POLYGON INDUSTRIES LIMITED

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INSTRUCTIONS FOR

INSTALLATION

OPERATION

MAINTENANCE

INDOOR VENTILATED DRY-TYPE TRANSFORMERS

TRANSFORMERS

Installation and Maintenance of Indoor Ventilated Dry-Type Transformers

Ventilated dry-type transformers normally are designed for installation indoors in dry locations. They will operate successfully where the humidity is high but under this condition it may be necessary to take precautions to keep them dry if they are shut down for appreciable periods. Locations where there is dripping water should be avoided. If this is not possible, suitable protection should be provided to prevent water from entering the transformer case. Precautions should be taken to guard against accidental entrance of water, such as might be obtained from an open window, by a break in a water or steam line, or from use of water near the transformers.

Adequate ventilation is essential for the proper cooling of transformers. Clean dry air is desirable. Filtered air may reduce maintenance if the location presents a particular problem. When transformers are installed in vaults or other restricted spaces, sufficient ventilation should be provided to hold the air temperature within established limits when measured near the transformer inlets. This usually will require approximately 100 cubic feet of air per minute per kilowatt of transformer loss. The area of ventilating openings required depends on the height of vault, the location of openings, and the maximum loads to be carried by the transformers For self-cooled transformers, the required effective area should be at least one square foot each of inlet and outlet per 100 KVA of rated transformer capacity, after deduction of the area occupied by screens, gratings, or louvers.

Ventilated Dry-type transformers should be installed in locations free from unusual dust producing mediums or chemical fumes. Transformers should be located at least 12 inches away from walls or other obstructions that might prevent free circulation of air through and around each unit. The distance between adjacent transformers should not be less than the value. Also accessibility for maintenance should be taken into account in locating a transformer. If the transformer is to be located near combustible meterials, the minimum separations established by The National Electrical Code should be maintained.

The transformer case is designed to prevent the entrance of most small animals and foreign objects. However, in some locations, it may be necessary to give consideration to additional protection.

If noise is a factor in the location and operation of any transformers, special consideration should be given to the installation of the equipment.

The impulse strength of these transformers is less than that of liquid-immersed units of the same voltage class. If there is any likelihood that transformers will be exposed to lightning or severe switching surges, adequate protective equipment should be provided.

For derating factors which apply to installations at high altitudes, see 12.00.520 of American Standard C57.12.1956.

INSPECTION

New transformers should be inspected when received for damage during shipment. Examinations should be made before removing from cars or trucks and if any injury is evident or any indication of rough handling is visible, a claim should be filed with the carrier at once and the manufacturer should be notified.

Subsequently, covers or panels should be removed and an internal inspection made for injury or displacement of parts, loose or broken connections, cracked porcelain, dirt or foreign material and for the presence of free water or moisture. Corrective measures should be taken where necessary. Shipping braces should be removed if present.

After a transformer is moved, or if it is stored before installation this inspection should be repeated before placing the transformer in service.

Before placing in service, the operation of fans, motors, thermal relays, and other auxiliary devices should be checked.

HANDLING

Ventilated dry-type transformers can be handled very much like liquid-immersed transformers except that somewhat greater care may be required because of the lighter case. If it is necessary to handle these transformers outdoors during inclement weather they should be thoroughly protected against the entrance of rain or snow.

GROUNDING

The case and core assembly of these transformers should be permanently and adequately grounded.

TESTING

It is recommended that tests be made before placing a transformer in service to determine that it is in satisfactory operating condition and to obtain data for future comparison. The following tests are suggested as a minimum

(1) Insulation resistance

(2) Dielectric tests in the field in accordance with 10.2 of American Standard C57.12.91-1979

INSULATION RESISTANCE TEST

The insulation resistance test is of value for future comparative purposes and also for determining the suitability of the transformer for application of the high-potential test. The insulation resistance tests should be made before applying the high-potential test. Variable factors affecting the construction and use of dry-type transformers make it difficult to set limits for the insulation resistance. Experience to date indicates that 2 megohms, (one minute reading at approximately 25C), per 1000 volts of nameplate voltage rating, but in no case less than 2 megohms total, may be a satisfactory value of insulation resistance for the application of the high-potential test. If a transformer is known to be wet or if it has been subjected to unusually damp conditions, then it should be dried out before application of the high-potential test or before placing in service regardless of the insulation resistance.

