galvi
the buffers

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HOW TO SELECT BUFFERS

The type of buffer should be selected on the following:

- 1): energy to be absorbed by the buffers;
- 2): maximum reaction force induced in the structures of the movable and fixed parts.

The following is to be considered:

Point 1

1.1 Distribution of the total mass between the bearings.

In case of overhead travelling cranes, two bearings are provided for each direction, as shown in fig. 1

P_1 = total weight;

P_2 = weight of the trolley and the overhung load (according to standards CNR-UNI 10021-73, FEM-Sez. I, DIN 15018, the load overhung on ropes should not be considered).

Part of weight concerning the bearings A:

$$P_A = \frac{P_1}{2} + P_2 \frac{L_2}{L_1} \qquad \text{[tons]} \qquad (1)$$

Part of the weight concerning the bearings B:

$$P_B = \frac{P_1}{2} + P_2 \frac{L_1 - L_2}{L_1} \qquad \text{[tons]} \qquad (2)$$

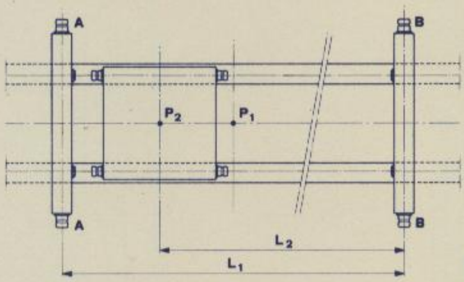


fig. 1

NOTE: The formulas mentioned above are also valid for cantilever cranes, where $L_2 \geqq L_1$;

1.2 Induced energy at the bearings.

The kinetic energy:

$$E = \frac{1000 \cdot P \cdot v^2 \cdot 9{,}81}{2 \cdot 9{,}81 \cdot 3600 \cdot 10} = \frac{P \cdot v^2}{72} \qquad \text{[daN·m]} \qquad (3)$$

where: v = speed at impact (m/min)
P = weight in tons

Should the mass be stopped by one limit stop, the total energy created must be absorbed by the applied buffer.

In case of two masses m_1 and m_2, with weights of P_1 and P_2, approaching each others at a speed V_1 and V_2, the impact energy can be determined by the relative speed between the two masses $v_r = (v_1 + v_2)$ and the equivalent mass $m_e = (m_1 \cdot m_2 / m_1 + m_2)$; referring to the weights it will be:

