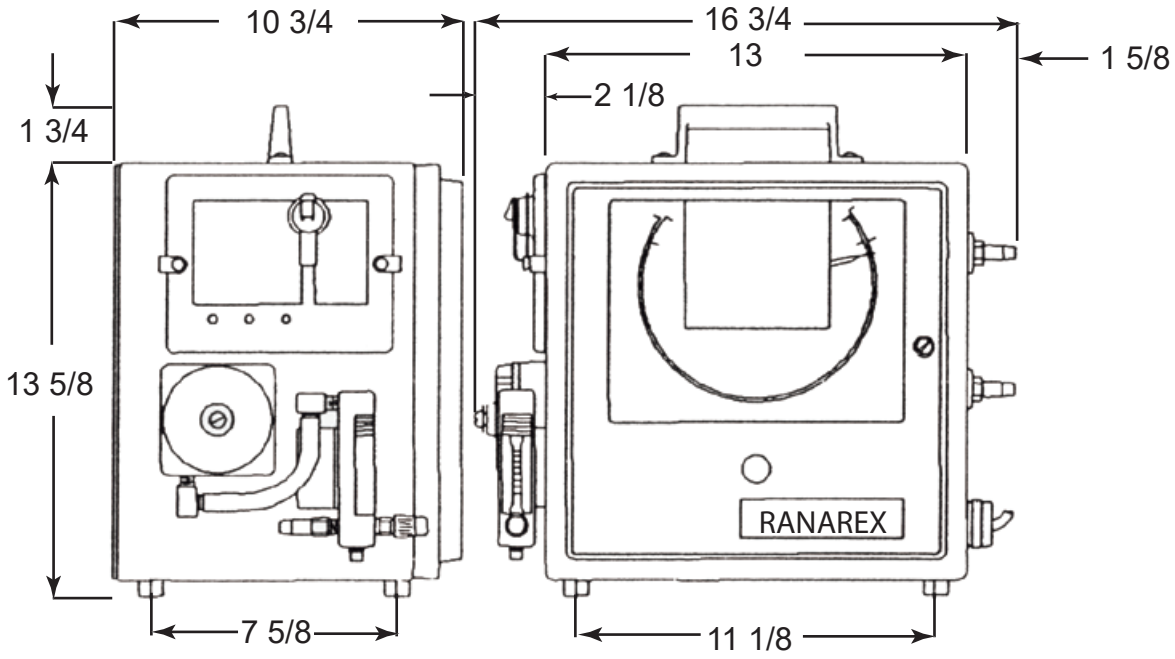

Figure 2-1.
Ranarex Gas Gravitometer outside and mounting dimensions.

Figure 2-2 illustrates the locations of connections and external controls.

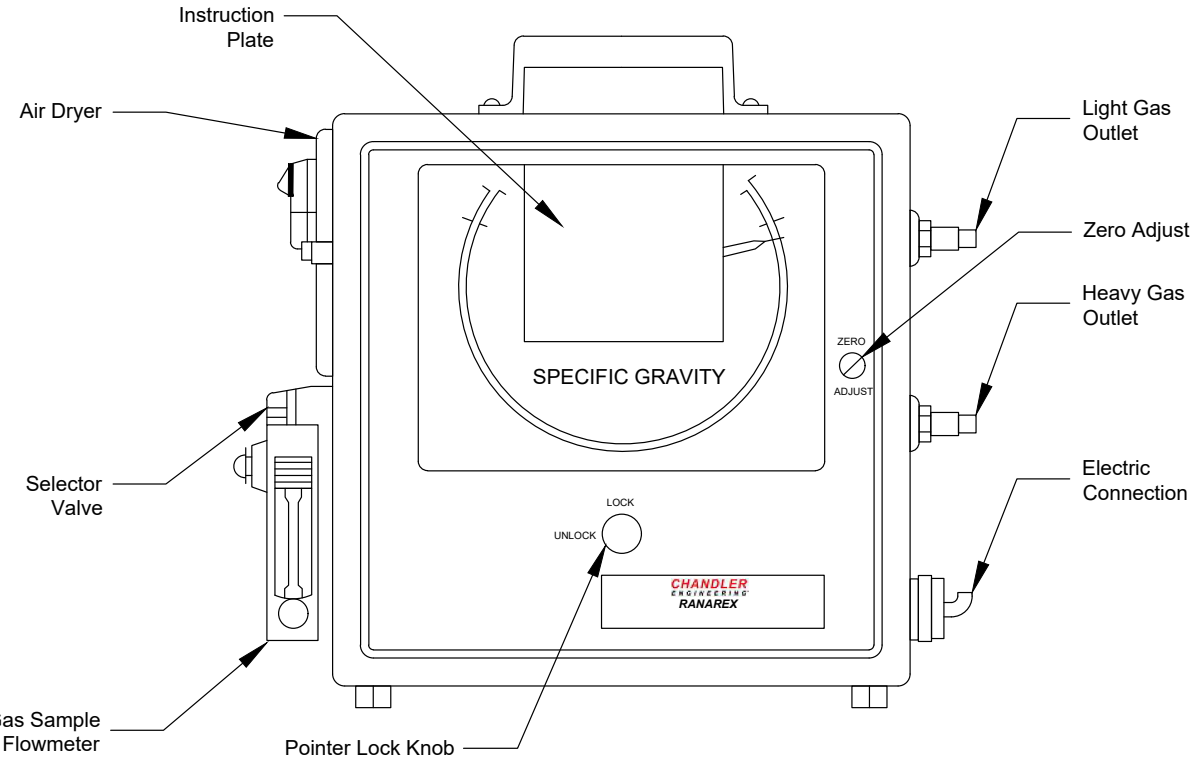

Figure 2-2.
Ranarex Gas Gravitometer – location of connections and controls.

DC-AC Power Inverter – Alternate Powering Method

The DC-AC Power Inverter, which can be purchased and used as an alternate powering method, is designed primarily for operating the Ranarex Gas Gravitometer. They are durable, transistorized units with no moving parts.

Part No.	Description	DC Input at Battery Posts	AC Output
CH300-27404	12 VDC/115 VAC, 500 W	12.0–14.2 VDC	110–125 VAC, 60 Hz, 500 W
CH300-28656	12 VDC/230 VAC, 1000 W	12.0–14.2 VDC	220–230 VAC, 50 ±0.5 Hz, 1000 W

Do not misuse the Inverter. Excessive or extended overload will cause permanent damage.

Damaging the Inverter

Operating under the following conditions will result in permanent damage to the Inverter transistor:

- With reversed DC polarity.
- With "no-load" for more than a few minutes.
- With long or large overload.
- With a "short" in the AC load.

Installing the Inverter

Check Vehicle Polarity

Negative-Grounded System
When the Inverter is used in a vehicle with a negative-grounded ignition system, the chassis of the Inverter can be safely grounded to the vehicle body.

Positive-Grounded System
If the vehicle has a positive-grounded system, the Inverter **must be insulated** from the vehicle.

Choosing a Location

To install the Inverter, select a secure location where you can easily access the power switch to operate the Inverter.

- Do not mount the unit in a location where the Inverter heat sinks will be blocked. Allow space of at least one (1) inch on both sides and on the top of the unit.
- Do not mount the unit under the engine hood or close to hot objects.
- Do not mount the unit or its connections in a location where it can be damaged when you are operating other equipment or handling tools.

Make sure that the Inverter is covered if you must operate it when it is raining.

Cable Installation

A 16-foot, 12-gauge, two-conductor cable is furnished with the Inverter. This cable can be used for the majority of Inverter installations.

Permanent Installation
You can permanently install the provided cable if you will be operating the Inverter under the following conditions:

- Vehicle engine is idling.
- Voltage regulator of the vehicle is set between 12.5 and 14.2 volts.

Temporary Installation
If you might need to make any modifications to the cable, or if any of the other conditions listed below are present, string the cables temporarily so that you are able to make any required modifications.

- Vehicle engine is stopped.
- Vehicle engine is idling but voltage regulator is set above 14.2 volts.
- Exceptionally short or long cables are needed.

Inverter Connections

To make the Inverter connections:

1. Verify that the On-Off toggle switch on the Inverter is in the Off position.
2. Make the connections from the Gravitometer to the Inverter binding posts first.
3. Make the connections from the Inverter to the battery posts or cable clamps after you have already made the connection from the Gravitometer to the Inverter binding posts.
4. Observe the correct polarity.

Do not connect the cable to the terminals of the generator, alternator, voltage regulator, starter relay, or any other similar device.

Connection Polarity

Do not reverse polarity as the transistors will be damaged; doing so will void the warranty.

To ensure proper polarity connections:

1. Connect the RED lead to (+) binding post of the Inverter using the hook terminal.
2. Connect the BLACK lead to (-) binding post of the Inverter using the hook terminal.
3. Connect the other end of the RED lead to the Positive (P) or (+) battery terminal using the clip.
4. Connect the other end of the BLACK lead to the Negative (N) or (-) battery terminal using the clip.

These connections apply to both negative- and positive-grounded vehicles.

