

# LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

- LIGO -

CALIFORNIA INSTITUTE OF TECHNOLOGY  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

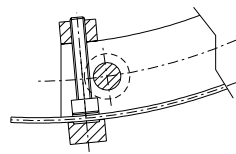
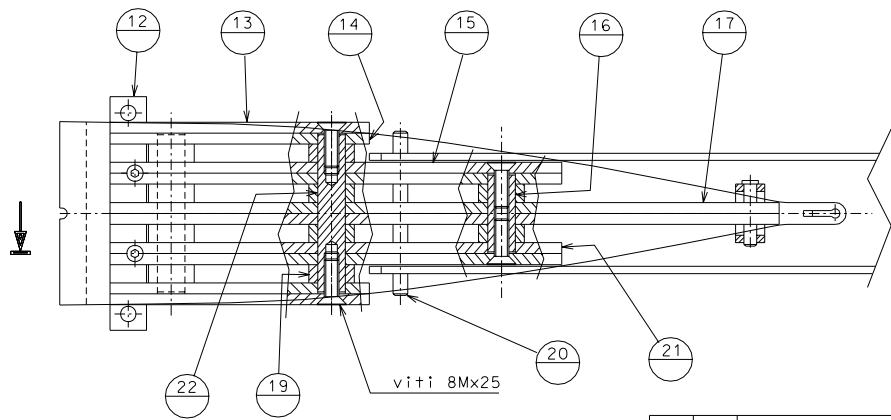
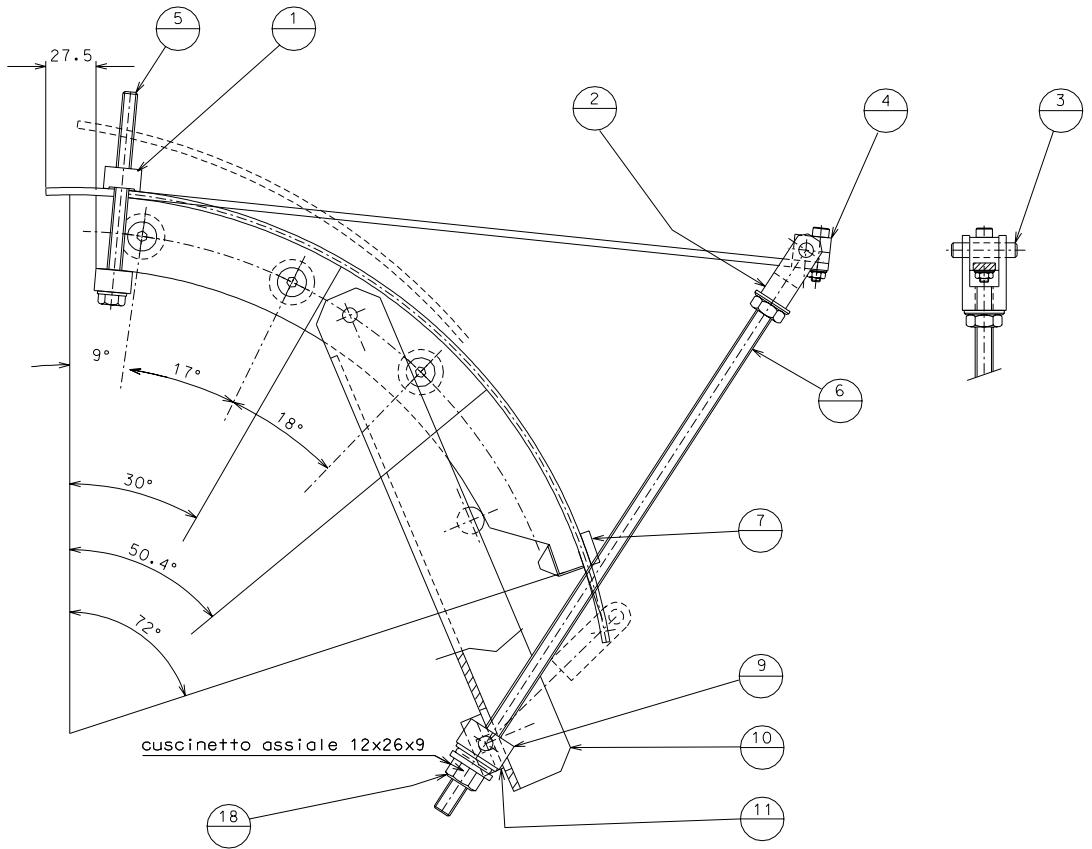
|  |   |                                       |
|--|---|---------------------------------------|
| Document Type<br><b>Technical Note</b>   | DCC Number<br><b>LIGO-D-010246-00-R</b> | Date<br>30 <sup>th</sup> October 2001 |
| <b>LIGO-II Seismic Attenuation System (SAS) test tower</b><br><b>Assembly tool Mechanical drawings</b><br><b>(Blade bender tool)</b> |   |                                       |
| <b>Gianni Gennaro, Tatiana Zelenova (PROMEC), Riccardo DeSalvo (LIGO)</b>  |   |                                       |

