

PACK 11

# THE TERMINATOR™

## BUILD THE T-800

1:2  
SCALE

THE MOST  
LEGENDARY  
CYBORG IN  
SCIENCE  
FICTION  
HISTORY!

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# THE TERMINATOR™

## BUILD THE T-800

### PACK 11

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**IDENTIFYING YOUR COMPONENTS:** Each of your Terminator packs is divided into stages. Each stage contains a number of components, and can be identified by referring to the images in your assembly guide or the number located on the sticker on the back of each stage. Each number begins with '77' and is followed by a further three digits. The last three digits indicate the number of each stage. For example, 77 001 indicates stage 01, 77 002 indicates stage 02, etc.

Find more helpful building tips and advice at [community.agoramodels.com](https://community.agoramodels.com)

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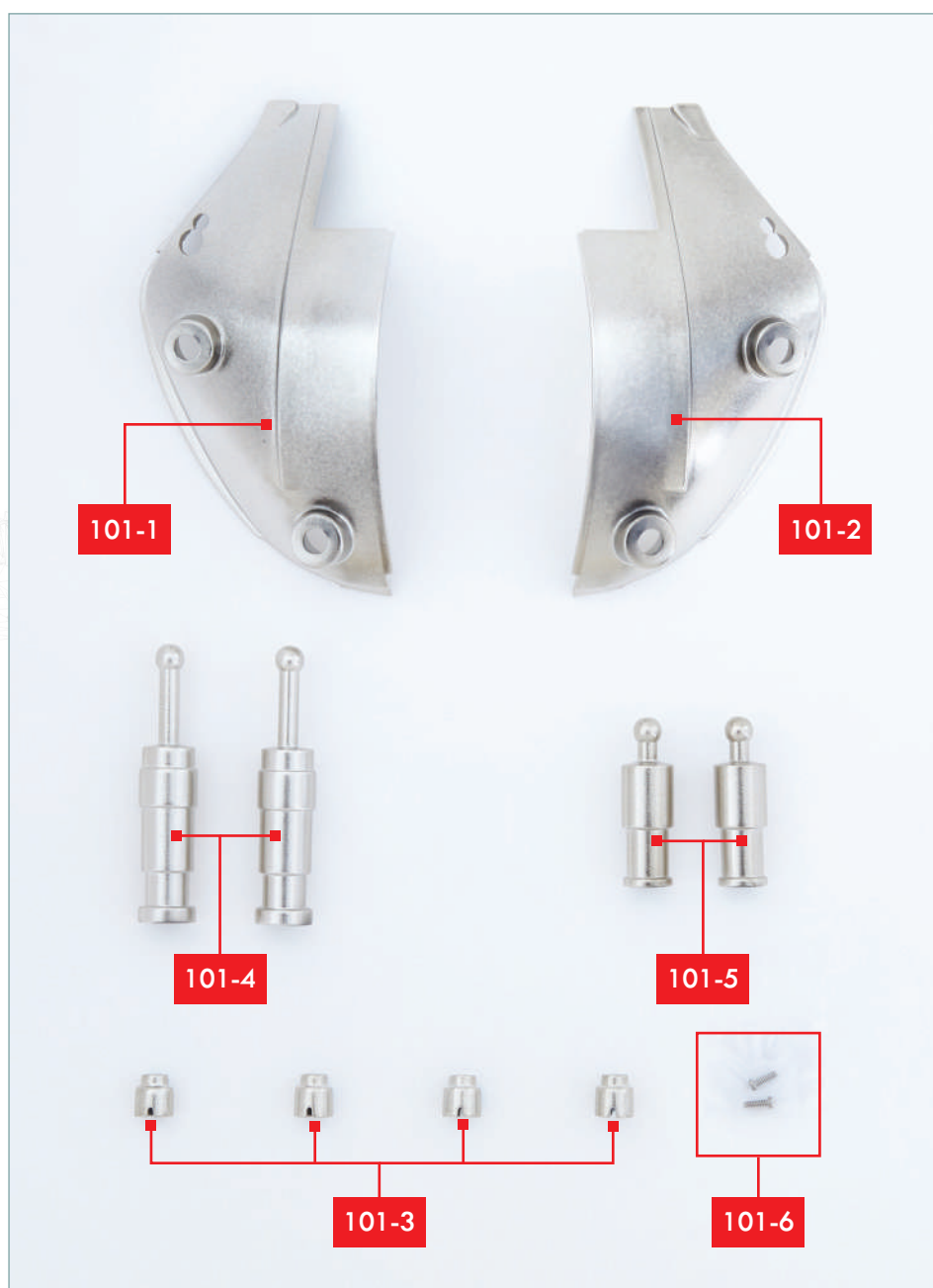
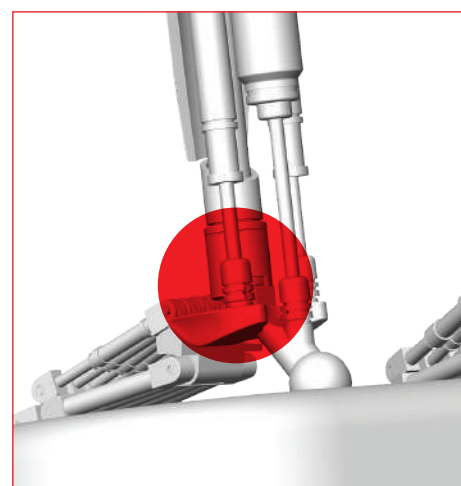
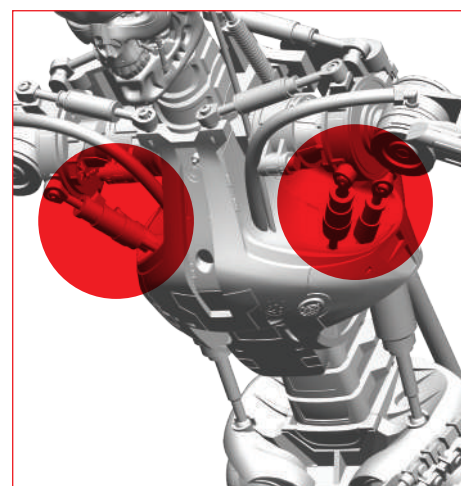
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Not suitable for children under the age of 14. This product is not a toy and is not designed for use in play. Keep the parts out of the reach of small children. Some parts may have sharp edges. Please handle them with care.

# STAGE 101: ATTACH THE LEFT FOOT, AND BEGIN CONSTRUCTION ON THE CHEST

Complete the left leg at the ankle, and begin the chest plate assembly by placing the chest attachments into their sockets.



## LIST OF PIECES

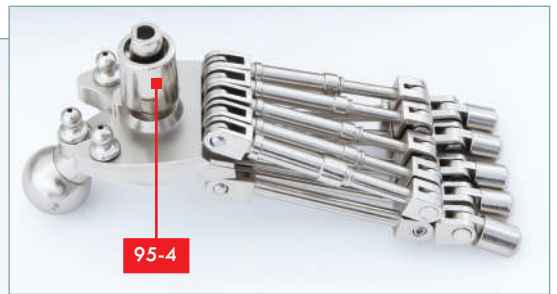
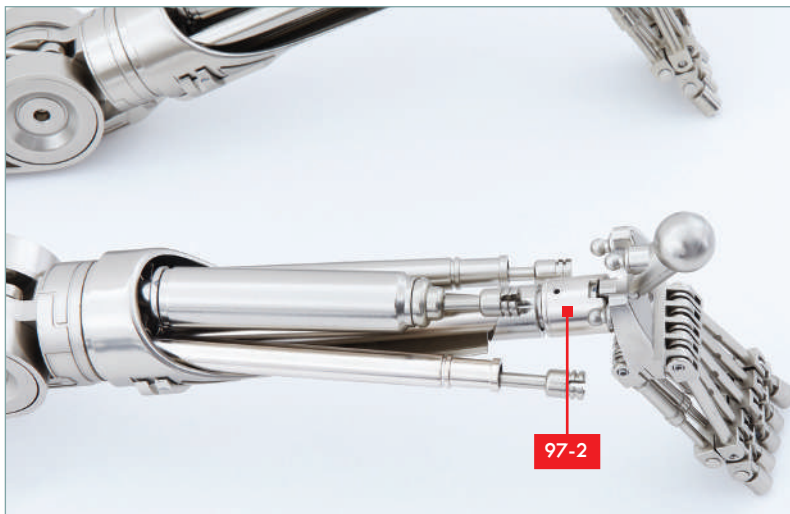
- 101-1 Right chest panel
- 101-2 Left chest panel
- 101-3 Four sockets
- 101-4 Two chest attachments
- 101-5 Two chest attachments
- 101-6 Two 1.7 x 6mm PB screws (1 spare)

## YOU WILL ALSO NEED

Model assembly and foot from stage 100

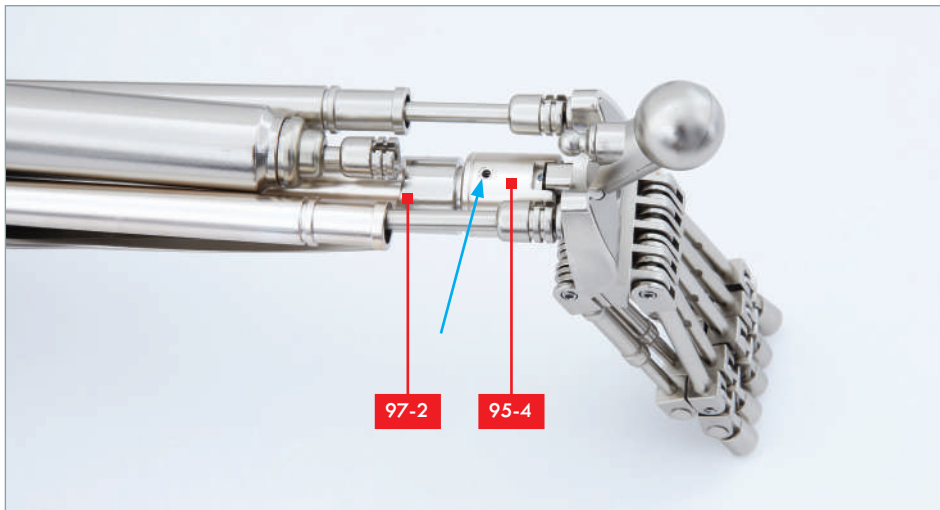
Superglue and a cocktail stick

A fine cross-head screwdriver



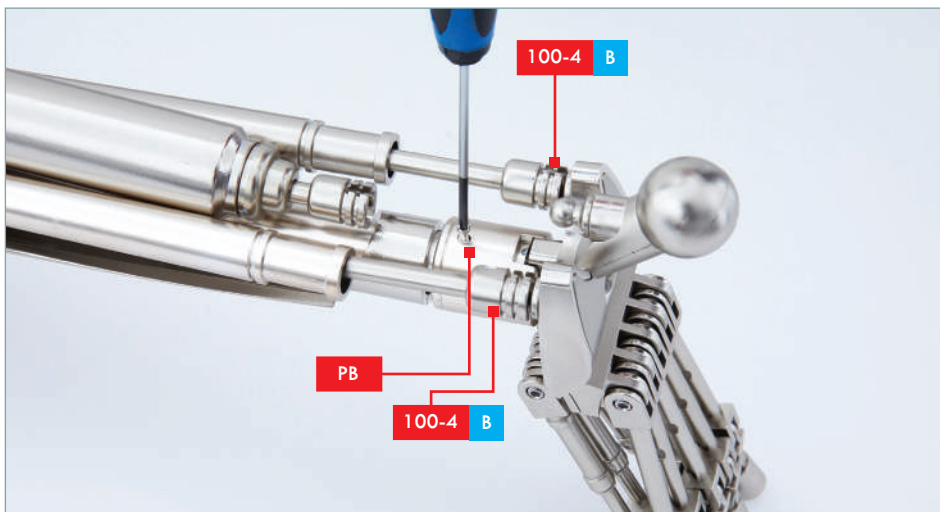
## STEP 1

Take the model assembly from stage 100 and position it face down. Fit the front part of the lower leg **97-2** into the end of part **95-4**, in the middle of the foot (inset). If necessary, to ensure a good fit, gently reduce the size of part **95-4** using a fine file or sandpaper.



## STEP 2

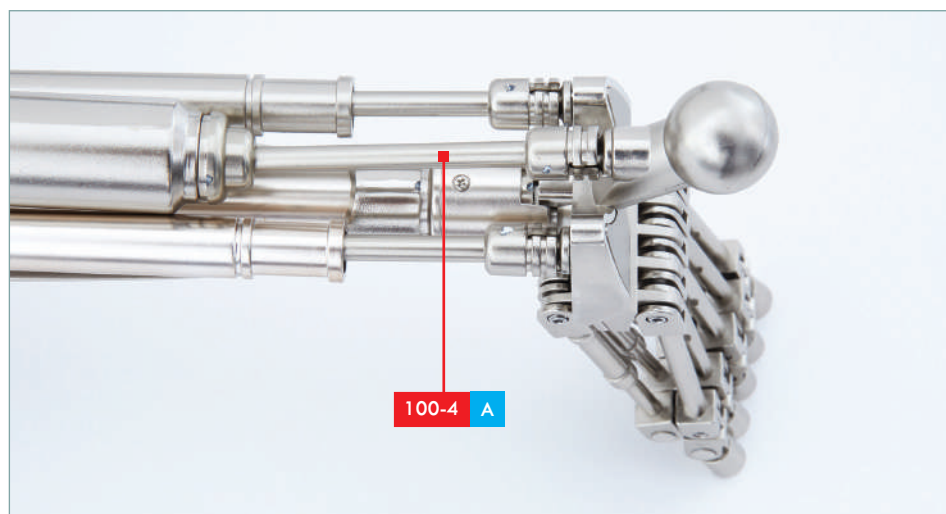
Identify the screw hole in part **95-4** (arrow) and check that it is aligned with the hole in part **97-2**.



## STEP 3

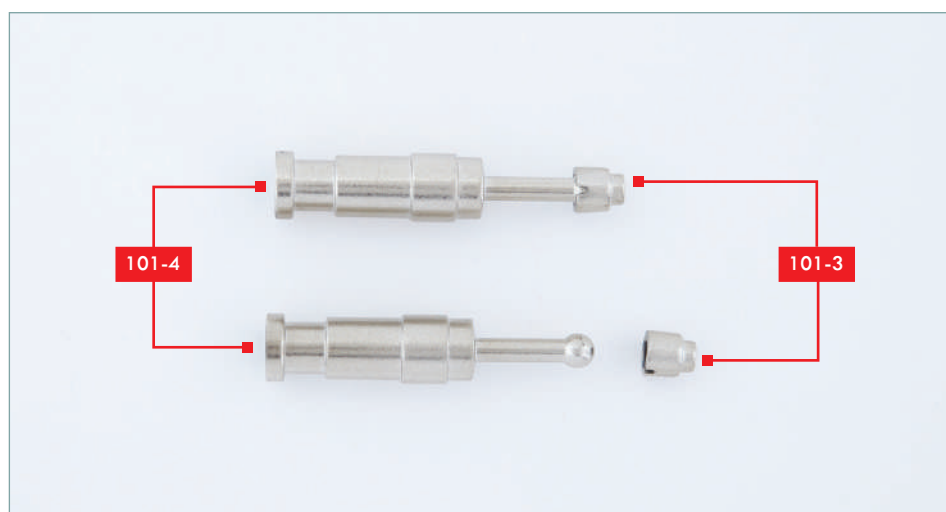
Fit the foot to the lower leg using a 1.7x6mm **PB** screw taking care not to over-tighten the screw. Fit the ends of parts **100-4-B** over the outer two balls around the rear of the foot. Push the sockets on the ends of parts **100-4-B** onto the balls until they click in position.





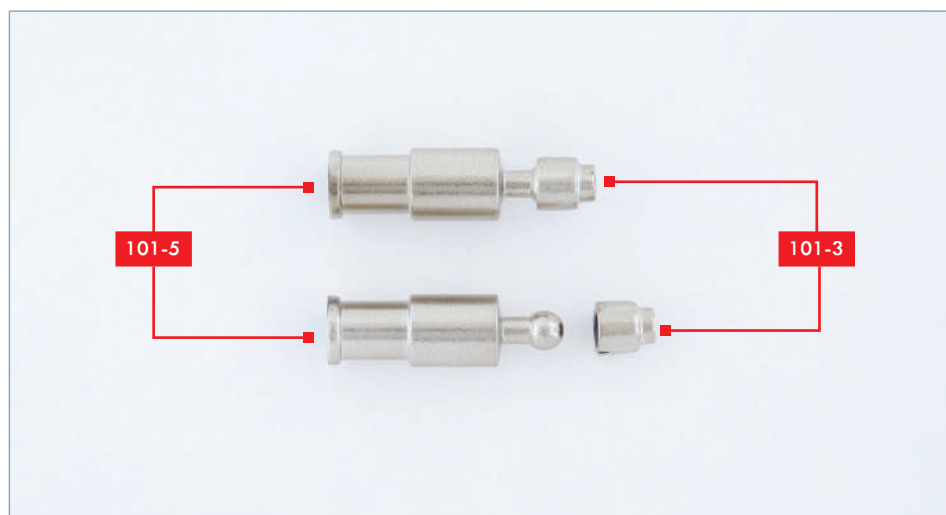
## STEP 4

Push the socket on the end of part **100-4-A** onto the third ball, above the heel. It will click in place when correctly fitted.



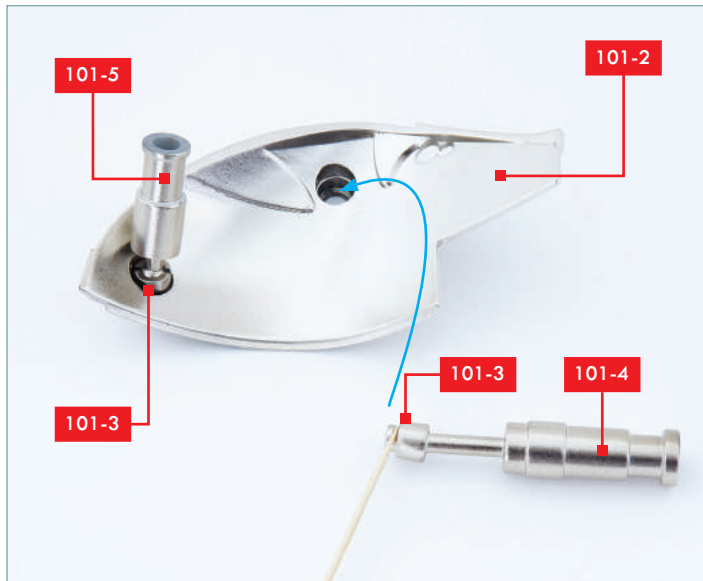
## STEP 5

Take the two chest attachments **101-4** and two of the sockets **101-3**. Push the sockets on to the ball on the ends of parts **101-4** so that they click in place. Firm pressure is needed.



## STEP 6

Take the two smaller chest attachments **101-5** and the remaining sockets **101-3**. Fit the sockets onto the balls, ensuring that they click in place. Again, firm pressure is needed.



## STEP 7

Use a cocktail stick to apply a little superglue to the rim of the socket **101-3** on the end of part **101-5**. Fix in place in the recess in the corner of part **101-2**, as shown. In preparation for the next step, apply adhesive to the socket **101-3** on the end of part **101-4**, as shown.



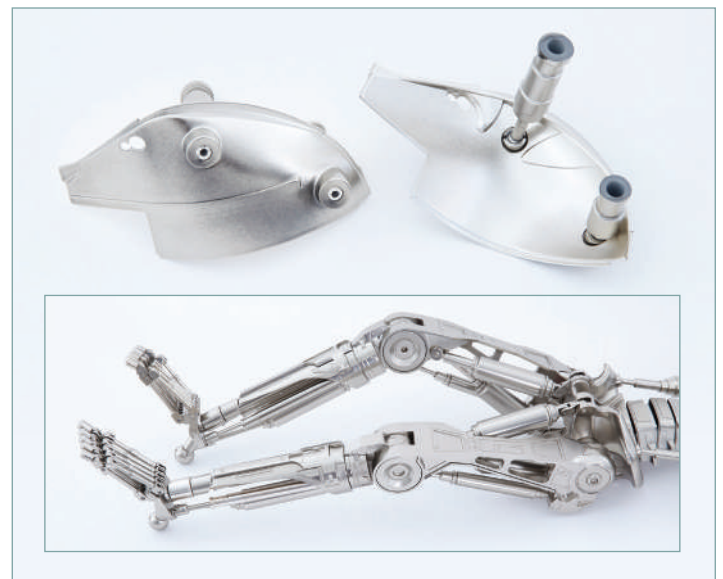
## STEP 8

Fit the second socket **101-3** into the second recess in part **101-2**, as shown.



## STEP 9

Repeat steps 7 and 8 to fit the remaining attachments into part **101-1**, as shown.



## STAGE COMPLETE!

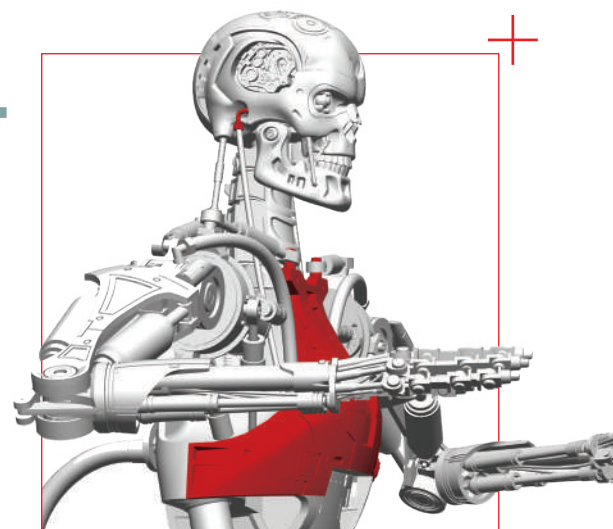
The left leg has been completed and work has started on the chest.





# STAGE 102: DETAIL THE HEAD, AND ADD PANELS AND SPRINGS TO THE CHEST

Thread springs through the chest casing, and connect it to the existing chest panel. Begin to finalise the head with extra details.

