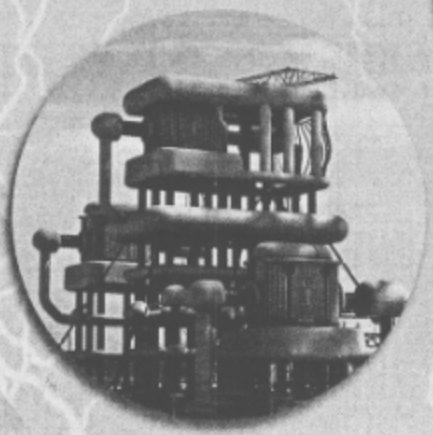
جمهورية مصر العربية
وزارة الكهرباء والطاقة
الشركة القابضة لكهرباء مصر

مركز أبحاث الجهد الفائق



التقرير الفنى رقم(٢٠٠٧/١٦٥)
بتاريخ ٢٠٠٧/١١/٨
بخصوص
اختبار كابل نحاس جهد ٢٢٠ ك.ف- قطاع
(١× ١٢٠٠مم²) مركب عليه عدد (٢) نهاية بورسلين ،
عدد (١) وصلة

الموقع : الكيلو ٢٧ طريق القاهرة - الاسكندرية الصحراوى
الموقع على شبكة الانترنت : www.pehvrc.com
بريد إليكترونى : pehvrc@pehvrc.com
تليفون : ٥٣٩٠٩٢٦ - ٥٣٩٠٧٣١ فاكس : ٥٣٩٠٧٢٨

المراسلة: قطاع البحوث والتصميمات
الشركة القابضة لكهرباء مصر
تليفون : ٢٦١٦٥٣٥-٤٠٢٩٨١٤
فاكس : ٤٠١١٦٣٠

TEST REPORT

REPORT No. (165/2007)

- ***CLIENT***: EGYTECH CABLES Co. (EL SEWEDY).
- ***Report Date:*** *08 /11 /*2007
- ***Place:***
  - Extra High Voltage Research Center.
  - *Internal code : TO – AC - 06 – 11 – 05 - 02*
- ***Requirements:***
  - Electrical type tests according to IEC 62067.
- ***Standard Specification:***
  - International standard IEC 62067 " Power cables with extruded insulation and their accessories for rated voltages above 150 kV (U_m= 170 kV) up to 500 kV (U_m = 550 kV)
- ***Description of the Specimen :***
  - Systems, cable and accessories consists of the following:

1- 130/230 kV Power cable with the following specification:

- Manufacturer : EGYTECH CABLES (EGC), Cairo, Egypt.
- Type : 130/230 kV/CU/XLPE/LEAD/HDPE /1 x 1200 mm2
- Year of Manufacture : 2005
- No. of Phases : 1
- Insulation : XLPE
- Conductor Material : Copper
- Conductor cross-section : 1200 mm2
- Screening Material : Lead
- Sheath Material : HDPE (ST_7)
- Sheath Color : Black
- Rated Frequency : 50 Hz

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2- *Tow 220 kV Porcelain termination with the following specifications:*

- Manufacturer : PRYSMIAN – CABLES & SYSTEMS
- Type : TPE 1245/O80 s.v.
- Serial Number : 41.147.2.050.
- Leakage path : 10770 mm.
- Porcelain height : 3160 mm.
- No. of sheds : 23 large and 22 small
- Greatest diameter of sheds : 580 mm
- Insulation material : Porcelain – type : NGK – SD-02, SE-09.
- Color : Brown.

3- *220 kV Sectionalized premolded joint with the following specifications:*

- Manufacturer : PRYSMIAN – CABLES & SYSTEMS
- Type : GMS 1245 CA/CK.
- Serial Number : 41.297.2.085.

- ***Description of the Equipment:***
  - High voltage reactor – 400 kV – 5000 KVA – 50 Hz – Type: (RSK) – Serial No. 204322/99.
  - PD detector – Type: (TE57).
  - Tan δ measurement devise – Type 254/321/02 Serial No. 144281.
  - Standard capacitor – Type NK400 Serial No. 434321.
  - Impulse voltage generator 2400 kV – 180 kJ – Type SGV 2400/180 SPZ.