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
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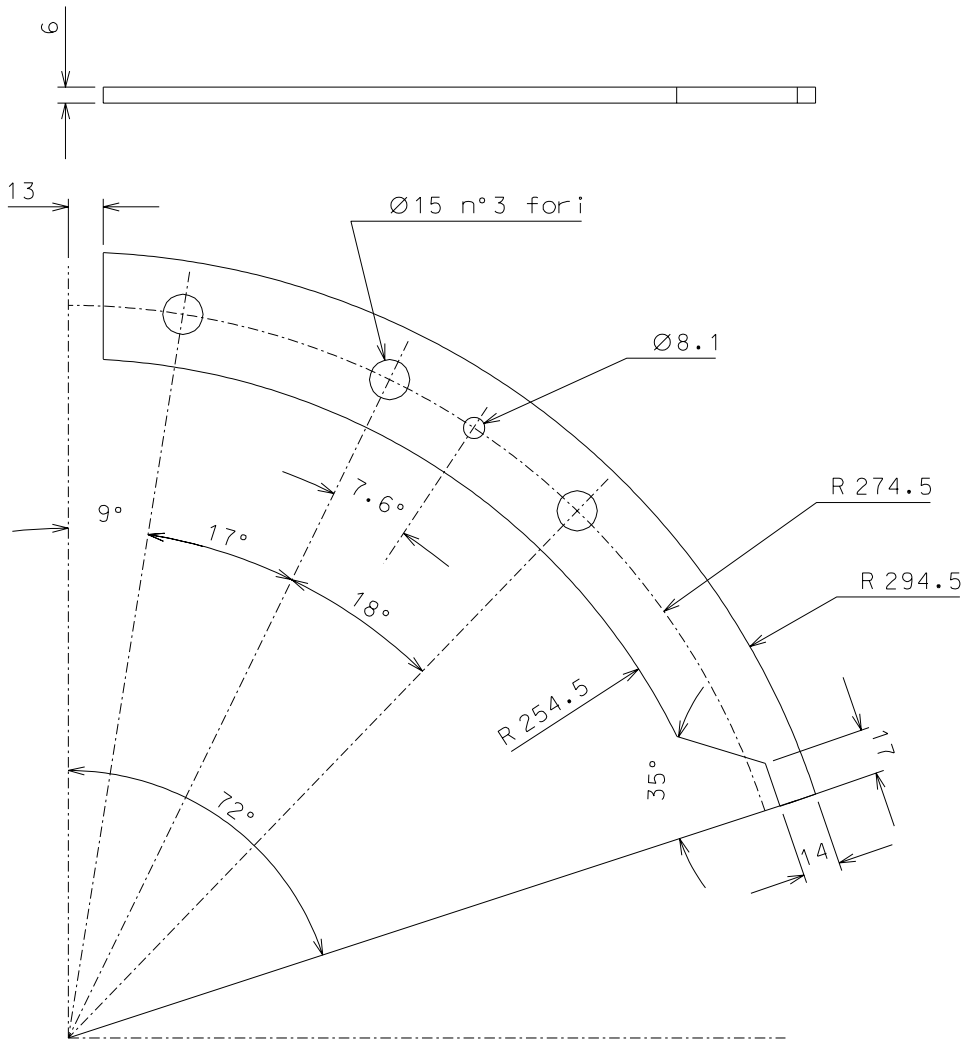
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|      |      |             |      |      |             |
|------|------|-------------|------|------|-------------|
| 11   | 008  |             | 22   | 009  |             |
| 10   | 007  |             | 21   | 003  |             |
| 9    | 008  |             | 20   | 008  |             |
| 8    |      | eliminato   | 19   | 005  |             |
| 7    | 006  |             | 18   | 008  |             |
| 6    | 006  |             | 17   | 001  |             |
| 5    | 006  |             | 16   | 005  |             |
| 4    | 008  |             | 15   | 002  |             |
| 3    | 006  |             | 14   | 004  |             |
| 2    | 006  |             | 13   | 004  |             |
| 1    | 005  |             | 12   | 005  |             |
| rit. | dis. | sottogruppi | rit. | dis. | sottogruppi |

|   |                      |
|---|----------------------|
|  <b>PROMEC</b> S.A.S.<br><i>Bientina (Pisa)-Italia</i> | cliente Caltech-LIGO |
|   | N. ass. Tend.000     |
|   | dis. Zelenova 9-4-99 |
|   | scalo 1:2            |
| titolo  | sost. II N.          |
| TENDITORE LAMA-2  |                      |

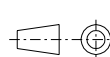


|      |       |                    |       |
|------|-------|--------------------|-------|
|      |       |                    |       |
|      |       |                    |       |
| 17   | 4     | antic.100 T6       | 1:2   |
| rif. | pezzi | mat. e trattamento | scale |

|      |       |                    |       |
|------|-------|--------------------|-------|
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|      |       |                    |       |
|      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale |

Tolleranze generali di lavorazione UNI 5307-63

| Dimensioni     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000 |
|----------------|-------|--------|----------|----------------------------------|------------|-------------|-------------|--------|
| Toll. lineari  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         | ± 3    |
| Toll. angolari | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato piu corto |            |             |             |        |