Inverter Operation

To use the Inverter with the Gravitometer:

1. Check the starting procedure for the operation of the Gravitometer.
2. Insert the plugs from the Gravitometer cordset into the receptacle of the Inverter.

Do not operate the Inverter without the Gravitometer connected as a load.

Do not connect a source of AC power to the output of the Inverter.

3. Turn the Inverter On-Off switch to the On position. The Inverter will start.

Stopping the Inverter

To safely power down the Inverter:

1. Purge the Gravitometer to 1.000. Refer to the section "Purging to 1.000 After Measuring a Gas" in Chapter 3.
2. Turn the On-Off switch of the Inverter to the Off position.
3. Disconnect the Inverter from the battery.
4. Disconnect the Inverter from the Gravitometer.

Regulating the Inverter Voltage

Voltage Too Low
If, after operating the Gravitometer you find that the battery voltage is too low, check to see if the voltage regulator can be reset to a higher voltage within the vehicle manufacturer's tolerance. If it is impractical to reset the voltage regulator, you can substitute either 8- or 10-gauge cables for the standard 12-gauge cables provided.

Voltage Too High
If the battery input voltage is too high, check to see if the voltage regulator can be set to a lower voltage within the vehicle manufacturer's tolerance. If it is impractical to reset the voltage regulator, you can substitute 14- or 16-gauge cable for the 12-gauge cables supplied with the unit.

Operating Other Equipment

Using the DC-AC Inverter for purposes other than with the Gravitometer is at the operator's risk. If the Inverter is damaged by overload, the manufacturer's warranty will become void.

This Inverter is designed and conservatively rated to operate the Gravitometer. Use the following rules as guidance in operation of the Inverter:

- Do not operate any device that consumes more than 250 Watts.
- Do not operate any device simultaneously with the Gravitometer.
- Do not operate the Inverter for more than two (2) minutes without load. You should turn On the Gravitometer before starting the Inverter.

Typical Loads

AMETEK Part No. CH300-27404 – 12 VDC/115 VAC, 500 W

Emergency Lighting	100–500 Watt lamp
Soldering Iron	100/140 Watt dual heat
Electric Drill	1/2-inch drills

AMETEK Part No. CH300-28656 – 12 VDC/230 VAC, 1000 W

Emergency Lighting	100–250 Watt lamp
Soldering Iron	100/140 Watt dual heat
Electric Drill	1/2-inch drills

Conditioning the Gas and Air Samples

The gas sample and the Reference air must be measured at the same temperature, atmospheric pressure and humidity content to ensure accuracy. The sampling system must condition the gas and air to meet these requirements. Once these conditions are met, the analyzer and sampling system as a unit will be self-compensating for all variations except the analysis and relative density of the gas.

Dry Reference Air

The dry Reference air is provided by the Gravitometer's built-in Dryer which uses Silica Gel as the desiccant.

The Silica Gel desiccant is normally blue in color and must be replaced when the color has changed to pink.

Pressure Requirements

The gas sampling system must reduce the gas to barometric pressure to equal; the pressure of the Reference air. The correct gas pressure corresponds to a sample flow rate of 15–20 SCFH for the stationary Ranarex Gas Gravitometer and 10–15 SCFH for the portable version. The flow rate is measured by a rotameter. As an operating convenience, the Flow Scale is graduated in relative density units so that you can adjust the needle valve so the Gas Sample Flowmeter reads the approximate relative density of the gas.

The Gas Sample Flowmeter can be used with inlet pressures up to 20 PSIG. When the sample pressure is greater than 20 PSIG, you must reduce to using an external pressure regulator.

Temperature Requirements

Reference air is admitted to the Gravitometer at the ambient temperature of the instrument. For the gas and air to be measured at the same temperature, the gas must be heated or cooled to ambient temperature. This is especially important if the gas pressure has been reduced more than 100 PSIG, or if the gas flows through a temperature zone of more than -12 °C (10 °F) difference from the ambient temperature of the Gravitometer. If the gas sample temperature must be adjusted, the gas can be passed through a coiled 3-meter (10-foot) section of metal tubing before entering the Gravitometer.

Moisture Content of Gases

Gases that are "wet" (dew point above 10 °C/50 °F), gases that are dissolved by a humidifier (e.g., NH_3) or gases that are corrosive when moist (e.g., SO_2) must be measured against dry air. You can use dry instrument air that has been reduced to barometric pressure as Reference air. If instrument air is not available, ambient air can be dried using the Gravitometer's integral Air Dryer.

Filtering Out Liquids

Use a commercial filter (25 microns) ahead of the regulator and Gas Sample Flowmeter to protect the instrument. Other precautions may be required to prevent liquids from entering the instrument. A Balston filter or equivalent may be necessary.

The Ranarex Gravitometer does not include the gas filter, pressure reducing regulator, or sample hose.

Do not operate the Gravitometer without first reading all Installation (Chapter 2) and Operation (Chapter 3) instructions.

Preparing the Dryer

The Air Dryer must be removed from its position in the upper left-hand side of the Gravitometer in order to fill it with Silica Gel.

1. Loosen the two (2) fasteners that secure the Dryer in place.
2. Pull out the plastic Dryer assembly from the instrument far enough so that the rubber tube can be removed from the elbow at the rear of the Dryer.
3. Remove the rubber plug on the front of the Dryer by lifting the lever (**do not turn the lever**) at the center of the plug.
4. Holding the Dryer horizontally with the front face up, use the funnel provided to pour Silica Gel into the spout.
5. Tap or shake the Dryer vigorously and continue to fill the Dryer to the base of the spout.
6. Replace the rubber plug, attach the rubber tube on the elbow at the rear of the Dryer, and replace the Dryer in the Gravitometer.

If the Dryer assembly is damaged, the entire assembly must be replaced.

The moisture capacity of the Silica Gel varies according to the atmospheric humidity and so it must be inspected at regular intervals. When the upper half of the narrow compartment shows a change from deep blue to a gray-pink color, replace the Silica Gel. To order Silica Gel, see "General Spare Parts" in Chapter 4.

Attaching the Outlet Hoses

When the Gravitometer is being operated in a confined space, such as inside a vehicle, the gas sample must be discharged outside the vehicle to prevent contaminating the operating space with noxious or hazardous gas and air mixtures.

- If you are only measuring gas below 1.000 relative density, attach a hose to the Light Gas Outlet port (Figure 2-2) on the upper right side of the Gravitometer case.
- If you are measuring gases above 1.000 relative density, attach a hose to the Heavy Gas Outlet port (Figure 2-2).

NOTE

These hoses must remain attached when checking the instrument "zero point."

Gas Filter

If the gas contains suspended particles larger than 25 microns, or if the gas is "wet," you must use a filter. If a commercial filter is not available, a suitable moisture trap can be made as follows:

- Vertically mount a piece of pipe that is 2.54 cm (1") diameter and 38 cm (15") long.
- Cap both ends of the pipe. Install a drain valve in the bottom cap.
- Install an inlet connection from the gas line 5 cm (2") from the bottom of the pipe.
- Place the outlet to the Gravitometer 5 cm (2") from the top of the pipe.
- Fill the pipe loosely with commercial No. 0 steel wool.

NOTE

Drain the trap frequently to keep the steel wool free from condensate.

Gas Temperature

If the gas sample is at a pressure above 100 PSIG, or if the sample flows through a temperature zone with a difference of -12 °C (10 °F) from the ambient temperature of the Gravitometer, you will need to adjust the sample temperature.

Adjusting Sample Temperature

Install a section of 1 cm (3/8-inch) metal tube that is 3 meters (10 feet) long and locate it near the Gravitometer case. The tube can be coiled or bent to suit the space available. The tube serves as a heat exchanger to heat or cool the gas sample.

Sample Gas Connections

Attach a pressure reducing regulator to the sample tap and then route the sample line to the Gravitometer. The sample line must be capable of delivering 12 SCFH gas, free of condensed liquids, at a pressure not exceeding 15 PSIG.

Use proper sample probes and sampling techniques as defined in ASTM, GPA, and API standards.

Operation

NOTE

Read this entire chapter before operating the Ranarex Gas Gravitometer.

Pointer Lock

CAUTION

The Ranarex Gravitometer has a Pointer Lock that must be kept locked at all times when the motor is not operating.

The lock exerts tension on the flexible tape that connects the Cam and the Reference Wheels. This tension maintains correct "tracking" of the tape when the motor is stopped. Keep the lock engaged when the motor is not in use but unlock it when you start the Gravitometer. Once operating the Gravitometer, you can engage the lock again right before you shut off the motor to avoid operating inconvenience and to prevent damage to the Gravitometer.

The "**LOCK**" position of the Pointer is at the upper right corner of the scale, near the 0.970–1.030 gradations. The position of the locking mechanism is shown by the arrow of the knob and the legends on the Gravitometer Front Cover.