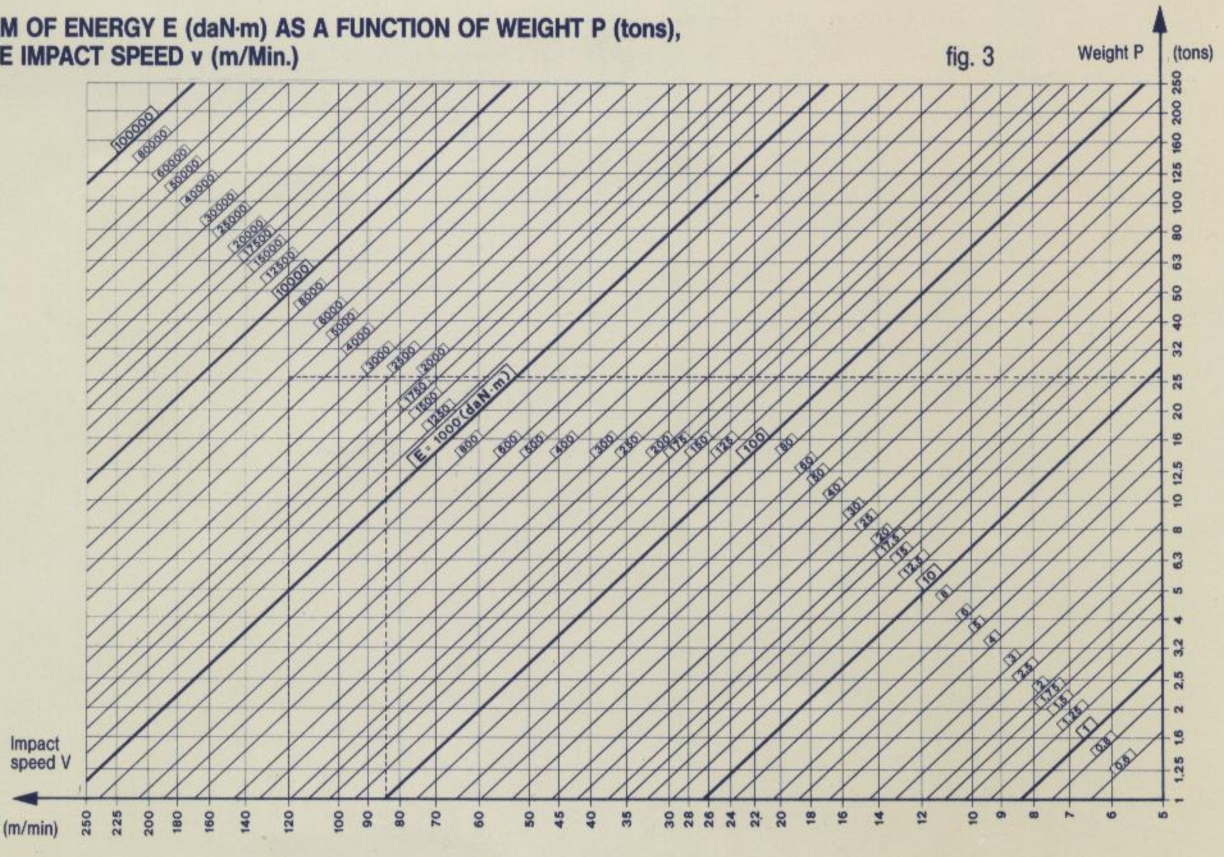
$$E = \frac{1000 \cdot P_1 \cdot P_2 \cdot 9{,}81}{9{,}81 \cdot (P_1 + P_2) \cdot 10} = \frac{(v_1 + v_2)^2}{2 \cdot 3600} = \frac{P_e \cdot v_r^2}{72} \qquad \text{[daN·m]} \qquad (4)$$

this energy should be absorbed by the buffers between the two masses.

Fig. 3, enables a quick determination of the kinetic energy induced at the bearing as a function of weight in tons, mass m (that is m_e) and the impact speed.

DIAGRAM OF ENERGY E (daN·m) AS A FUNCTION OF WEIGHT P (tons), AND THE IMPACT SPEED v (m/Min.)

fig. 3



Point 2) Configuration of the buffer system.

The configuration of the system varies according to the energy that the relevant buffer system has to absorb at a specified bearing and of the maximum reaction force which can be applied to the structures. The system itself can be differently shaped.

It is possible to provide a buffer system consisting of one buffer only (fig. 2a) or two similar opposed buffers, of which one is on the moving part and one on the stationary part (fig. 2b).

In this case 50% of the energy will be absorbed by each buffer resulting in a lower final force.

Knowing the energy to be absorbed and the impact speed, suitable speed can be selected by using figs. 4 and 5. Selecting the buffer according to CNR-UNI 10021-73 standards, the impact speed is equal to 70% of the operating speed. It is recommended that the buffer is selected on the basis of up to 50% deflection of its free lenght; this will result in:

- low final reaction force, in relation to the absorbed energy;
- ample reserve for further elastic absorbtion of energy.

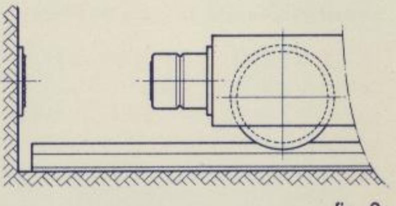


fig. 2a

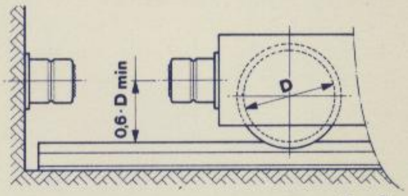


fig. 2b

Use of fig. 4:

Draw a horizontal line from the value of the deflection to the impact speed curve (interpolating at intermediate values): draw a vertical line from the intersection and extend it until it meets the curves of the buffers; draw a horizontal line from the calculated energy value until it crosses the drawn vertical line.