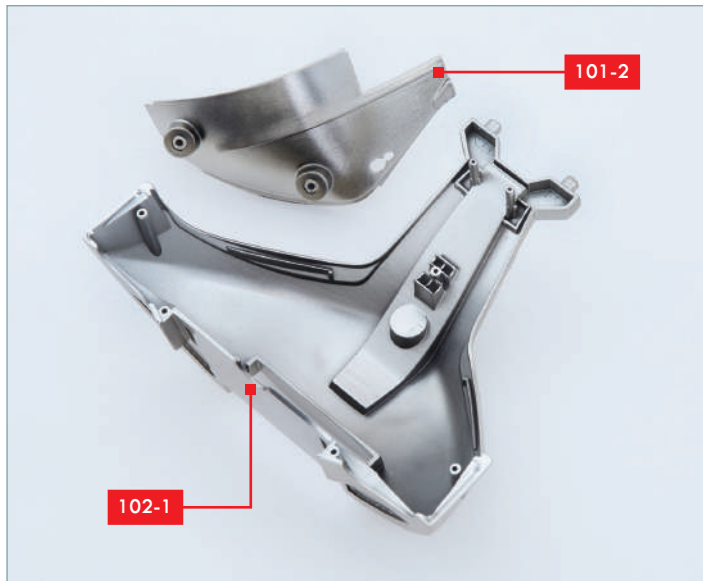


## LIST OF PIECES

102-1	Chest casing	102-4	Large washer
102-2	Head detail	102-5	Larger diameter spring
102-3	Head detail	102-6	Smaller diameter spring
		102-7	Two 2 x 6mm PB screws (1 spare)

## YOU WILL ALSO NEED

Model assembly from stage 101  
Superglue and a cocktail stick  
Chest panels from stage 101  
A fine cross-head screwdriver



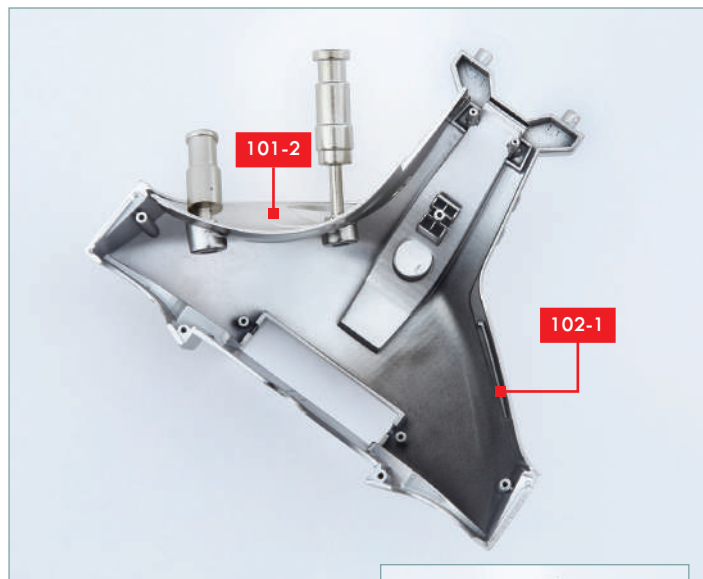
## STEP 1

Take the panel **101-2**, with its attachments, from the previous stage. Check how the rim of part **101-2** fits against the shaped edge of the chest casing **102-1**. Ribs on part **102-1** create fine channels to hold the edge of part **101-2**. (See also step 3.)



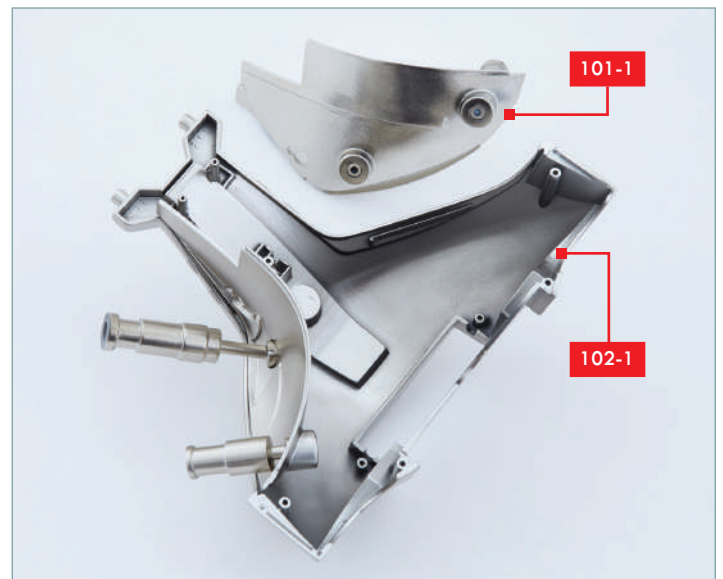
## STEP 2

Once satisfied with the fit of the part, apply a little superglue along the rim of part **101-2** where it comes into contact with part **102-1**.



## STEP 3

Glue part **101-2** in place to part **102-1**, as shown. The main photo shows the view from the inside of the chest casing. The inset (right) shows the view from the side.

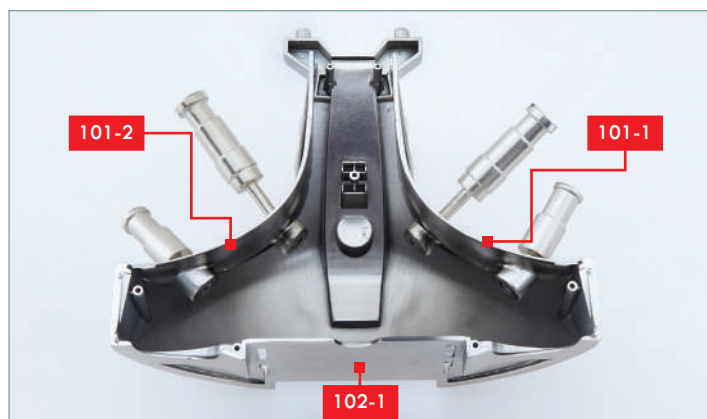


## STEP 4

When the glue is dry, take the chest panel **101-1** from the previous stage. Check the fit against the shaped edge of the chest casing **102-1**.

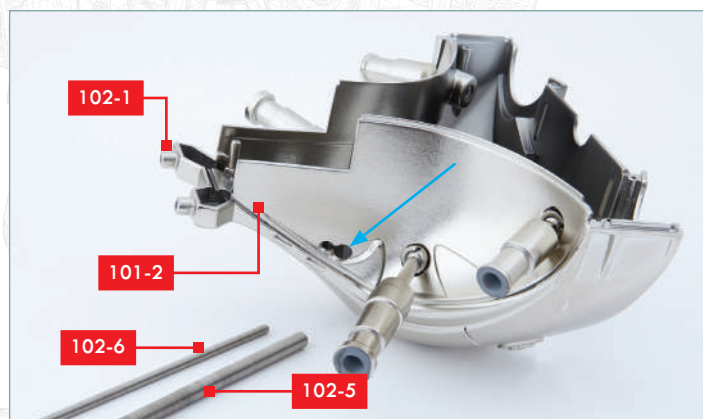






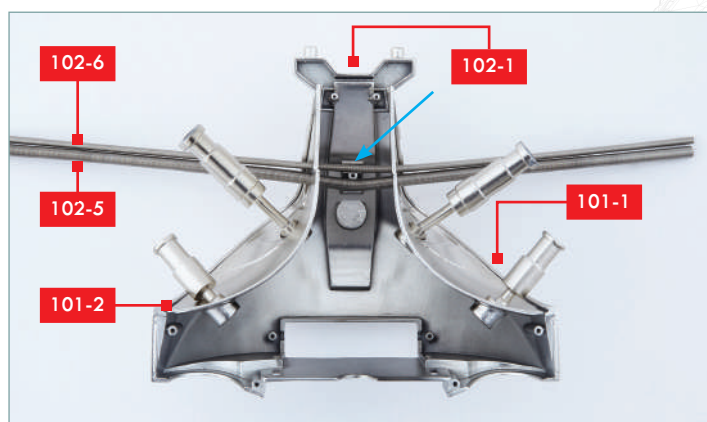
## STEP 5

Apply glue to the rim of part **101-1** that fits against part **102-1** and glue in place, as shown.



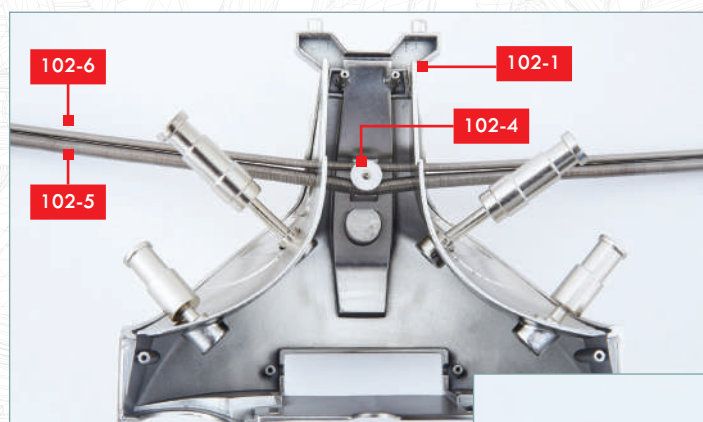
## STEP 6

Identify the double hole in part **101-2** (arrow). Take the two springs **102-5** and **102-6**. These will be threaded through the holes.



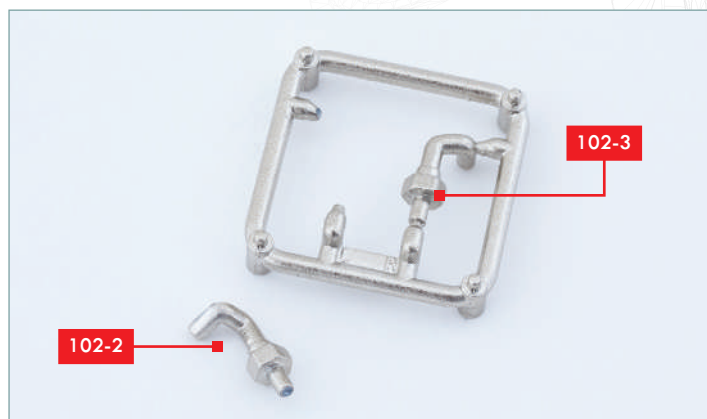
## STEP 7

Thread the springs **102-5** and **102-6** through the holes in part **101-2**, across the inside of the chest casing **102-1** and out through the holes in part **101-1**. The centrepont of each spring should be in the centre of part **102-1**. The springs are arranged on each side of the screw socket in part **102-1** (arrow).



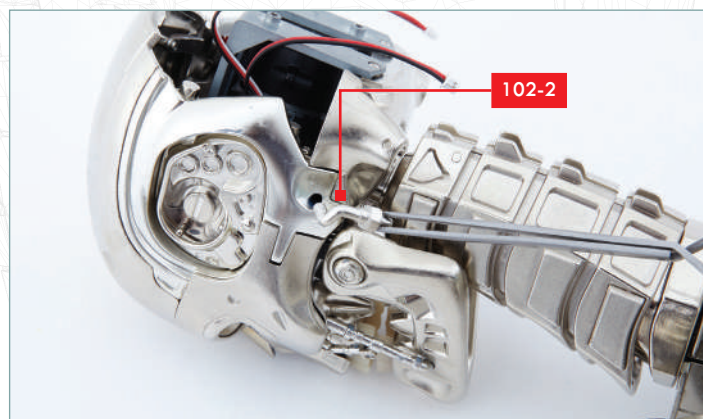
## STEP 8

Fit 2 x 6mm **PB** screw into the washer **102-4** (inset). Fit the screw into the screw socket in the back of the chest casing **102-1** and tighten the screw so that the washer **102-4** holds the springs **102-5** and **102-6** in place.



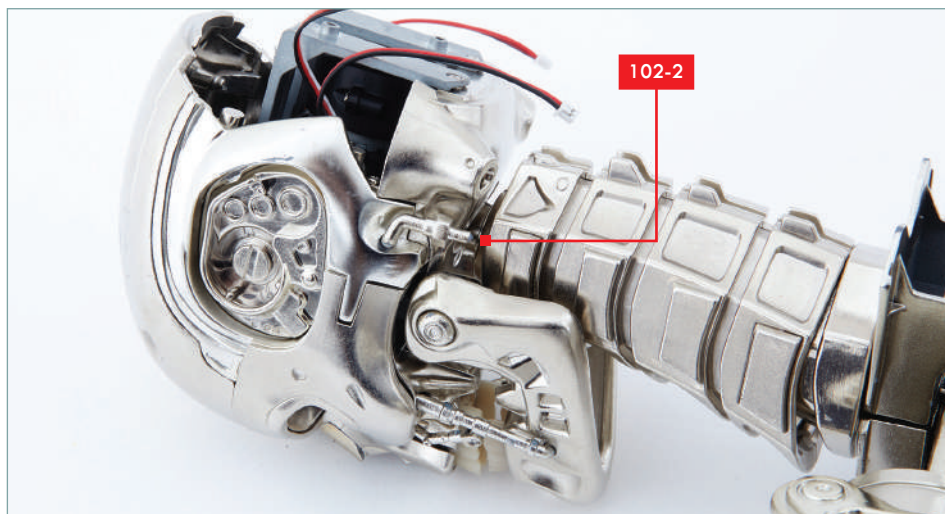
## STEP 9

Cut part **102-2** from the frame.



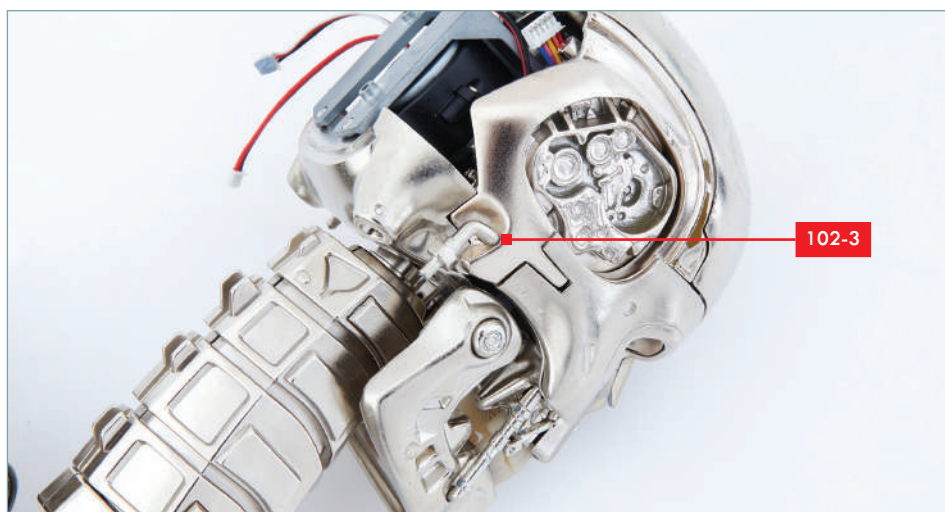
## STEP 10

Take the model assembly from the previous stage and position it so that you can access the left side of the head. Identify the hole where part **102-2** fits and check the fit.



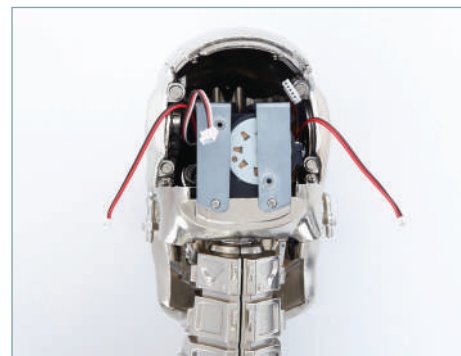
## STEP 11

Apply a little superglue to the peg on the end of part **102-2** (above). Fix the peg in place on the side of the head.



## STEP 12

Cut part **102-3** from the frame and repeat the previous steps to fit part **102-3** to the right-hand side of the head.



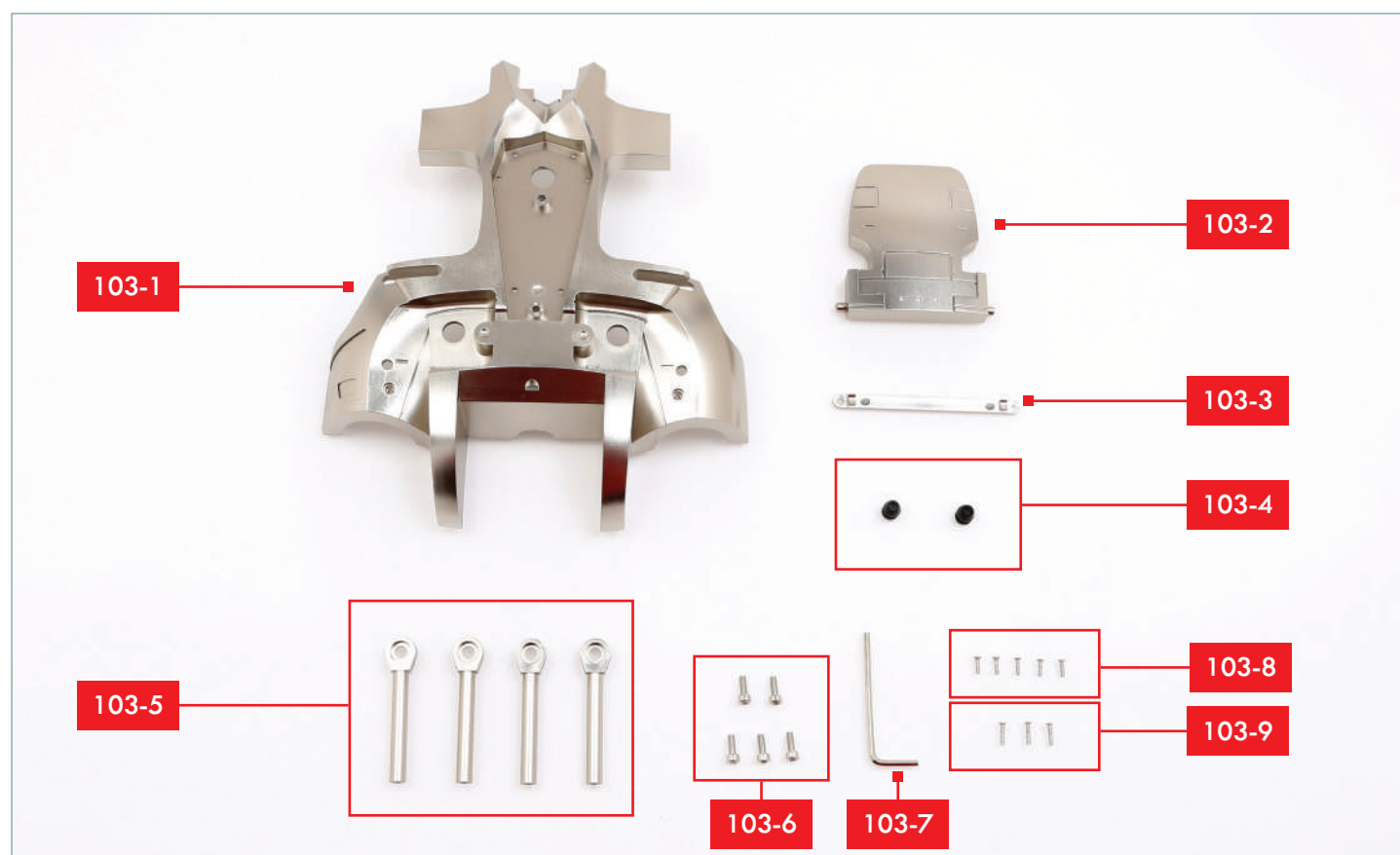
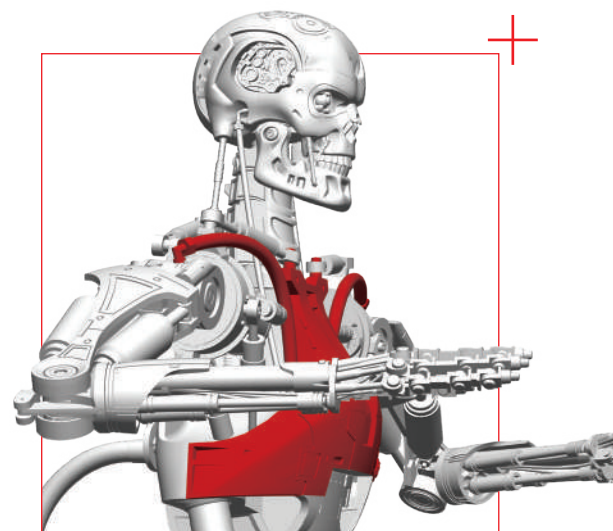
## STAGE COMPLETE!

The chest panels and springs have been fitted to the chest and details have been added to the sides of the head.



# STAGE 103: AFFIX THE CHEST ASSEMBLY AND ATTACH SPRING TUBE DETAILS

Use the chest attachments to fit the chest assembly, and connect spring tubes to the head and shoulders.



