INSTRUCTIONS

FOR

THE INSTALLATION AND THE USE

OF THE

LOAD CELL

Mod. **S/N**

For the Series: 500QD – 500QDT – QB700 – LD – LT – HC 2000 – BC 300- MD 5000 – - MB 400 – MR 400 – AP 7000 – ME – MF – 942 (Liftsentry) – LCR 200

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INDEX

NOTICE

EC CONFORMITY DECLARATION

Applied Directives: 89/336/CEE modified by Directives 92/31/CEE and 93/68/CEE

Standard to which is declared the conformity:

EMC: EN 50081-2: 1994 - Generic emission standard
EN 55011
EN 50082-2: 1995 - Generic immunity standard
ENV 50140
ENV 50141
EN 61000-4-4
EN 61000-4-2
EN 61000-4-8
ENV 50204

Manufacturer: DS Europe srl

Address: via F. Russoli, 6 Milano (Italy)

Type of product: Amplified estensimetric transducers

Models: Series 500 QD; Series LD-LT; Series ME-MF; Series AP 7000 – Series MD5000

Year of mark's apposition: 1997

The product has been tested in a typical configuration, as prescribed in product's instruction manual.

DS Europe srl declares that the overlisted product complies with the requirements of the EMC Directive over mentioned.

DS Europe srl
Technical Direction

Milano, 25/11/98

1) PRELIMINARY REMARKS

1.1 This instruction manual is an integral part of the supply-order and it is delivered with the material, even if not listed on the invoice.
Moreover, it is sent, under request, during the negotiation, whether the Customer tells about the installation or about the use of the cell.
When several cells are supplied, the quantity of manuals could decrease to one copy, if not requested the contrary.

1.2 The transducers described in the present manual have been designed for general purpose applications and, consequently, it is not possible to specify for all the possible applications specific limits of use.

Under the technical impossibility to ascertain the limits of use, it becomes obligatory for the Customer to put in progress all the safety rules and accessories in order to avoid: damages to Persons and things and damages for stopping of plants, etc.

In case of risky uses, it is obligatory for the Purchaser and for the User to inform immediately the Supplier so that he may suggest safety solutions or he may refuse the order and the supply.

1.3 The load cells are only elements of machineries or plants; they are sold in thousands pieces/year, for disparate applications having them to satisfy different specifications and standards unknown to the Supplier.

Under these circumstances DS Europe is compelled to refuse any responsibility for the use, just listing, also on this manual, the most and common precautions for a correct use of its products.
Furthermore it is pointed out the need for a complete and focused insurance coverage particularly when these machinaries have as final destination U.S.A. and Canada.

1.4 DS Europe load cells have an high professional quality, they are robust and are designed for the best in safety and in reliability: the cautions and limitations listed in this manual want to suggest and to remember to the Customer the importance to avoid damages.

1.5 In the case of instructions and of data different among them, has priority and validity: first what enclosed with the transducers; second that is listed in this instruction manual, last what is listed in the bulletin. Our revisions are done following these priorities.

2) TERMINOLOGY

OF THE FINAL TEST CERTIFICATE

2.1 REMARKS:

The final test certificate is issued only in English. The various data are processed and printed directly by the computer, so without subsequent manipulation. As a result they appear with all the decimal numbers (no rounding) although, sometimes, the last digits are not-significant.
Positive polarity is not indicated, but negative polarity is shown by a minus sign.
The test is done in compression nevertheless differently indicated.
The following text comments only the main parameters of the certificate.

2.2 RATED CAPACITY:

It is the maximum weighing capacity. The unit of measure is the Kilogram force = Kgf = 0,9806 daN, (daN = decaNewton) where 0,9806 is the gravity in Milan.

2.3 SENSITIVITY:

It is expressed in V/V FS (FS = full scale). It is the output voltage when the cell is supplied with 1 Volt and it is subjected to a weight equal to the full scale capacity value.

2.4 CALIBRATION EQUIVALENT LOAD VALUE:

Shorting the yellow and green leads simulates a load on the cell expressed in Kg on the "test certificate" (Excitation = 10 V).

The procedure for calibrating the electronic weighing system is as follows:
Introduce the calibration signal. Adjust the span (=gain) of the signal-conditioner until the digital display shows the calibration value. Remove the calibration signal and check the zero; if the zero needs further adjustment still continue the procedure with successive approximations.

2.5 E = EXPONENT OF 10:

An example clarifies better the meaning of this datum:

2.5.1 Sensitivity: 2.01146E-03 V/V FS means: $2{,}011.10^{-3}$ V/V FS = 2,011 mV/V FS.

3) TESTS THROUGH IN-PROCESS OPERATIONS

Through in-process operations of the cells, at least, 5 operational tests are done, including also: the strain gauge bridge continuity, the insulation against the body of the cell and the stability of measure.

When finished, the cells are submitted to several thermal and mechanical cycling; then, during the final test certification are controlled: the zero unbalance, the creep, the return to zero, the validity and the stability of the technical specifications.

Periodically, samples taken from production, are submitted to a full cycle of tests, in order to verify conformity of the production to product's specifications..

For the overlisted all the cells are delivered perfectly working as clearly declared even in the "final test certificate".