- ***Test Samples:***
  - Test sample were choose under the responsibility of the client.

- ***Tests:***

  - **Electrical Type Tests on Completed Cable:**
    1- Check on insulation thickness of cable for electrical type tests
    2- Bending test on the cable followed by installation of accessories and partial discharge test at ambient temperature.
    3- ***Tan δ*** measurement.
    4- Heating cycle voltage test.
    5- Partial discharge test:
       - At ambient temperature.
       - At high temperature
    6- Lightning impulse voltage test followed by a power frequency voltage test.
    7- Resistivity of semi-conducting screens.
    8- Tests of outer protection for buried joints.
    9- Examination of the test assembly.

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- ***Test Method and Results:***

  - **Electrical Type Tests on Completed Cable:**

    1- Check on insulation thickness before electrical type tests:

    - Prior to the electrical type tests the insulation thickness was measured in accordance with clause 12.4.1 of IEC 62067.
    - The measured value of the insulation thickness is shown in the following table:

Average thickness (mm)	Specified thickness (mm)	Requirement
25.5	25	The average thickness of the insulation doesn't exceed the specified value by more than 5%

2- Bending test on the cable followed by installation of accessories and partial discharge test at ambient temperature:

2.1 Bending test:

- The test cable was subjected to a bending test at ambient temperature in accordance with clause 12.4.4 of IEC 62067. The test cable was bent around a test cylinder. The diameter of the cylinder was 4.19 m. The test consisted of three cycles. The test object was bent for one complete turn. It was then unwound. The process repeated, except that the bending of the sample was in the reverse direction..

Outer diameter of cable D (mm)	Diameter of conductor d (mm)	Requirement of bending diameter < 25(D+d)+5% (mm)	Hub diameter of drum (mm)
118	43.7	< 4244.6	4190

2.2 Partial discharge test:

- After bending test the terminations were installed on the cable and the test assembly was subjected to a partial discharge test at ambient temperature in accordance with clause 12.4.5 of IEC 62067. The test voltage was raised gradually to and held at 1.75 U_o for 10 s and then slowly reduced to 1.5 U_o.
- The measured value of the partial discharge level is shown in the following table

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Applied voltage (kV)	Duration (S)	Max. Partial discharge level (PC)	Measured partial Discharge level (PC)
227.5	10	--	--
195	--	≤ 5	2.9

- *The test assembly passed the test.*

3- Tan δ measurement:

- Another sample test cable was subjected to a tanδ measurement in accordance with clause 12.4.6 of IEC 62067. The test assembly was heated by passing a current through the conductor until it reached a steady temperature, which was 98 °C. The tan δ was measured at a power frequency voltage of U_o at the temperature specified above.

- The measured value of the partial discharge level is shown in the following table

Applied voltage (kV)	Maximum allowable value for *tan δ* (x 10^{-4})	*tan δ* (x 10^{-4}) [Measured value]
130	10	5.52

- *The cable passed the test.*

4- Heating Cycle Voltage Test:

- The test assembly was subjected to a heating cycle voltage test in accordance with clause 12.4.7 of IEC 62067. The test assembly was heated by passing a current through the conductor until it reached a steady temperature, which was 98 °C. The heating was applied for 8 h. The conductor temperature was maintained within the stated temperature limits for 4 h of each heating period. This was followed by 16 h of natural cooling. The cycle of heating and cooling was carried out 20 times. During the whole of the test period a voltage of 2 U_o was applied to the test object.

- The result of the heating cycle voltage test is shown in the following table.

No. of heating cycles	Required conductor temperature (°C)	Heating		Cooling time (h)	Applied voltage continuously (kV)
		Total heating time (h)	Duration of heating at 98 °C (h)		
20	95 ≤ t ≤ 100	8	4	16	260

- ***The test assembly passed the test.***

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5- Partial discharge test:

5.1 At ambient temperature:

- After the last heat cycle, partial discharge was measured for the test assembly at ambient temperature in accordance with clause 12.4.5 of IEC 62067. The measurement was carried out as mentioned above under item 2.2.
- The measured value of the partial discharge level is shown in the following table.