The curve immediately above this crossing point indicates the size of a suitable buffer.

Use of fig. 5:

Draw a horizontal line from the value of the deflection, until it crosses the impact speed curve (interpolating, at intermediate values); draw a vertical line from the intersection and extend it to cross the characteristic curve of the selected buffer; a horizontal line drawn from this point will intersect the vertical scale showing the final reaction force.

CALCULATION EXAMPLE

Select the main buffers for on overhead travelling crane given the following data:

- weight of crane without trolley: $P_1 = 38$ tons
- weight of trolley: $P_2 = 7{,}1$ tons
- rail centres: $L_1 = 28$ m
- position of the fully displaced trolley: $L_2 = 26$ m
- speed of the overhead travelling crane: $v = 120$ m/min
- load hanging on ropes (uninfluential)
- crane stops against one limit stop

The selection is based on the following remarks:

- the load hanging on ropes can be neglected as stated by standards CNR-UNI 10021-73: FEM Sez. I; DIN 15018;
- the impact speed is considered to be equal to 0,7·v (based upon the above mentioned standards);
- in order to have a low final impact force and an energy absorbtion reserve with maximum reaction force still contained, assume a deflection of the buffer of 50% of the free lenght;
- the selection should be based on the worst condition; hence considering bearing "A" in this case.

Referring to fig. 1 and formula (1) the calculation is:

$$P_A = \frac{38}{2} + 7{,}1 \cdot \frac{26}{28} = 25{,}59 \text{ tons; the impact speed is: } v = 0{,}7 \cdot 120 = 84 \text{ m/min.}$$

The energy value "E" that the buffer has to absorb can be established by using fig. 3 based on the above values. Fig. 3 shows a value slightly above 2500 daN·m (rounded off to 2600).

Using fig. 4 a buffer size 400/400 is selected. Following onto fig. 5, the diagram will show that applying a 400/400 buffer the maximum reaction force is about 25 tons.

Should the overhead travelling crane accidentally collide at 120 m/min, the impact energy will be about 5200 daN·m. The 400/400 buffer can still absorb all the energy causing a deflection of about 64% of the free lenght. The maximum final force will be 42 tons.

The final force that is imposed on the supporting structure can be further reduced by using two opposing buffers as shown in fig.2b. This, however, will decrease the free travelling distance of the crane.

Each buffer has to absorb 1300 daN·m energy, therefore, with 50% deflection and at an impact speed of 84 m/min, fig. 4 shows two 315/315 buffers are suitable, fig. 5 gives a final force of 16 tons.

Should the collision speed reach 120 m/min the resulting impact energy will be 2600 daN·m for each buffer.

In this instance the deflection is 64% and the final force is 26 tons as shown in fig. 5. The cost difference between one 400/400 and two 315/315 buffers is negligible.