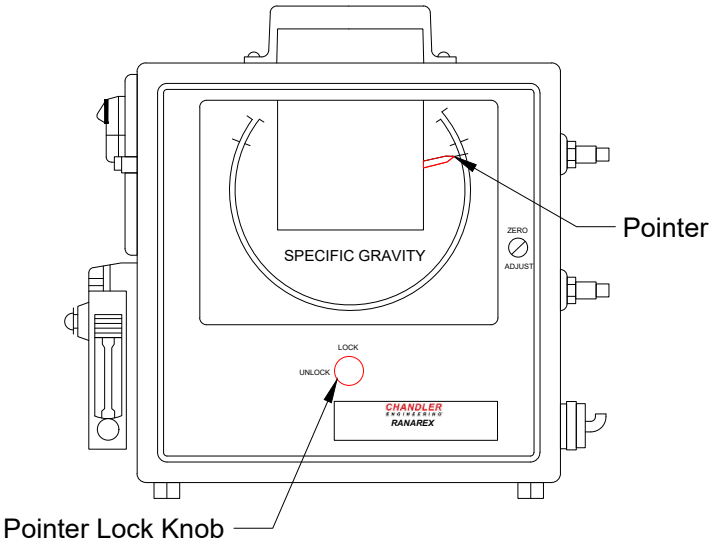

Figure 3-1.
Ranarex Gas Gravitometer Pointer/Pointer Lock Knob locations.

To check if the Pointer is locked, turn the knob to "**UNLOCK**" and see if the Pointer drifts downward. Turn the knob to the "**LOCK**" position and see if the Pointer snaps into its original position.

Operating the Ranarex Gas Gravitometer

The correct operating instructions for the Ranarex Gravitometer can also be found on the Instruction Plate over the center of the Indicating Scale on the instrument. To ensure instrument accuracy, follow the sequence of steps as listed.

Before starting the Gravitometer ensure that the:

- Pointer and Pointer Lock Knob are in the "**LOCK**" position.
- Gravitometer Selector Valve is in the "**0**" (zero) position.
- Silica Gel in the Dryer is in active condition (blue).
- Gas vent hose is connected and exhausted to a safe area.

Starting the Gravitometer

To start the Gravitometer:

1. *Gravitometer with Inverter:*
   Connect the Ranarex Gravitometer cord to the Inverter Outlet and turn the switch to On.

   Gravitometer without Inverter:
   Connect the Ranarex Gravitometer cord to the correct current.

2. Wait five (5) seconds. Turn the Pointer Lock Knob to "**UNLOCK**". Watch as the Pointer moves toward "**1.000**" reading.

3. Connect the regulator delivery to 15 PSIG maximum.

Reading the Gas

To read the gas:

1. Ensure that the Pointer reads "**1.000**" on air. If not, reset with the Zero Adjust screw.

2. For gas below **1.000**, turn the Selector Valve to "**LG**".
   For gas above **1.000**, turn the Selector Valve to "**HG**".

3. Connect the gas hose to the Flowmeter Inlet. Adjust the flow valve so the float rises to the approximate relative density.

4. Once the Pointer stabilizes, read the relative density.

Shutting Down the Gravitometer

To shut down the Gravitometer:

1. Disconnect the gas hose from the Flowmeter. Turn the Selector Valve to "**0**" (zero). Purge the Gravitometer to 1.000. Refer to the section "Purging to 1.000 After Measuring a Gas" in Chapter 3.

2. Firmly turn the Pointer Lock Knob to the "**LOCK**" position.

3. *Gravitometer with Inverter:* Turn switch to Off.

   Gravitometer without Inverter: Disconnect Gravitometer cord from current.

Helpful Operation Tips

Zero Adjustment

The Zero Adjust screw must be turned in the direction opposite to the correction required in the Pointer reading. For example, if the Pointer needs to move *clockwise* to "**1.000**" on the scale, turn the Zero Adjust screw *counterclockwise*. After making adjustments, allow the Pointer to stabilize.

*During normal operation, the Zero Adjust screw requires less than 1/4 turn to set the Pointer to "**1.000**". If more than 1/2 turn is ever required, stop the motor and investigate the cause.*

Never turn the Zero Adjust screw to the limit of the adjustments, clockwise or counterclockwise, with the motor On.

Response Time

When measuring gas at the normal flow rate of 12 SCFH, the response time to reach the final reading is 40–45 seconds. To reduce this time, you can operate at a higher flow rate. This can be done by adjusting the Flowmeter Valve so that the float reads higher than the actual gas relative density.

Over-Pressure Protection

If the Flowmeter Valve is opened before the Selector Valve is turned to "**LG**" or "**HG**", the valve cover will lift off the body of the instrument to relieve the pressure and will be reseated by the spring.

Purging to 1.000 After Measuring a Gas

The Gravitometer must be purged to bring the Pointer within the range of the Pointer Lock mechanism. If the Pointer starts toward "**1.000**", and then hesitates and remains at an intermediate reading, turn the Selector Valve halfway beyond zero ("**0**") towards the next position. If the Pointer then continues forward and reaches "**1.000**" check for an obstruction as described in the "Air and Gas Flow Checks" Diagnostic Flowchart in Chapter 4.

Maintenance and Troubleshooting

This chapter describes how to request technical support and authorization on returning equipment, and lists spare parts required for general and continued operation. This chapter also includes Diagnostics Flowcharts which can be used to check for possible problems with the Ranarex Gas Gravitometer and information about how to clean and replace parts in the Gravitometer.

Safety Considerations

Before performing any maintenance, service, or troubleshooting on the Ranarex Gas Gravitometer , review and follow all safety information in this manual. This information describes procedures to follow to avoid personal injury and/or damage to the equipment. ***All regulatory agency and personnel safety procedures for your jurisdiction must be followed.***

Personnel should be thoroughly familiar with the operation of the Gravitometer before performing the maintenance and troubleshooting procedures described in this section.

Before working on the Gravitometer, read the entire procedure you will be performing to learn how to safely perform maintenance or service the Gravitometer.

Aftermarket Excellence and Long-Term Commitment to Safety and Quality

Our goal is to make your experience with our products exceptional. We stand behind our analyzers with a broad service offering that provides a sense of security long after the initial purchase has been made. We commit to fulfilling your service needs with speed, quality, and professional consideration.

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Recommended Spare Parts Lists

This section lists the recommended spare parts to have readily available for the Ranarex Gas Gravitometer.

Operating Mechanism

Description	AMETEK Part No.	Chapter/ Figure No.
Impulse Wheel Bearing Locknut	CH302-02151	4-4
Upper Impulse Wheel Bearing	CH302-01920	4-4
Upper Impulse Wheel Shaft	CH302-01919	4-4
Zero Adjust Shaft and Sprocket	CH302-01927	4-4
Zero Adjust Chain	CH302-03280	4-4
Zero Chain Takeup	CH302-02147	4-4
Lower Impulse Wheel Shaft	CH304-01919	4-4
Lower Impulse Wheel Bearing and Sprocket	CH302-01921	4-4
Spacer Ring	CH188-14708	4-4
Grip Ring	CH188-14707	4-4
Retaining Ring	CH188-14706	4-4
Front Chamber Gasket	CH329-02218	4-4
Rear Chamber Gasket	CH329-02126	4-4
Impeller	CH302-04001	4-4
Impeller Bearing Assembly	CH300-00258	4-4
Idler Pulley with Bearing and Shaft	CH302-02658	4-5

General Spare Parts

Description	AMETEK Part No.	Chapter/ Figure No.
Spare Parts Kit, Portable	CH449-21100	—
Spare Parts Kit, Sour Gas	CH449-21100-SG	—
Gas Flowmeter	CH300-00046	4-2.1
Silica Gel, 6-16 mesh (1 required for refill)	CH300-00259	4-2.1
Dryer Box Assembly	CH300-00017	4-2.1
Window Gasket	CH357-01956	4-2.2
Window Glass	CH357-01955	4-2.2
Connecting Tape	CH302-02042	4-3.1
Drive Belt	CH187-11546	4-3.2
Motor and Capacitor, 115 V, 60 Hz	CH300-00256	4-3.2
Motor Pulley, 50 Hz Motor Pulley, 60 Hz	CH304-02298 CH303-02298	4-3.2
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Accessories

Description	AMETEK Part No.	Chapter/ Figure No.
Cordset, 115 VAC	CH302-03021	7-2
Cordset, 230 VAC	CH302-28714	7-3
Funnel	CH187-000299	—
Inverter, 12 VDC/115 VAC, 500 W, 60 Hz	CH300-27404	—
Inverter, 12 VDC/230 VAC, 1000 W, 50 ±0.5 Hz	CH300-28656	—
Transformer, Stepdown, 230–115 VAC	CH187-15033	7-1

Calibration Pulley

Description	AMETEK Part No.	Chapter/ Figure No.
Calibration Pulley (0.640 S.G.)	CH316-03031	4-3.2

Diagnostic Flowcharts

If the Gravitometer is reading incorrectly, AMETEK recommends that you perform the following tests and in the sequence they are listed in these Diagnostic Flowcharts.

The Diagnostic Flowcharts suggest possible causes and conditions of problems, and actions to take to correct the problems. Detailed information and assembly drawings that are intended to assist you when changing out parts can be found in appropriate sections in this chapter and/or in the *Documentation Package* folder shipped with the analyzer.