## LIST OF PIECES

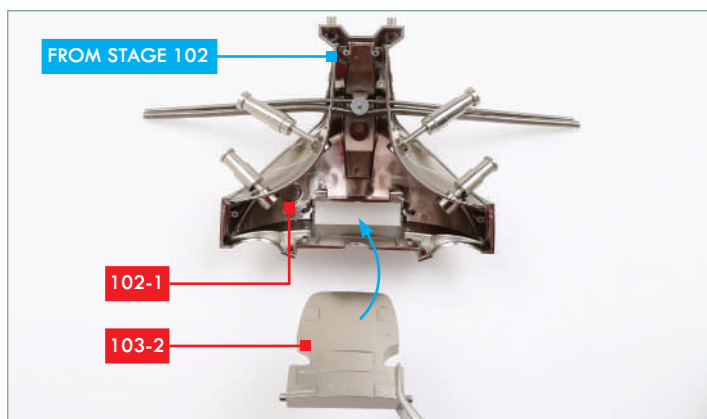
103-1	Back panel	103-6	Five hex socket 3 x 8mm screws (1 spare)
103-2	Chest detail	103-7	Allen key
103-3	Fixing strip	103-8	Five 2 x 6mm PB screws (1 spare)
103-4	Two rubber sockets	103-9	Three 2 x 8mm PB screws (1 spare)
103-5	Four shafts		

## YOU WILL ALSO NEED

Model assembly from stage 102

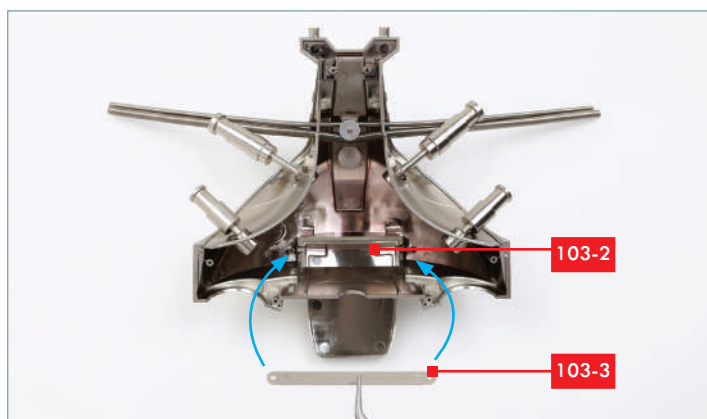
A fine cross-head screwdriver

Superglue and a cocktail stick



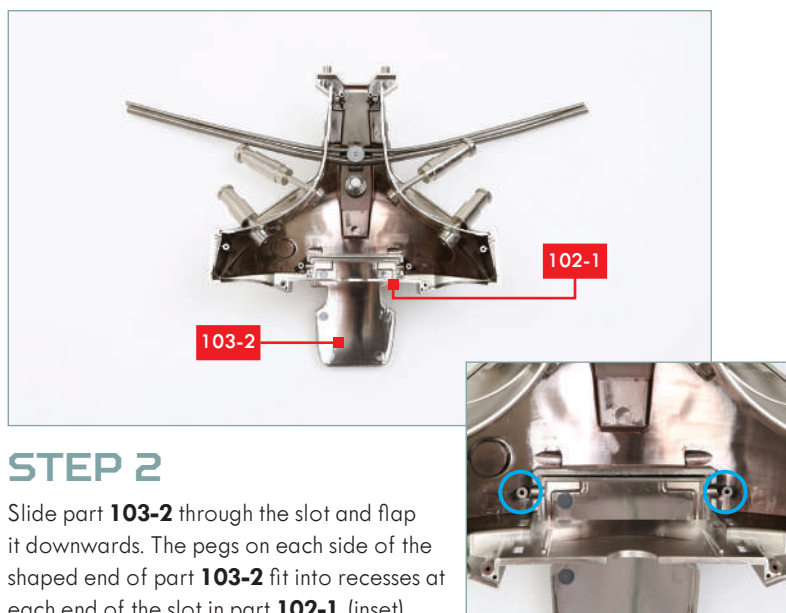
## STEP 1

Take the chest assembly from the previous stage. Fit the narrower end of the chest detail **103-2** through the slot in the chest panel **102-1**, as indicated. Note which way up part **103-2** is inserted.



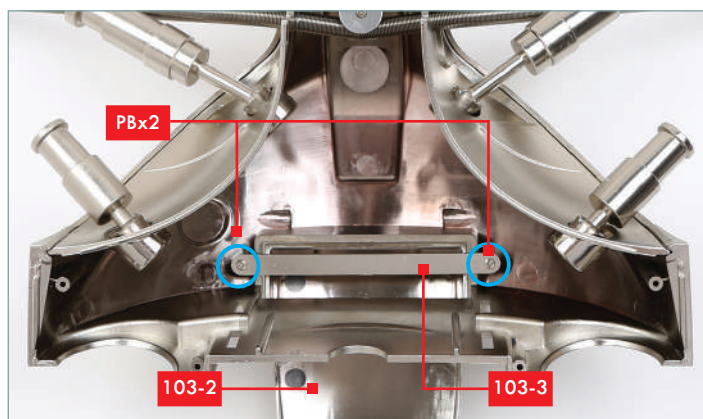
## STEP 3

Fit the fixing strip **103-3** over the end of the detail **103-2**, so that the screw holes are aligned as indicated.



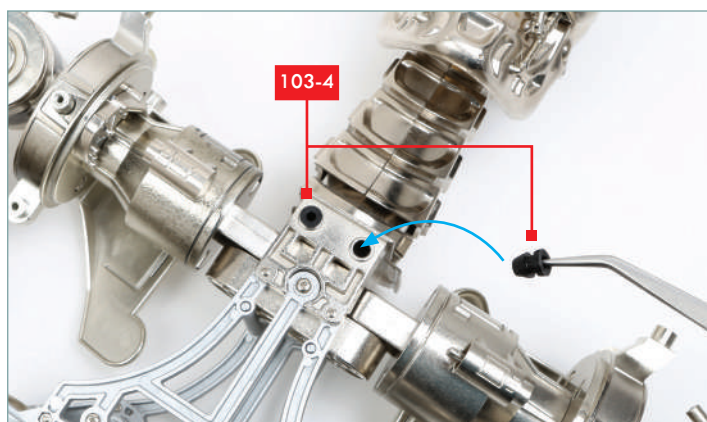
## STEP 2

Slide part **103-2** through the slot and flap it downwards. The pegs on each side of the shaped end of part **103-2** fit into recesses at each end of the slot in part **102-1** (inset).



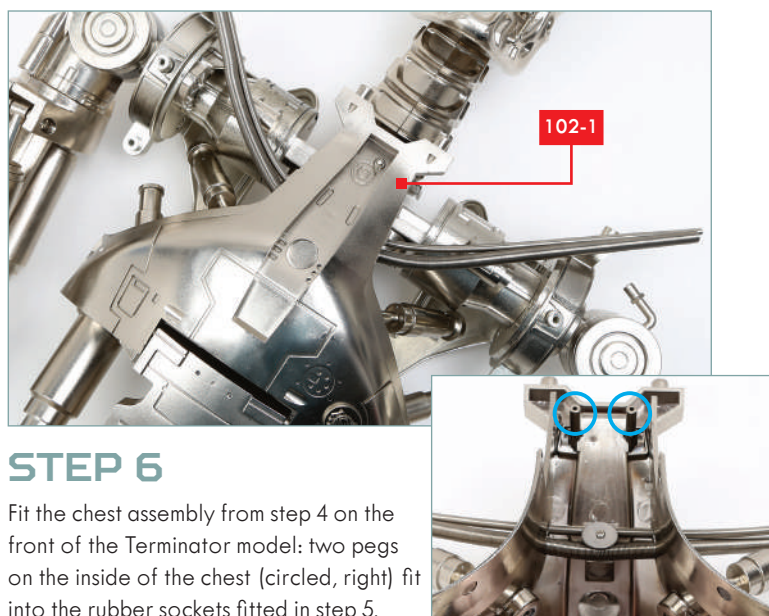
## STEP 4

Fix the fixing strip **103-3** in place with two 2 x 6mm PB screws (circled).



## STEP 5

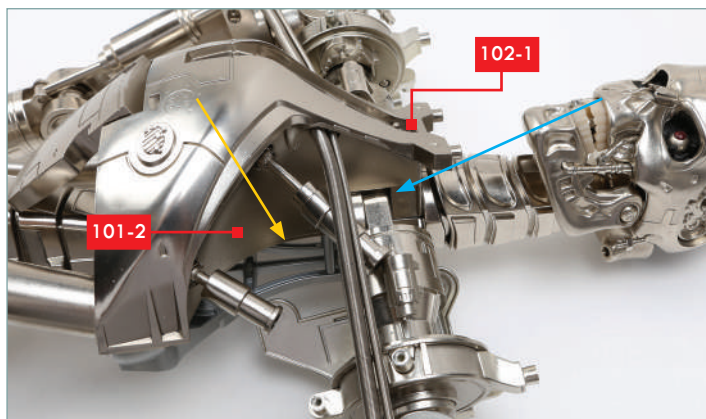
Take the two rubber sockets **103-4** and fit them into the two holes in the front of the chest of your model at the base of the neck, as indicated. You will need to push them firmly into the holes.



## STEP 6

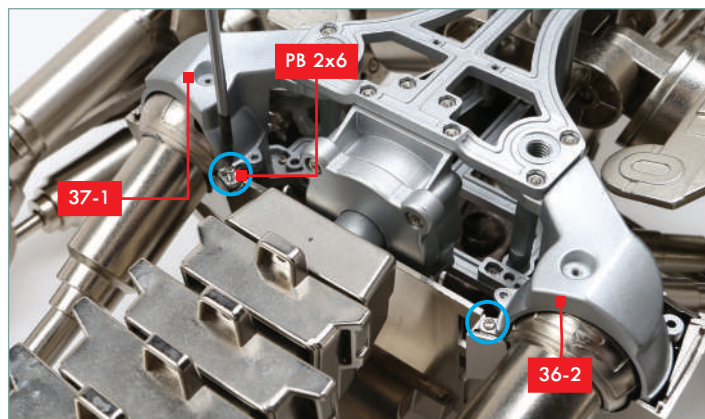
Fit the chest assembly from step 4 on the front of the Terminator model: two pegs on the inside of the chest (circled, right) fit into the rubber sockets fitted in step 5.





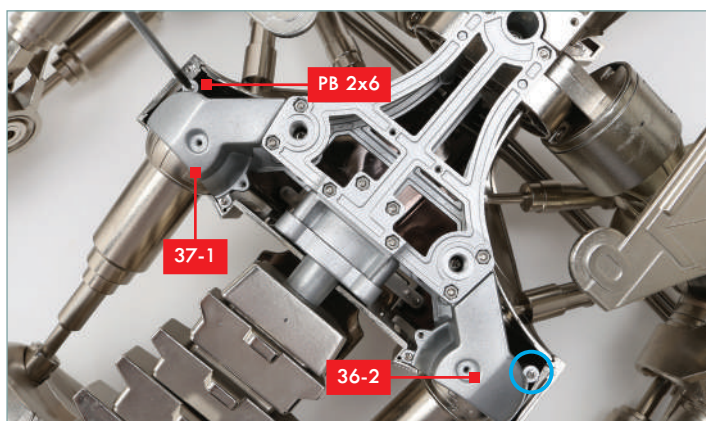
## STEP 7

The curved edges of the chest panels **101-2** and **101-1** (not seen) fit snugly against the curved bar of the metal frame (yellow arrow) and the angled shape of the panels fits against the shoulder parts (blue arrow).



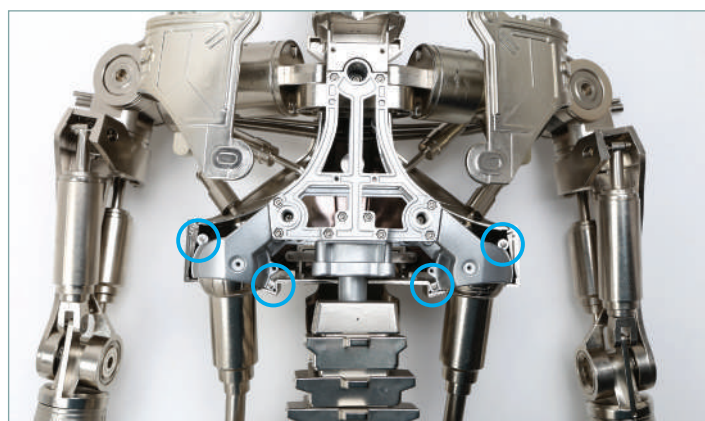
## STEP 8

Carefully turn the model over, keeping the chest section in place. Fix the lower edge in place using two 2 x 6mm **PB** screws. They go through screw holes in the parts **37-1** and **36-2**, and into screw sockets in the back of the chest panel.



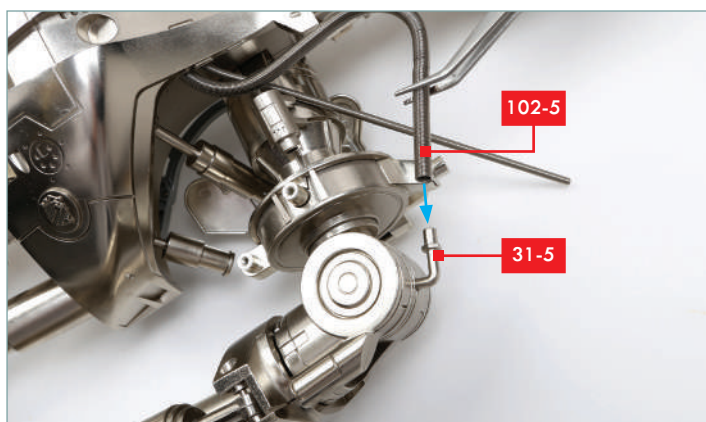
## STEP 9

Fix the side edges of the chest panel in place using two 2 x 8mm **PB** screws. They go through screw holes in the parts **37-1** and **36-2**, and into screw sockets in the back of the chest panel.



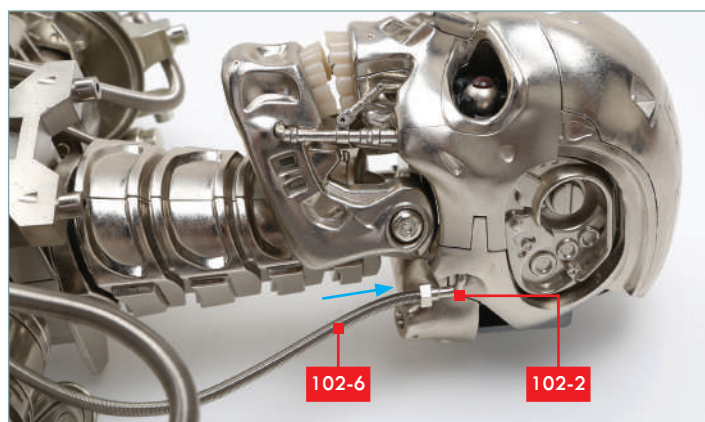
## STEP 10

This shows the four screws in place (circled).



## STEP 11

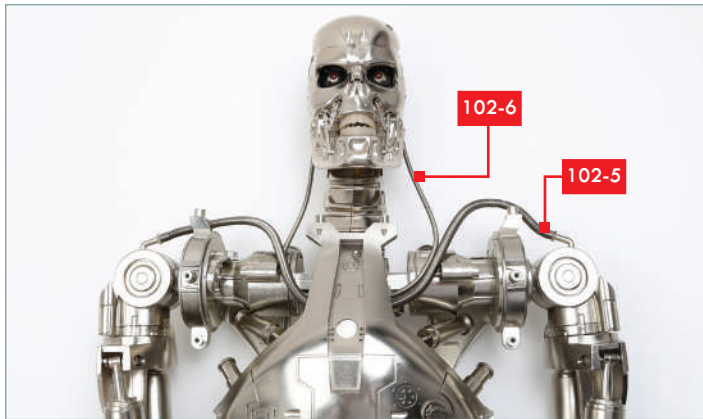
Turn the model on its back. The ends of the larger spring tube **102-5** fit on to the pipes from **31-5** (on the left shoulder) and **25-3** (on the right shoulder). Apply a little glue to the ends of the pipes before fixing the tube ends in place. You may need to twist the spring as you fit it.



## STEP 12

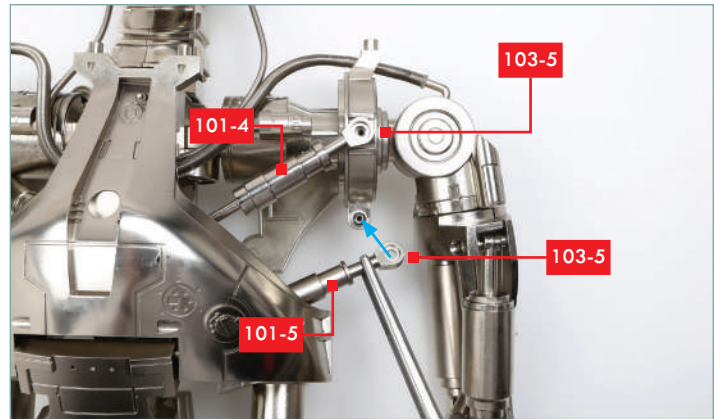
The ends of the narrow tubes **102-6** fit on to the details on the side of the head, **102-2** (on the left) and **102-3** (on the right). Again, apply a little superglue to the ends of the pipe before fixing the tube ends in place.





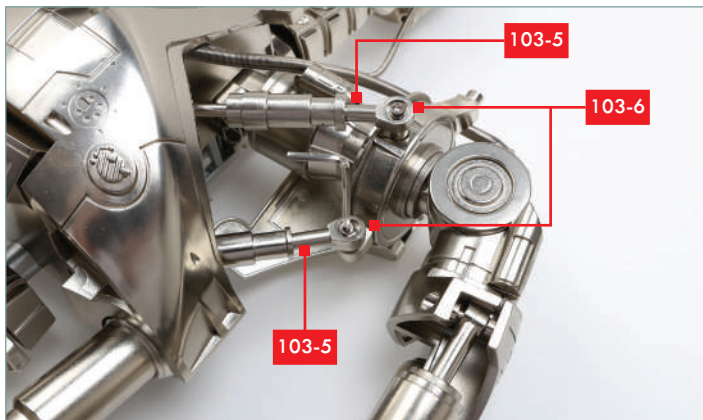
## STEP 13

This shows the ends of the tubes fitted to the pipe details.



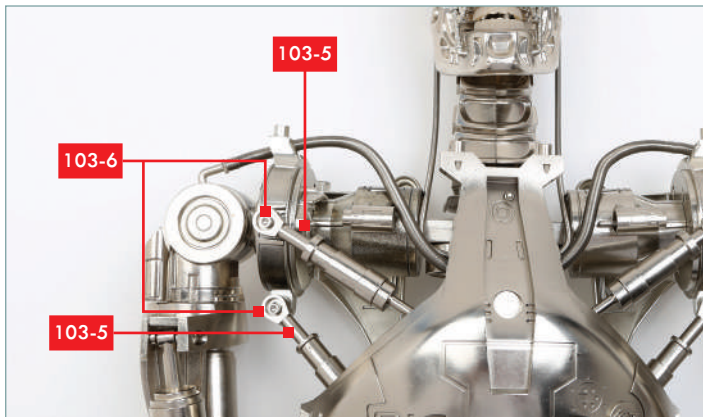
## STEP 14

Fit two of the shafts **103-5** into the chest attachments **101-4** and **101-5** on the left-hand side of the model. Fit the shaped ends of the shafts **103-5** over the shoulder attachments, as shown.



## STEP 15

Use hex screws **103-6** and the Allen key supplied with this stage to fix the ends of the shafts **103-5** in place. They do not fit tightly into the recesses, as the shafts need to have movement.



## STEP 16

Repeat the two previous steps to fit the shafts **103-5** in place on the right-hand shoulder, using the hex screws **103-6**.



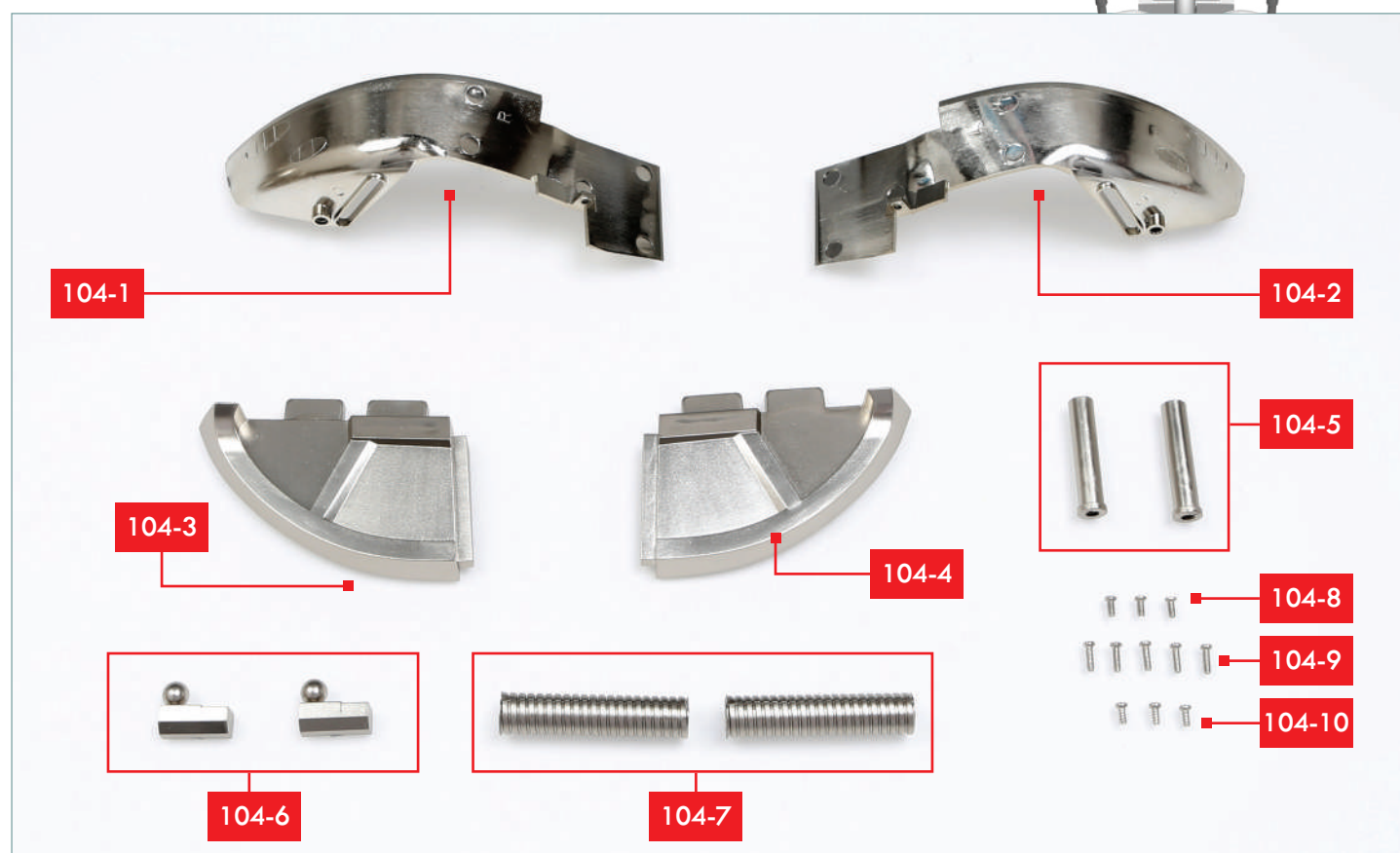
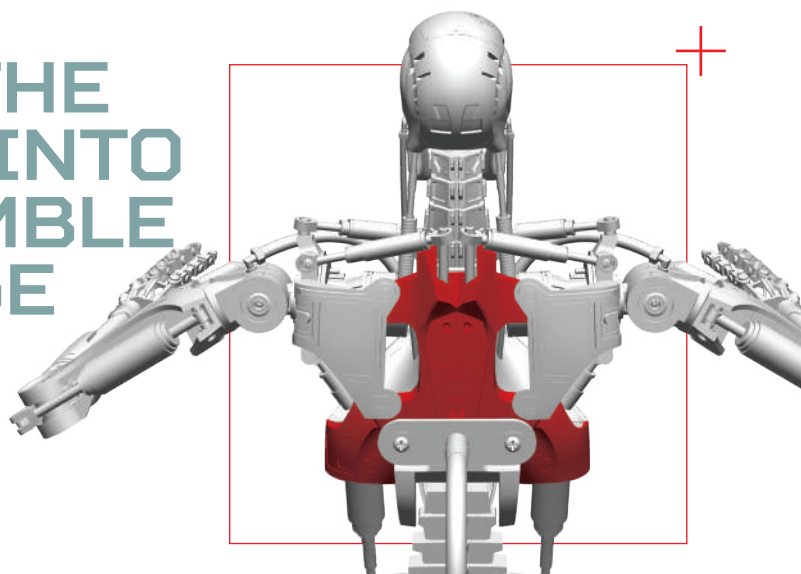
## STAGE COMPLETE!