4) WORKING PRINCIPLE OF THE CELLS

4.1 FORCE MEASURED:

All the load cells (single - axis) measure the force only in the direction of their weighing axis (= measuring axis). The component vector-forces on other directions not only are not measured but they can deform the cell, they introduce supplementary errors and they can destroy it. When a cell is used in a scale or in a weighing system, it is submitted to the vertical gravity-force due to the weight (= mass) to be measured, therefore the weighing axis of the cell has to remain perfectly vertical in all the loading and measuring conditions.

4.2 DISTANCE BETWEEN THE FORCE AND THE WEIGHING AXES:

From this point of view the load cells are divided in 4 different categories:

4.2.1 In a load cell are acting 2 vector-forces: the *force to be measured* applied to the cell and the *reaction force* of the fixing plane. Both these forces are the resultant (as value and as direction) of many distributed forces.
Important: the positions of the barycentre (= point of origin) and of the directions of these two forces must not change during the application of the load; moreover both these two forces and the axis of measure of the cell must coincide or must be parallel among them depending on the principle of working of the cell.
Conditions different from the overlisted decrease of many times the quality of the measure.
For the overlisted important and necessary is the preload on the base of the cell against the fixing base.

4.2.2 ***Series QB 700 and Series 500 QD:*** (for scales): with a flexing parallelogram.
The point of application of the force can be far, from the weighing axis of the transducer, up to several centimeters in the QB 700 (see bulletin) and few centimeters in 500 QD.
This distance is increasing with the area of the flexing parallelogram.

4.2.3. ***Series MB 400 - MR 400 - MD 5000 – LCR 200:*** with working principle = shear.
The point of application of the force can be far 2÷3 mm from the weighing axis of the transducer, with an error still acceptable for most of the industrial applications.

4.2.4. ***Series LD-LT - HC 2000 - BC 300 – ME – MF - LCR***: with working principle = flexion.
The point of application of the force can be far 1÷2 mm from the weighing axis of the transducer, with an error still acceptable for most of the industrial applications.

4.2.5 ***Series AP 7000 :*** with working principle: tension and compression.
The point of application of the force can be far only 1 mm from the weighing axis of the transducer, with an error still acceptable for most of the industrial applications.

Remarks: from the overlisted: category 4.2.1. can accept the weighing pan directly connected to the cell. For the other categories (from 4.2.2 to 4.2.5) it is always important the use of accessories (spherical joints, chains, etc.) in order to obtain that both axes always coincide.

5) CAUTIONS FOR THE INSTALLATION AND FOR THE USE OF THE CELLS

5.1 PRELIMINARY REMARKS:

Have to be avoided risks of damages to Persons and things and damages due to the stopping of machineries and of plants.

For risky uses, during the negotiations or before the installation of the cell or when known, it is obligatory for the Purchaser and for the User to supply this information so that DS Europe can renounce to the order and to the delivery of the goods or to give, under the full responsibility of the User, instructions to reduce or to cancel the risks.

Note: This chapter is referred mainly to high load (= FS) cells.

5.2 CATEGORIES OF RISKS IN THE USE OF THE CELL:

All the accessories introduced to reduce the risks of the use of a load cell have not to introduce a "by-pass" to the measuring force; they have to act not over the 50% for the FS (= full scale); they have to bear overloads at least 10 times the FS of the cell and they have to apply a symmetric and balanced action in case of operation.

5.2.1 *Compression load cells:*

The use in compression is usually less risky and, when possible, it is preferable to convert the tension applications into compression ones.
The accessories for the overload and for the torque protections, etc. are made by metal blocks complete of distance regulation. They are low cost components manufactured directly by the Customer.
The free play is regulated for an action around 20% over the FS.

5.2.2 *Tension load cells:*

The use in tension is usually risky, especially for hanging loads.
They need the best care to avoid damages.

In order of priority for tension applications, can be used the Series AP 7000 (the most advisable), the Series MD 5000, and last, the Series LT, BC 301 – BC 305 (only for static tension applications).

For cells used in tension, two complementary stopping blocks have to be actuated:

- ***Overload protector (= block):*** on which the cell goes to lay for the measure deformation when the overload exceeds about 20% over the FS (= full scale).
  It has to be robust, stiff and in position to bear at least 10 times the FS.
  Usually it has a play adjustment so to act when the overload reaches the 20% over the FS.

- Block in case of rupture of the cell: this is made by chains, flexible metal cables, etc., usually in a group of 2-3-4 symmetrical pieces.

- **Note**: even when the internal parts of the transducers include overload-protections, in case of danger, external overload protectors must be applied.

5.2.3 ***Use of the cells under shocks, bumps and vibrations:***

Under shocks, bumps and vibrations the applied force is always the product of the mass applied to the cell multiplied by the acceleration (F = ma) and the cell is easily loaded over the max acceptable limit and it could break.

The risk of damages is high and always not-qualifiable and submitted to the frequency and amplitude of the vibrations, to the resonance of the structures, to the fatigue processing of the materials, etc., usually unknown.

The ***main cautions*** to be taken are the following:

- Never use the cell for a force over 25% FS.

- Select a cell more suitable to accept overload (e.i.: prefer the Series AP 7000; on contrary the Series LT, BC 301 – BC 305 are only for strictly static measures).

- Insert overload and stopping blocks as listed in paragraph 5.2.2. Each block has to bear loads at least 10 times the full scale of the cell and higher loads in case of free fall or shocks.