To ensure accuracy, the Gravitometer must meet the following conditions:

- There must be sufficient flow of gas sample and Reference air.
- The impellers must be rotating at the correct speed.
- The Pointer must move without friction.
- The Gravitometer must be free of internal leaks.
- The Air Dryer must be filled with active Silica Gel.
- The Gravitometer must be properly calibrated.

If you need to perform service on the Gravitometer, refer to the "Gravitometer Disassembly Procedure" in the Maintenance section in this chapter.

Air and Gas Flow Checks

Possible Cause/ Condition	Corrective Action
Gas Sample or Reference Air Flow Appears to be Stopped or Insufficient	1. Disconnect all inlet and outlet hoses, set the Selector Valve to "0" (zero), and purge the Gravitometer. Refer to the section "Purging to 1.000 After Measuring a Gas" in Chapter 3. 2. Verify that there is flow at the discharge ports. • If there is no obvious evidence of flow, disconnect the hose from the rear of the Air Dryer and retest. If flow is established, empty the Air Dryer, clean the outlet elbow, and fill the Dryer with new Silica Gel (6-16 mesh) and retest. • If there is no evidence of flow, remove the cover of the Selector Valve, inspect and clean the ports and channels of the cover and valve body. Retest. • If there is still no evidence of flow, it means that the passages inside the Gravitometer are obstructed. Remove the Rear Chamber Cover and check the passages that extend from the Impeller Bearing location to the elbows near the bottom of the chamber cover. Check the outlet tubes and nipples for both chambers.

Impeller Speed Check

The correct impeller speed is approximately 2800 RPM as measured with a strobe tachometer. If a tachometer is not available, remove the drive belt and verify that the Motor Pulley, Impeller Pulleys, and the Idler Pulley turn freely.

Possible Cause/ Condition	Corrective Action
Possible Impeller Speed Problems	• If the Impeller Pulleys do not turn freely, install a new Impeller Bearing Assembly (Part No. CH300-00258). See Figure 4-4. • If the Idler Pulley does not turn freely, install a new Idler Pulley (Part No. CH302-02658). See Figure 4-4. • If the Motor Pulley does not turn freely, replace the Motor (Part No. CH300-00256) must be replaced. See Figure 4-3.2.

Frictionless Indicator Response

Possible Cause/ Condition	Corrective Action
Possible Impeller Speed Problems	1. Remove the Front Cover and connect the Gravitometer to a gas sample. Record the reading. 2. Gently move the indicator to each side of the true reading and release. The indicator should return to the same reading from each direction within 0.001 relative density within 15 seconds. 3. If the indicator does not point to the same reading, clean and/or replace the Impulse Wheel Shafts and Bearings. • Remove the Front Chamber Cover of the operating mechanism and clamp it upright in a vise with smooth jaws in order to prevent damage. • Loosen the set screws in the hub of the Cam and Reference Wheels and draw the Impulse Wheels with shafts out of the bearings. *Caution:* *Take care to ensure that the Cam and Reference Wheels and the flexible tape are not damaged while they are removed from the Gravitometer.* • Tag the Impulse Wheels to indicate the chamber from which they were removed. • Polish the shafts with crocus cloth or fine steel wool. Do not bend the shafts. If the Impulse Wheel Shafts show a bright groove where they rotate in the jeweled bearings, or if the hubs of the Cam and the Reference Wheels show a groove where they have been drawn down against the ends of the Impulse Wheel, replace the shafts. • Use clean air to gently blow out the Impulse Wheel Bearings. Add a drop of instrument oil to both ends of each bearing. • Replace the shafts with wheels in their bearings in the correct chamber and turn them slowly. If the protruding portion of the shaft wobbles or if the wheel does not turn freely, replace the shaft with a new one. A bent Impulse Wheel Shaft will cause the Gravitometer to lose accuracy and sensitivity. • Attach the Measuring and Reference Wheels to the Impulse Wheel Shafts making sure that the set screws are tight on the flats of the shafts. *Note:* *A small amount of shaft end-play, 0.005"–0.010" (0.13–0.25 mm) maximum must exist to prevent binding.* • Verify that no parts of the mechanism have been bent and that there is no binding between parts.

Internal Leak Check

Possible Cause/ Condition	Corrective Action
There are no leaks on the external connections, but the relative density is dropping	1. Operate the Gravitometer connected to a gas sample and obtain a relative density reading at the far end of the measuring range. 2. Shut off the gas flow by closing the Gas Sample Flowmeter Valve. The indicator should remain steady or should not return towards 1.000 reading at a rate faster than 0.007 on the inner (RED) Scale in three (3) minutes. 3. If it does not meet this test, there is an internal leak. • To determine where the leak is located, stop the motor, remove the front and Rear Covers and disconnect the hose from the inlet port of the Selector Valve. • Individually pressurize (approximately 10 PSIG) the upper and lower chambers with gas and use a gas leak detector to find the leak. The leak may be caused by loose screws or a gasket that is damaged. • Verify that the Tygon tubes are not cracked or damaged. These tubes join the internal connector to the Selector Valve and to the elbows near the bottom of the Rear Chamber Cover.

Check the Indicator Balance

Possible Cause/ Condition	Corrective Action
Possible Impeller Speed Problems	The measuring mechanism is statically balanced by the manufacturer and does not change with wear or age. The balancing weights behind the cam should not be disturbed. However, if required, the balance can be verified and restored as described. 1. Stop the motor and remove the Front Cover. 2. Place the Pointer first at the right side of the Indicating Scale, then the bottom, and then the left side of the scale. At each position, tap the front of the Gravitometer case to eliminate static friction. The Pointer should remain stationary or move very little. If the Pointer drifts more than two (2) small gradations on the RED Scale, make adjustments to the balancing weights on the threaded rods to compensate for the difference. *Note:* *When loosening or retightening the balancing weight, use care to unsure that the threaded rods, Pointer, and Impulse Wheel Shaft are not bent or damaged.* Balancing the cam and mechanism is a trial and error process. The Pointer may be considered balanced if it remains steady or drifts only by two (2) scale gradations. *Note:* *After rebalancing, do not allow the weights to be moved. A drop of low-strength Loctite lacquer or fingernail polish on the weights and threaded rods will lock the adjustments in place.*

Check the Silica Gel in the Dryer

Possible Cause/ Condition	Corrective Action
Silica Gel used to dry the gas sample needs to be replaced.	If the Silica Gel is pink in color, it is exhausted and must be replaced. Remove and empty the Air Dryer. Refill the Dryer with new Silica Gel and reinstall.

Gravitometer Calibration

Possible Cause/ Condition	Corrective Action
Silica Gel used to dry the gas sample needs to be replaced.	The Gravitometer was accurately calibrated by the factory and the calibration does not change appreciably with wear or age. The adjustments should not be changed without first checking every other possible source of error. Calibration should proceed only if all other sources of error have been eliminated. *Note:* *Sometimes during calibration, repeatability problems may occur due to static friction. Gently tap the side of the Gravitometer case to eliminate the static friction.*

Preparing the Gravitometer for Service

If after reviewing the Diagnostic Flowcharts, it is determined that the Gravitometer requires internal adjustments or its parts needs to be replaced (for example, the Impeller Bearing), follow the procedures in this section to remove its covers and to prepare the Gravitometer for service.

NOTE

Follow the sections in sequence when disassembling the Gravitometer.

Removing the Front and Rear Covers

To remove the Front and Rear Covers:

1. Release the Pointer Lock and turn it to fully to the "**UNLOCK**" position. This sets the lock spring below the bottom of the Indicating Scale plate.

2. Loosen the eight (8) fasteners while holding the cover so that it does not drop on the Indicating Scale and Pointer.

NOTE

If the cover must be placed on a workbench, ensure that the inside face is facing up so to prevent damage to the locking spring.

3. To remove the Rear Cover, loosen the eight (8) fasteners.

Removing the Indicating Scale

If the Indicating Scale needs to be replaced, or removed to access other internal parts:

1. Set the Pointer to about 0.950.

2. Loosen the screws that secure the Indicating Scale by one (1) turn.

3. Lift the Indicating Scale so that the keyholes pass over the screw heads.

4. Move the Indicating Scale downward while holding it in until the right side clears the Pointer.

Removing the Front Chamber Cover

To remove the Front Chamber Cover:

1. Remove the eight (8) screws around the rim of both chambers.
2. Grasp the assembly by the Indicating Scale posts and the Zero Adjust screw and pull forward.
3. Place it on its right edge using the Zero Adjust screw to steady it.

When the assembly is leaning in this direction, take care to ensure that the Pointer is not bent.

Removing the Rear Chamber Cover

Remove the Front Chamber Cover before removing the Rear Chamber Cover.

To remove the Rear Chamber Cover:

1. Remove the belt and unscrew both Impellers from the front of the chamber. The impellers have right-hand threads.
2. Remove the ten (10) screws around the rim of the chambers.
3. Grasp the assembly by the bearing housing and pull away from the body.

   On a workbench, place the assembly down on its right edge, steadied by the Idler Pulley, or with both pulleys facing down.