BUFFERS RME - RMV

IN MICROCELLULAR STRUCTURE

DIAGRAM TO ESTABLISH BUFFER SIZES

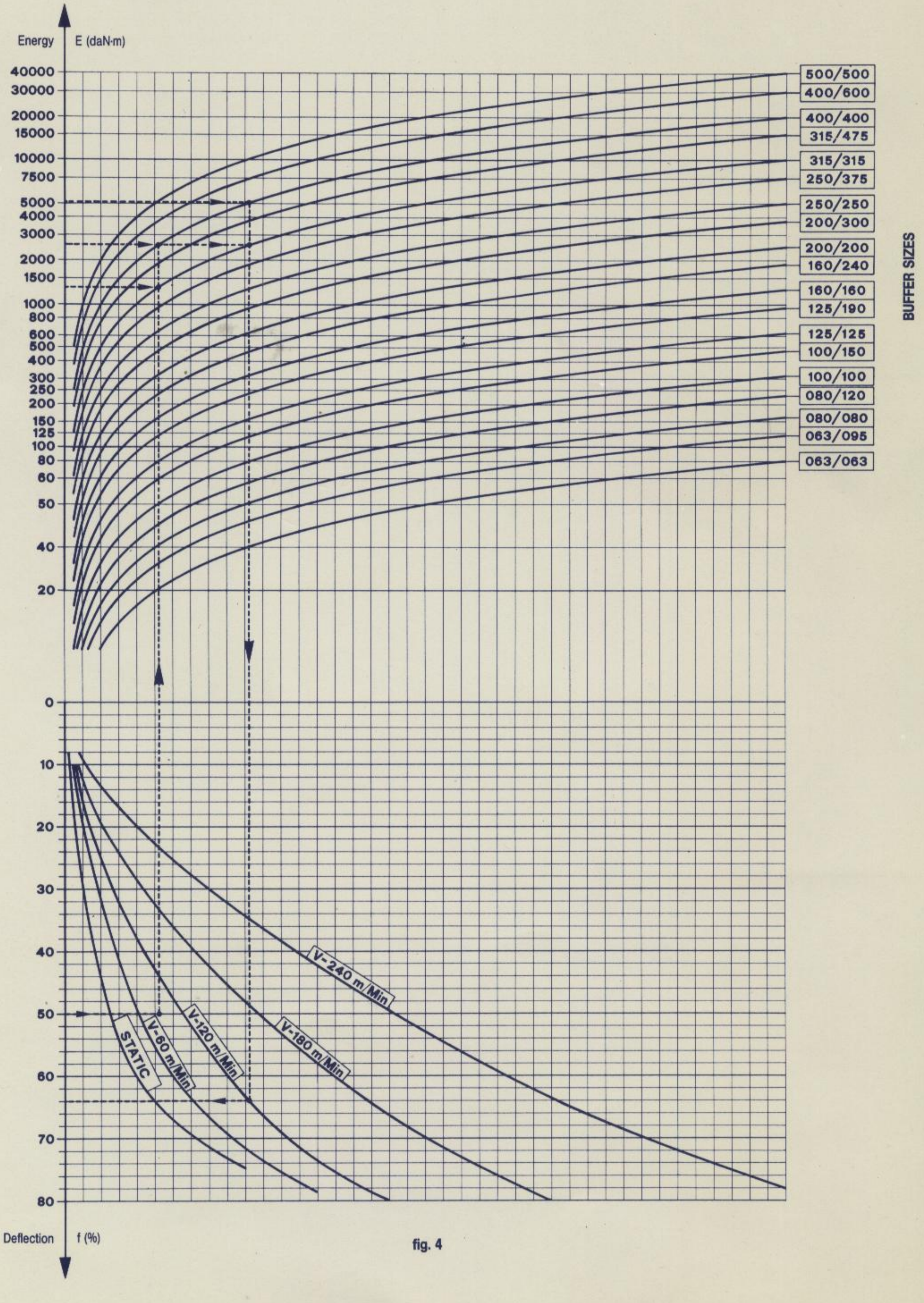


fig. 4

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DIAGRAM TO ESTABLISH FINAL REACTION FROCE "F" (tons)