The chest assembly has been fitted to the front of the model, with the chest attachments fixed to the shoulders. The spring tubes have been attached to details on the sides of the head and the top of the shoulders. Part **103-1** (inset) will be fitted in the next stage.



# STAGE 104: GLUE THE CHEST SUPPORTS INTO PLACE, AND ASSEMBLE AND AFFIX A LARGE BACK PANEL

Construct the back assembly from two sizeable components, and attach the chest supports to the front of the model.



## LIST OF PIECES

104-1	Back panel (right)	104-6	Two fixing blocks
104-2	Back panel (left)	104-7	Two ribbed shafts
104-3	Chest support (left)	104-8	Three 2 x 4mm PM screws (1 spare)
104-4	Chest support (right)	104-9	Five 2 x 6mm PM screws (1 spare)
104-5	Two straight shafts	104-10	Three 2 x 4mm PB screws (1 spare)

## YOU WILL ALSO NEED

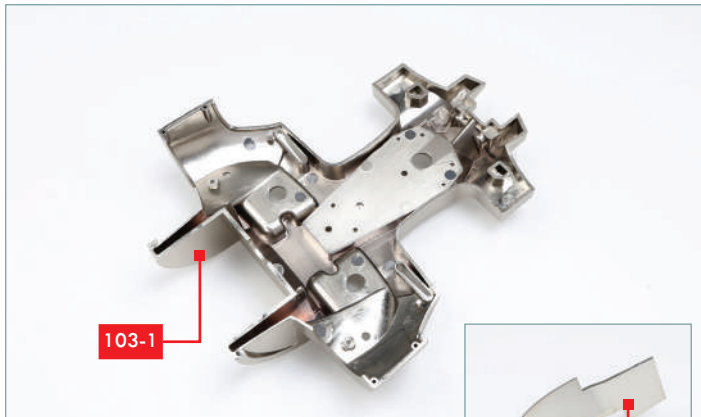
Back panel 103-1 from the previous stage

Model assembly from stage 103

A fine cross-head screwdriver

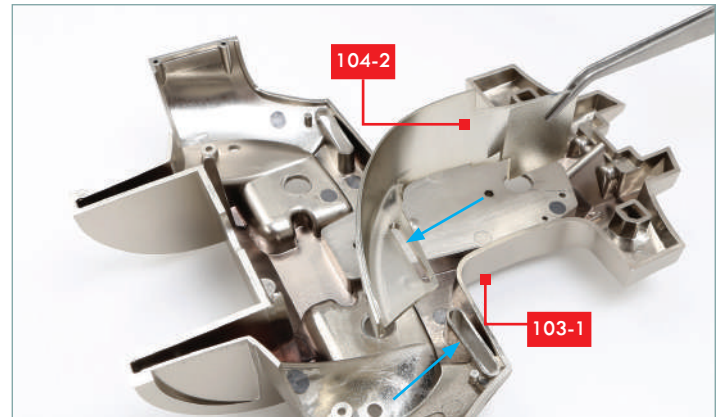
Superglue and a cocktail stick





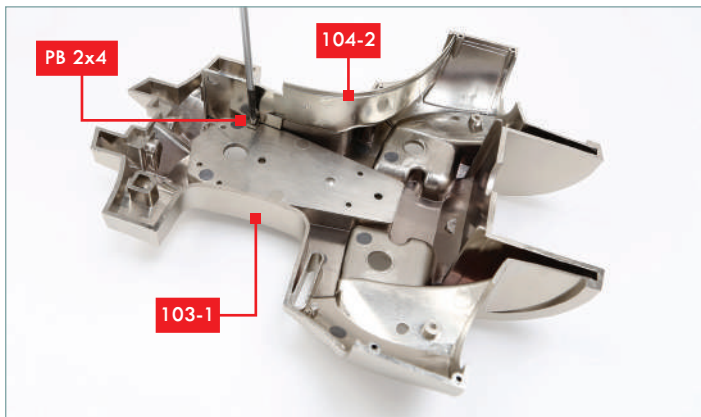
## STEP 1

Take the back panel **103-1** from the previous stage and the left back panel **104-2**, which is marked with an L (inset right).



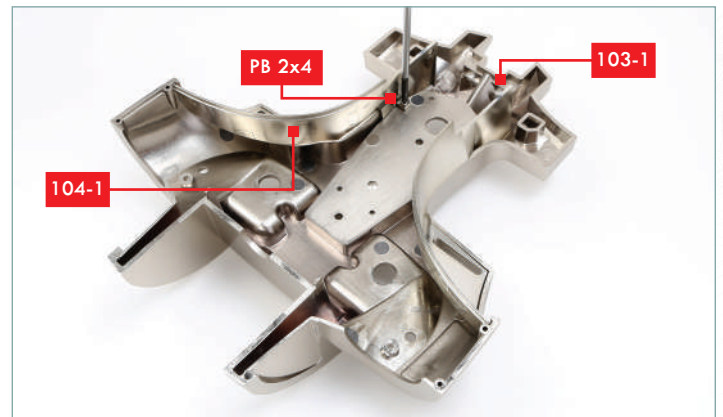
## STEP 2

Fit part **104-2** to the side of part **103-1**. Note that each part has a slot (arrows) and these should align.



## STEP 3

There is a tab with a screw hole on the inside of part **104-2**. Use a **PB 2 x 4mm** screw to fix the two parts together.



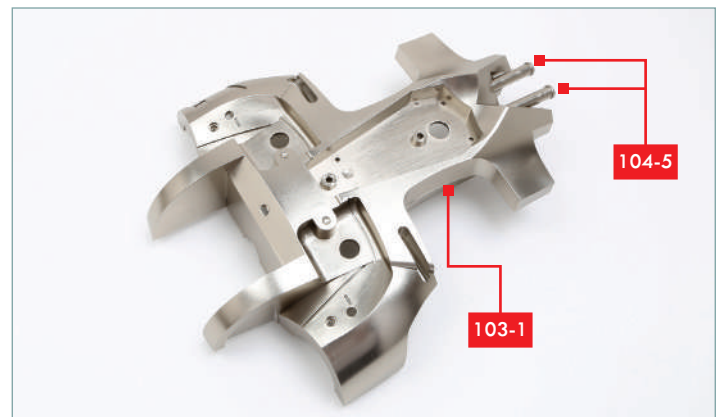
## STEP 4

Repeat the previous steps to fit part **104-1** (marked R) to the other side of the back panel **103-1**. Fix in place with a **PB 2 x 4mm** screw.



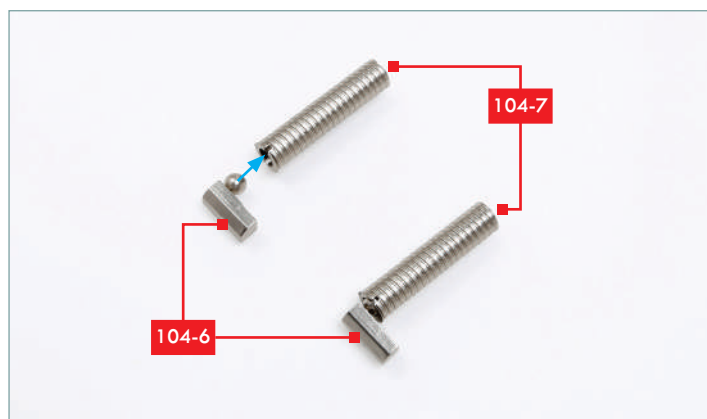
## STEP 5

Take one of the shafts **104-5** and apply a little superglue to the flat end of the shaft. Note that the glue is applied to the end without a lip.



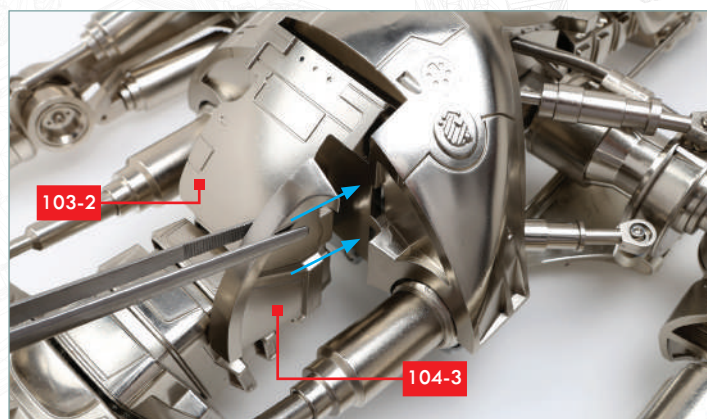
## STEP 6

Fit the shaft into the socket at the top of part **103-1**. Repeat to fit the second shaft, as shown.



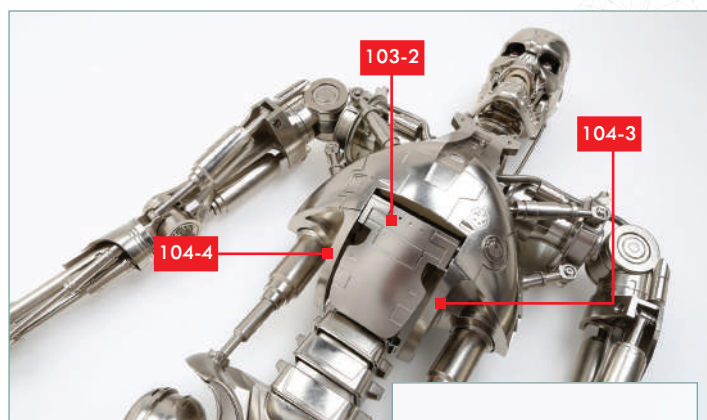
## STEP 7

Take the two ribbed shafts **104-7** and identify the ends with the notches (arrow). Fit the ball on each part **104-6** into the end of the shaft with a notch. Push firmly until the ball clicks in place.



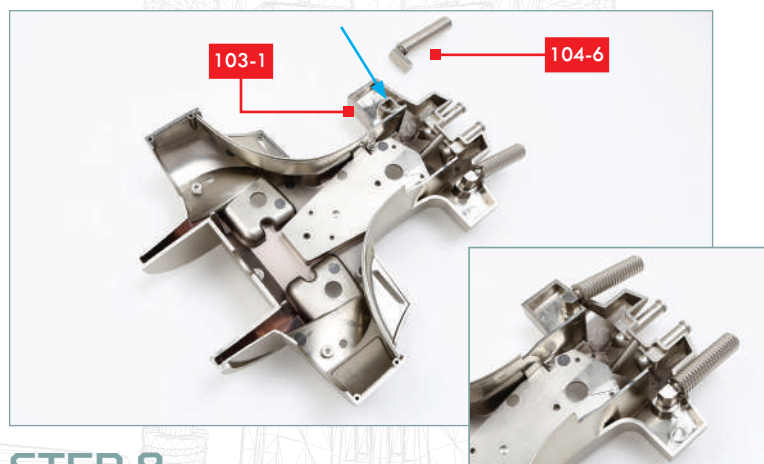
## STEP 9

Lay the model assembly on your work surface on its back. Check the fit of the chest support panel **104-3** (marked L) next to the chest detail **103-2**. The two large tabs on part **104-3** fit into slots on the underside of the chest (arrows).



## STEP 11

In the same way, apply superglue to the horizontal surfaces of part **104-4** (marked R) fix in place next to the right hand side of part **103-2**.



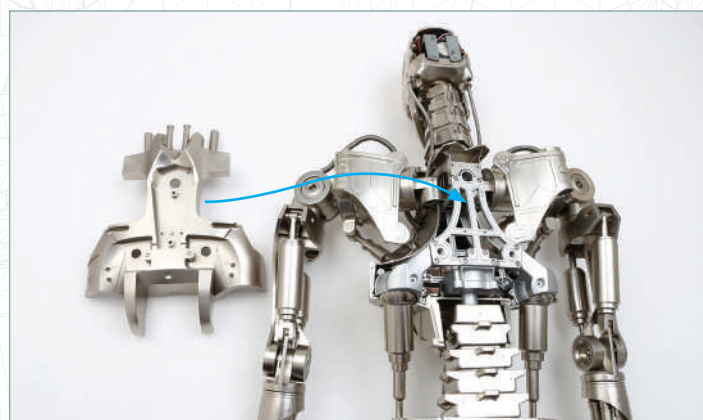
## STEP 8

Identify the two sockets on the back of part **103-1** where the parts **104-6** are fitted (arrow). Push the ends of the parts **104-6** into the sockets, as shown (inset). The parts are not firmly fixed at this stage.



## STEP 10

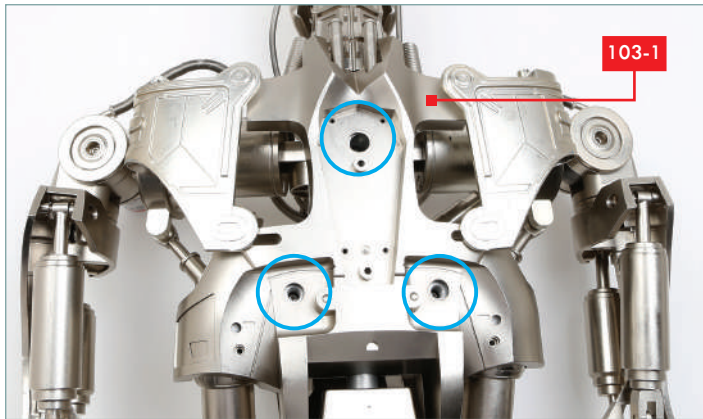
Hold the chest support panel **104-3** (marked L) in the orientation shown and apply superglue to the horizontal surfaces. Fix in place on the model.



## STEP 12

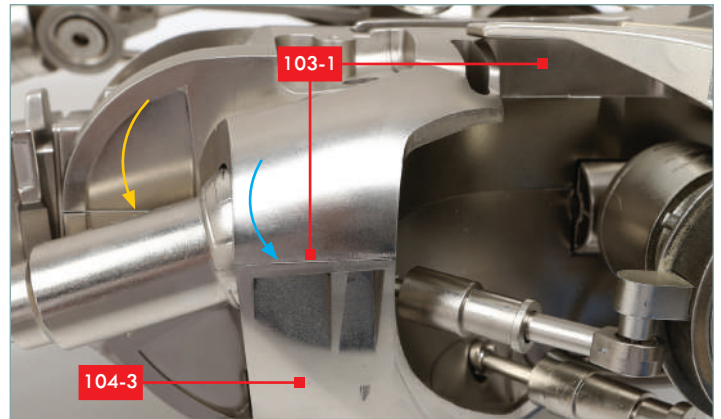
When the glue has dried, turn the model over. Take the assembly from step 8 and check how it fits on the back of the model.





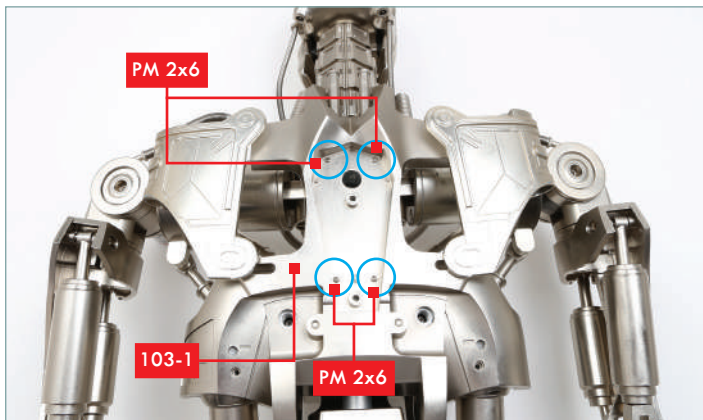
### STEP 13

This shows the back assembly in place: three large holes in the back section **103-1** (circled) align with sockets in the metal frame of the back.



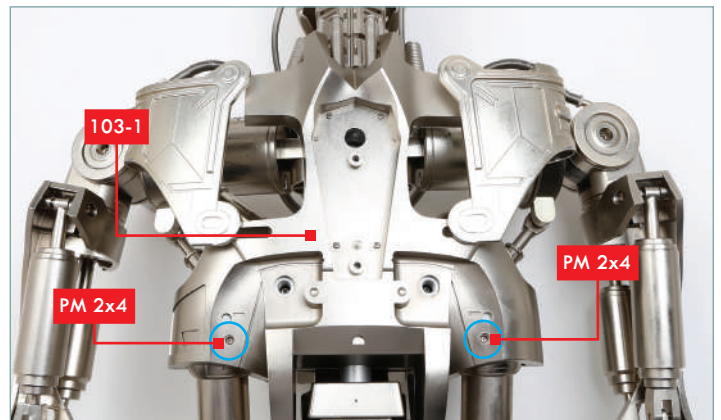
### STEP 14

At the side of the model, the back panel **103-1** fits over the edge of the chest panel (blue arrow) and the lower part of the back panel fits over the edges of the chest supports (yellow arrow).



### STEP 15

Fix the central section of the back panel **103-1** in place with four **PM 2 x 6mm** screws.



### STEP 16

Fix the lower corners of part **103-1** in place using two **PM 2 x 4mm** screws (circled).



## STAGE COMPLETE

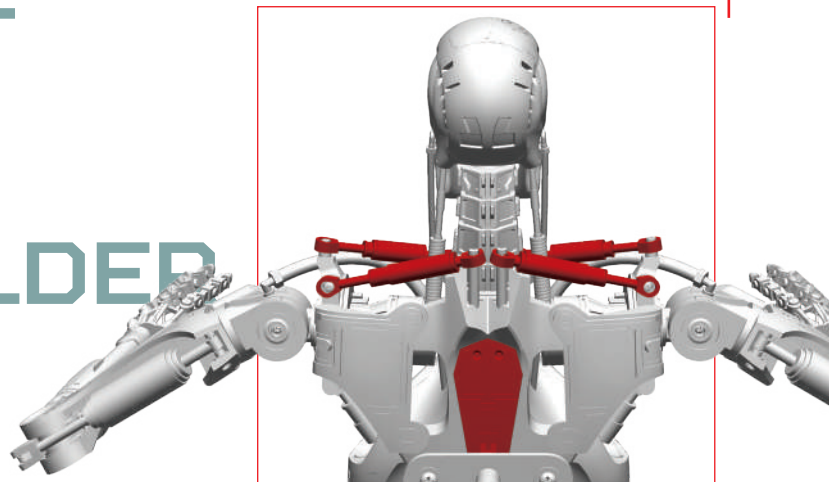
Supports have been fitted to the lower edge of the chest, and a back panel has been assembled and fitted in place.