**PROMEC S.A.S.**  
Bientina (Pisa)-Italia

cliente Caltech-LIGO

N. Tend.001

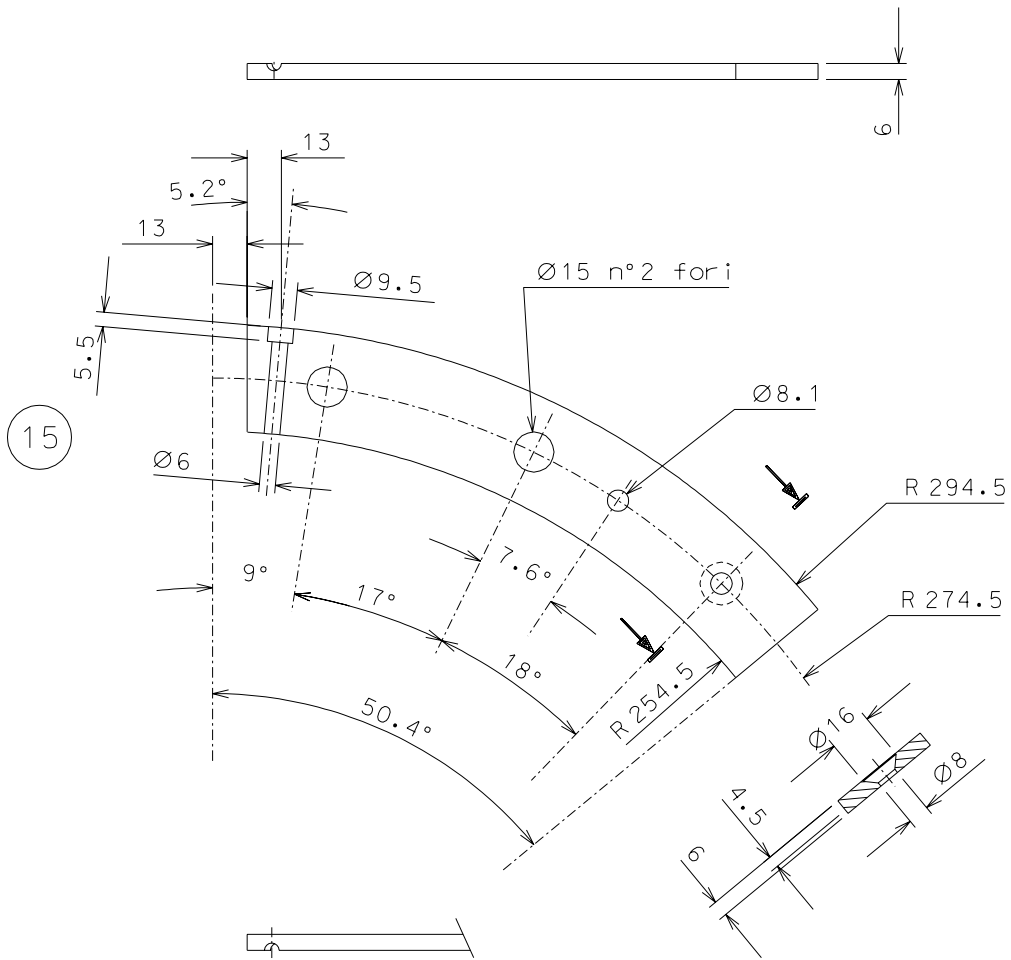
dis. Zelenova 9-4-99

part. dal 000

sost. il N.

titolo

TENDITORE LAMA-2



15

15.1

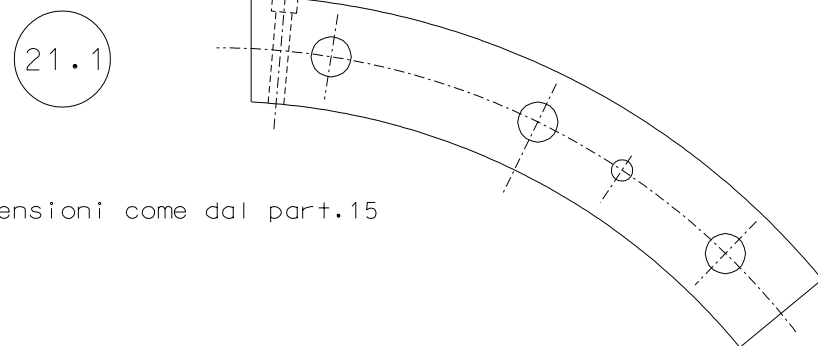
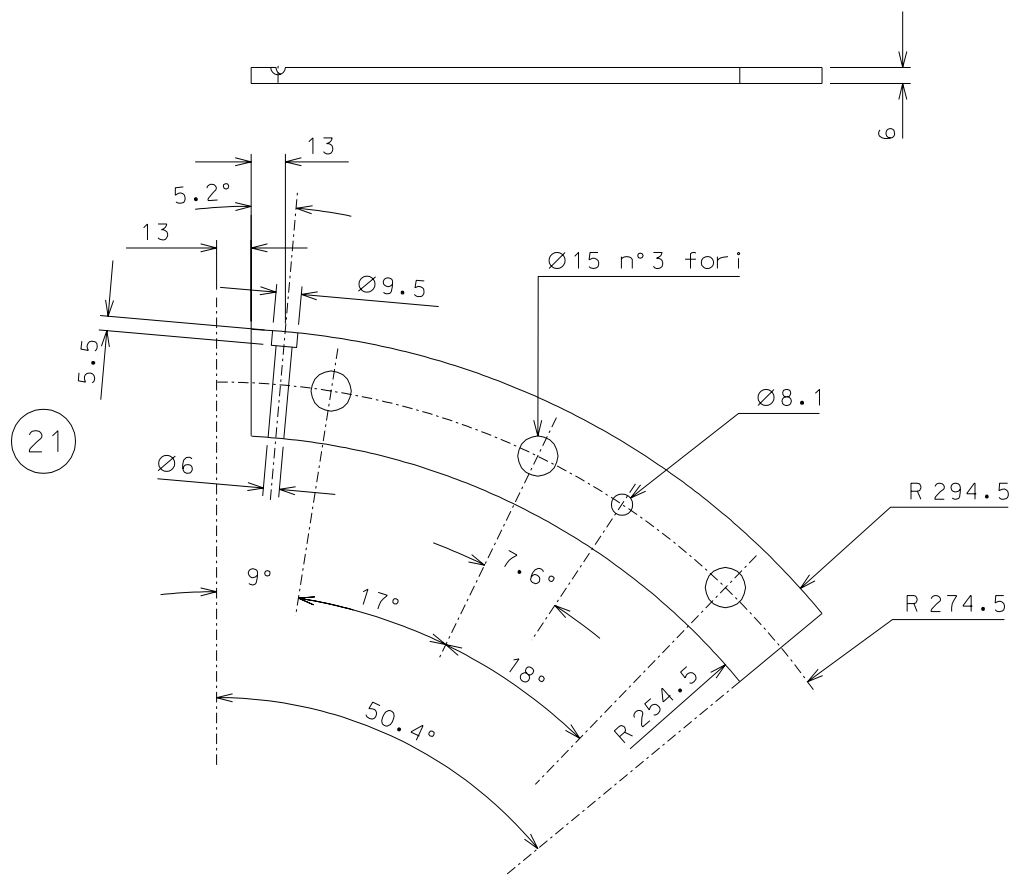
dimensioni come dal part.15