Applied voltage (kV)	Duration (S)	Max. Partial discharge level (PC)	Measured partial Discharge level (PC)
227.5	10	--	--
195	--	≤ 5	1.4

- ***The test assembly passed the test.***

5.2 At high temperature:

- After test assembly was subjected to a partial discharge test at ambient temperature, partial discharge was measured for the test assembly at the conductor temperature 98 °C in accordance with clause 12.4.5 of IEC 62067. The measurement was carried out as mentioned above under item 2.2.
- The measured value of the partial discharge level is shown in the following table:

Applied voltage (kV)	Duration (S)	Max. Partial discharge level (PC)	Partial Discharge level (PC)
227.5	10	--	--
195	--	≤ 5	0.23

- *The test assembly passed the test.*

6- Lightning impulse voltage test followed by a power frequency voltage test:

6.1 Lightning impulse voltage test:

- The test assembly was subjected to a lightning impulse voltage withstand test in accordance with clauses 12.4.9 of IEC 62067. The test was performed on the test assembly at a conductor temperature of 98 °C. The cable withstood 10 positive and 10 negative voltage impulses with crest value of 1050 kV without failure.
- *The test assembly passed the test.*

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6.2 Power frequency voltage test:

- After the impulse voltage test, the test assembly was subjected to power frequency voltage test of $2U_o$ for 15 min. in accordance with clause 12.4.9 of IEC 62067.
- The result of the power frequency voltage test is shown in the following table

Applied voltage (kV)	Frequency (Hz)	Duration (min)	Observations
260	50	15	No breakdown

- *The test assembly passed the test.*

7- Resistivity of semi-conducting screens:

- The measurement of the resistivity of the semi-conducting screens was carried out in accordance with clause 12.4.11 of IEC 62067. The resistivity of extruded semi-conducting screens applied over the conductor and over the insulation was determined by measurements on test pieces taken from the core of a sample of cable as manufactured and a sample of cable which has been subjected to the ageing treatment to test the compatibility of component materials specified in IEC 62067. The measurements were made at a temperature of 90 °C.
- The result of the resistivity of the semi-conducting screens are shown in the following table:

Item	Unit	Requirement	Measured/ Determined
Conductor screen			
- without ageing	Ωm	≤ 1000	92.3
- after ageing	Ωm	≤ 1000	43.6
Insulation screen			
- without ageing	Ωm	≤ 500	2.5
- after ageing	Ωm	≤ 500	4.1

- *The cable passed the test.*

8- Tests of outer protection for buried joints

- After completion the above tests the joint that still on the cable was immersed in water to a depth of 1m at the highest point of the outer protection in accordance with clause D.3 (Annex D) of IEC 62067. The total of 20 heating/cooling cycles was applied by raising the water temperature to 70°C and maintained at this temperature for 5 hours and then permitted to cool to 10 °C above the ambient temperature.

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- After completion the heating cycles and with the joint still immersed in the water, the following tests were carried out:

a- DC voltage test:

- The test voltage of 20 kV d. c. was applied for 1 min. in accordance with clause D.4.2.1 (Annex D) of IEC 62067 between the metallic sheath (Lead) of the power cable, at either end of the accessory and also between the metallic sheath and the earthed exterior of the joint outer protection (the water).

- The result of the test is shown in the following table:

Water immersion and heat cycling			d. c voltage test		
No. of heating cycles	Required water temperature (°C)	Heating time (h)	Applied voltage (kV)	Duration (min)	Observations
20	$70 \leq t \leq 75$	5	20	1	No breakdown

- ***The joint passed the test.***

b- Impulse voltage test

- After completion the DC voltage test the joint that still on the cable was immersed in water, the joint withstood 10 positive and 10 negative voltage impulses with crest value of 30 kV between the metallic sheath and the earthed exterior of the joint outer protection (the water) without failure.

- After the previous test the joint was removed from the water, the joint withstood 10 positive and 10 negative voltage impulses with crest value of 60 kV between each metallic sheath

- ***The joint passed the test.***

9- Examination of the test assembly.