# STAGE 105: FIT BACK PANEL DETAIL AND ATTACH SHOULDER CONNECTORS

Attach a panel to the back of the model, and use hex screws to connect four shoulder connectors



105-1



105-2



105-3



105-5

105-4

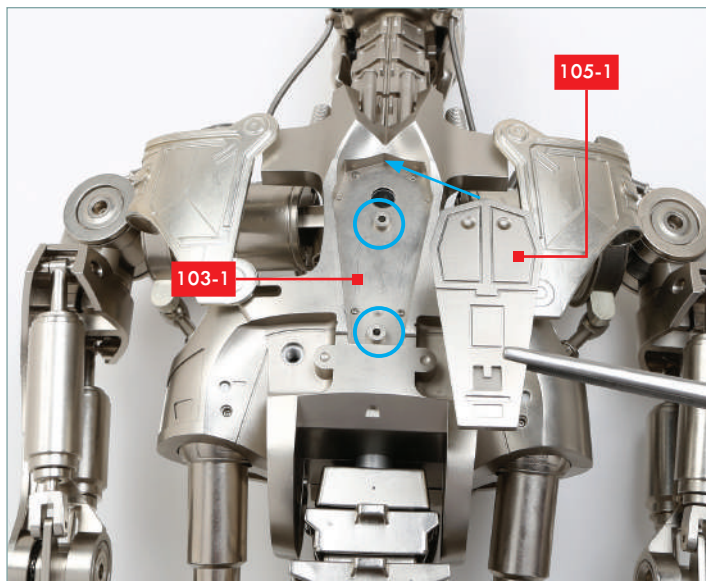


## LIST OF PIECES

105-1	Back panel detail	105-4	Two shoulder connectors
105-2	Four shoulder connector shafts	105-5	Nine 3 x 8mm Hex socket screws (1 spare)
105-3	Two shoulder connectors		

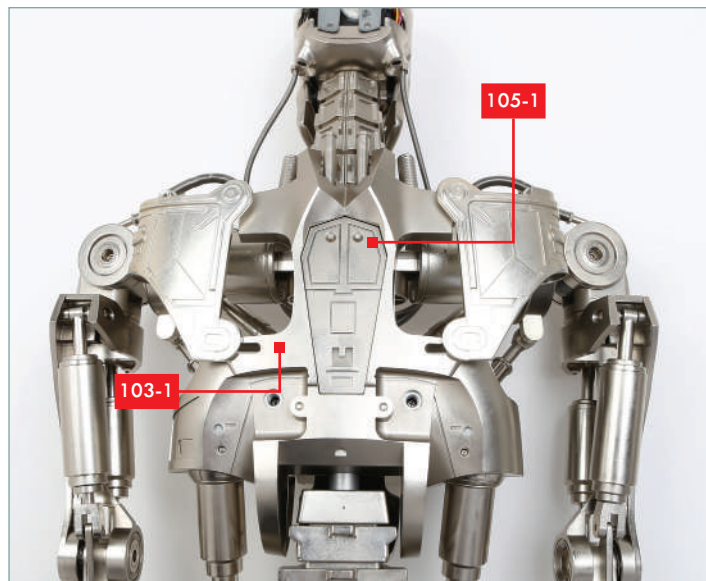
## YOU WILL ALSO NEED

Model assembly from stage 103  
Allen key supplied with stage 103



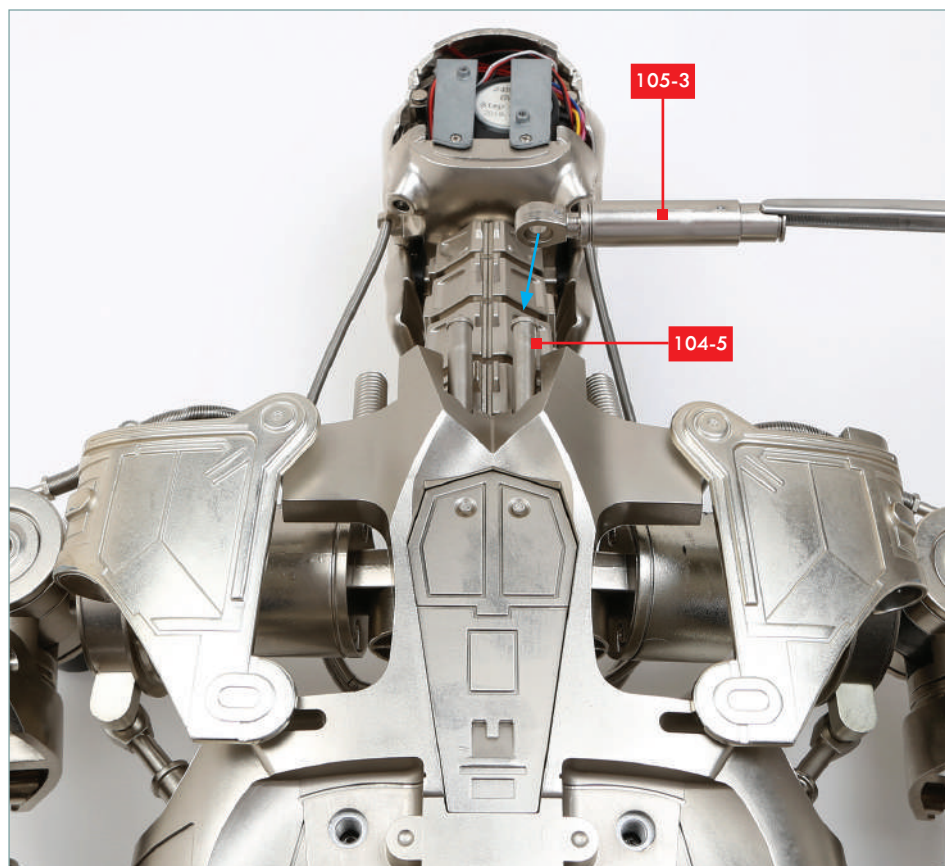
## STEP 1

Take the back panel detail **105-1** and fit it into the recess in the back panel **103-1**. Two pegs on the inside of part **105-1** fit into the raised sockets in part **103-1** (circled). This is a push-fit connection.



## STEP 2

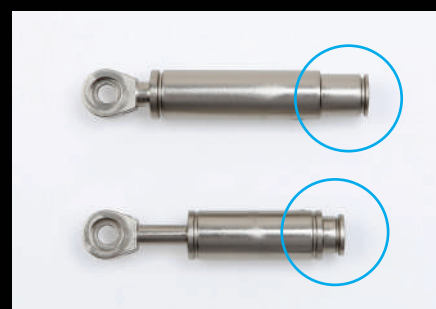
This shows part **105-1** in place.



## STEP 3

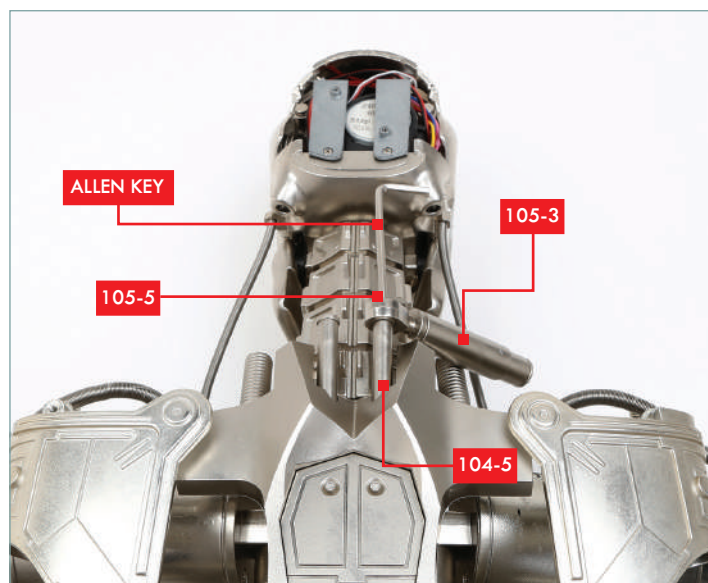
Take one of the shoulder connectors **105-3** and fit the recess around the hole over the end of the right-hand shaft **104-5**.

### EXPERT TIP!



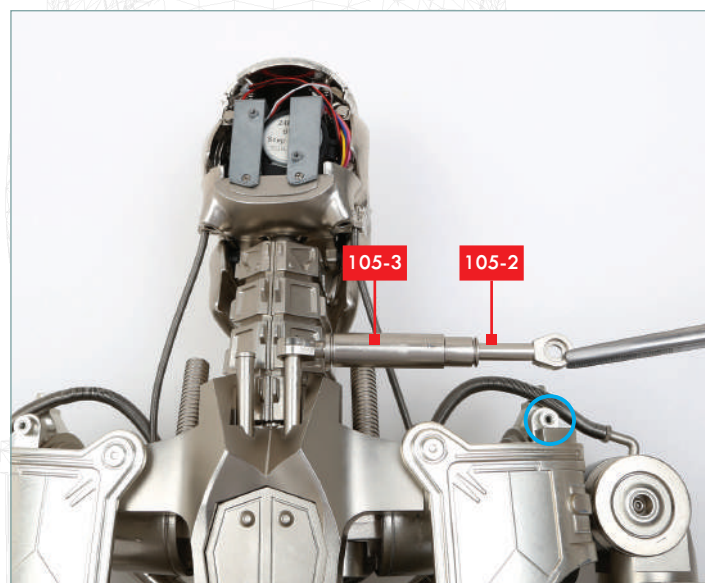
Note the difference between the ends of parts **105-3** and **105-4** (circled). Parts **105-3** are fitted to the back of the shoulder; parts **105-4** are fitted to the top of the shoulder.





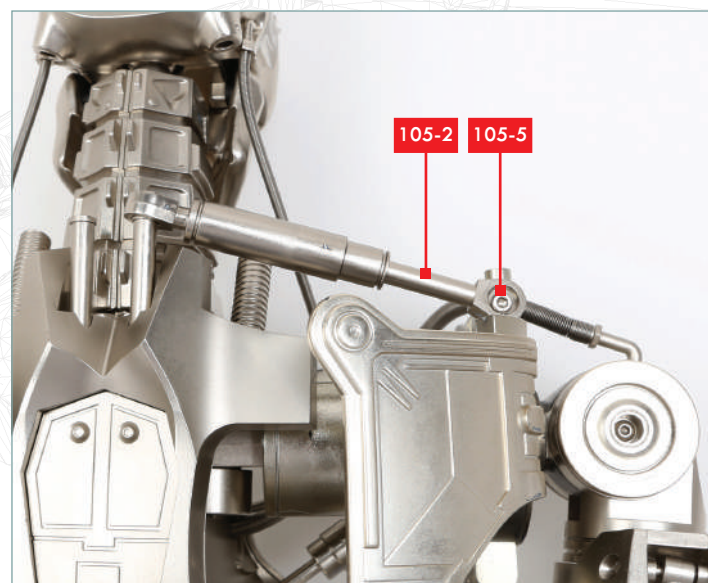
## STEP 4

Fit a hex screw **105-5** through the hole in part **105-3** and into the socket in the top of part **104-5**. Fix in place using the Allen key supplied with stage 103. Do not overtighten as part **105-3** needs to be able to sit at an angle.



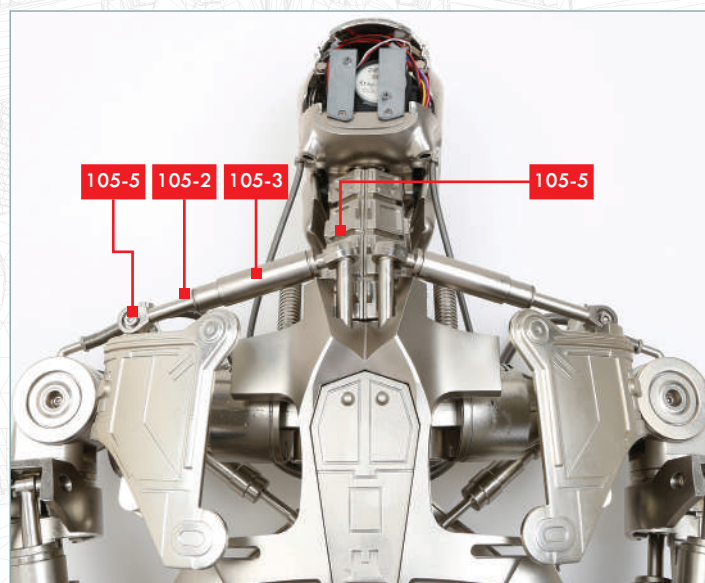
## STEP 5

Fit one of the shafts **105-2** into the end of part **105-3**. Identify the fixing point on the shoulder accessory where the hole on the end of the shaft will fit (circled).



## STEP 6

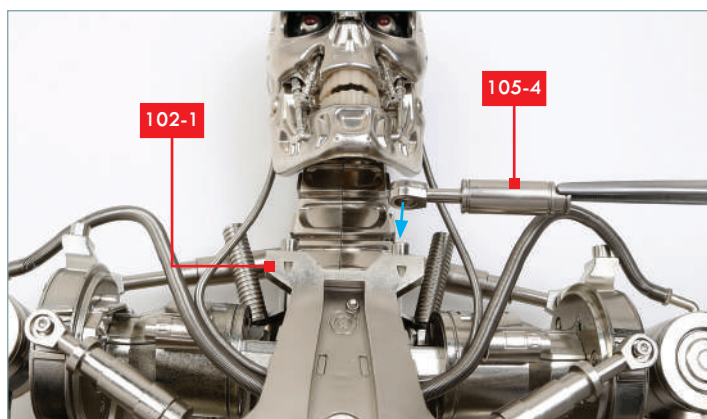
Fix part **105-2** in place using a hex screw **105-5**.



## STEP 7

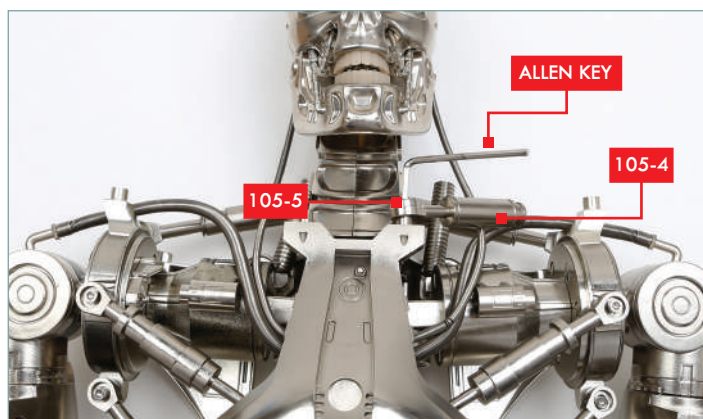
Repeat steps 3 – 6 to fit the second part **105-3** and shaft **105-2** in place on the left-hand side of the model using two hex screws **105-5**.





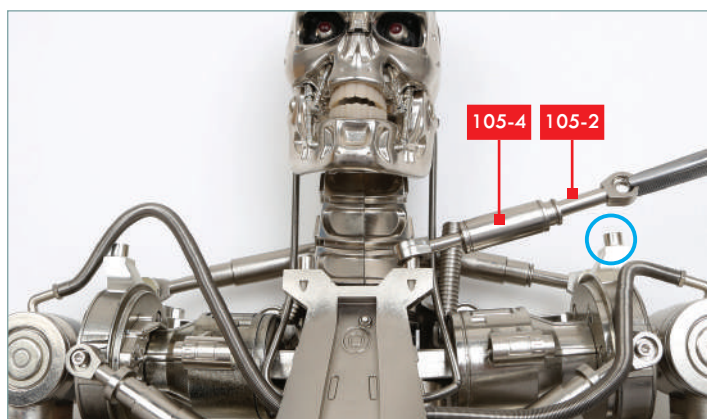
## STEP 8

Carefully turn your model on its back. Take one of the parts **105-4** and fit the recessed hole over the socket on the top of the chest casing **102-1** (arrow).



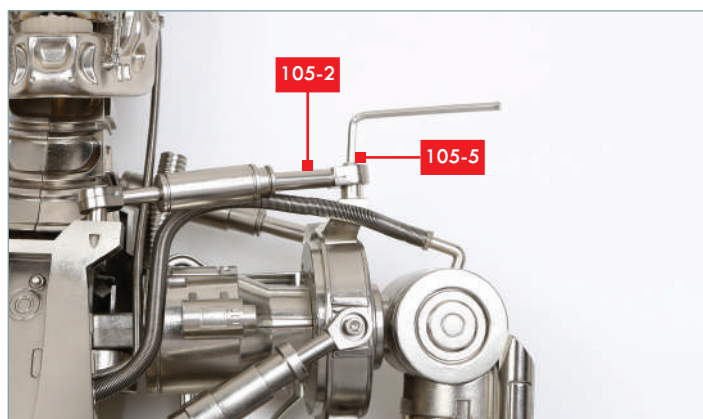
## STEP 9

Use a hex screw **105-5** to fit part **105-4** in place. Do not overtighten, as the connector **105-4** needs to have movement.



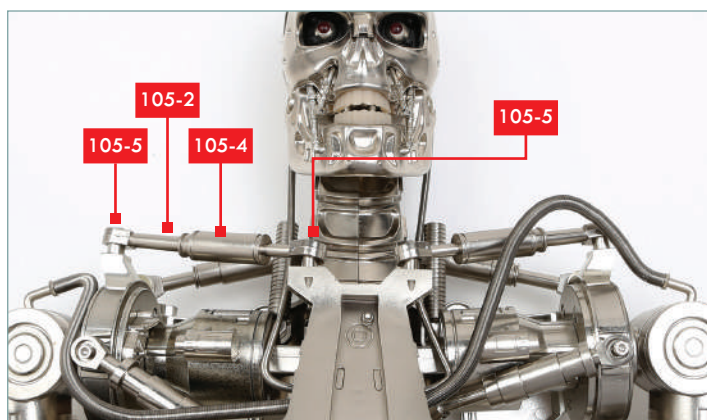
## STEP 10

Slide the third connector shaft **105-2** into the end of part **105-4**. Identify the fixing point for part **105-2** on the shoulder accessory (circled).



## STEP 11

Use the Allen key and a hex screw **105-5** to fix part **105-2** in place. Do not overtighten as there needs to be movement in the shoulder connectors.



## STEP 12

Repeat steps 8 – 11 to fit the remaining connector **105-4** and shaft **105-2** in place on the right shoulder, using two hex screws **105-5**.



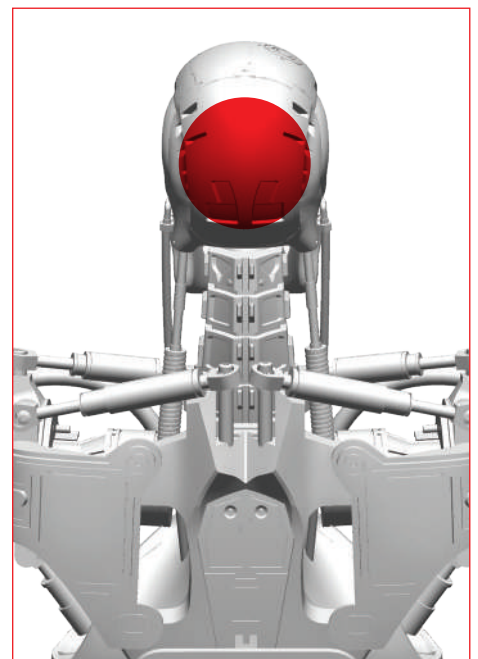
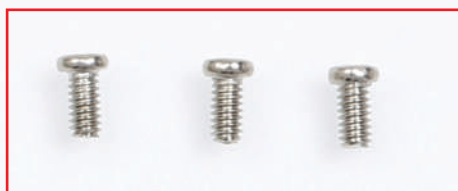
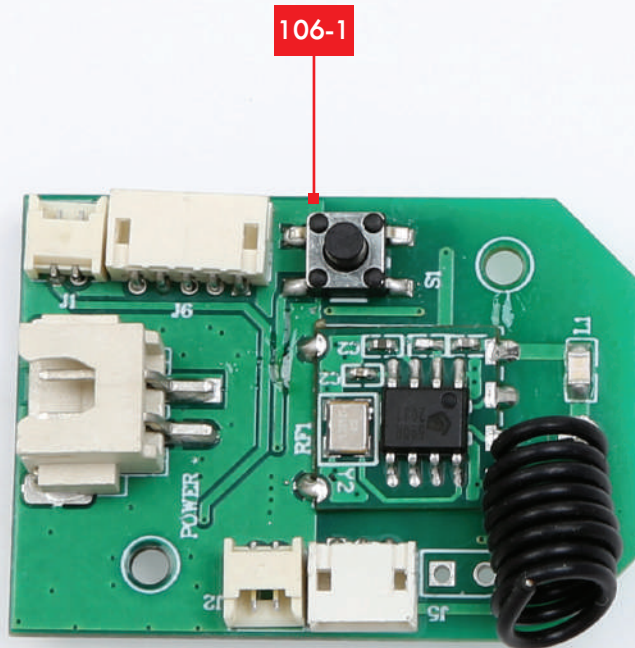
## STAGE COMPLETE!

A detail has been fitted to the back panel and connectors have been fitted to the top and back of the shoulders.



# STAGE 106: INSTALL THE CIRCUIT BOARD

Insert the circuit board into the back of the Terminator T-800 Endoskeleton's head



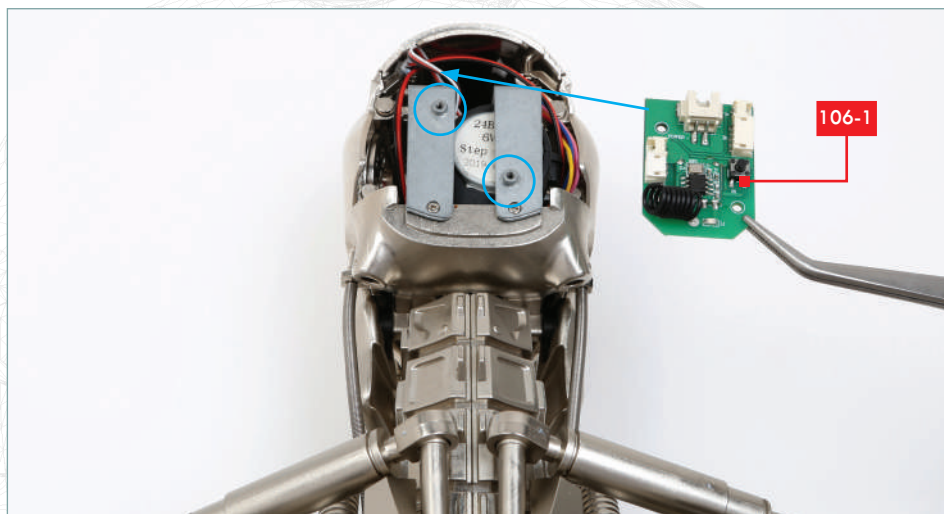
## LIST OF PIECES

- |       |                                   |
|-------|-----------------------------------|
| 106-1 | Circuit board                     |
| 106-2 | Three 2 x 4mm PM screws (1 spare) |

## YOU WILL ALSO NEED

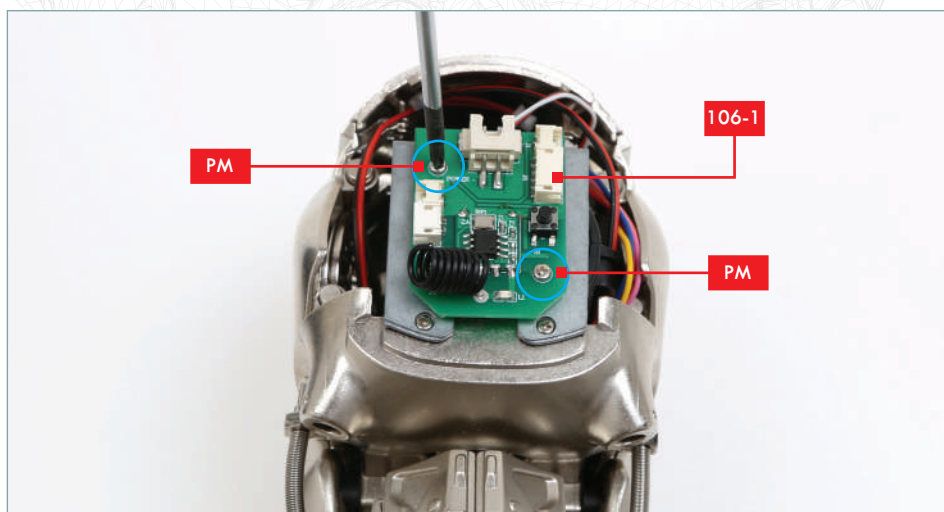
Model assembly from stage 105  
Fine cross-head screwdriver





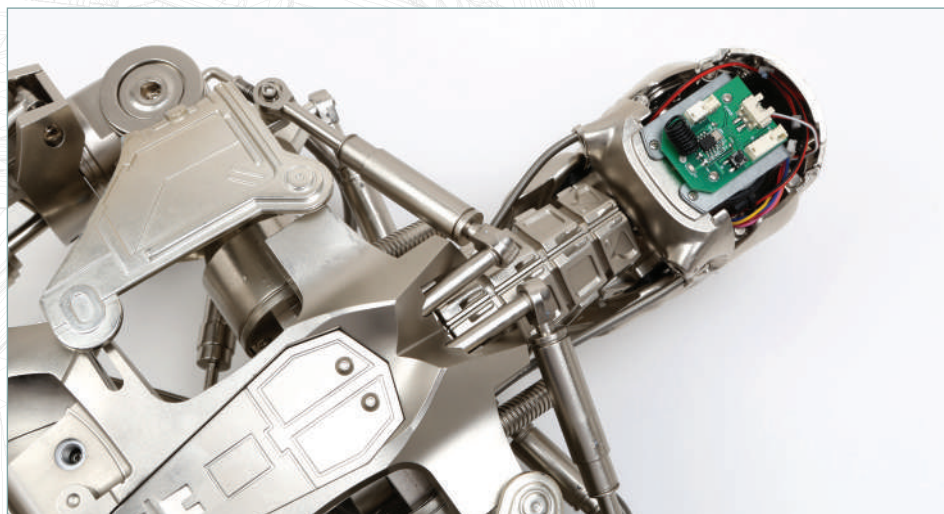
## STEP 1

Position your model face down on the work surface. Position the circuit board **106-1** on the plates in the back of the head so that the two holes in the circuit board are aligned with the raised screw sockets (circled).