Cleaning and Servicing the Selector Valve

If the sample Selector Valve becomes contaminated, you will need to clean and lubricate it. If contamination occurs regularly, use a gas filter to prevent contamination. See "Filtering Out Liquids" and "Gas Filter" in Chapter 2 for information.

Cleaning the Selector Valve

To clean the Selector Valve (see Figure 4-1):

1. Remove the screw at the center of the valve cover and withdraw the screw, both washers, the spring and cover.
2. Remove all of the old grease and other contaminants from the surface and channels in the cover and valve body.
3. Lubricate the faces of the cover and body with silicone-based grease.
4. Replace all parts.

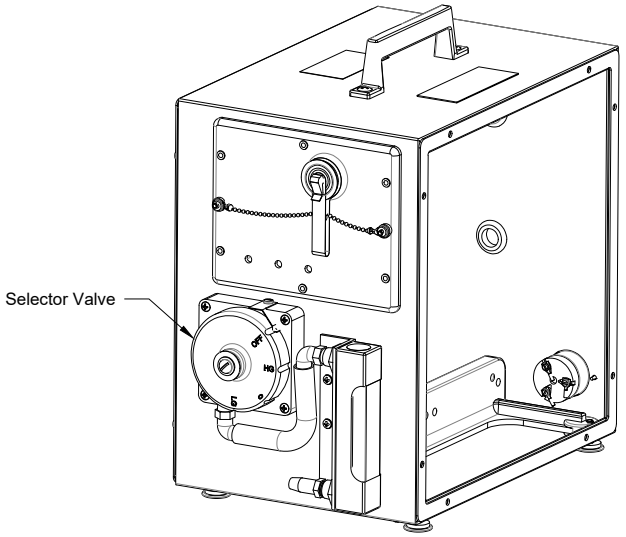

Figure 4-1.
Selector Valve, Gravitometer.

Polishing the Valve

If the valve cover or valve body become scored, you will have to lap/polish the mating surfaces to eliminate the scoring.

1. Clean both surfaces and then apply a fine valve grinding compound to them. Reassemble the valve.
2. Loosen the detent spring that engages the "**0**", "**LG**," and "**HG**"notches on the cover.
3. Rotate the cover on the valve body repeatedly beyond its normal operating range until the scoring is removed.
4. After the lapping/polishing operation, thoroughly clean, lubricate, and reassemble all of the parts.

Adjusting the Pointer Lock

If the connecting tape becomes loosened from the Cam or Reference Wheels while the Gravitometer is in transit, you will need to adjust the Pointer Lock.

To adjust the Pointer Lock:

1. Remove the Front Cover and check to see if the sides of the U-hook at the end of the lock spring are parallel with the inner face of the cover.

2. Ensure that the set screw is fully tightened in the shaft of the Pointer Lock Knob. If necessary, turn the spring and tighten the screw.

3. Remove the Indicating Scale and track the connecting tape on the Cam and Reference Wheels. Set the Pointer at approximately the "**1.000**" position.

4. Holding the Front Cover in the correct position on the Gravitometer casing, turn the knob toward the "**LOCK**" position to check if the U-hook straddles the radial edge of the cam. If necessary, bend the spring in the correct direction at the knob shaft.

5. Holding the Front Cover to the casing, turn the knob toward the "**LOCK**" position to check to see if the spring takes up the slack in the connection tape before the lower end of the spring snaps between the detent pins of the cover.

   If it does not work correctly as described, bend the upper section of the lock spring, at the knob, toward the cam edge or toward the left when viewed from inside the cover.

6. Hold the cover to the casing and check to see if the lower end of the lock spring snaps between the detent pins and is retained there. If necessary, bend the lower end of the spring towards, or away from, the Front Cover as required.

Cleaning, Adjusting, and Replacing the Connecting Tape

Tracking the Tape

To adjust the Pointer Lock:

1. Release the Pointer Lock Knob and remove the Front Cover and Indicating Scale from the Gravitometer.
2. If the tape does not track on both the Measuring and Reference Wheels, turn both wheels clockwise.
3. Replace the tape onto each wheel and set the Pointer to approximately 1.000.
4. Turn the Reference Wheel to take up the slack in the tape.

If the tape has fallen behind either wheel, extract it by rotating the wheel as necessary to avoid kinking the tape.

Cleaning the Tape

Use a tissue to wipe off any dust, fingerprints, or oil on the tape. At the same time, clean the rims of the Cam and the Reference Wheels.

Do not use cleaning fluid or solvent.

Replacing the Tape

1. Loosen the clip screws at the ends of the tape and remove the retaining clips from the rims of the Cam and the Reference Wheels to remove the old tape.
2. Hook the new tape over the screw heads and install the clips with the curved end pointing in the direction of the tape.
3. Adjust the tape flush with the edges of the wheels and tighten the clip screws.

Idler Bearing

Inspect the Idler Bearing, and replace it necessary, if it does not turn freely or becomes noisy (Part No. CH302-02658).

Replacing the Impeller Bearings

If the Impeller Bearings do not turn freely or they become noisy, replace the bearings. The bearings are included in the Impeller Bearing Assembly (Part No. CH300-00258):

When removing the Front and Rear Covers and the Front and Rear Chamber Covers, refer to "Preparing the Gravitometer for Service" earlier in this chapter.

To replace the Impeller Bearings:

1. Remove the Front Chamber Cover assembly, then remove the impellers and the Rear Chamber Cover assembly from the Gravitometer.

2. Temporarily reinstall the Front Chamber Cover assembly in the instrument to avoid damage while working on the bearings.

3. Install the new Impeller Bearing Assembly (Part No. CH300-00258). To do this:

    a. Remove the three (3) screws that secure the Impeller Bearing Assembly to the inside of the Gravitometer, and remove the Bearing Assembly from the Rear Chamber.

    b. Apply RTV or sealant to the mating surfaces and then install the new Impeller Bearing Assembly.

    c. Tighten the screws to secure the Impeller Bearing Assembly to the inside of the Gravitometer.

4. Replace the Rear Chamber Cover and then the Front Chamber Cover.

5. Replace the Front Chamber Cover assembly, then replace the Rear and Front Covers on the Gravitometer.

The procedure is complete.

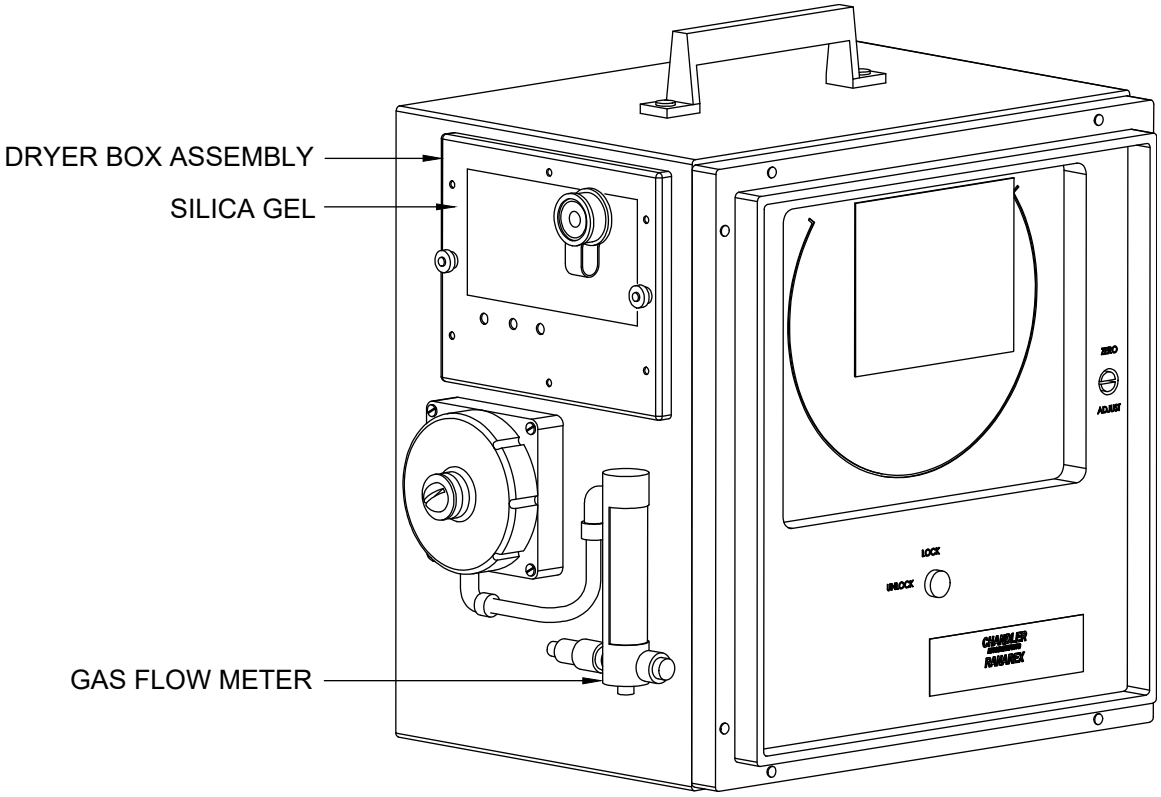

Figure 4-2.1.
Portable Gas Gravitometer.