- After completion the mentioned test above the test assembly was examined. The termination was examined in accordance with clause 12.4.10 of IEC 62067.

- ***The terminations were revealing no signs of degradation, leakage, corrosion or harmful shrinkage.***

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- ***Conclusion :***

  - ***The Systems, cable and accessories consists of 130/220 kV/ CU/XLPE/LEAD/HDPE/ 1x1200 mm^2- power cable manufactured by EGYTECH CABLES Co. (EL SEWEDY), tow 220 kV Porcelain termination manufactured by PRYSMIAN – CABLES & SYSTEMS type: TPE 1245/O80 s.v and 220 kV Sectionalized premolded joint manufactured by PRYSMIAN – CABLES & SYSTEMS type: GMS 1245 CA/CK fulfilled the requirements of electrical type tests mentioned in this report according to IEC (62067).***
  - ***The user must be ensured that the non-electrical type tests were carried out on this cable.***

- ***Notes:***

  - Tests were carried out on the above specimens only without any responsibility concerning other untested specimens.
  - The tests were carried out without any obligation on Egyptian Electricity Holding Company.
  - This test report shall not be reproduced except in full, without written approval of EHVRC.

- ***TEST ENGINEERS:***

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GENERAL MANGER

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1-11-2007

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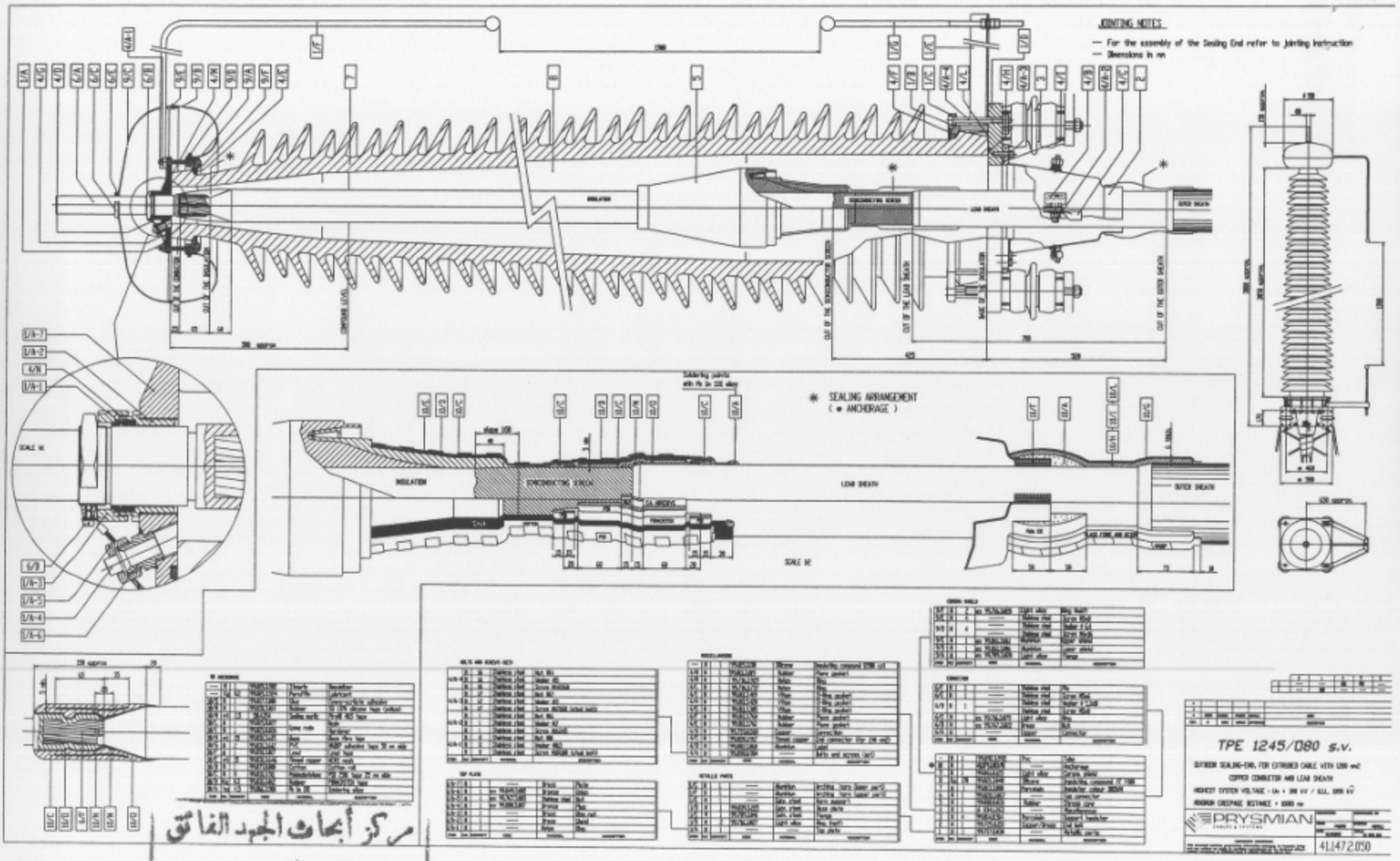
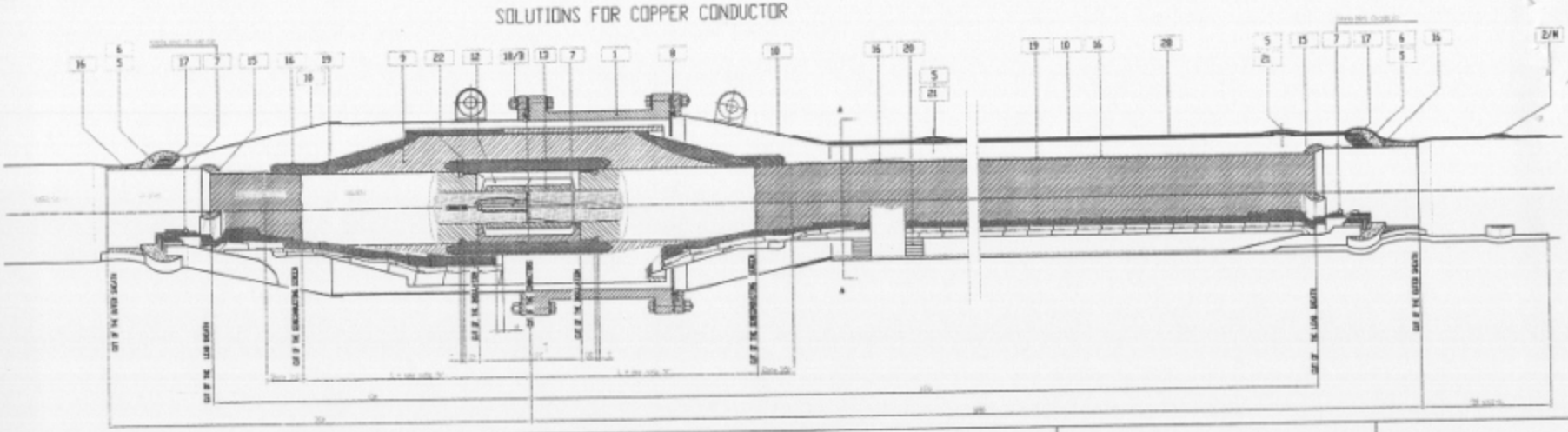