## STEP 2

Fix the circuit board **106-1** in place using two **PM** screws (circled).



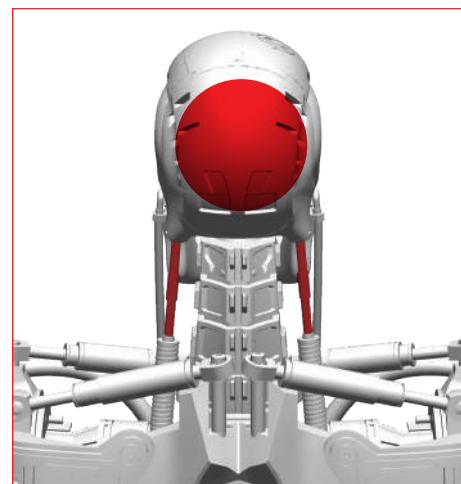
## STAGE COMPLETE!

The main circuit board has been fitted in the back of the head.



# STAGE 107: CONNECT THE BATTERY, ATTACH THE BACK OF THE HEAD, AND FIT AN LED INTO ITS HOUSING

Insert the battery box, connect it to the circuit board, and use magnets to close the skull - then build out a searchlight for the base.



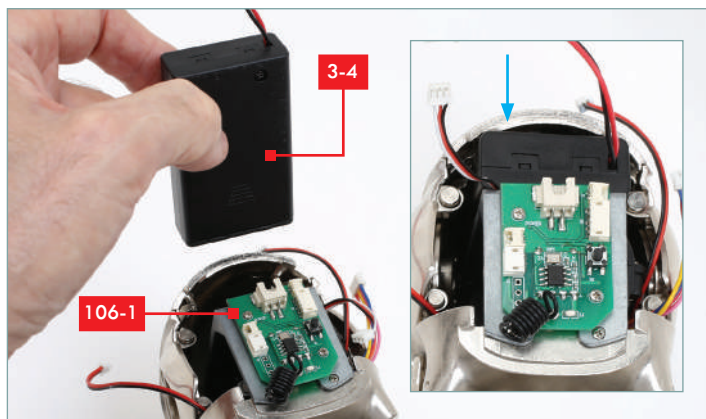
## LIST OF PIECES

- |        |                                      |
|--------|--------------------------------------|
| 107-1  | Back of head                         |
| 107-2  | Two magnets (5mm diameter)           |
| 107-3  | Two magnets (3mm diameter)           |
| 107-4  | Two neck connectors                  |
| 107-5  | LED and cable                        |
| 107-6  | Lens for searchlight                 |
| 107-7  | LED housing                          |
| 107-8  | LED housing                          |
| 107-9  | Searchlight stand                    |
| 107-10 | Rubber washers                       |
| 107-11 | Three 1.7 x 4mm PWB screws (1 spare) |
| 107-12 | Two M2 nuts (1 spare)                |
| 107-13 | Five 2 x 4mm PB screws (1 spare)     |
| 107-14 | Two 2 x 10mm PM screws (1 spare)     |

## YOU WILL ALSO NEED

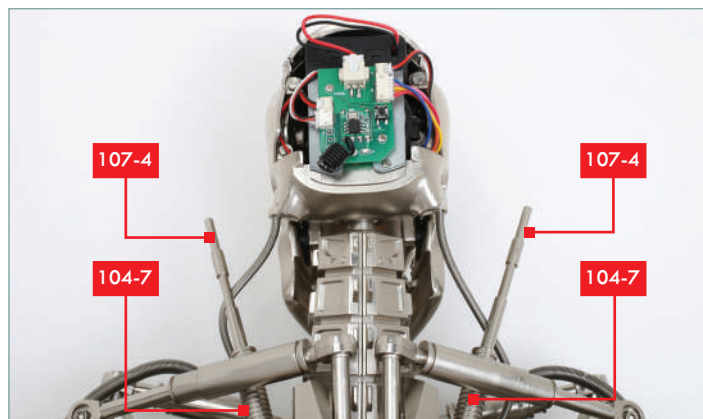
Superglue and a cocktail stick  
Model assembly from stage 106  
A fine crosshead screwdriver





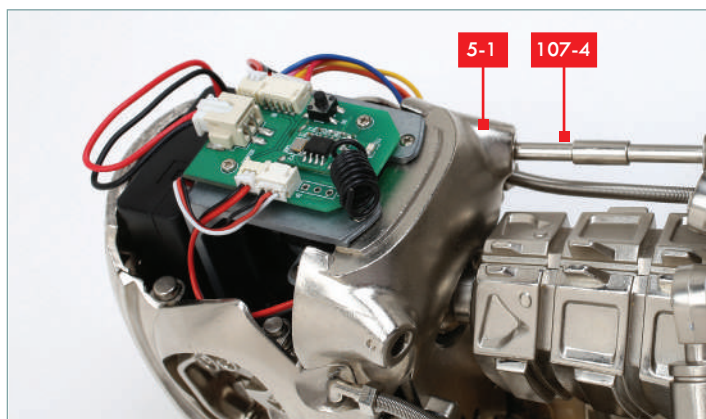
## STEP 1

Fit the battery box **3-4** (with batteries) in the top of the head. Check that it is switched off. The switch on the battery box should be at the top left (arrow, inset). Check that all the cables reach to the sockets on the circuit board **106-1**, but do not plug them in fully at this stage. See also step 5.



## STEP 2

Fit the broader ends of the neck details **107-4** into the open ends of the ribbed shafts **104-7**.



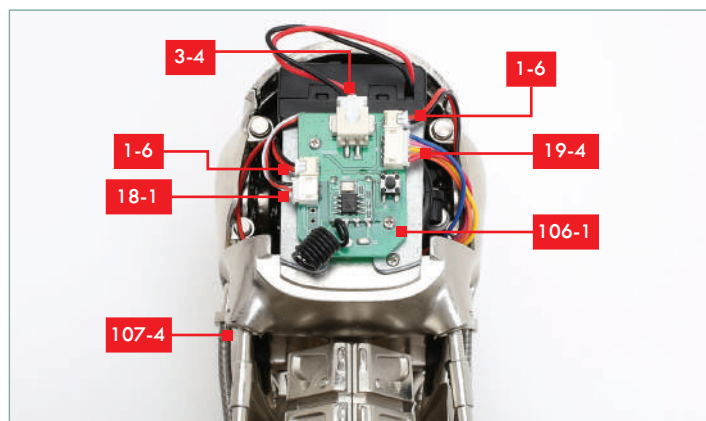
## STEP 3

Fit the top ends of parts **107-4** into holes in the bottom of the skull section **5-1**.



## STEP 4

Identify the screw hole in the top of the first part **107-04**. Fit a rubber washer **107-10** on to the thread of a **PWB** screw, and attach to the end of a magnetic screwdriver (inset). Holding part **107-4** in place, fix the top end by fixing the **PWB** screw with rubber washer into the top of the neck detail. Test-fit the **PWB** screw into part **107-4** to create a thread in the shaft before fitting it in place.



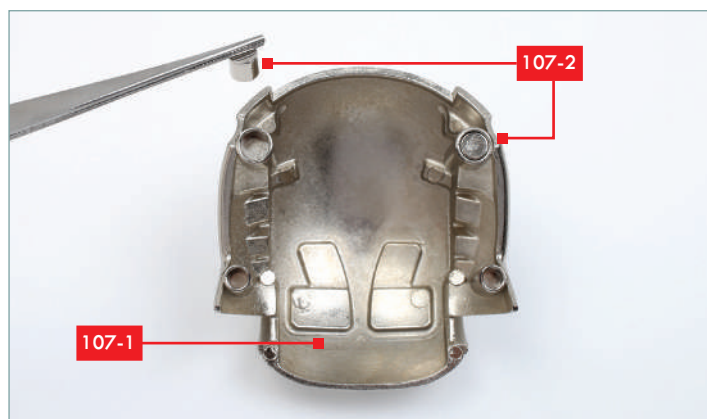
## STEP 5

Repeat the previous two steps to fix the top of the second neck detail **107-4** in place. Plug the connectors into the circuit board **106-1**. Working clockwise, from bottom left:

- 18-1:** Eye motor
- 1-6:** Left eye LED
- 3-4:** Power cable
- 1-6:** Right eye LED
- 19-4:** Jaw motor

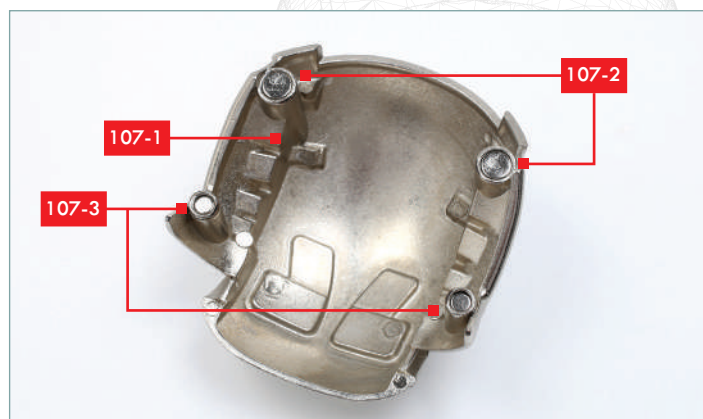






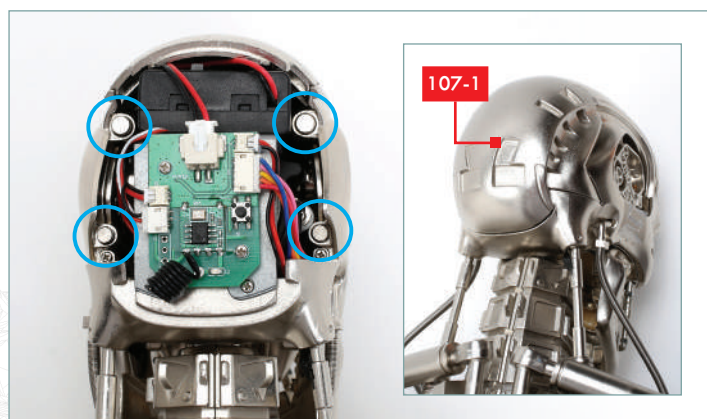
## STEP 6

Pick one of the larger magnets **107-2** on the end of a pair of tweezers or similar. Apply a little superglue to one end of the magnet. Fit the magnet into one of the sockets at the top of the back of the head **107-1**. Repeat to fit the second large magnet **107-2** in place.



## STEP 7

Glue the two smaller magnets **107-3** into the two lower sockets in part **107-1**. Allow the glue to dry.



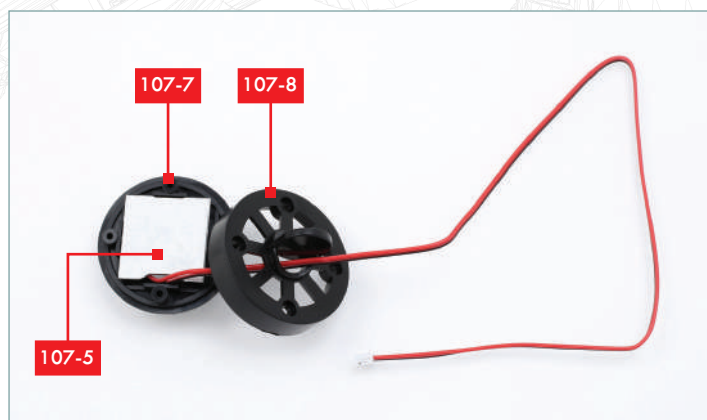
## STEP 8

Tuck the cables into the skull so that they are clear of the four magnet anchor points (circled). Fit the back of the head **107-1** in place on the back of the skull, so that the magnets connect with the magnet anchor points and the edge of part **107-1** butts up neatly with the edge of the skull.



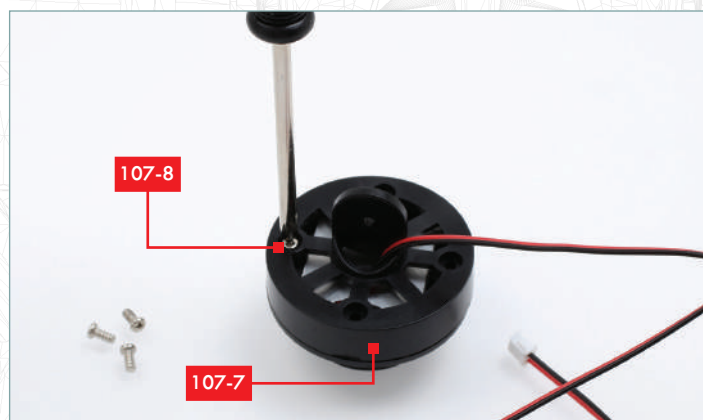
## STEP 9

Take the LED **107-5** and bend the cables so that they fit through the recess in the edge of the circuit board. Fit the LED **107-5** into the housing **107-7**: note that there are four lips on one side of the housing, which hold the LED circuit board in place. The fit is quite loose at this stage.



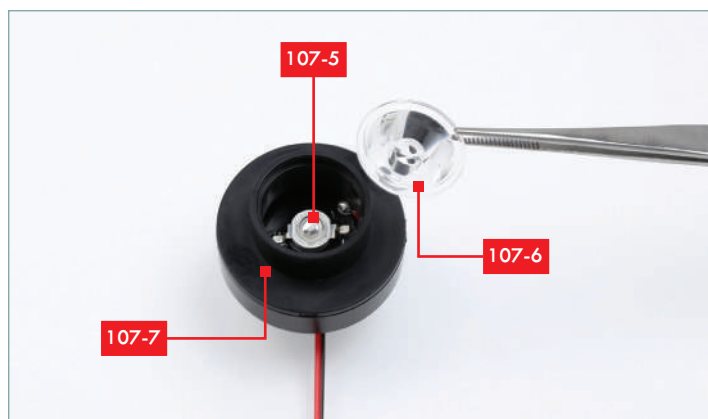
## STEP 10

Take the second part of the housing **107-8** and thread the cable of the LED **107-5** through the semicircular hole in the centre of the **107-8**.



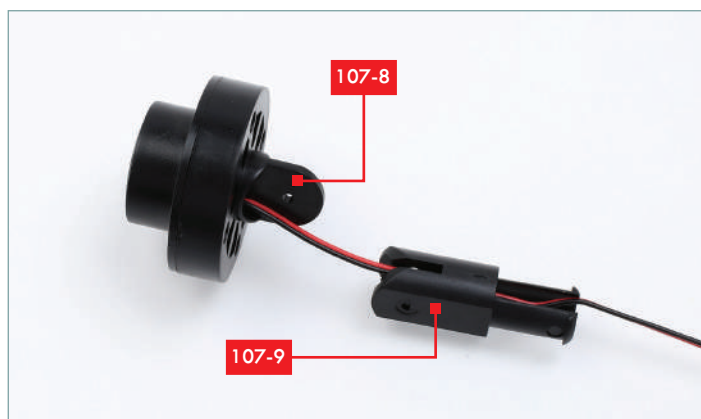
## STEP 11

Fit parts **107-8** and **107-7** together, ensuring that the screw holes are aligned. Fix part **107-8** in place using four **PB 2 x 4mm** screws.



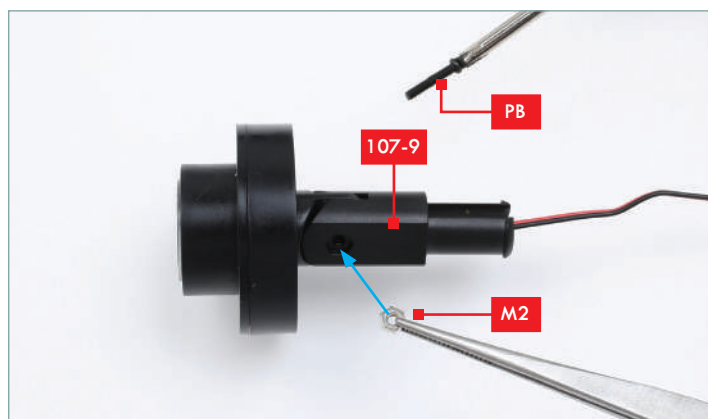
## STEP 12

Turn the housing over and fit the lens **107-6** into the opening in the housing part **107-7**, covering the LED **107-5**. The flat side of the lens should face outwards. Push it in place until it clicks.



## STEP 13

Thread the cable through the stand **107-9**, ensuring you have it the right way around. The slots in the wider end of the stand fit over the large tab on housing part **107-8**.



## STEP 14

Fit an **M2** nut into the socket on one side of part **107-9**. You will need a **PM 2 x 10mm** screw to fix the parts together.



## STEP 15

Holding the **M2** nut in place, turn the assembly over. Thread the **PM 2 x 10mm** screw through part **107-9** and the hole in the tab on part **107-8** to the other side. Tighten the screw (arrow) into the nut. Do not overtighten, as you need to be able to adjust the angle of the searchlight.



## STAGE COMPLETE!

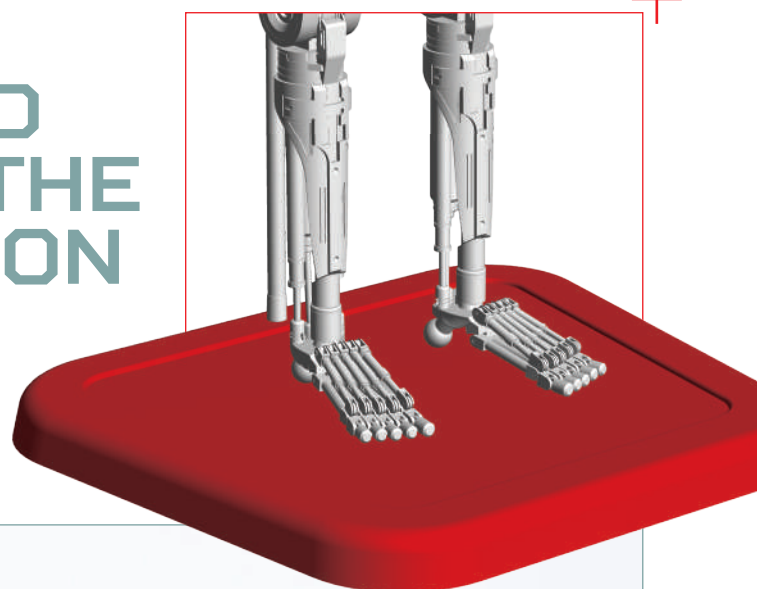
The panel at the back of the head has been fitted. A searchlight for the base of the model has been assembled.





# STAGE 108: AFFIX ROCK DETAILS AND SEARCHLIGHT TO THE FIRST BASE SECTION

Superglue the larger and smaller rock details to the larger scenic base, and attach the adjustable searchlight you assembled last stage.