- For hanging loads has to be introduced also a dumping system to reduce starting tears and hunting joints to avoid torsion and transversal loads.

- By mechanical or by design tricks avoid that the cell and the structure connected enter into resonance also for short periods of start and stop of the machine (e.g. Series LCR 200). If necessary increase the full scale of the cell.

All these accessories have to be scaled and made by the Customer, in relation to the applications and the standards imposed.

6) MECHANICAL CONNECTION OF THE CELL

6.1 FIXING AREA OF THE CELL (See again the paragraph 4.2.1):

The fixing area of the cell has to touch the fixing base always **in all its points.**
Errors, even of 20÷30% FS, may occur from separated contact points which number and position change the axis of force in relation to the applied load.

The ***main installation cares to be taken*** are the following:

6.1.1 fixing base in high strength steel with thickness, at least, 1,5 times that of the cell.

6.1.2 Contact surface flat and finely machined.

6.1.3 Interposition between fixing area and fixing base of a layer of silicon grease or of silicon sealing: to obtain a uniform and extended contact of the two surfaces.

6.1.4 Very important: Strong clamping of the screws by dynamometric wrench: to obtain an uniform and extended contact. Use only high strength steel socket head screws and lock washers with external teeths.

6.1.5 For the load cells with low full scales (up to 50 Kg), during the installation, avoid overloads and torsions that may damage the cell even if it is not electrically connected.

6.2 *The underlisted cells need particular instructions:*

- ***Series LD-LT***: all the cares overlisted are very important. Changing the numbers and position of the fixing points can strongly decrease the quality of the cell.

- ***Series HC 2000***: The contact of the upper fixing area has to be uniform and extended to **all the loading area**. The use of a thrust spherical bearing is imperative.

- ***Series MD 5000***: The contact on all the surface of the two external bearings (and not only on two external contact lines) is imperative; the same on the central loading surface.
  The cell has to work always as a supported beam never as a restrained beam even when different dilatation coefficients of the materials and great temperature changes occur.

▪ ***Series LCR 200***: The radial load cell (= tensiometer) is made up by 3 separated parts: the fixing base, the central measuring body, the lid. The measuring axis of the cell coincides with the axis of the connector connected to the axis of the grub screw on the central body (opposite to the connector).
Make the holes and screw them on the structure in which the cell will be settled. Split the cell in its parts. Fasten the fixing base by high strength screws. Assemble the separated parts and position the measuring axis of the cell with the resultant of the forces to be measured.
The body of the cell can rotate, about ±10 degrees, on its axis. Before the final clamping of the screws of the lid rotate the measuring body so to obtain the maximum electrical signal output from the cell: this maximum value means the coincidence of the weighing and of the measuring axes. Now make the final clamping of the fixing screws of the lid and of the grub screw on the central body.

Important: during the transport and the installation, the cell has not to be submitted to overloads that can destroy it.

Where possible, it is imperative to settle overload protectors (= blocks) in all the directions (x-y-z) between shaft or cylinder and frame or other fix points of the machine.

The overload protectors (blocks) have to be taken away in normal operation.

For the *electrical connection* of the not amplified cell: see chapter 7.

▪ ***Series BC 300***: *Central pin***:**
The measuring force has to be applied only on the pin and not on the diaphragm, also for the models BC 301 – BC 305 with screwed pin.
Moreover the weighing force has to coincide with the pin axis without any transversal component of the applied force.

External circular bearer:
The support and the fixing has to be limited only to the external circular crown without extending to the internal area of the cell.
The setting can be done in several ways: by epoxy cements or by an housing without cement.

Housing: by an hollow with diameter 0,3÷0,6 mm larger than the cell. Smear the bottom by a thin layer of silicon grease. *Important*: assure at least 0,2÷0,3 mm gap for the deformation of the measuring diaphragm). Smear the bottom and the gap between cell and housing by a thin layer of silicon grease.

- ***Mod. 942 (flexion link) - Liftsentry***: Fasten the link on a surface stressed to flexion (from 10 to 20 Kg/mm²), if necessary, reduce the section of the structure.
  Choose a measuring point far from junctions by screws or rivets (weld them) the two fixing surfaces must be coplanar and finely machined without paint. Smear on them a thin layer of epoxy cement. Tighten diagramally the screws by a dynamometric wrench.
  The hysteresis and the non-return to zero of the measure show a slipping of the surfaces. Do not take care of an high residual out-of-zero: set it to zero by software or by the zero regulation.

  To increase the flexion of the link the User can apply the following installation tricks (increase the flexion: up to 2 times):
  - Two spacer blocks (height: 10÷15 mm.): each settled under the fixing ends of the link. They increase the distance from the neutral axis of the structure.
  - Two spacer-extension blocks: each settled as above. They increase either distance from the neutral axis (as above) or the distance between the fixing ends of the link.

  Both the blocks have to be welded to the structure. They are made by the User or supplied by DS Europe.

6.3 PANS, PLANES AND STRUCTURES OF WEIGHING (see again the paragraph 4.2.1):

- **Cells with pan directly connected and solid with the load cell** (e.i..: QB 700):
  The pan has to be very stiff. Flexions of about 1 mm at the edges may reduce even 10 times the measure accuracy.
  To avoid increase of weight of the pan: bending beads or the use of aluminium die-casting pans are suggested.