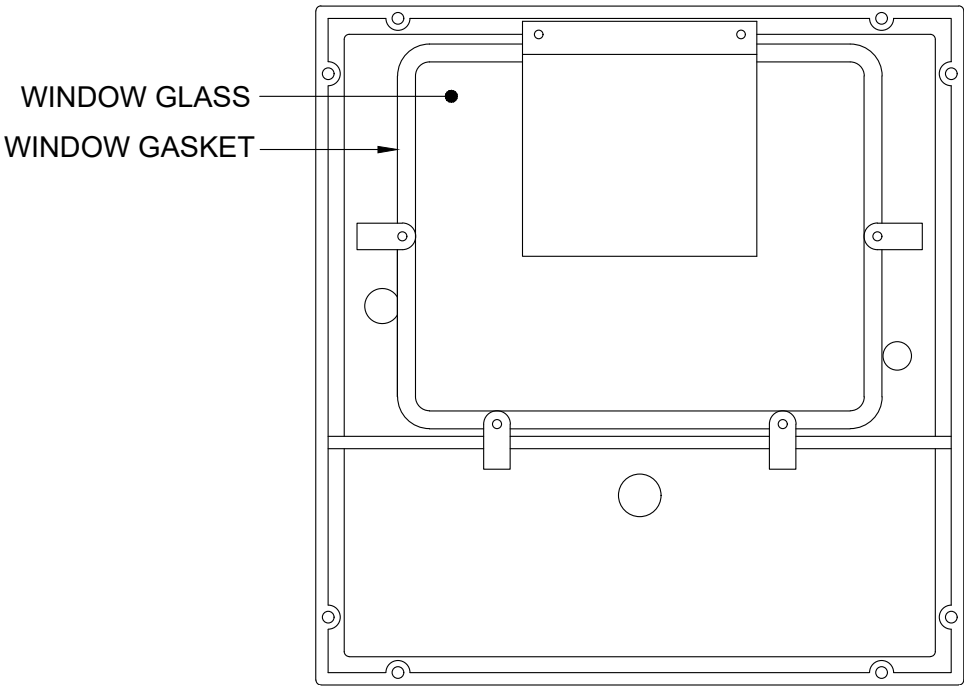

Figure 4-2.2.
Gravitometer, Front Cover, inside view.

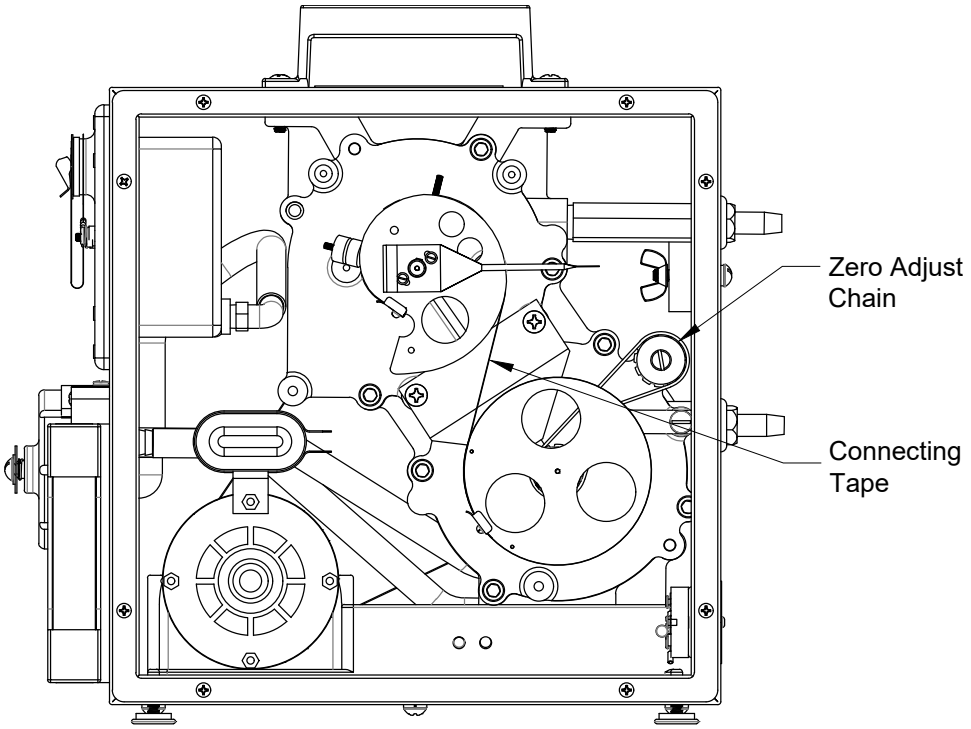

Figure 4-3.1.
Gravitometer, front view, cover removed.

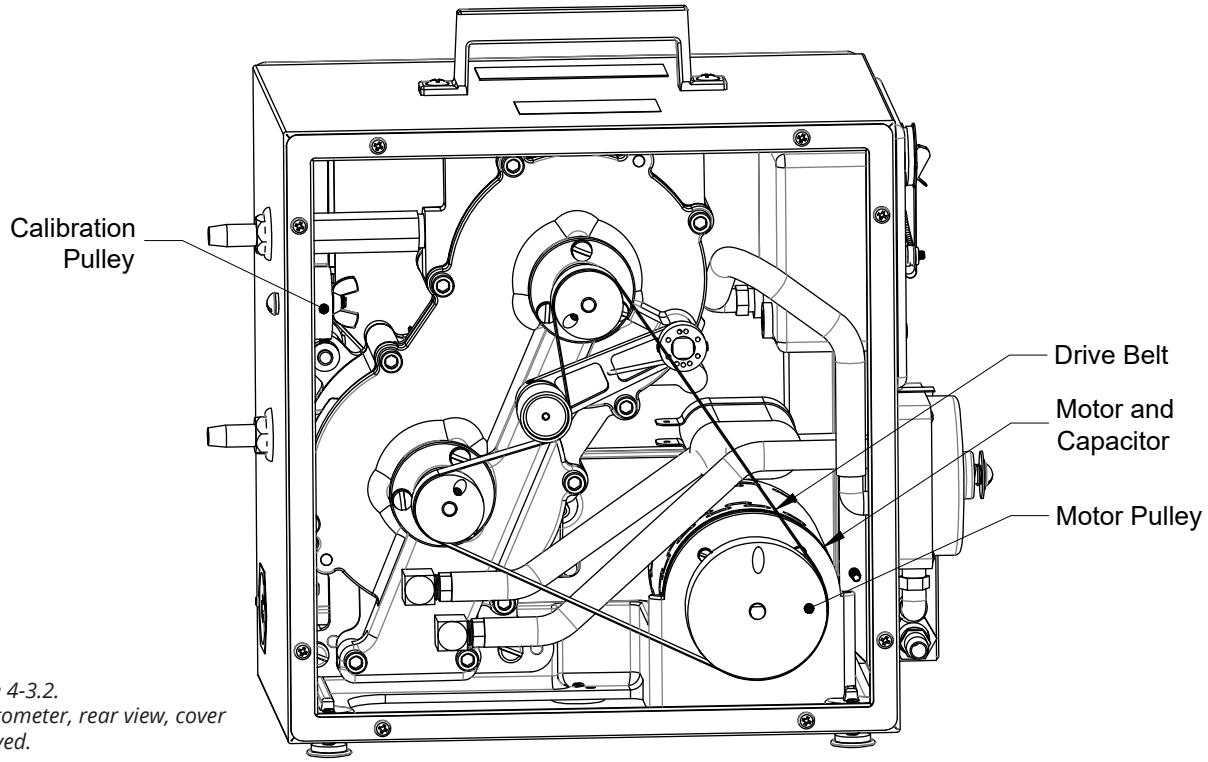

Figure 4-3.2.
Gravitometer, rear view, cover removed.