Nota - Eseguire il foro per vite 6M con i pezzi 15 e 21 accoppiati. Vedi assieme

|      |       |                    |       |      |       |                    |       |
|------|-------|--------------------|-------|------|-------|--------------------|-------|
| 15.1 | 2     | antic.100 T6       | 1:2   |      |       |                    |       |
| 15   | 2     | "                  | 1:2   |      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale | rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |       |         |                                  |           |            |            |
|--|-------|-------|---------|----------------------------------|-----------|------------|------------|
| Dimensioni                                     | < 6   | >6-30 | >30-120 | >120-315                         | >315-1000 | >1000-2000 | >2000-4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2 | ± 0.3   | ± 0.5                            | ± 0.8     | ± 1.2      | ± 2        |
| Toll. angolari                                 | ± 1   | ± 30' | ± 20'   | ± 10' riferito al lato più corto |           |            |            |

|                  |  |                      |
|------------------|--|----------------------|
|                  | <b>PROMEC S.A.S.</b><br>Bientina (Pisa)-Italia | cliente Caltech-LIGO |
|                  |  | N. Tend.002          |
| titolo           |  | dis.Zelenova 9-4-99  |
| TENDITORE LAMA-2 |  | part. dal 000        |
|                  |  | sost. il N.          |



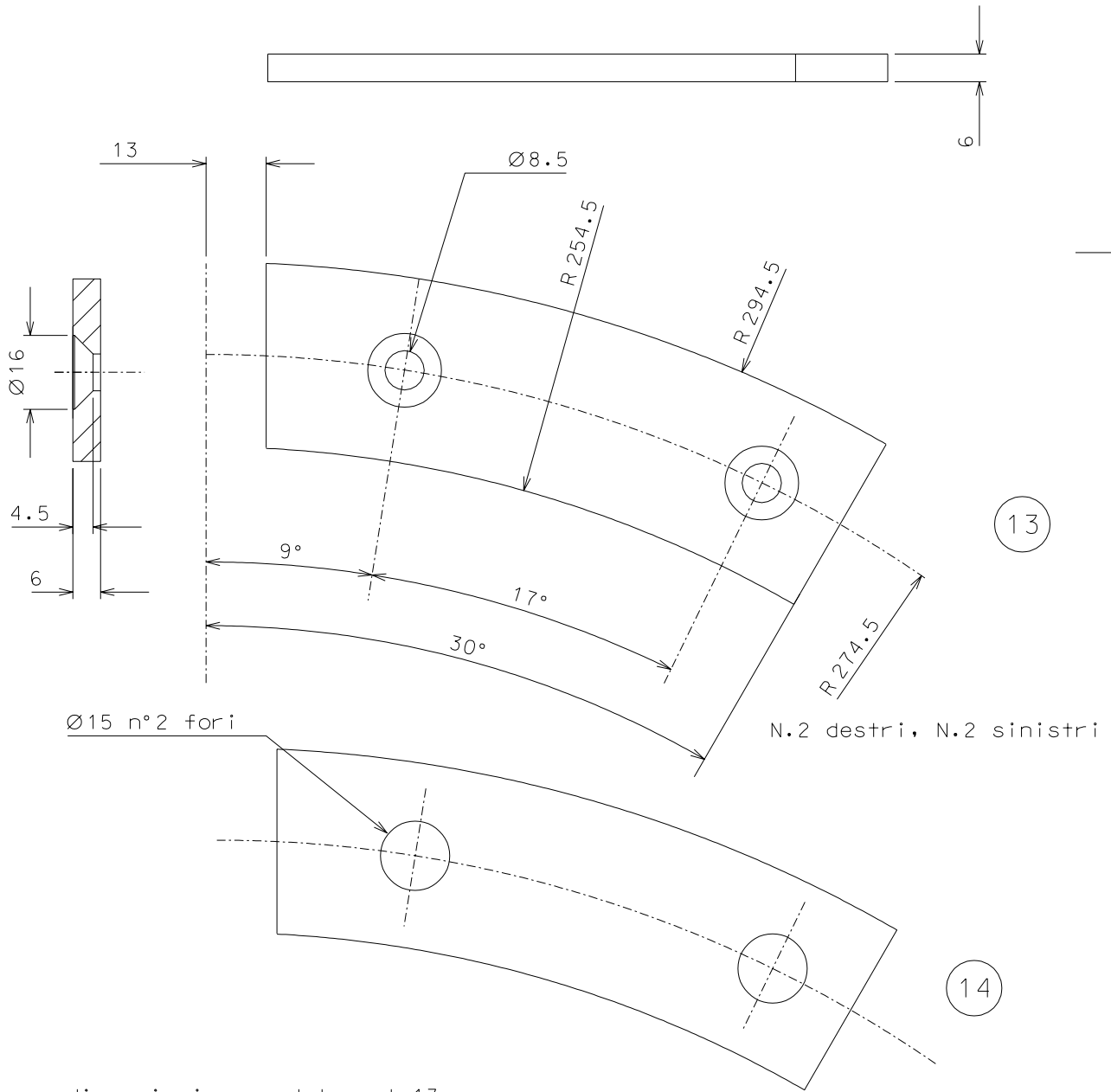
dimensioni come dal part.15

Nota - Eseguire il foro per vite 6M con i pezzi 15 e 21 accoppiati. Vedi assieme

|      |       |                    |       |      |       |                    |       |
|------|-------|--------------------|-------|------|-------|--------------------|-------|
| 21.1 | 2     | antic.100 T6       | 1:2   |      |       |                    |       |
| 21   | 2     | "                  | 1:2   |      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale | rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|
| Dimensioni                                     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato più corto |            |             |             |

|                                   |  |                      |
|-----------------------------------|--|----------------------|
|                                   | <b>PROMEC S.A.S</b><br><i>Bientina (Pisa)-Italia</i> | cliente Caltech-LIGO |
|                                   |  | N. Tend.003          |
| titolo<br><b>TENDITORE LAMA-2</b> |  | dis.Zelenova 9-4-99  |
|                                   |  | part. dal 000        |
|                                   |  | sost. il N.          |