- **Cells with overhanging structures** (e.i..: Series LD - MB 5000 – HC 2000 - ME –MF – BC 300):
  The applied force has to be always coincident with the weighing axis. Transversal components of the force or torque moments introduce errors and may damage the cell.
  Are advisable: the use of saddles (LD Series), spherical heads, thrust spherical plain bearings (HC 2000), rod ends, etc. and of stiff and strong overhanging structure welded together and never connected by screws or riveted joints.
  A flexion or a displacement of few millimetres of the baricentre of the applied force may introduce errors of 5÷20% FS.

6.4 WEIGHING SYSTEM WITH SEVERAL CELLS (see again the paragraph 4.2.1.):
The distance among the cells brings to the solution of the following installation problems:

Important: with several cell systems use only not-amplified load cells (see par. 8.1.2).

6.4.1 ***The radial movement*** between the upper structure of the cell and the lower one, due to the difference of the thermal and mechanical expansion of the two structures: this problem is usually limited as the *upper structure* is, in general, in steel and the *lower structure* (= the bed-plate) is in the same metal or in reinforced concrete which has the same coefficient of thermal expansion of the steel.
If possible, for round reservoirs, lay radially the reinforcing rods. The remaining expansion difference may be compensated by saddles, or by thrust spherical plain bearings or by roller plates.

6.4.2 ***Flexion of the upper structure due to the load***: it is compensated by strengtherming of the structure, by tie rods, by rod ends, by spherical bearings, etc.
In case of weighing vertical reservoirs, if possible, settle the shelfs with the load cells at half the height, that is, at the same elevation of the baricentre of the tank.
In general, the technical cares applied on the installation are important elements to define the quality results of the weighing system.

7) ELECTRICAL CONNECTIONS FOR NOT-AMPLIFIED CELLS

7.1 CABLE OR CONNECTOR ?

For outdoor applications and for all the industrial environments, the cable connection is preferable.

The mating connector, even if sealed, has always inside dead volumes with air and the air, due to the thermal variations, exchanges humidity which, in long periods, brings oxidations on the electrical contacts, electrical jumpers of moist dust acting directly on the strain-gauge bridge and, consequently, introducing shifts of the zero and instability of the measure.

7.2 CONNECTION BY CABLE - COLOURS OF THE LEADS (see Note 1.5):

Standard length: 2 meters. Connection: by coloured leads.

- ***For all the Series*** :

  Excitation: + red - black. Signal output: + green - white.
  Calibration: yellow (with green)
  Code of the colors: as for ISA S37.8-1975.
  The screening sheath is not connected to the body of the cell.

7.3 CONNECTION BY CONNECTOR - NUMBER OF CONTACTS (see Note 1.5):

- ***For all the series:***

  Excitation: +1 -4; Signal output: + 2 -3.
  Calibration: 5 (with 2).

- ***For the Series QB 700:***

  Excitation: +2 -4; Signal output: + 1 -3.
  Calibration: 5 (with 1).

7.4 EXCITATION OF THE CELL:

The standard and recommended voltage is: 10 V stabilized.
The cells can accept up to 15 V.
The upper voltage value is limited: by the heat dissipation capability of the sensors, by the ambient temperature and by the warm-up time wanted.
In the " final test" the cells are tested with excitation: 10 V.

Exceptions are the button cells models BC 301 – BC 302 – BC 303. Due to their extreme compactness and its poor thermal dissipation capability, it is advisable an excitation voltage from 1 to 5 Volts.
To increase the thermal dissipation: bond the cell at the base by conductive cement and, by conductive silicon grease, fill the air gap between the upper surface of the cell (= diaphragm) and the weighing surface (separated together by the thickness of the central weighing pin).

7.5 SIGNAL CONDITIONER:

Are recommended amplifiers with high stability; linearity, low noise and thermal drift; with high impedence ($\geq$ 1 Mohm) and differential input (Mod. EL 525 – EL 521 – 694A).

The "span" (= gain) regulation has to be large enough to convert, on a digital display, the electrical signal outputs into physical values (Kg, tons, etc.).

The signal conditioners with microprocessor are preferable (Mod. AN 201 - AN 401 – EL 642 - 698).

8) ELECTRICAL CONNECTIONS FOR AMPLIFIED LOAD CELLS

8.1 PRELIMINARY NOTES:

8.1.1. The Series 500 QD; LD; LT; AP 7000; ME; MF; LCR 200, can be supplied with an amplifier inside.
The *Series AP 7000* are supplied only amplified. The cells AP 7000 have, intentionally, an original sensitivity without amplifier of 1 mV/V FS (instead of 2mV/V FS), that is, they are underloaded so to increase to the double the value of rupture load.

8.1.2. In weighing system with several cells and a summing unit, **use cells not amplified** with a summing signal unit including a stabilizer and an amplifier (e.i.: Mod. EL 574 complete with external case). (See also par. 6.4).
The amplified cells are not suggested as they are, usually, at different temperature conditions and the thermal drift of each amplifier and of each stabilizer, even if low, may add together in the summing unit.

8.1.3 To satisfy the CE directives the amplified load cells have not the calibration lead.

8.2 CHOICE OF THE INTERNAL AMPLIFIER:

Two categories of amplifiers are available of which are listed the advantages and the disadvantages.