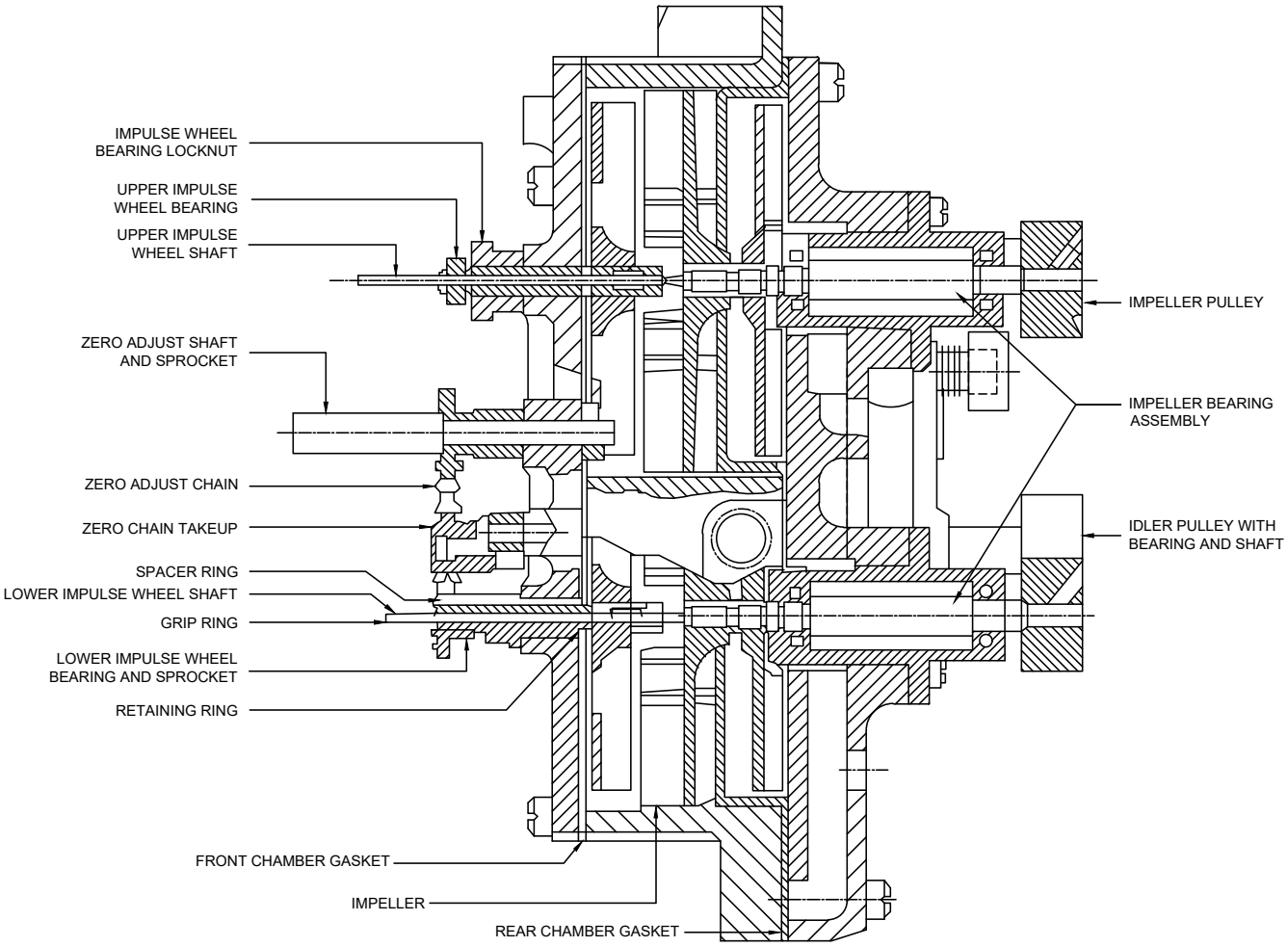

Figure 4-4.
Gravitometer, operating mechanism assembly.

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Specifications

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Specification	Description
Accuracy	±0.5 % of actual value
Readings	Indicating only
Drive Motor	115 VAC or 230 VAC, 50/60 Hz
Sample Flow Rate	15–20 SCFH
Sample Pressure	20 PSIG maximum
Specific Gravity Range	Dual Scale: 0.52–1.03 and 0.97–1.90
Ambient Air Reference Dryer	Silica Gel
Ship Weight	23 kg (50 lb)
Case	Portable with carrying handle.

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Calibration

Calibrating the Ranarex Gravitometer

There are three (3) adjustments used to calibrate the Ranarex Gravitometer.

Zero Adjust

This is the only adjustment required in normal operation. The Zero Adjust screw operates the chain, sprockets, and lower Impulse Wheel Bearing. When operating on air, the Impulse Wheel Bearing positions the lower Impulse Wheel longitudinally in the lower chamber to match the torque of the upper chamber. Refer to "Zero Adjustment" in Chapter 3.

Sensitivity

The longitudinal position of the upper Impulse Wheel in the upper chamber governs the sensitivity of the Gravitometer. The sensitivity adjustment requires loosening the 7/8-inch hex lock nut behind the Measuring wheel, turning the 1/2-inch hex head of the bearing in the correct direction, and then tightening the lock nut. Turn only one flat (1/6 turn) at a time and then retest.

Too Sensitive

If the Pointer is too sensitive, the sensitivity can be reduced by moving the upper Impulse Wheel closer to the front of the chamber. This is accomplished by turning the upper Impulse Wheel Bearing counter-clockwise.

Not Sensitive Enough

If the Pointer lacks sensitivity and there is no evidence of mechanical binding, sensitivity can be increased by moving the upper Impulse Wheel closer to the rear of the chamber. This is accomplished by turning the upper Impulse Wheel Bearing clockwise.

Span Adjustment

The Span of the Gravitometer is governed by the angular position of the Pointer on the Measuring wheel.

To allow adjustment, the Pointer is attached to the Measuring wheel by two (2) screws that pass through circular slots in the Pointer hub. If Span Adjustment is necessary, the Pointer is moved in relation to the Measuring wheel in the direction of the desired reading.

For example:
If the Pointer reads too high numerically on the RED Scale (too low on the BLACK Scale), the Pointer should be moved clockwise. Similarly, if the Pointer reads too low numerically on the RED Scale (too high on the BLACK Scale), the Pointer should be moved counterclockwise.

Before making an adjustment, mark the position of the Pointer hub on the face of the cam and then loosen the screws just enough so that the Pointer can be turned against slight friction of the washers under the screw heads without allowing it to slip freely. Make adjustments in small increments of two (2) or three (3) small gradations on the RED Scale at a time. Retest.

When either the sensitivity or the Span Adjustment is changed, you must reset the Zero Adjust to "**1.000**" on air.

Calibration Pulley

A Calibration pulley is fastened inside every new Gravitometer (Figure 6-1). This pulley can be used instead of a certified gas to check the calibration of the instrument. The pulley (Part No. 316-03031) is intended to make the Gravitometer read 0.640 theoretical relative density.

Because of the tolerance on the diameters of the pulleys, you must use the following test procedure to determine the exact relative density (±0.001) the pulley will produce.

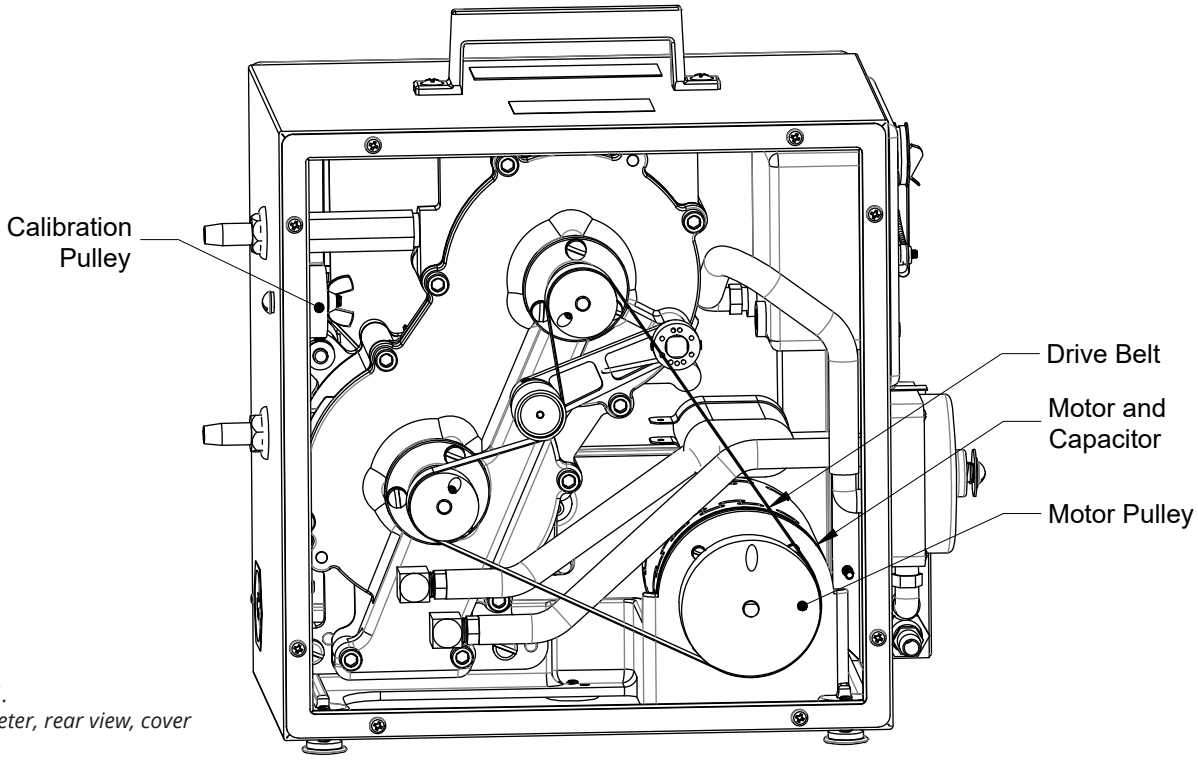

Figure 6-1. Gravitometer, rear view, cover removed.