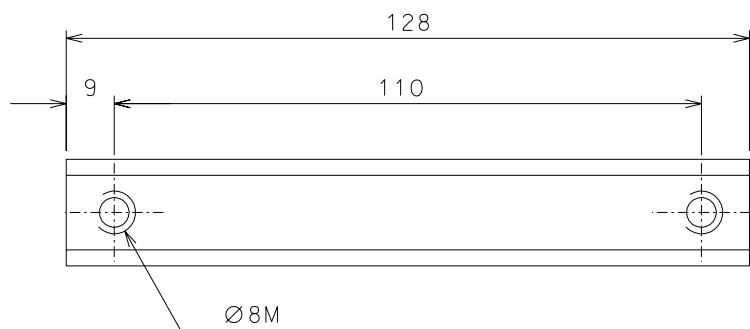
dimensioni come dal part.13

|      |       |                    |       |
|------|-------|--------------------|-------|
|      |       |                    |       |
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| 13   | 4     | "                  | 1:1   |
| rif. | pezzi | mat. e trattamento | scale |

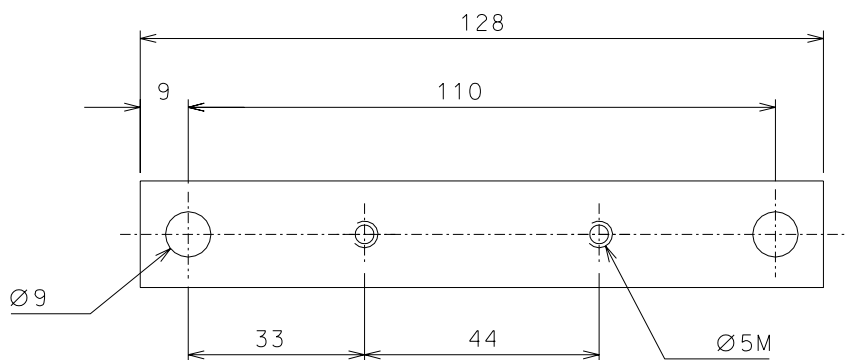
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|      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |        |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|--------|
| Dimensioni                                     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         | ± 3    |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato piu corto |            |             |             |        |

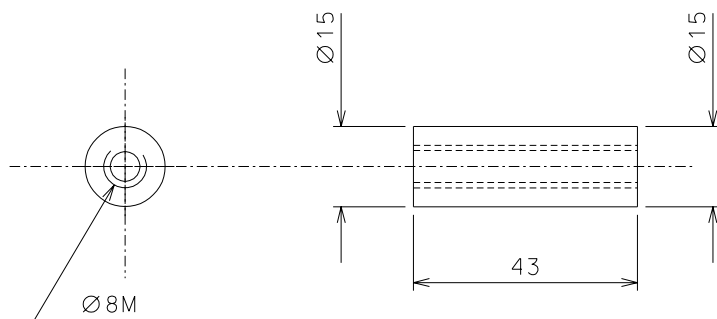
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|                  |  | N. Tend.004          |
| titolo           |  | dis. Zelenova 9-4-99 |
| TENDITORE LAMA-2 |  | part. dal 000        |
|                  |  | sost. il N.          |



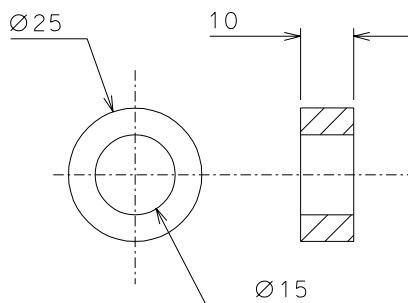
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12



16



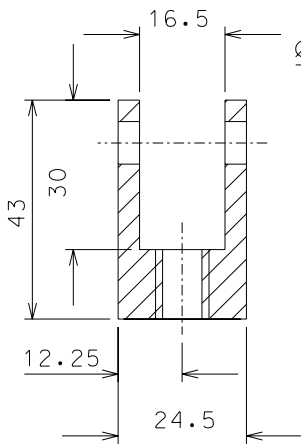
19

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| 12   | 2     | acc. nich.         | "     |
| 1    | 2     | "                  | "     |
| rif. | pezzi | mat. e trattamento | scale |

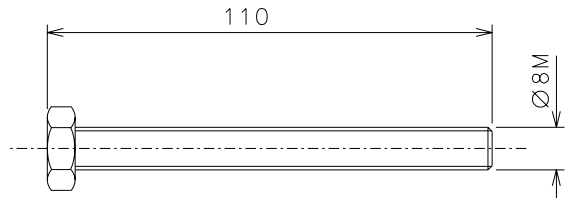
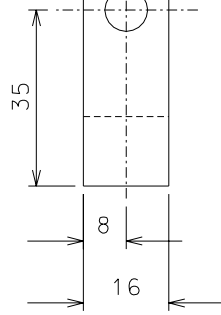
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|      |       |                    |       |
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| rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |        |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|--------|
| Dimensioni:                                    | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         | ± 3    |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato più corto |            |             |             |        |

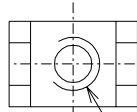
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|                                   | <b>PROMEC S.A.S.</b><br><i>Bientina (Pisa)-Italia</i> | cliente Caltech-LIGO |  |
|                                   |   | N. Tend.005          |  |
| titolo<br><b>TENDITORE LAMA-2</b> |   | dis. Zelenova 9-4-99 |  |
|                                   |   | part. dal 000        |  |
|                                   |   | sost. il N.          |  |