مركز أبحاث الجهد الفائق

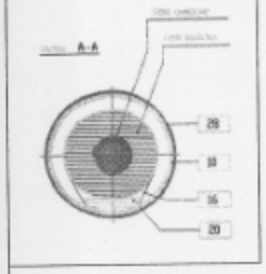
مرفق رقم / ٢

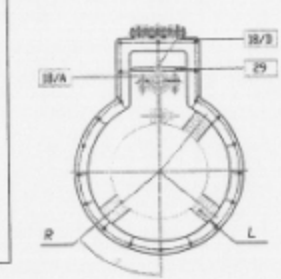
للتقرير الفني رقم ١٦٥ / ٧٠٠

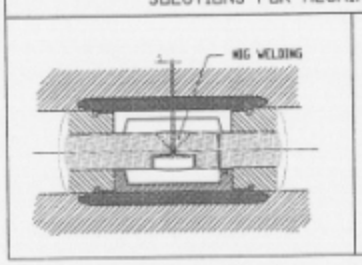
SOLUTIONS FOR COPPER CONDUCTOR

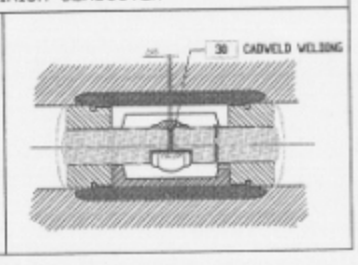


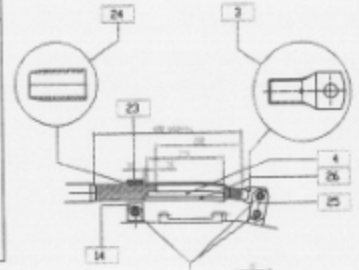
SOLUTIONS FOR ALUMINIUM CONDUCTOR

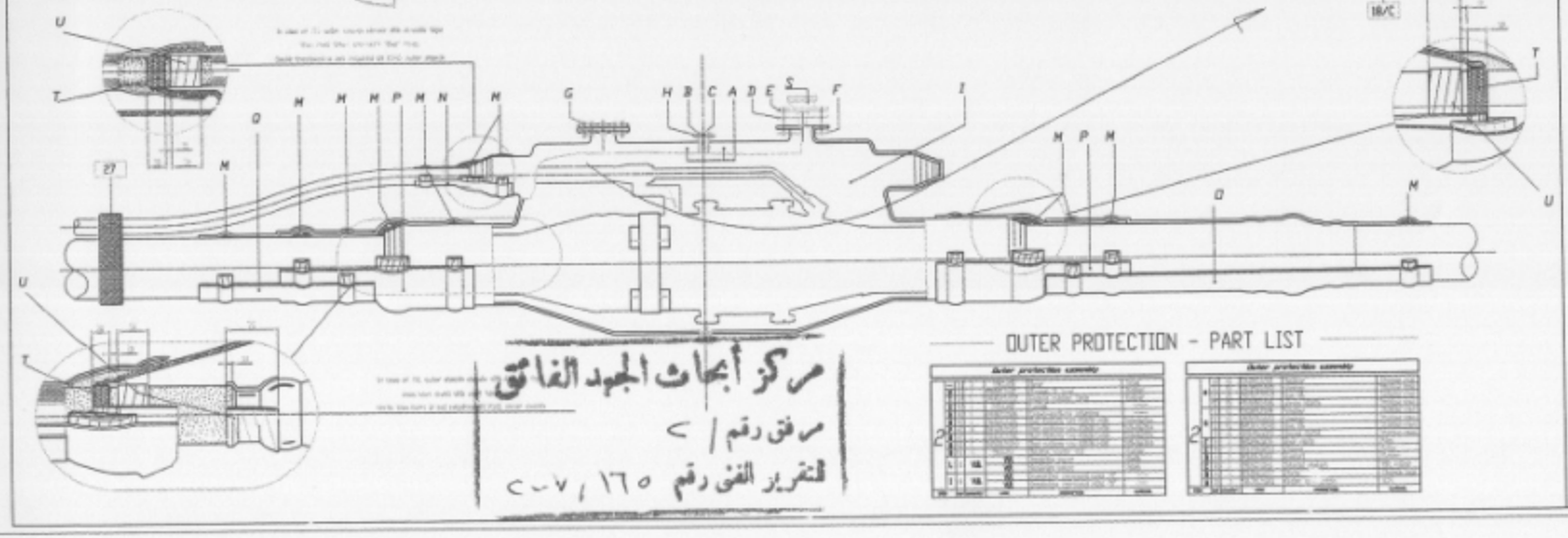












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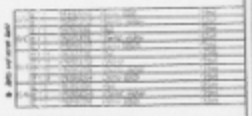
مرفق رقم / ٢

التقرير الفني رقم ٢٠٠٧/١٦٥

OUTER PROTECTION - PART LIST

NOTES



GMS 1245 CA/CK