8.2.1 *Voltage amplifiers:*

- A 5 = supply voltage: from 10,5 V to 28 Vcc; Signal output = ± 5 Vdc FS

- A 10 = supply voltage: from 18 V to 28 Vcc; Signal output = ±10 Vdc FS

The Model -A5 is preferable to the Model -A10, as the heat to be dissipated inside the cell is lower.

- *Advantages:*

  - The *Voltage stabiliser*, inside the cell, keep insensible the excitation of the cell to the voltage drops due to the length and to temperature changes of the connection-cable. With power voltages around 15 Vdc, distances cell/electronics of several kilometres are acceptable !

  - The *internal amplifier* and the high voltage output (± 5 V) bring the signal insensible to the external noise (great S/N ratio).

- *Disadvantages:*

  none.

8.2.2 ***Current amplifier*** (see paragraph 8.6 and further diagram): (2 - wires)

- A 4 = supply voltage (= V_{ps}): from 15 to 40 Vdc; Signal output: 4-20 mA; 1-5 V

- *Advantages:*

  - As for the voltage amplifiers (-A5; -A10).
  - Saving (insignificant) of a lead in the connecting cable.

- *Disadvantages:*

  - Low output signal from the strain-gauge bridge, very high amplifier gain and, consequently, high sensitivity to the electrical disturbances of the signal before amplification.
    In fact: excitation of the bridge (at zero load) =V=RI = $350 \cdot 3 \cdot 10^{-3} = 1{,}05$ V;
    when, R= bridge resistance = 350 Ohm; I= 3mA (see Note below)
    From which: bridge output signal = $2 \cdot 1{,}05 = 2{,}1$mV FS
    against $2 \cdot 10 = 20$ mV/FS of the -A10 amplifier) (about 10 times less).

  - Limitation on the choice of the further electronics.
    Note: the total circuit at zero load is 4mA of which about 3 mA for the bridge and about 1 mA for the internal current amplifier.

8.3 ELECTRICAL CONNECTIONS FOR AMPLIFIED CELLS:

The table lists the colours of the leads of the cable and the numbers of the pins of the connector.
The amplified load cells are supplied by cable excepted the Series AP 7000 and LCR 200 that can be supplied also with connector.

Connection		**Version**	- A5	- A 10	- A 4
Lead	Pin	Output	0÷ ±5 V	0÷±10 V	4-20 mA
Red	1		+ excitation	+ excitation	+ excitation and signal
Black	4		Common	Common	Common
White	3		Output	Output	Output: 1-5 V
SCREENING SHIELD:			not connected to the body of the cell		

In order to maintain the greatest protection against electromagnetic disturbances, in relation to CE mark, for the amplified load cells is duty for the User/Installer the grounding of the cable screen toward the electronic side and the grounding of the metallic body of the load cell.

8.4 ZERO AND GAIN REGULATIONS:

8.4.1 *Important:* the gain (= span) regulation is done at the final test by DS Europe and it cannot be regulated by the Customer. A regulation of it changes the values of sensitivity and of calibration listed on the "final test certificate" enclosed with the cell.

8.4.2 Wait for a warm-up period of, at least, 30 minutes before doing the regulation of the zero and the further use of the cell.

8.4.3 The regulations of "zero" and of "gain" are by multiturn potentiometers (= trimmers); they are reachable by screwed holes on the body of the cell, protected by a sealing screw. (Remember the point 8.4.1).

8.4.4 The amplifier and the potentiometers are immersed in silicon gel, which is not an handicap for the regulation. For the regulation, a screwdriver (with shank: 1,5÷2 mm) bores the gel which, by itself, closes again when the screwdriver is pulled out.

8.5 POSITION OF ZERO AND GAIN REGULATIONS:

8.5.1 ***Series LD-LT and Series AP 7000****:*

The zero and gain regulations are reached thorough a large screwed hole protected by a sealing screw.

The *zero regulation* (about ±10% FS) is the nearest to the external enclosure and the most easy to be reached. The gain regulation is the most internal one and far from the external enclosure and difficult to be reached. This regulation is done by DS Europe and it has not to be touched by the Customer.

- *Series LD and LT:*
  When the cell is installed and it has the label on the upper position and the regulations on the lower position, the *zero regulation* is the most external on the right and the only one that may be regulated.

- *Series AP 7000:*
  When the cell is installed and the cable is on the upper position the *zero regulation* is the most external on the left and the only that may be regulated.

8.5.2 ***Series 500 QD and 500 QDT:*** (see the "overall dimensions" of the bulletin)
The zero and gain regulations are reached by separated screwed holes.
As listed in the "overall dimensions" of the bulletin, when the cell is installed, the cable exits on the left, the two holes are vertically lined up on the right, then the zero hole is in the upper position. *Do not touch the gain regulation* on the lower position.

8.5.3 ***Series ME-MF:***
The zero and gain regulations are reached removing the metal cover and the rubber gasket having unscrewed the 2 fixing screws.
Important: remove only the cover without the central screw (support of the internal electronics).

Take-away the filler silicon grease and uncover the transparent silicon gel below.
On the printed board are settled 2 multiturn potentiometers. The *zero pot* is the nearest to the centre; the *gain pot* is the most external and *it has not to be regulated*.
When the zero regulation is finished, fill entirely by silicon grease the cavity up to the metal cover to be fixed by the 2 screws.

8.6 WORKING AREA OF THE CURRENT AMPLIFIER -4: (2 -wires)

NOTE: see the diagram of the "Pressure transducer" valid also for the current amplifier -A4 of the load cells.