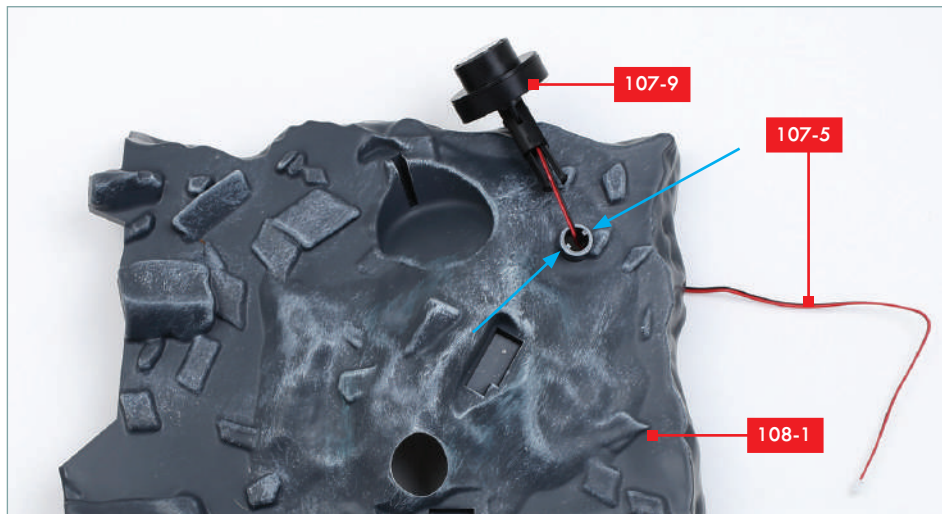
## LIST OF PIECES

- |       |                     |
|-------|---------------------|
| 108-1 | First base panel    |
| 108-2 | Larger rock detail  |
| 108-3 | Smaller rock detail |

## YOU WILL ALSO NEED

Searchlight assembly from stage 107

Superglue and a cocktail stick



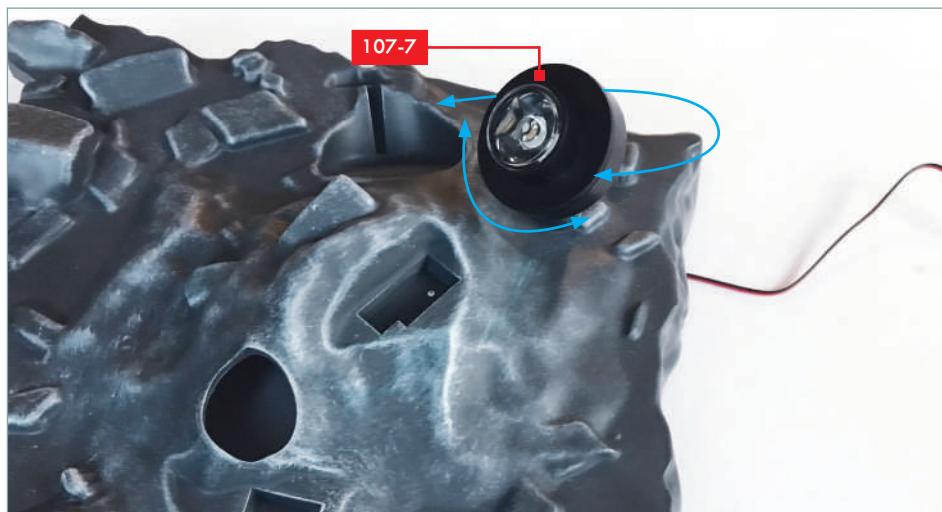
## STEP 1

Identify the hole in the base **108-1** where the searchlight assembly will fit. Thread the cable of the searchlight **107-5** through the hole. Note that the stand of the searchlight **107-9** has two slots that should align with the raised ribs on the inside of the hole (arrows).



## STEP 2

Squeeze the sides of part **107-9** together and push it into the hole.



## STEP 3

Once in place, the searchlight can be rotated a few degrees and tilted up and down.



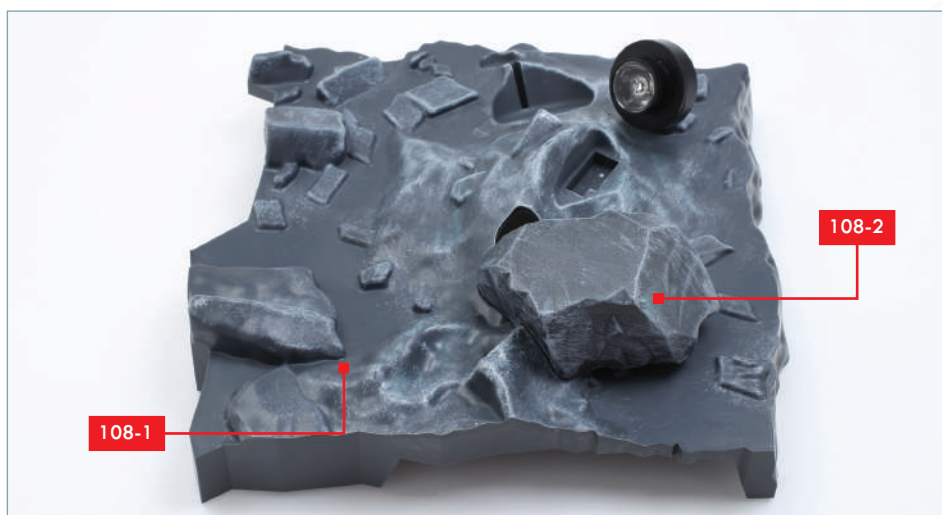


## STEP 4

Take the larger rock **108-2** and check the fit in the recess in the base **108-1**. Apply superglue around the sides of the large peg on part **108-2** and fix the rock in place.

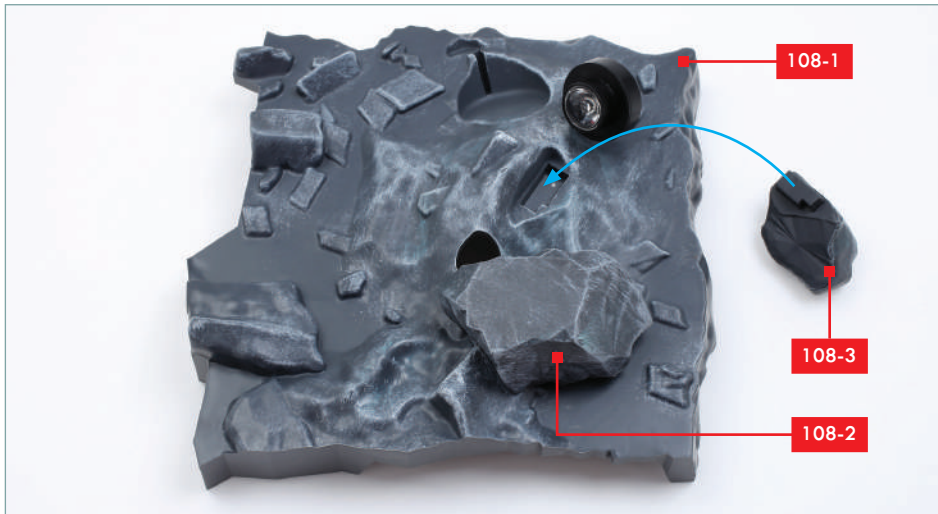
### EXPERT TIP!

When applying superglue it is advisable to spread the glue around the sides of the peg, rather than in the recess.



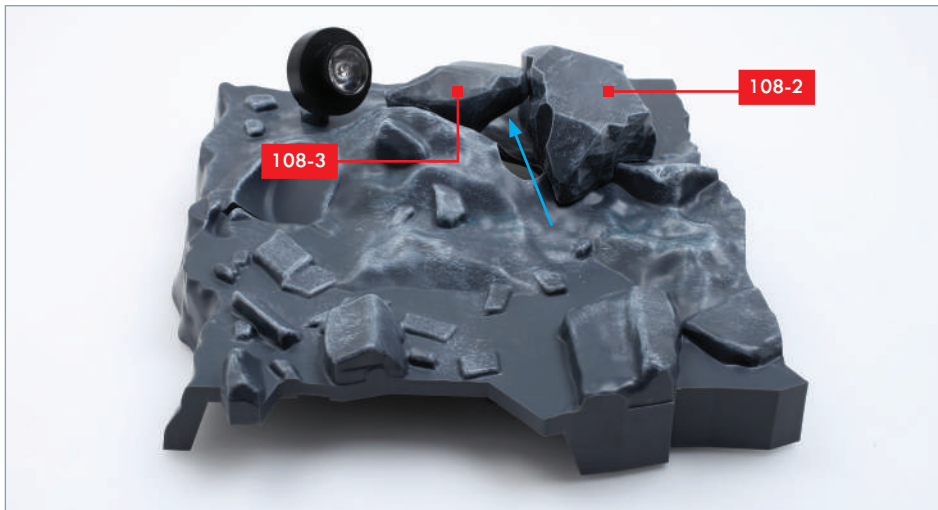
## STEP 5

Hold the rock **108-2** in place on the base **108-1** until the glue has dried.



## STEP 6

Check the fit of the smaller rock **108-3** in the base **108-1**. Apply glue around the sides of the peg and fix the rock in place.



## STEP 7

The smaller rock **108-3** leans against the larger rock **108-2** leaving a gap underneath (arrow).



## STAGE COMPLETE!

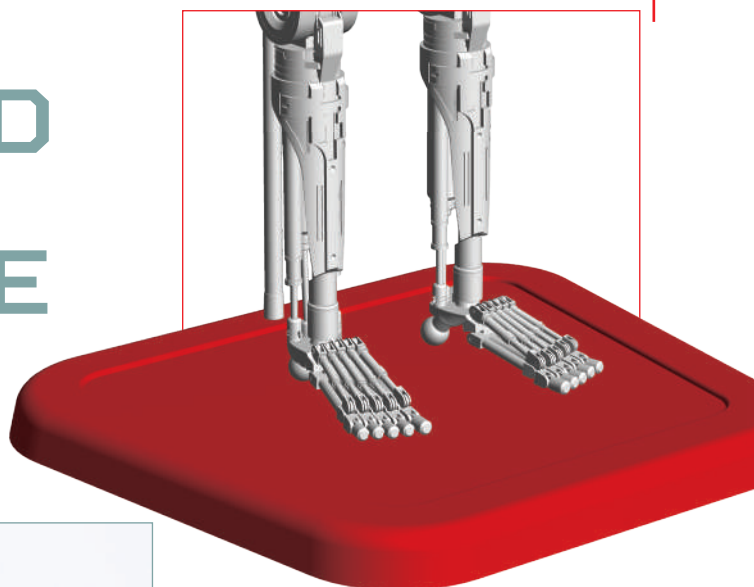
Rock details and a searchlight have been fitted to the base.





# STAGE 109: BUILD A SECOND SEARCHLIGHT AND ADD A BASE DETAIL

Attach the LED to its adjustable housing and connect it to the base, and superglue the detail element into the recessed fixing point.

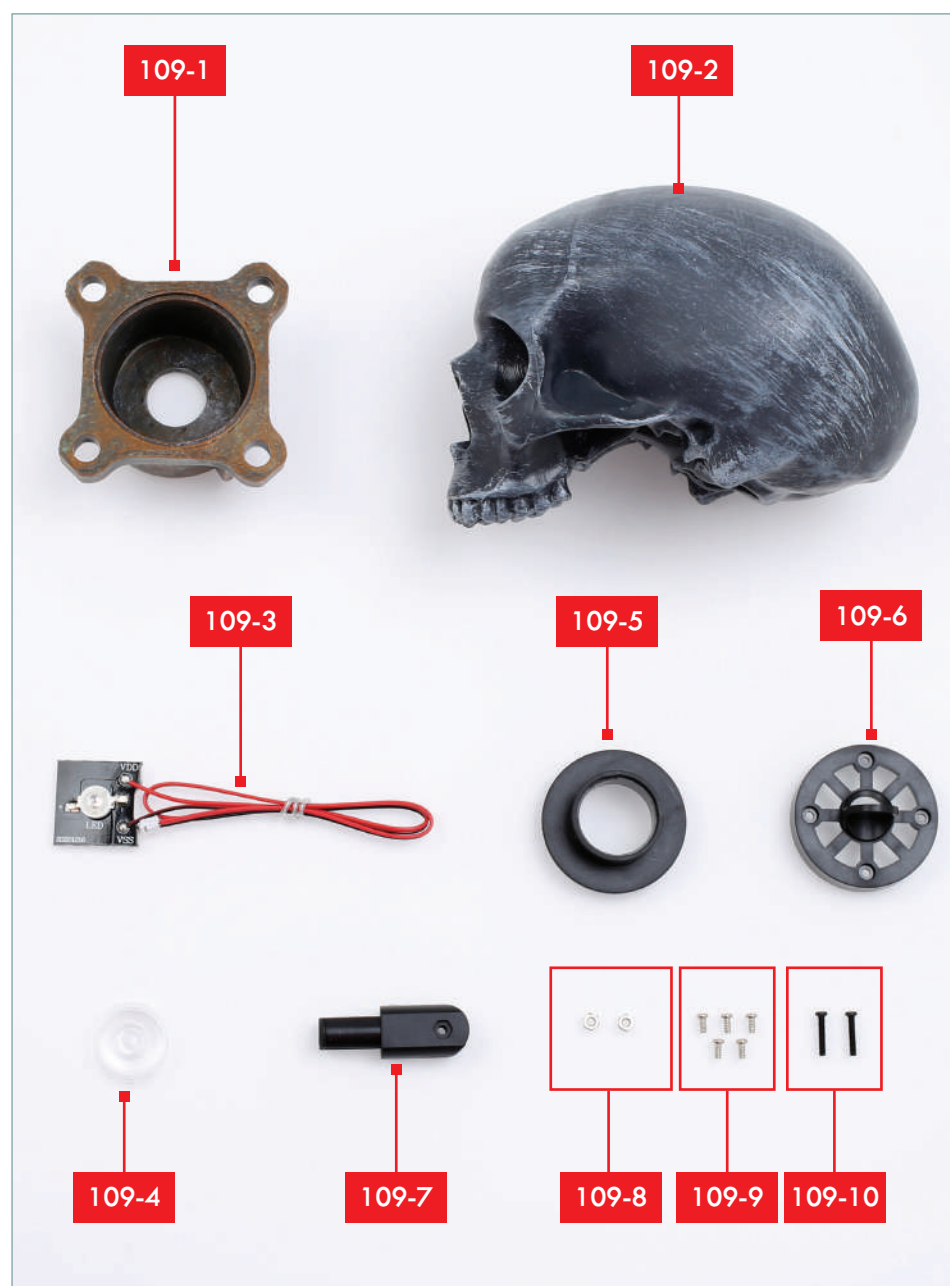


## LIST OF PIECES

- |        |                                  |
|--------|----------------------------------|
| 109-1  | Detail for base                  |
| 109-2  | Discarded skull                  |
| 109-3  | LED and cable                    |
| 109-4  | Lens for searchlight             |
| 109-5  | LED housing                      |
| 109-6  | LED housing                      |
| 109-7  | Searchlight stand                |
| 109-8  | Two M2 nuts (1 spare)            |
| 109-9  | Five 2 x 4mm PB screws (1 spare) |
| 109-10 | Two 2 x 10mm PM screws (1 spare) |

## YOU WILL ALSO NEED

Superglue and a cocktail stick  
Base assembly from stage 108  
A fine cross-head screwdriver





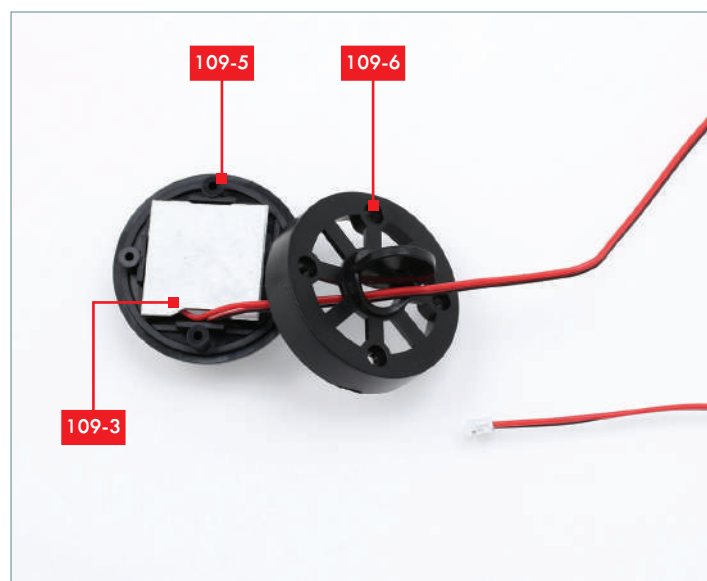
## STEP 1

Take the LED **109-3** and bend the cables so that they fit through the recess in the edge of the circuit board and then bend away from the back of the circuit board.



## STEP 2

Fit the LED **109-3** into the housing **109-5**: note that there are four lips on one side of the housing, which hold the LED circuit board in place.



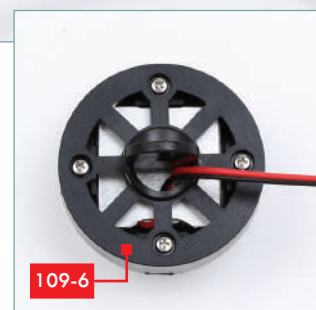
## STEP 3

Take the second part of the housing **109-6** and thread the cable of the LED **109-3** through the semicircular hole in the centre of the **109-6**.



## STEP 4

Fit parts **109-6** and **109-5** together, ensuring that the screw holes are aligned. Fix part **109-6** in place using four **PB 2 x 4mm** screws (inset, below).







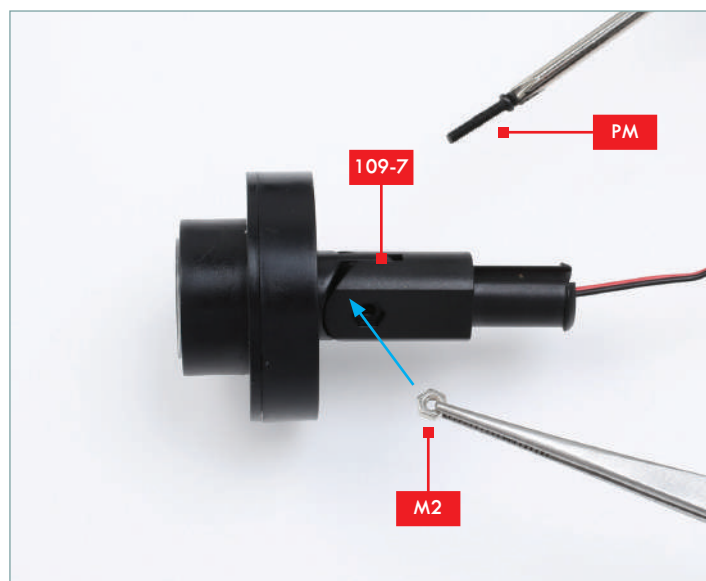
## STEP 5

Turn the housing over and fit the lens **109-4** into the opening in the housing part **109-5**, covering the LED **109-3**. The flat side of the lens should face outwards. Push it in place until it clicks.



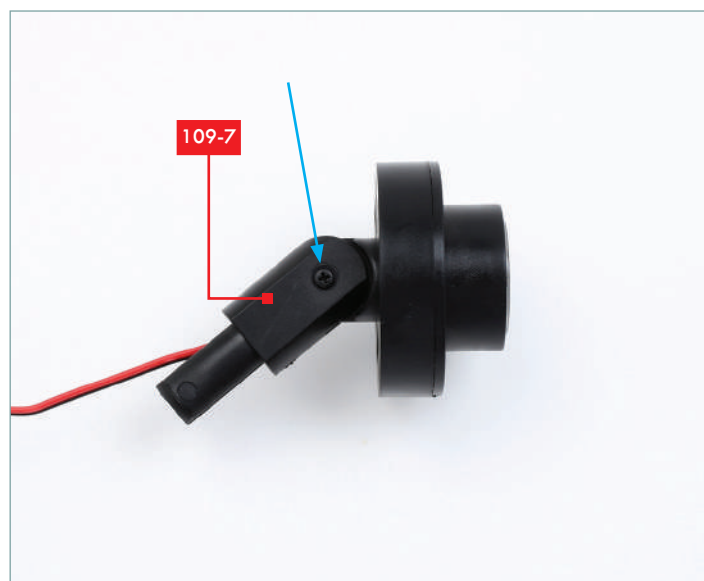
## STEP 6

Thread the cable through the stand **109-7**, ensuring you have it the right way around. The slots in the wider end of the stand fit over the large tab on housing part **109-6**.



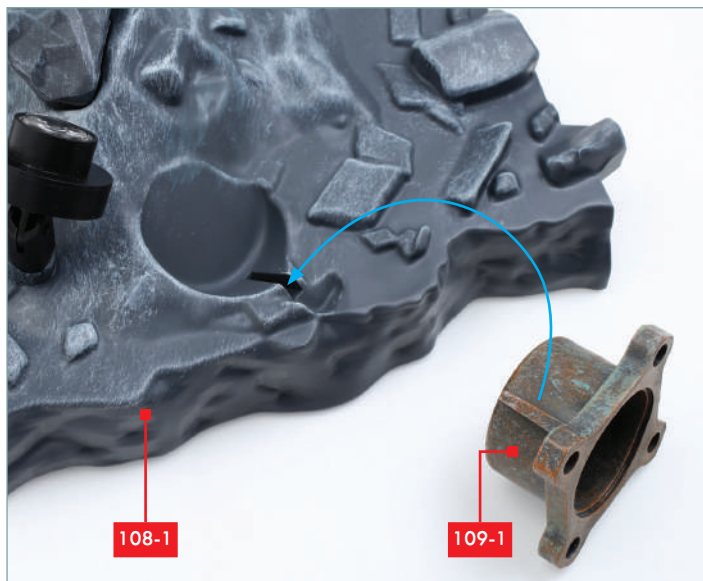
## STEP 7

Fit an **M2** nut into the socket on one side of part **109-7**. You will need a **PM** 2 x 10mm screw to fix the parts together.



## STEP 8

Holding the **M2** nut in place, turn the assembly over. Thread the **PM** 2 x 10mm screw through part **109-7** and the hole in the tab on part **109-6** to the other side of part **109-7**. Tighten the screw (arrow) into the nut. Do not overtighten, as you need to be able to adjust the angle of the searchlight.



## STEP 9

Take the base assembly from stage 108. Identify the fixing point for the detail **109-1**. The rib on part **109-1** fits into a slot in the recess in part **108-1**, as indicated.



## STEP 10

Use a cocktail stick to spread superglue to the sides of the rib on part **109-1**.



## STEP 11

Glue part **109-1** in place as shown.