ADDITIONAL TESTS

In addition to the insulation resistance and high-potential dielectric tests, the following tests may be made if desired.

(1) Ratio tests for the full windings and for all tap positions

(2) Resistance measurements of windings

(3) Polarity or phase relation

(4) Power factor of insulation

If any of these tests are made, it is preferable that they be made before applying the dielectric tests.

STORAGE

Transformers preferably should be stored in a warm dry location with uniform temperature. Ventilating openings should be covered to keep out dust. If it is necessary to leave a transformer outdoors it should be thoroughly protected to prevent moisture and foreign material from entering. Condensation and the absorption of moisture can be prevented or greatly reduced by the installation of space heaters or other small electric heaters.

MAINTENANCE

Periodic Inspection and Maintenance Like other electric equipment, these transformers require maintenance from time to time to assure successful operation. Inspection should be made at regular intervals and corrective measures taken when necessary to assure the most satisfactory service from this equipment.

The frequency at which these transformers should be inspected depends on operating conditions. For clean dry locations an inspection annually, or after a longer period, may be sufficient. However, for other locations; such as may be encountered where the air is contaminated with dust or chemical fumes, an inspection at three or six month intervals may be required. Usually after the first inspection periods a definite schedule can be set up based on the existing conditions.

With the transformer de-energized, covers over openings in the case should be removed. Inspections should be made for dirt, especially accumulations on insulating surfaces or for those which tend to restrict air

flow, for loose connections, for the condition of tap changers or terminal boards, and for the general condition of the transformer. Observation should be made for signs of overheating and of voltage creepage over insulating surfaces as evidenced by tracking or carbonization.

Evidence of rusting, corrosion, and deterioration of the paint should be checked, and corrective measures taken where necessary.

Fans, motors, and other auxiliary devices should be inspected and serviced during these inspection periods.

CLEANING

If excessive accumulations of dirt are found on the transformer windings or insulators when the transformer is inspected, the dirt should be removed to permit free circulation of air and to guard against the possibility of insulation breakdowns. Particular attention should be given to cleaning top and bottom ends of winding assemblies, and to cleaning out ventilating ducts.

The windings may be cleaned with a vacuum cleaner, a blower, or with compressed air. The use of a vacuum cleaner is preferred as the first step in cleaning followed by the use of compressed air or nitrogen. The compressed air or nitrogen should be clean and dry and should be applied at a relatively low pressure (not over 25 pounds per square inch). Lead supports, tap changers and terminal boards, bushings, and other major insulating surfaces should be brushed or wiped with a dry cloth. The use of liquid cleaners is undesirable because some of them have a solvent or deteriorating effect on most insulating materials.

DRYING OF CORE AND COIL ASSEMBLY

When it is necessary to dry out a transformer before installation or after an extended shutdown under relatively high humidity conditions, one of the following methods may be used.

(1) External heat

(2) Internal heat

(3) External and internal heat

Before applying any of these methods, free moisture should be blown or wiped off of the windings to reduce the time of the drying period

Drying by External Heat External heat may be applied to the transformer by one of the following methods

(1) By directing heated air into the bottom air inlets of the transformer case.

(2) By placing the core and coil assembly in a nonflammable box with openings at the top and bottom through which heated air can be circulated.

It is important that most of the heated air passes through the winding ducts and not around the sides. Good ventilation is essential in order that condensation will not take place in the transformer itself or inside the case. A sufficient quantity of air should be used to assure approximately equal inlet and outlet temperatures.

When using either of the first two external heating methods, heat may be obtained by the use of resistance grids or space heaters These may either be located inside the case or box or may be placed outside

and the heat blown into the bottom of the case or box. The core and coil assembly should be carefully protected against direct radiation from the heaters.

It is recommended that the air temperature should not exceed 110C Drying by Internal Heat. This method is relatively slow and should not be used if one of the other two methods is available.

The transformer should be located to allow free circulation of air through the coils from the bottom to the top of the case. One winding should be short-circuited, and sufficient voltage at normal frequency should be applied to the other winding to circulate approximately normal current.