8.6.1 The diagram states the relation between the Power supply voltage: V_{ps} of the cell (=abscissa) and the load resistor value: RL (= ordinate).
The amplifier -A4 rightly works within all the points of the "Area of V_{ps} " defined by the line (on the left) of "minimum V_{ps} allowed" and by the line (on the right) of "maximum V_{ps} allowed".

Great attention has to be put on the choice of the electronics to be connected to the self-amplified cell (-A4) regarding the supply voltage (= V_{ps}) and the load resistor (=RL).
The best acceptable points of the working area (= "area of V_{ps}) have to be 15÷30% far from the left line (= minimum V_{ps} allowed) within the "Area of V_{ps} ".
It is not convenient to exaggerate on the supply voltage (= V_{ps}) to avoid useless thermal dissipation inside the transducer.

Two explanatory examples:

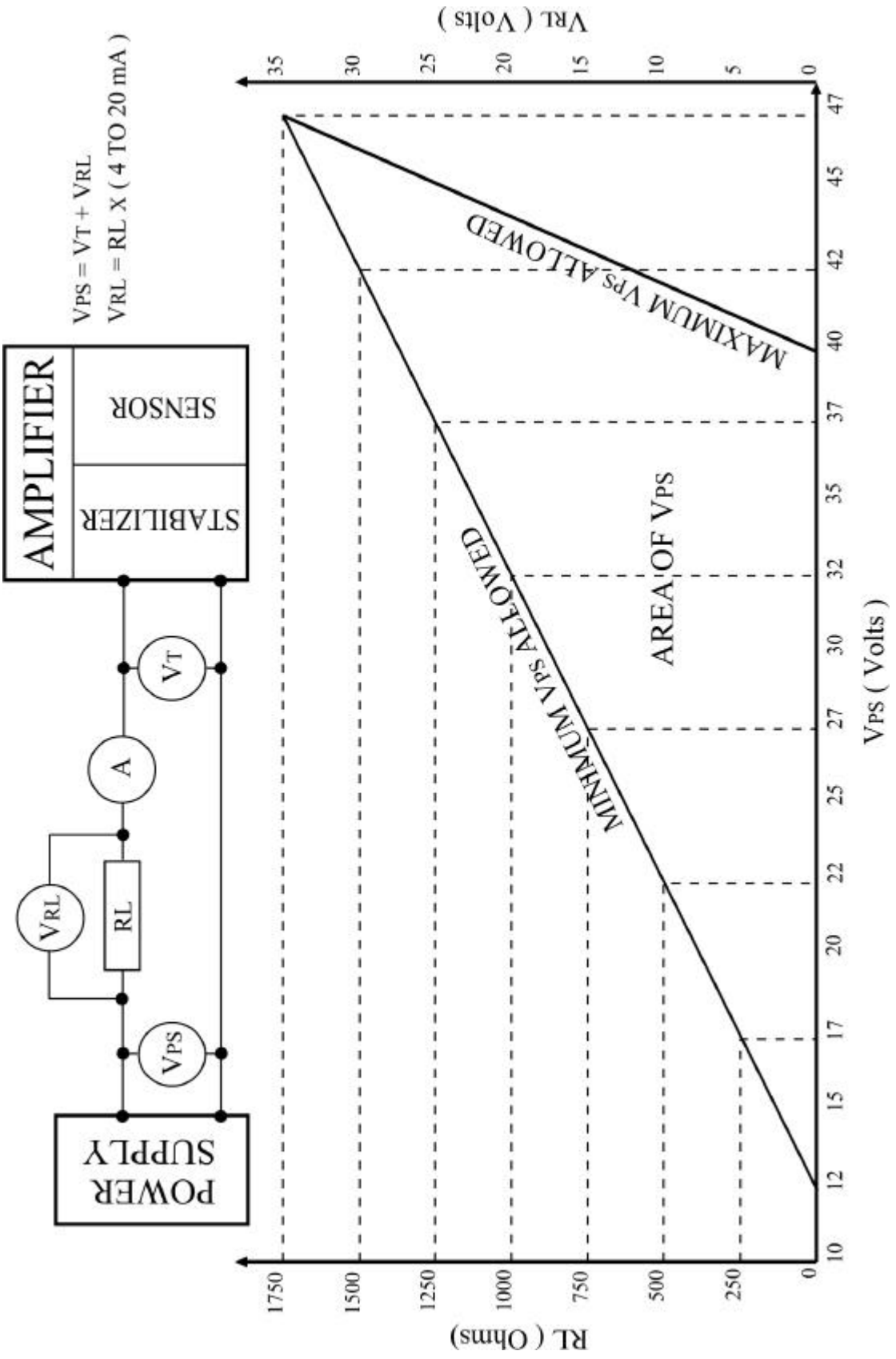
1) R_L = 250 ohms = external load resistor.

Supply voltage = V_{ps} = 15 V: not sufficient.
" " " = 17 V: just at the limit; not advisable.
" " " = 20÷24 V: advisable.
" " " = 28 up to 41 V: not advisable; useless thermal dissipation.

2) RL = 750 ohms = external load resistor.

Supply voltage = V_{ps} = 24 V: not sufficient.
" " " = 27 V: just at the limit; not advisable.
" " " = 30 V: advisable.
" " " = 35 up to 43 V: not advisable; useless thermal dissipation.