Test Procedure for Calibration Pulley

1. Ensure that there is new Silica Gel in the Dryer and that the Selector Valve is on "**Zero**". If necessary, turn the Zero Adjust until the Pointer reads "**1.000**". Operate the Gravitometer.

2. Turn the power Off. Remove the upper Impeller pulley and measure its maximum diameter at the crown with a micrometer.

3. Measure the maximum diameter of the Calibration pulley at the crown using the micrometer. Install the Calibration pulley on the upper Impeller Shaft.

4. Continue to operate the Gravitometer without making any adjustments. Observe and record the relative density reading.

5. Divide the diameter of the standard upper Impeller pulley by the diameter of the Calibration pulley and square the answer. This value is the correct relative density reading.

   Example:
   Upper Impeller pulley diameter= 3.762 cm (1.481")
   Calibration pulley diameter = 4.699 cm (1.850")

$$\textbf{Correct Reading} = \left[\frac{1.481}{1.850}\right]^2 = \textbf{0.640 Relative Density (or Specific Gravity)}$$

6. If you need to test the calibration at different relative density values, a Calibration pulley is required for each test value. See the "Calibration Pulley" spare parts list in Chapter 4.

7. After completing the tests, replace the Calibration pulley with the standard upper Impeller pulley and store the Calibration pulley for future use.

Drawings

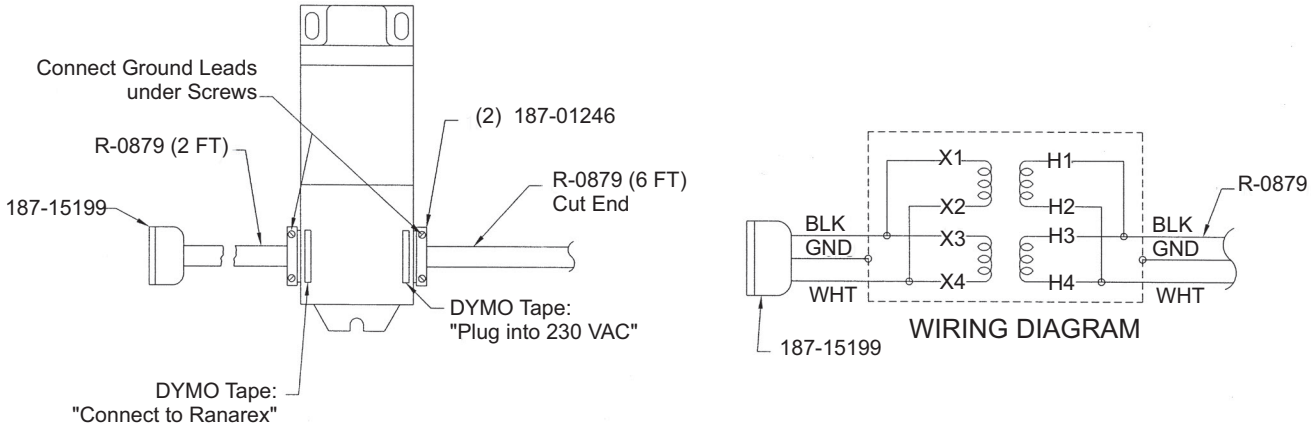

Figure 7-1.
Stepdown transformer with cables assembly (Part No. CH302-03025).

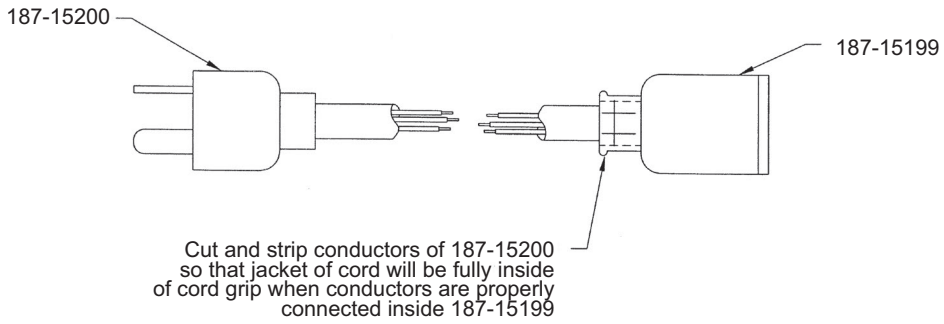

Figure 7-2.
Cordset, 3-conductor, 115 VAC (Part No. CH302-03021).

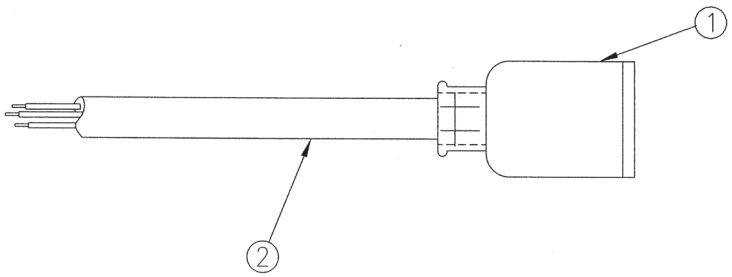

Figure 7-3.
Cordset, 3-conductor, 230 VAC (Part No. CH302-28714).

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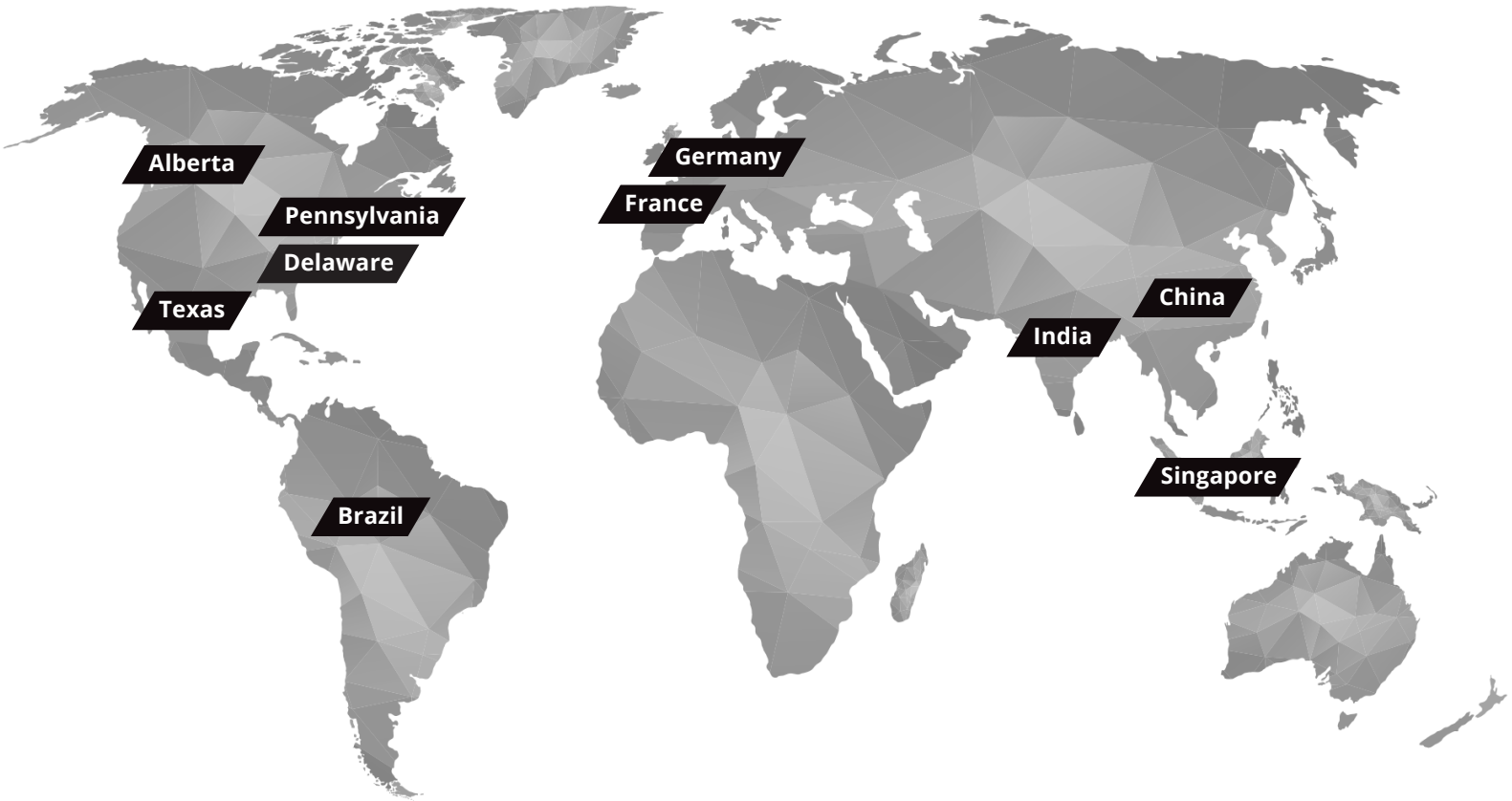

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