It is recommended that the winding temperature not be allowed to exceed 100C, as measured by resistance or by thermometers placed in the ducts between the windings. The thermometers used should be of the spirit type because mercury thermometers give erroneous readings due to the generation of heat in the mercury as a result of induced eddy currents. The end terminals of the windings (and not the taps) must be used in order to circulate current through the entire winding. Proper precautions should be taken to protect the operator from dangerous voltages.

Drying by External and Internal Heat This is a combination of the two methods previously described, and is by far the quickest method. The transformer core and coil assembly should be placed in a nonflammable box, or kept in its own case if suitable, and external heat applied as described in the first method, and current circulated through the windings

as described in the second method. The current required will be considerably less than when no external heating is used but should be sufficient to produce the desired temperature of the windings. It is recommended that the temperatures attained not exceed those stated in the foregoing.

Use of Insulation Resistance for Determining Drying Time

Drying time depends on the condition of the transformer, size, voltage, amount of moisture absorbed, and the method of drying used.

The measurement of insulation resistance is of value in determining the status of drying. Measurements should be taken before starting the drying process and at two-hour intervals during drying. The initial value, if taken at ordinary temperatures, may be high even though the insulation may not be dry. Because insulation resistance varies inversely with temperature, the transformer temperature should be kept approximately constant during the drying period to obtain comparative readings. As the transformer is heated, the presence of moisture will be evident by the rapid drop in resistance measurement. Following this period the insulation resistance will generally increase gradually until near the end of the drying period when it will increase more rapidly. Sometimes it will rise and fall through a short range before steadying because moisture in the interior of the insulation is working out through the initially dried portions. A curve with time as abscissa and resistance as ordinate should be plotted and the run should be continued until the resistance levels off and remains relatively

constant for from three to four hours.

Insulation resistance measurements should be taken for each winding to ground with all windings grounded except the one being tested. Before taking insulation resistance measurements the current should be interrupted and the winding should be short-circuited and grounded for at least one minute to drain off any static charge. All readings should be for the same time of application of the test voltage, preferably one minute.

Cautions Constant attendance during the drying process is desirable. It is advisable to have a suitable fire extinguisher convenient for use in the event of an emergency.

OPERATION

Removal of Covers Over Openings Covers over openings in the transformer case should not be removed while the transformer is energized.

Effect of Humidity As long as the transformer is energized, humidity conditions are unimportant. In the event that a dry-type transformer is de-energized and allowed to cool to ambient temperature, consideration must be given to the possible effects of humidity.

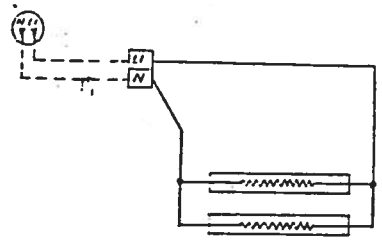
If the shutdown period occurs during low humidity conditions, no special precautions should be required before energizing the unit.

Experience indicates that if a shutdown exceeding 24 hours occurs during a period of high humidity, particularly if atmospheric conditions are such as to cause condensation within the housing, then precautions should be taken. Small strip heaters may be placed in the bottom of the unit shortly after shutdown to maintain the temperature of the unit a few degrees above that of the outside air. If such precaution has not been taken then the