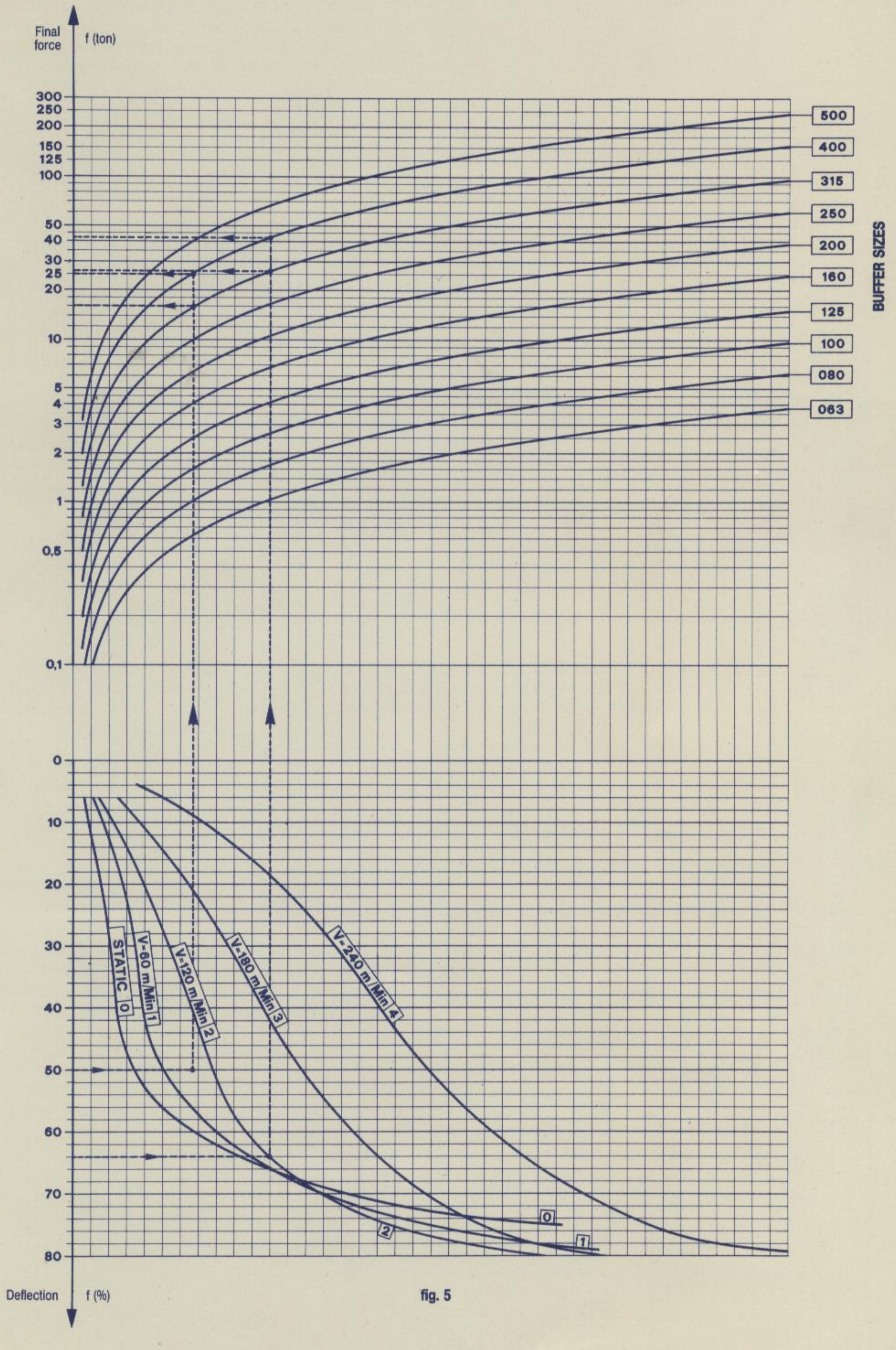

fig. 5

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BUFFERS RME - RMV

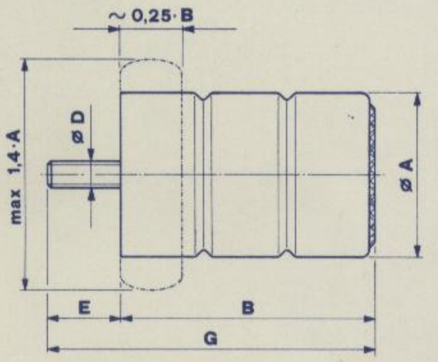
IN MICROCELLULAR STRUCTURE

DESCRIPTION OF THE MAIN FEATURES

The shock absorbing element of these buffers consists of an elastic body of polyurethane expanded resin with a microcellular structure of opened and closed cells.
This special structure makes the buffers capable of high performance as far as elasticity and energy absorbtion is concerned.
A special characterisc of these buffers is the differentiated reaction according to the impact speed: at a higher impact speed, with the same deflection, the reaction force and consequently the kinetic energy absorption capacity of the buffer increases, as shown in fig. 4.
The buffers are designed to allow the axial deflection to reduce the compressed lenght to 25% of the free lenght.
This reduction will increase the outside diameter by only 40%.
The "deflection load" curves show that under shock loading causing up to 50% deflection, the buffers reaction will be similar to metal springs. The system offers the optimum in mechanical energy absorbtion resulting in minimizing the final impact force imposed on the structure.
The material of the elastic element is anti-aging, with a good resistance to mechanical wear, oil, grease and gasoline; its structure is homogeneous and self-extinguishing.
In each buffer a steel chain is encased and attached to the metallic support in order to avoid damage to people or property, in case of detachement because of radial impacts.
The working temperature is limited to a range of –30° to a +80°C.