Low values of RL and of V_{ps} are always preferable (the example 1 is preferable to the example 2).
Due to the limitations and to the disadvantages of the current amplifiers -A4 are always advisable the voltage amplifiers; particularly the version -A5 (= output ±5 V).


POWER SUPPLY
AMPLIFIER
STABILIZER
SENSOR
VPS = VT + VRL
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1500
1250
1000
750
500
250
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VRL (Volts)
35
30
25
20
15
10
5
0
MAXIMUM VPS ALLOWED
MINIMUM VPS ALLOWED
AREA OF VPS
VPS (Volts)
10
12
15
17
20
22
25
27
30
32
35
37
40
42
45
47

9) PROTECTION AGAINST ELECTRICAL DISTURBANCES

9.1 The signal outputs from the load cells are always low and they may be seriously spoilt by the external electrical disturbances.
The *main cares* to be taken are the following:

9.2 For the connection cell-signal conditioner always use cable with braiding shield 100%.
The cell and the cable have to be set up far from electric motors, power switches, etc.
The cables have to run into separated raceways.

9.3 The braiding shield is insulated from the cell body and it has to be grounded at the electronics side only.
When the screen is insufficient, the cable can be put in a tube of normal iron (paramagnetic, with low percentage of carbon) (= good electromagnetic screen) with an external insulating sheath to avoid to pick up the stray currents of the metal structures connected.

9.4 When mating connectors are needed along the cable, the shield has to go through a pin and not through the metal shell of the connector and the connector has to be insulated and covered by plastic tape.

9.5 Avoid to use earth nets of industrial plants, always rich of electrical disturbances, but use separated ground taps.
The ground tap has to be at the centre of all the ground leads of the instrumentation only.
Never connect the ground in series but each directly connected to the ground tap as a sun (= ground tap) with separated planets (= the instruments).

9.6 *Follow all the local laws imposed for electrical connections and for the earth connections.*

9.7 To satisfy to the EMC normatives it is imposed to connect the body of the transducer and the shield of the cables to a good earth, without disturbances, as for the CE mark.

10) ENVIRONMENTAL PROTECTION

10.1 CONNECTION BY CABLE:

In ambients with humidity or dust and for outdoor applications, use connections by cable only. The connector has to be excluded.

In long periods, the connectors are never hermetically sealed and the internal air dead volumes exchange humid air with outside. Oxidations of the electrical contacts, jumpers of humid dust and decrease of electrical insulation may occur. Decreases of the insulation to several megaohms among the signal leads and against the body could create zero unbalance and output instability.

10.2 CELLS FOR OUTDOOR APPLICATIONS:

Common features of nearly all DS Europe load cells (excluded the Series QB 700 - BC 300) are the great protection for industrial purpose and for outdoor applications.
This protection is done filling the cell by silicon gels and rubbers, which allows a tightness greater than that realized by weldings.
In fact, in long periods, the internal air dead volume, on welded mechanics, exchanges air and humidity through the cable never hermetically sealed even if clamped.

The Series LD is the most advisable for heavy and outdoor applications.
In these Series the strain-gauges, the electrical circuits are settled in the inferior cavity filled by sealing silicon filler and covered, like an umbrella, by the body of the load cell.
To increase further the tightness of the cell is useful to spread a layer of silicon sealing rubber between the circular fixing rim and the base.

For heavy applications also the following Series can be used, in order of priority: AP 7000 - MD 5000 - HC 2000 - 500 QD.

To support better the environmental conditions varnishes and lacquers can be used to cover the body of the cells, the cavities, the cables alternating epoxy with silicon varnishes.

11) TESTS FOR THE APPLICATION OF THE CE MARK

11.1 AMPLIFIED TRANSDUCER:

They are subjected to CE mark. Those one *without internal amplifier* are considered "passive components" and therefore *any certification is necessary.*

11.2 TEST CENTER AND LIST OF THE TESTS:

The tests have been done at a *Test Center "competent body" internationally approved.*

For the compatibility tests have been chosen the standards **EN 50081-2 (*for emission*) and EN 50082-2 (*for immunity*)**, the most severe for industrial applications.

11.2.1 *Normative reference: EN 55011*: Test category: Emission; Port: enclosure; Type of test: radiated interference field strength; Frequency range: 30 to 1000 MHz.

11.2.2 *Normative reference: ENV 50140*: Port: enclosure; Test category: Immunity; Type of test: radiated radio-frequency, electro-magnetic field; Frequency range: 80 to 1000 MHz; Test level: 10 V/m.

11.2.3 *Normative reference: ENV 50141*: Port: DC I/O power port; Test category: Immunity; Type of test: RF common mode; Frequency range: 0,15 to 80 MHz; Test level: 10 V.

11.2.4 *Normative reference: ENV 50141*: Port: signal lines; Test category: Immunity; Type of test: RF common mode; Frequency range: 0,15 to 80 MHz; Test level: 10 V.

11.2.5 *Normative reference: EN 61000-4-4*: Port: DC I/O power port; Test category: Immunity; Type of test: Fast transient (burst). Common mode; Test level: 3.

11.2.6 *Normative reference: EN 61000-4-4*: Port: signal lines; Test category: Immunity; Type of test: Fast transient (burst) common mode; Test level: 3.