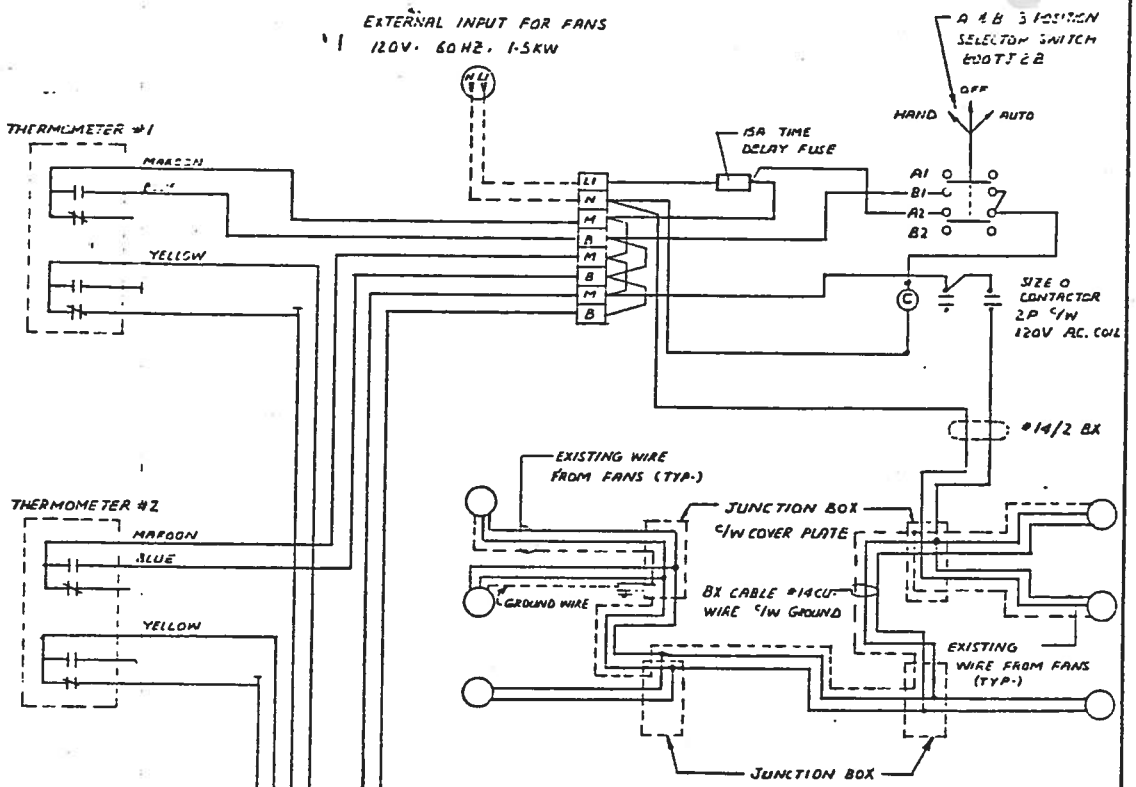
unit should be inspected for evidence of moisture, and insulation resistance should be checked. If there is evidence of moisture or if the insulation resistance is low, the transformer should be dried out by one of the methods described.

22049-2C REV. 1

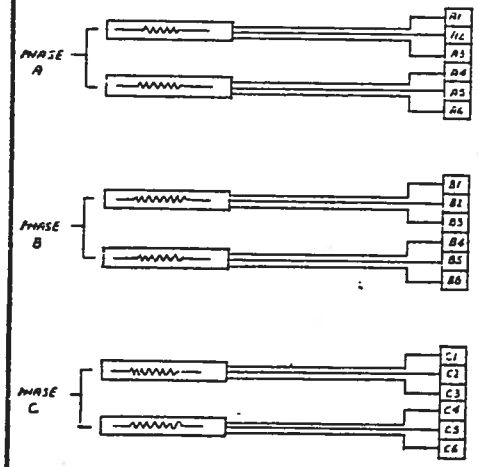
EXTERNAL INPUT FOR HEATERS. 600V. 60 HZ. 2KW



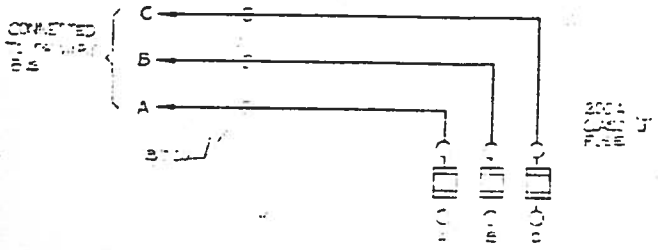
EXTERNAL INPUT FOR FANS
120V. 60 HZ. 1.5KW