Ø8 alesato sm. 4x45°

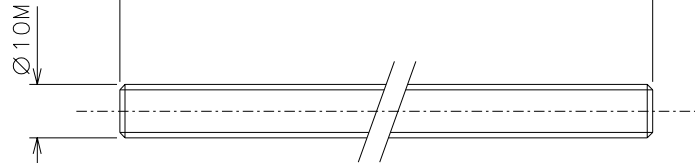


5

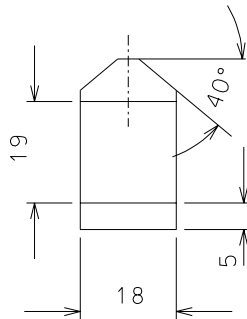
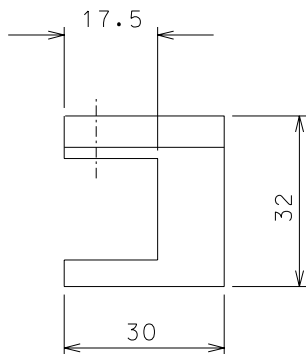


Ø10

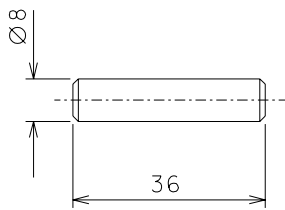
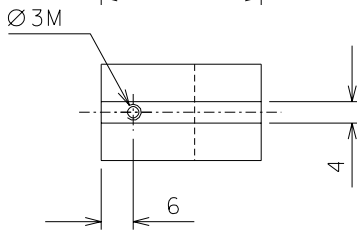
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6



7



3

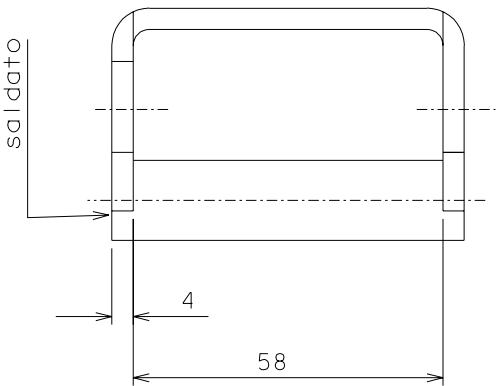
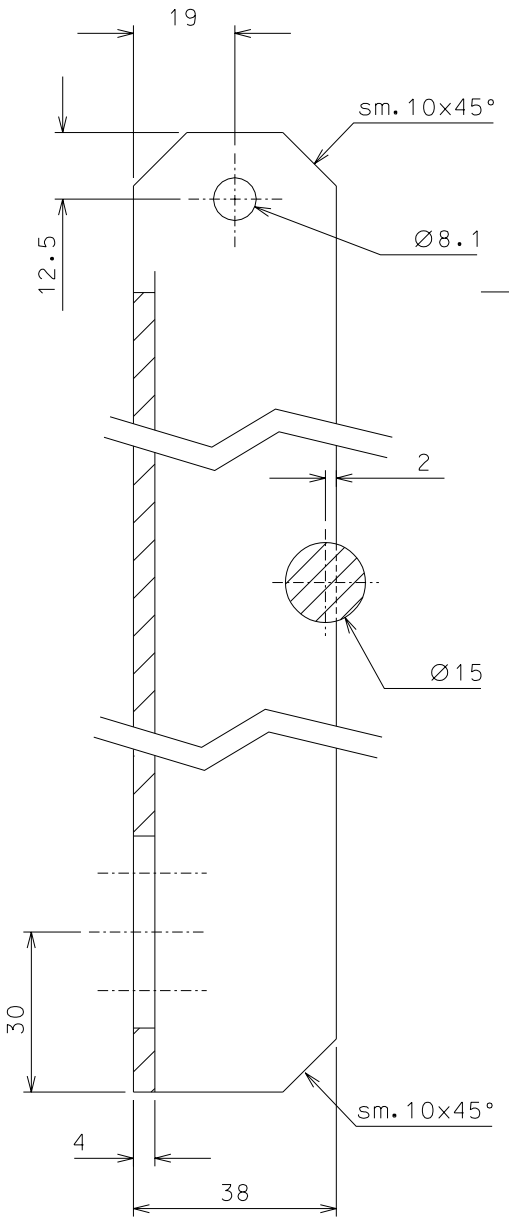
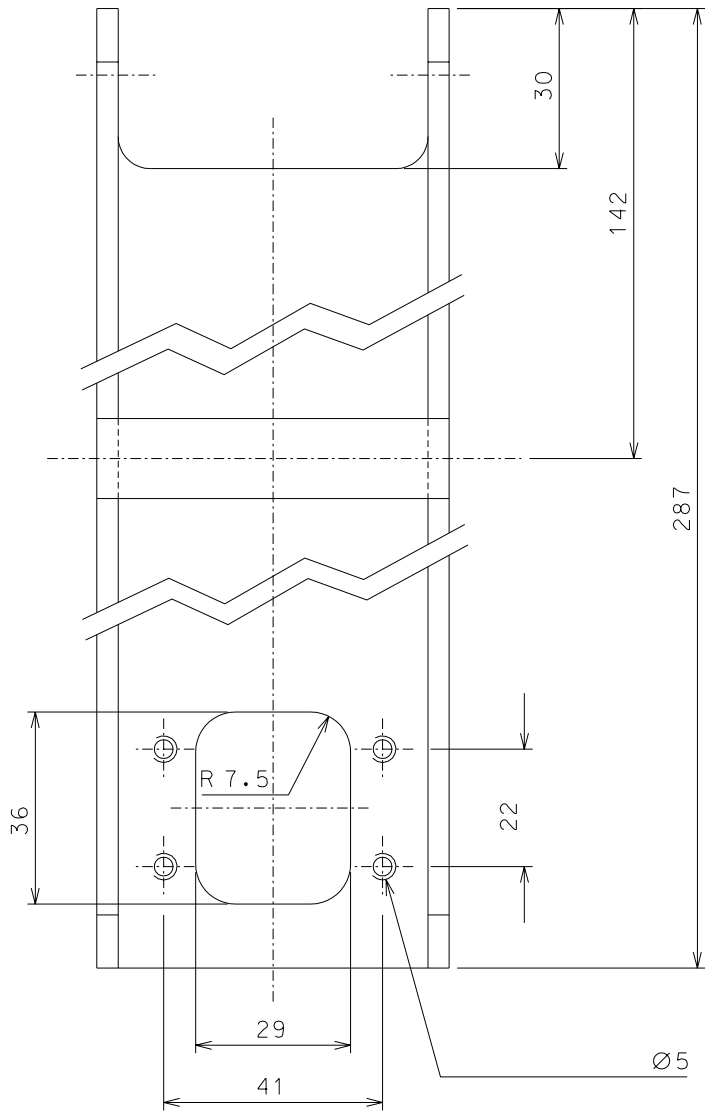
spina commerciale cementata