11.2.7 *Normative reference: EN 61000-4-2*: Port: Enclosure; Test category: Immunity; Type of test: ESD; Test level: ±4kV.

11.2.8 *Normative reference: EN 61000-4-8*: Port: Enclosure; Test category: Immunity; Type of test: Power frequency magnetic field. Frequency range: 50 Hz; Test level: 4.

11.2.8 *Normative reference: ENV 50204*: Port: Enclosure; Test category: Immunity; Type of test: Radio frequency electromagnetic field. Pulse modulated: 900 + 5 MHz; Test level: 3.

Notes:

1) **The tests have given positive results.**

2) The test Laboratory and the EC normatives compel reserve on the paper-works and on the data of the tests; they neither can be advertised nor photocopied and they remain at disposal only to the Competent Authorities in our Factory.

12) CONTROLS AND LIFE OF A LOAD CELL

12.1 STARTING PERIOD:

During the first months from the cell construction, are discharged the superficial stresses due to the machining and the stresses included in the cements; they follow possible little variations of zero and sensitivity.

For laboratory precise tests, it is advisable a control and a calibration after the first 6 months of life of the cell and, further, every year period.

For industrial applications the changes are insignificant and the recalibration useless.

12.2 CREEP:

On a cell loaded for a long period can appear creep of the metal body, of the cements, of the plastic backing of the gauges. This creep is shown as a variation of the measure and, unloading the cell, as a non-return to zero. The variations are acceptable in industrial applications.

12.3 LIFE OF A CELL FOR USE WITH RISKS OF DAMAGES:

(See Chapter 5). After a maximum period of 5 years the cell must be substituted in use with risks of damages.

A finished cell cannot be submitted to a complete check-up by ultrasound and magnetoscopic tests, to discover fatigue deteriorations, microfractures, etc., due to unknown shocks and vibrations.

This rule is imposed by several safety recommendations.

13) PROBLEMS WHICH CAN OCCUR WITH LOAD CELLS

A load cell can rarely be repaired and the repair is almost always more expensive than the replacement of a new cell, in that disassembly means destruction of parts and repair with subsequent control carried out by specialist staff outside the production cycle.

The main damages that can happen to a cell are the following:

13.1 YIELD (OR BREAKING) OF THE MECHANICAL PARTS:

- *Problem:* the electrical zero has a high value, generally varying form test to test. The linearity is poor with notable hysteresis. Also the breaking of strain-gauges is possible.

- *Causes:* applied load, bending and torsional moments above the maximum accepted by the cell; this damage occurs also when the cell is not electrically connected and by force transients (shocks) not shown in the digital display (because of longer reading time).

- *Remedy*: a repair is not possible. Replacement by a new cell is necessary.

13.2 INTERRUPTION OF SOME STRAIN-GAUGE:

- *Problem:* the electrical zero has a high value and the bridge resistances across the excitation or across the output signal leads shows different values or even an infinite resistance.

- *Causes:* load cell supplied with voltage exceeding the maximum allowed, overvoltages, transients, electrical discharges introduced through the signal leads or through the power supply leads.

- *Remedy*: a repair is possible but is more expensive than a replacement by a new cell.

13.3 POOR INSULATION AGAINST THE BODY OF THE CELL:

- *Problem:* excessive zero-drift, notable instability of the zero, insulation below one Mohm.

- *Causes:* water penetration, persistent high humidity in the cell, electrical discharges between the electrical circuit and the body of the cell.

- *Remedy*: if the cause is the penetration of water, it is recommended to bake the cell in an oven at 85°C for at least 10 days, hoping that no conductive residue will remain;
  if the causes are electrical discharges with carbon residues the repair is more expensive than the replacement by a new cell.

SALE CONDITIONS
(for all the products DS Europe)

A) WARRANTY:

From raw material through in-process operations to the final test and to finished piece, DS Europe product is subject to rigorous inspections and to continuous quality controls to assure a production free from defects in parts, in materials and workmanship.

When the product is submitted to warranty claims and it results defective from normal use within 6 months from the date of shipment, it will be repaired or substituted free of charge in our factory; the transport, insurance expenses, custom's duties are to be prepaid and borne by the Customer.

The material delivered has to be controlled within 10 days from the receipt; after this period the material is considered as accepted.

The responsibility is strictly restricted to the above provision and DS Europe declines any liability for damages to Persons and things, for damages of stopping of plants, of machineries due to the applications and due to the use of its products.

B) RESPONSABILITY FOR DAMAGES:

DS Europe products are only parts of more complex machineries and of plants sold in thousands of pieces/year, for thousands of different applications with different local standards and specifications unknown to the Supplier.

For installations and for uses which directly or indirectly may involve risks of damage to Persons and things, of damage for stopping of machineries, of plants is precise obligation for the end User, for the Distributor, or for the Retailer to inform immediately and before the installation DS Europe which will stop the negotiation and which will cancel the delivery of the product.

Nevertheless DS Europe is at disposal to suggest, without any responsibility, protection accessories, test certificates, Consulting Companies or research and test Laboratories so to reduce or to zero the risks of damages.

It is underlined to read the "instructions of installation and of use" of the products that may be sent, under request, even during the negotiations.

C) REMARKS:

These "sale conditions" are integral part of the bulletins, of the invoices, of the instruction manual, also if not written on them.

DS EUROPE S.R.L.

Sale conditions N°221194 dated November 22, 1994.