RTD'S IN PRIMARY WINDING



HARMONIC FILTER BANK CONNECTIONS



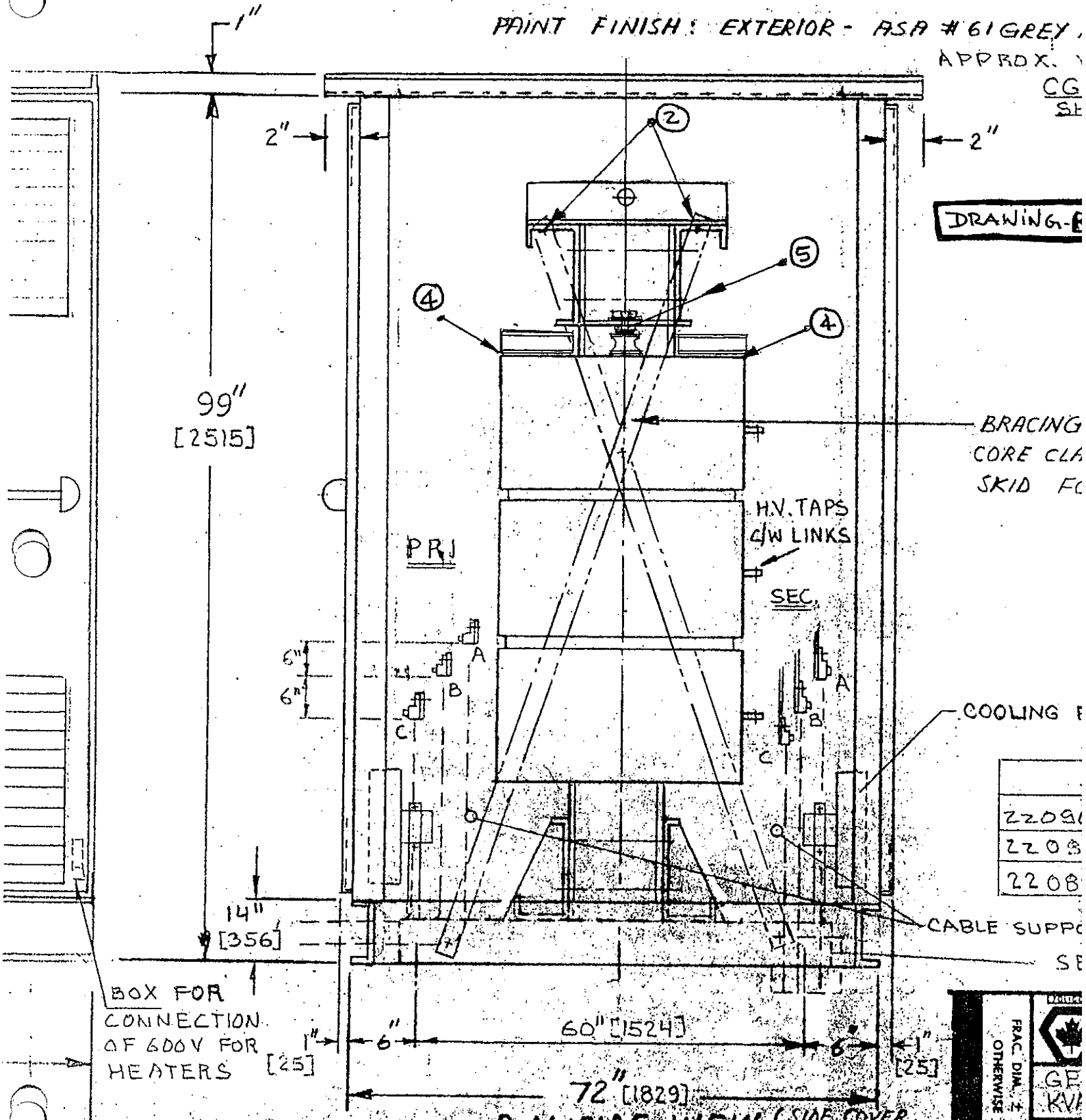
NO	REVISION	DATE	BY	APP'D

POLYGON INDUSTRIES LIMITED
50 NORTHLINE ROAD, TORONTO 16, ONTARIO

TYPE UE800 WI

DRAWING-B

1 - VENTILATED ENC
INSULATED GRA
1 - ANTICONDENSATIC
PAINT FINISH: EXTERIOR - ASA #61 GREY,
APPROX.
CG
SE



R.H. SIDE VIEW (SIDE COVER REMOVED)

NO	REVISION	DATE	BY	APP'D
A	CONNECTON BOX FOR RTDS & THERMOMETER ADDED	MAY 3/84	W.B.	

22091	
22083	
22081	

FRAC. DIM. ± 1/4" UNLESS OTHERWISE SPECIFIED

GE
KV
REQ.
DRAV
CHEC
APPR

2090-1C | REV. A

DRAWING-A