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| 6    | 8     | acciaio duro       | "     |      |       |                    |       |
| 5    | 8     | "                  | "     |      |       |                    |       |
| 3    | 5     | C 40               | "     |      |       |                    |       |
| 2    | 2     | AISI 316           | "     |      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale | rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |        |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|--------|
| Dimensioni                                     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         | ± 3    |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato più corto |            |             |             |        |

|                  |  |                       |
|------------------|--|-----------------------|
|                  | <p><b>PROMEC S.A.S.</b><br/>Bientina (Pisa)-Italia</p> | cliente Caltech-LIGO  |
|                  |  | N. Tend.006           |
|                  |  | dis. Zelenova 10-4-99 |
|                  |  | part. dal 000         |
| titolo           |  | sost. il N.           |
| TENDITORE LAMA-2 |  |                       |



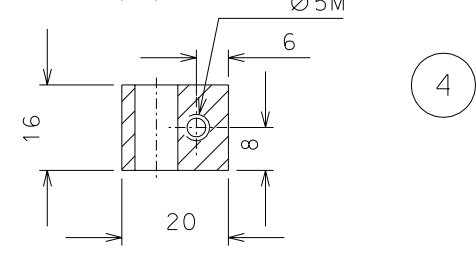
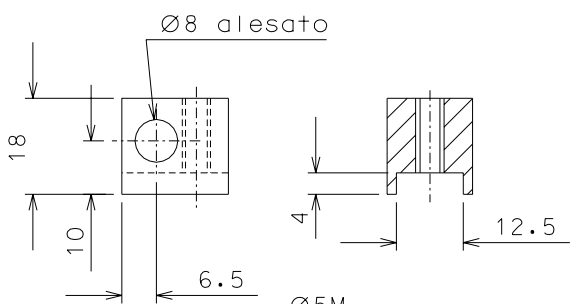


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| rif. | pezzi | mat. e trattamento | scale |

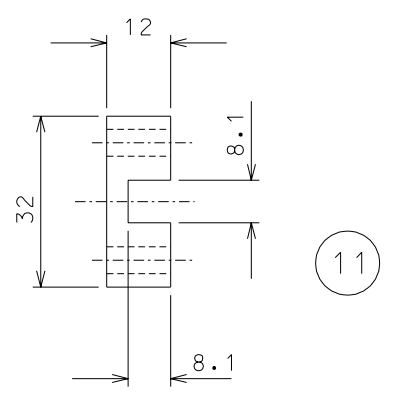
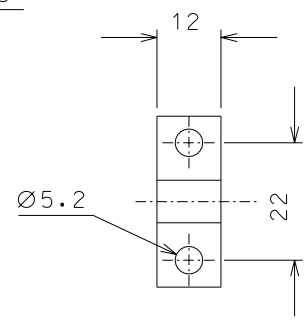
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| rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |        |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|--------|
| Dimensioni                                     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         | ± 3    |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato più corto |            |             |             |        |

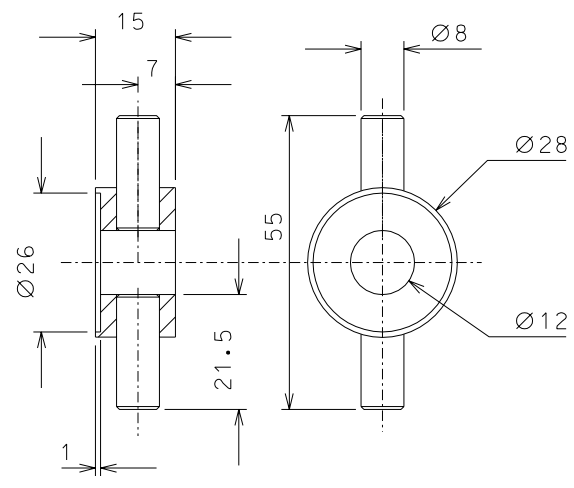
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|                  |   | N. Tend.007           |
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| TENDITORE LAMA-2 |   | part. dal 000         |
|                  |   | sost. il N.           |



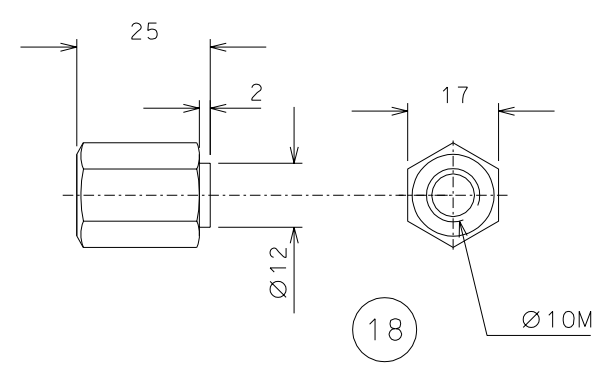
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11