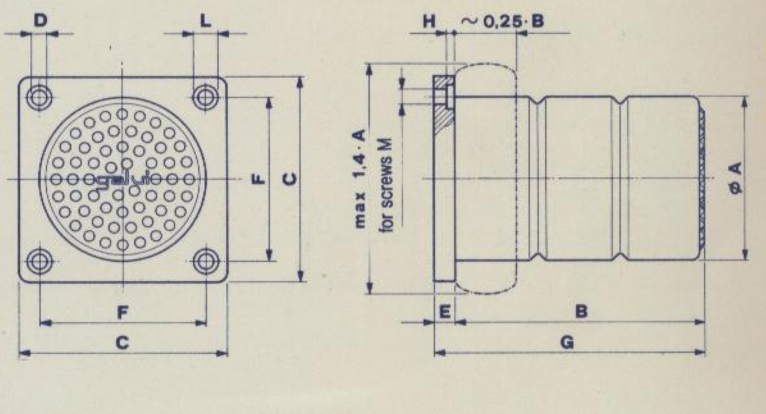
NOTE: The surface contacting to the buffer should be pattesned.

RME



Type	ø A	B	ø D	E	G	Weight (kg)
RME.080.080	80	80	M12	35	115	0,350
RME.080.120	80	120	M12	35	155	0,455
RME.100.100	100	100	M12	35	135	0,600
RME.100.150	100	150	M12	35	185	0,800
RME.125.125	125	125	M12	35	160	1,065
RME.125.190	125	190	M12	35	225	1,380
RME.160.160	160	160	M12	40	200	2,620
RME.160.240	160	240	M12	40	280	3,490
RME.200.200	200	200	M12	40	240	4,510
RME.200.300	200	300	M12	40	340	6,160
RME.250.250	250	250	M24	80	330	9,240
RME.250.375	250	375	M24	80	455	12,390
RME.315.315	315	315	M24	80	395	17,190
RME.315.475	315	475	M24	80	555	23,540
RME.400.400	400	400	M30	80	480	34,780
RME.400.600	400	600	M30	80	680	48,580

RMV



1) The buffer has to befastened with screws according to DIN 7984 or DIN 6912 standard.

Type	ø A	B	C	D	E	F	G	H	L	M(1)	Weight (kg)
RMV.063.063	63	63	80	9	8	63	71	—	—	M8	0,230
RMV.063.095	63	95	80	9	8	63	103	—	—	M8	0,275
RMV.080.080	80	80	100	11	10	80	90	—	—	M10	0,440
RMV.080.120	80	120	100	11	10	80	130	—	—	M10	0,545
RMV.100.100	100	100	125	11	10	100	110	—	—	M10	0,750
RMV.100.150	100	150	125	11	10	100	160	—	—	M10	0,950
RMV.125.125	125	125	160	14	12	125	137	5	20	M12	1,535
RMV.125.190	125	190	160	14	12	125	202	5	20	M12	1,850
RMV.160.160	160	160	200	14	12	160	172	5	20	M12	2,950
RMV.160.240	160	240	200	14	12	160	252	5	20	M12	3,820
RMV.200.200	200	200	250	18	15	200	215	6	26	M16	5,600
RMV.200.300	200	300	250	18	15	200	315	6	26	M16	7,250
RMV.250.250	250	250	315	18	15	250	265	6	26	M16	10,000
RMV.250.375	250	375	315	18	15	250	390	6	26	M16	13,150
RMV.315.315	315	315	400	18	15	315	330	6	26	M16	18,200
RMV.315.475	315	475	400	18	15	315	490	6	26	M16	24,550
RMV.400.400	400	400	500	22	20	400	420	7	33	M20	39,000
RMV.400.600	400	600	500	22	20	400	620	7	33	M20	52,280
RMV.500.500	500	500	630	26	20	500	520	8	39	M24	76,300