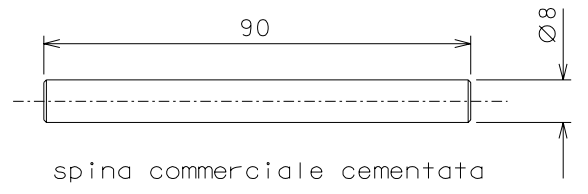
9



18

Montare forzati i perni in C 60  
corpo in AISI 316

20



|      |       |                    |       |
|------|-------|--------------------|-------|
| 9    | 2     | AISI 316           | 1:1   |
| 8    |       | eliminato          |       |
| 4    | 2     | AISI 316           | 1:1   |
| rif. | pezzi | mat. e trattamento | scale |

|      |       |                    |       |
|------|-------|--------------------|-------|
| 20   | 6     | C 40               | 1:1   |
| 18   | 6     | bronzo             | 1:1   |
| 11   | 4     | bronzo             | 1:1   |
| rif. | pezzi | mat. e trattamento | scale |

| Tolleranze generali di lavorazione UNI 5307-63 |       |        |          |                                  |            |             |             |
|--|-------|--------|----------|----------------------------------|------------|-------------|-------------|
| Dimensioni                                     | < 6   | > 6-30 | > 30-120 | > 120-315                        | > 315-1000 | > 1000-2000 | > 2000-4000 |
| Toll. lineari                                  | ± 0.1 | ± 0.2  | ± 0.3    | ± 0.5                            | ± 0.8      | ± 1.2       | ± 2         |
| Toll. angolari                                 | ± 1   | ± 30'  | ± 20'    | ± 10' riferito al lato più corto |            |             |             |

|                                   |  |                       |
|-----------------------------------|--|-----------------------|
|                                   | <p><b>PROMEC S.A.S.</b><br/>Bientina (Pisa)-Italia</p> | cliente Caltech-LIGO  |
|                                   |  | N. Tend.008           |
| titolo<br><b>TENDITORE LAMA-2</b> |  | dis. Zelenova 10-4-99 |
|                                   |  | part. dal 000         |
|                                   |  | sost. il N.           |

1

2

3

A

A

B

B

C

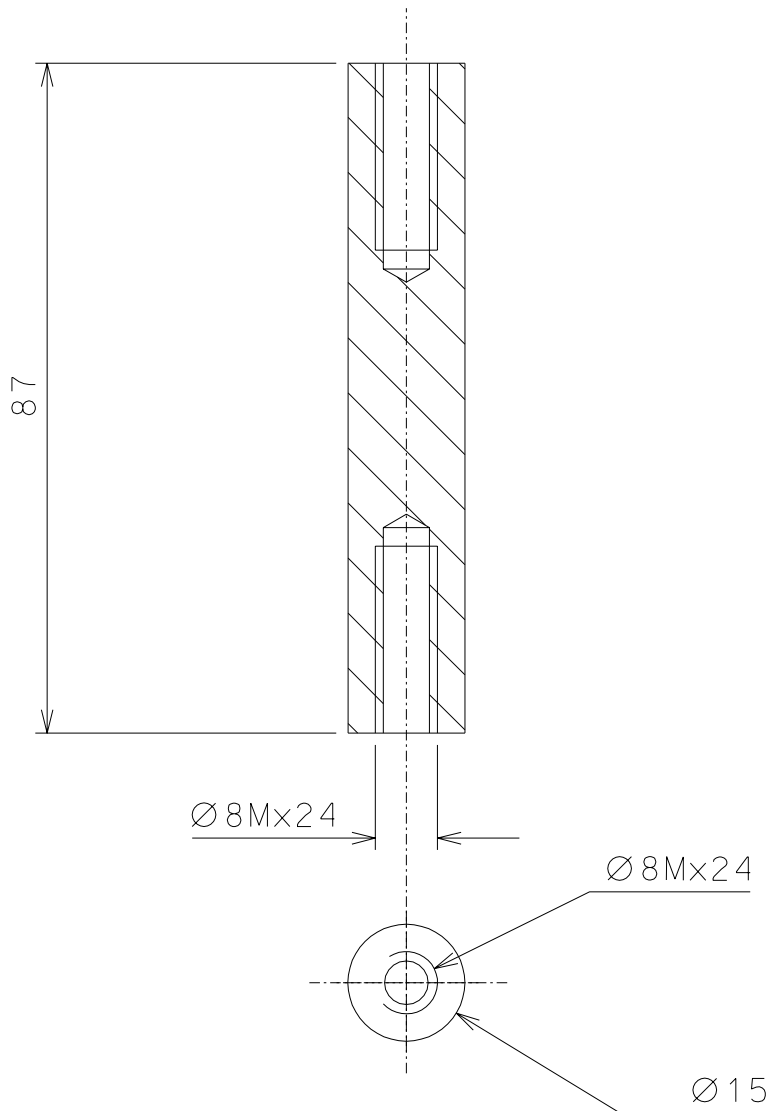
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D

E

E

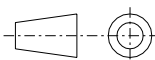


|      |       |                    |       |
|------|-------|--------------------|-------|
| 22   | 4     | antic.100          | 1:1   |
| rif. | pezzi | mat. e trattamento | scale |

|      |       |                    |       |
|------|-------|--------------------|-------|
|      |       |                    |       |
| rif. | pezzi | mat. e trattamento | scale |

Tolleranze generali di lavorazione UNI 5307-63

| Dimensioni     | < 6       | > 6-30    | > 30-120  | > 120-315                            | > 315-1000 | > 1000-2000 | > 2000-4000 | > 4000  |
|----------------|-----------|-----------|-----------|--------------------------------------|------------|-------------|-------------|---------|
| Toll. lineari  | $\pm 0.1$ | $\pm 0.2$ | $\pm 0.3$ | $\pm 0.5$                            | $\pm 0.8$  | $\pm 1.2$   | $\pm 2$     | $\pm 3$ |
| Toll. angolari | $\pm 1$   | $\pm 30'$ | $\pm 20'$ | $\pm 10'$ riferito al lato piu corto |            |             |             |         |



**PROMEC S.A.S**  
Bientina (Pisa)-Italia

cliente Caltech-LIGO

N. Tend.009

dis. Zelenova 10-4-99

part. dal 000

sost. il N.

titolo

TENDITORE LAMA-2

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