## STAGE COMPLETE!

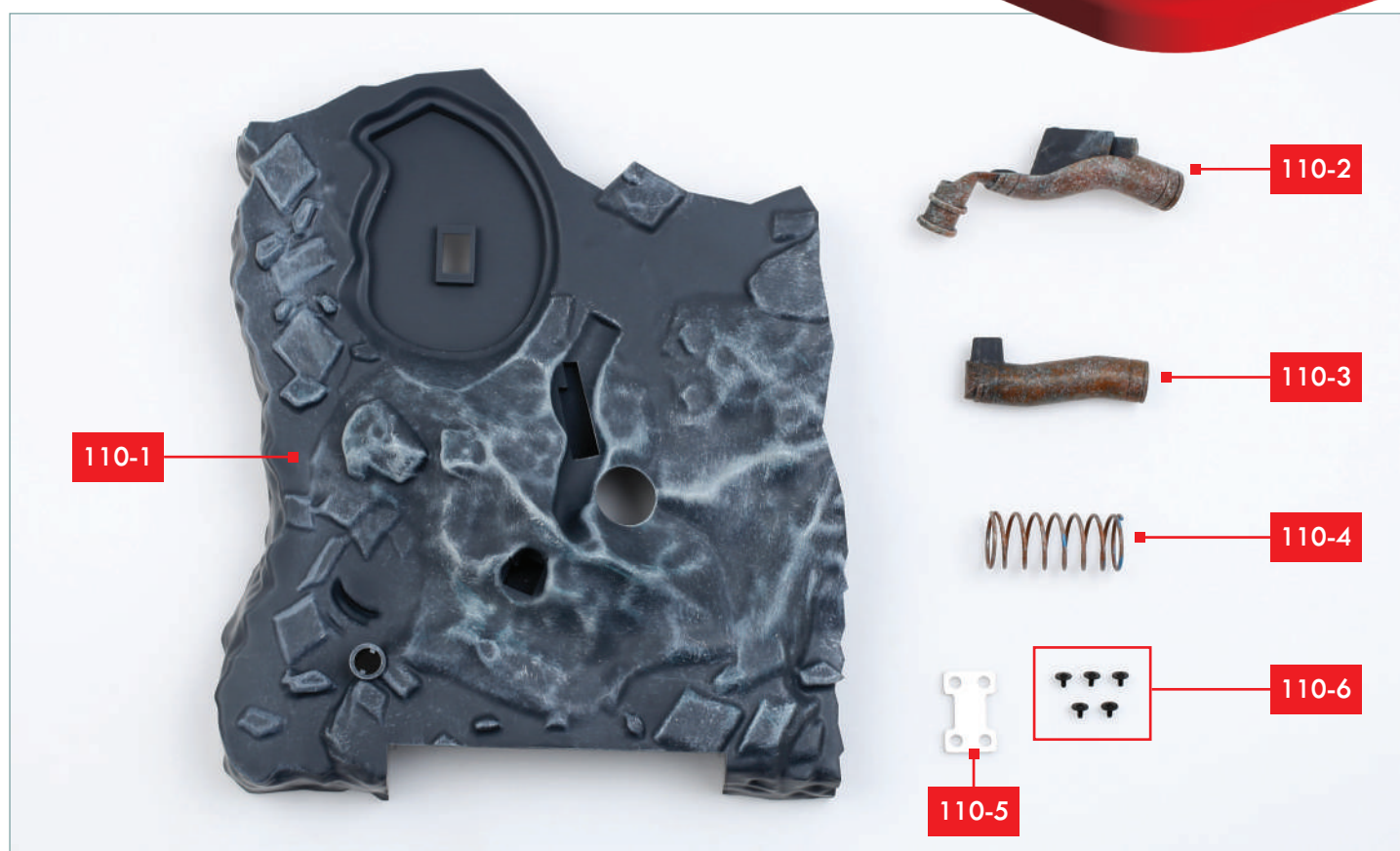
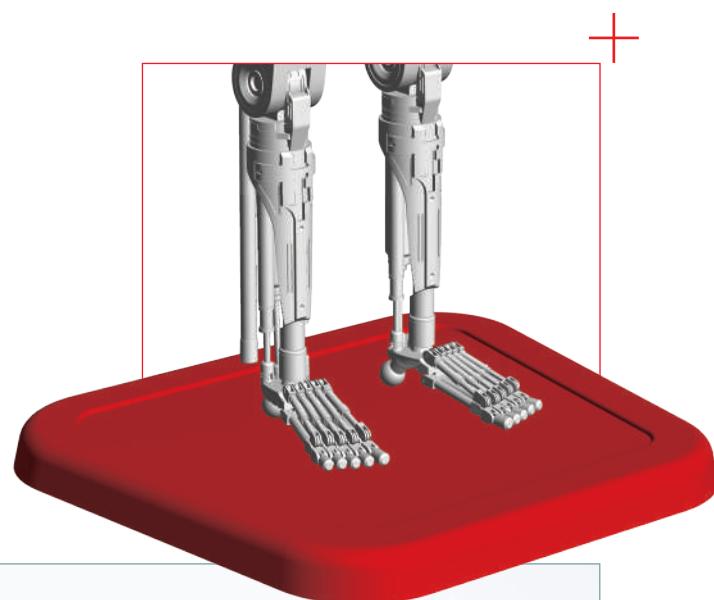
A second searchlight has been assembled, and a detail has been added to the base. Part **109-2** will be used in the next stage.





# STAGE 110: CONNECT A SECOND BASE SECTION TO THE FIRST, AND APPLY DETAILS

Join two base sections together, and attach the second searchlight, skull, two rusted pipe details, and a spring.



## LIST OF PIECES

110-1	Base section	110-4	Spring detail
110-2	Pipe detail	110-5	Joining plate
110-3	Pipe detail	110-6	Five 2 x 4mm PWB screws (1 spare)

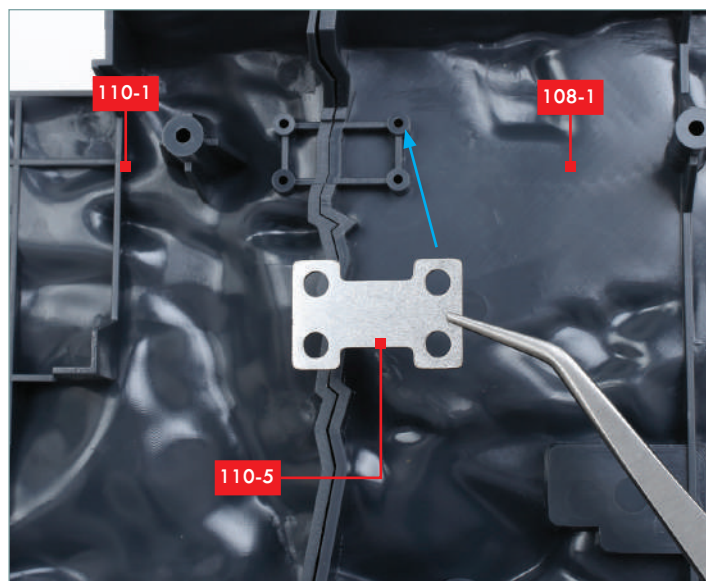
## YOU WILL ALSO NEED

Superglue and a cocktail stick  
Base assembly from stage 109  
Part 109-2 from stage 109  
Searchlight assembly from stage 109  
A fine cross-head screwdriver



## STEP 1

Take the base assembly from stage 109 and the base section **110-1**. Check how they fit together and butt the matching edges together (right).



## STEP 2

Carefully turn the bases over, taking care not to dislodge any of the details. You may need to arrange supports underneath to keep the parts level. Take the joining plate **110-5** and identify the fixing point across the two base sections **110-1** and **108-1**, as indicated.

### EXPERT TIP!

You may find it helpful to grip the edges of the base parts together using a bulldog clip or similar (arrows).



## STEP 3

Fix the joining plate **110-5** in place using four PWB 2 x 4mm screws (inset below).



## STEP 4

Take the two pipe details **110-2** and **110-3** and identify the recesses in part **110-1** where they fit.





## STEP 5

Use a cocktail stick to spread superglue to the sides of the large peg on part **110-2**.



## STEP 6

Glue part **110-2** in place.



## STEP 7

Use a cocktail stick to apply superglue to the sides of the peg on part **110-3**.



## STEP 8

Glue part **110-3** in place, as shown.



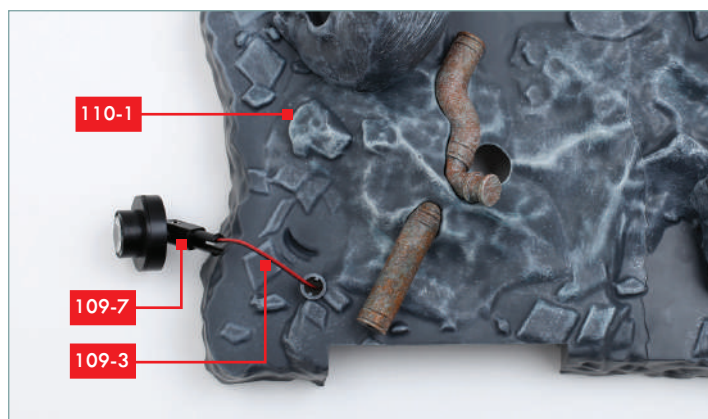
## STEP 9

Take skull part **109-2** and identify the recess in part **110-1** where it will fit. DO NOT APPLY ANY GLUE.



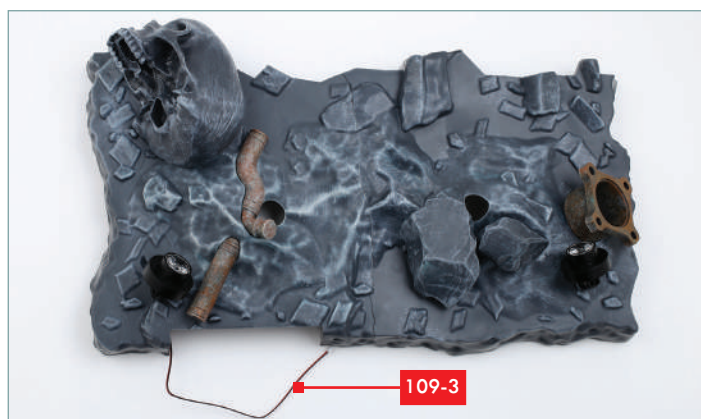
## STEP 10

Position the skull in the recess, as shown. It is not glued in place.



## STEP 11

Take the searchlight assembly from stage 109. Identify the hole in part **110-1** where the searchlight stand **109-7** fits and thread the cable of part **109-3** through the hole.



## STEP 12

Draw the cable through the hole and squeeze the sides of part **109-7** together so that you can fit the stand into the hole. The searchlight can rotate slightly.



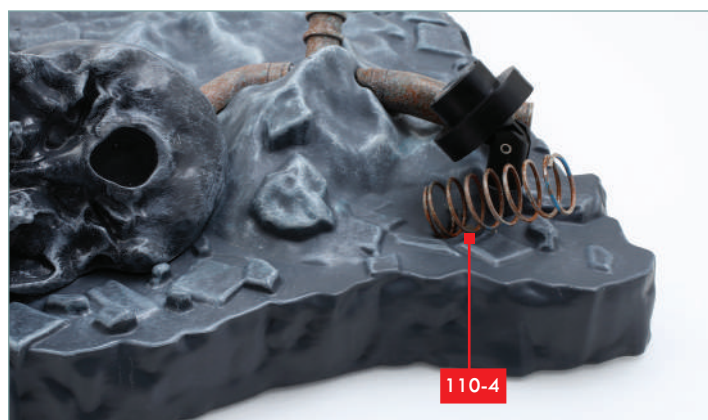
## STEP 13

Take the spring **110-4** and identify the notch near the searchlight where it fits.



## STEP 14

Fit the rim of the spring into the notch. Rotate the spring clockwise, as indicated.



## STEP 15

As you rotate the spring, coils that are wider apart will grip the spring into the notch. If necessary, apply a little superglue.

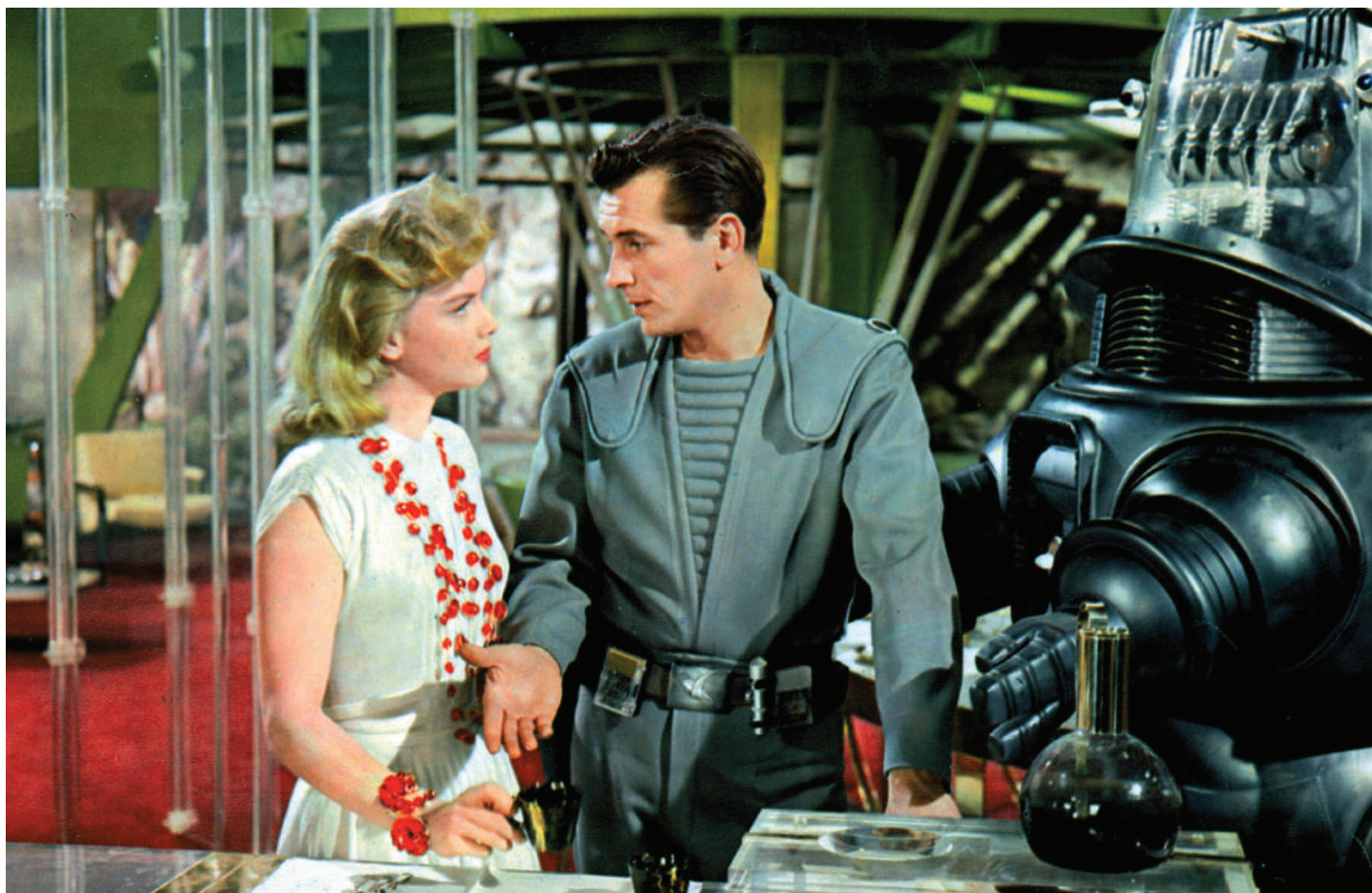


## STAGE COMPLETE!

A second base panel, with searchlight and other details, has been attached to the first base section.







# FORBIDDEN PLANET

Paving the way for the star-faring space opera genre as we know it, this trailblazing Shakespearean science-fiction tale marks a turning point in cinematic history.

**A**t the time of its release, nobody could have predicted the monumental impact *Forbidden Planet* would have on our movie landscape.

Premiering in a decade awash with schlocky sci-fi features, spurred on by the public's burgeoning interest in space travel, the 1950s film appears little more than another cheap (albeit not *quite* as cheap as its contemporaries) and cheerful attempt to capitalize on a genre still struggling to spread its cinematic wings.

In reality, *Forbidden Planet* was a game changer; an innovative film that redefined science-fiction on the big screen.

Set in the 23rd century, following humanity's mastery of faster-than-light travel, the film follows the exploits of the starship C-57D and its deep space "mission of conquest and colonization".

Hoping to determine the whereabouts of a missing research vessel, the ship is dispatched to the distant world of Altair IV, where its skipper, Commander Adams, and his

crew encounter the dubious Dr. Edward Morbius — lone survivor of the marooned *Bellerophon* — along with his beautiful daughter, Altaira, and mechanical steward, Robby the Robot.

Despite a frosty welcome, Morbius eventually reveals to Adams the bounties of his wondrous world; advanced technologies left behind by its former inhabitants, the Krell. Reluctant to share his finds and urging the Commander and his men to leave Altair IV as soon as possible, Morbius also discloses the fate of his former expedition party, all of whom perished at the hands of an elusive "planetary force".

While awaiting further instructions, Adams finds himself falling for the alluring young Altaira, but his advances are interrupted by an invisible being that begins to systematically eliminate his crew.

Sensing a connection between Morbius and the creature, further investigation reveals its true nature as a manifestation of Morbius' subconsciousness — a "monster

ABOVE: Altaira Morbius [Anne Francis] introduces Lt. Jerry Ferman [Jack Kelly] to the comforts of Altair IV. [Photo: PictureLux / The Hollywood Archive / Alamy Stock Photo]

of the id" — brought into being by the very technologies that led the Krell to their destruction.

Convincing the doctor to confront his literal demons, the creature is eventually vanquished, but at a great cost to Morbius, who opts to destroy the Krell's formidable machines, lest their powers fall once again into the hands of those undeserving. Giving Adams little alternative, the remaining crew of the C-57D flee the planet with Robby and Altaira in tow, leaving Altair IV to its obliteration.

With MGM sparing no expense, it's clear the producers at least saw something in the project; *Forbidden Planet*'s million-dollar budget was the biggest of any sci-fi movie of its time.

Starring a young Leslie Nielsen in his debut film appearance, the movie's thrilling premise, big-budget effects, and clever blend of comedy and caper were an immediate success, garnering a number of Oscar nominations and creating a breakout star of its mechanical marvel, Robby. But it's the film's subsequent impact that would prove its greatest legacy.

### IS THIS A BLASTER I SEE BEFORE ME?

*Forbidden Planet* mines heavily from the cowboy and naval-war films of the 30s and 40s — its unexplored frontiers and gun-blasting aplomb offering perfect analogues for the perils of the Wild West — but finds its chief distinction through its reimagining of a more sophisticated work.

Taking William Shakespeare's tragicomic fantasy, *The Tempest*, and transposing it to an extra-terrestrial setting, *Forbidden Planet* acts as a fairly faithful adaptation of the play; mirroring its characters, plot and moral lesson, with alien technology standing in for the magical elements.

Also touching on elements of Freudian theory, the film's

Shakespearian bent was wisely concealed by its producers for fear of alienating its audience, but it's precisely these ambitious intentions that raise it above those of its low-brow contemporaries.

### RISE OF THE ROBOT

Arguably the biggest star of *Forbidden Planet* is its scene-stealing, wise-cracking automaton — Robby the Robot — who would grow beyond the film's constraints, and his own gaudy trappings, to become a dominant pop culture figure in his own right.

Cumbersome by modern standards, his sophisticated

### FILM DATABLAST

**Director:** Fred M. Wilcox

**Screenplay:** Cyril Hume (from a story by Irving Block and Allen Adler)

**Producers:** Nicholas Nayfack

**Composer:** Bebe Barron, Louis Barron

**Director of Photography:** George J. Folsey

**Editors:** Ferris Webster

**Cast:** Walter Pidgeon (*Dr. Edward Morbius*), Anne Francis (*Altaira Morbius*), Leslie Nielsen (*Commander John J. Adams*), Warren Stevens (*Lt. 'Doc' Ostrow*), Jack Kelly (*Lt. Jerry Farman*), Richard Anderson (*Chief Quinn*), Earl Holliman (*Cook*), George Wallace (*Bosun*), Robby the Robot (*Robby the Robot*)

**Year:** 1956

**Duration:** 98min

**Aspect Ratio:** 2.55 : 1

**Country of Origin:** USA

ABOVE: Robby the Robot makes a lasting impression on the crew of the C-57D. [Photo: Pictorial Press Ltd / Alamy Stock Photo]





finish was a world away from the walking oil-cans of old, but his scintillating personality gave Robby his biggest impact. More than a gaudy prop or marauding metal monstrosity, Robby was a fully-functioning character, integral to the film's plot, with a deadpan disposition that opened up brand new opportunities for his kind's later depiction within the cinematic arena. While he may not share the T-800 Endoskeleton's sleek and ergonomic design, without Robby and his efforts, there may well have never been a *Terminator*™ to begin with.

Following the film's release, Robby's star appeal saw his career skyrocket. Appearing in slew of later productions, from *Columbo* to *Lost in Space*; while his name and appearance occasionally changed, it was always the original Robby underneath. Created by an uncredited Robert Kinoshita (his previous experiences designing washing machines resulting in Robby's bulky lower frame) and costing a whopping \$125,000 to build (over a million

dollars in today's money, equating to 7% of the movie's total budget), the original prop would later sell in auction for an eye-watering \$5.3 million, making Robby the Robot one of history's most valuable pieces of movie memorabilia.

## WHERE NO ONE HAS GONE BEFORE

Mirroring the fantastic voyage of its characters, *Forbidden Planet* dives deep into unknown territories; deconstructing stereotypes that had previously plagued science fiction cinema and pioneering many of the tropes and technologies that now define it.

*Star Trek* in particular owes a heavy debt to Hume's screenplay; a fact fully acknowledged by its late creator, Gene Roddenberry. Replicators, communicators, faster-than-light engines; these iconic Starfleet gadgets are often considered original and integral to the *Trek*iverse, but they all debuted on screen in *Forbidden Planet* in some form or another. As the first feature film set entirely on an alien planet, as well as the first to follow a human crew in an intergalactic vessel of their own making, at face value, the film's influences are even more apparent; Commander Adams and his squad's space-crawling adventures and interplanetary dalliances serve as the perfect prototype for Captain Kirk and co. a decade later.

The influence on Lucas's *Star Wars* saga also cannot be underestimated. Heavily inspired by its brave visuals, bold sound effects and its introduction of a new kind of robot (with Robby acting as a pseudo-grandfather figure to C-3PO), when stacked alongside the 1979 original, certain tropes and even lines of dialogue seem directly culled from its mid-50s predecessor.

The film's ethereal and totally electronic score was also a first. Composed by Bebe and Louis Barron, the husband and wife team constructed their own ring modulator and oscillator circuits to create the various bleeps, hums and whirs heard on film, further manipulating the noises to achieve an otherworldly effect. Often mistaken for a Theremin, but based on jury-rigged instruments, the technique was hugely innovative.

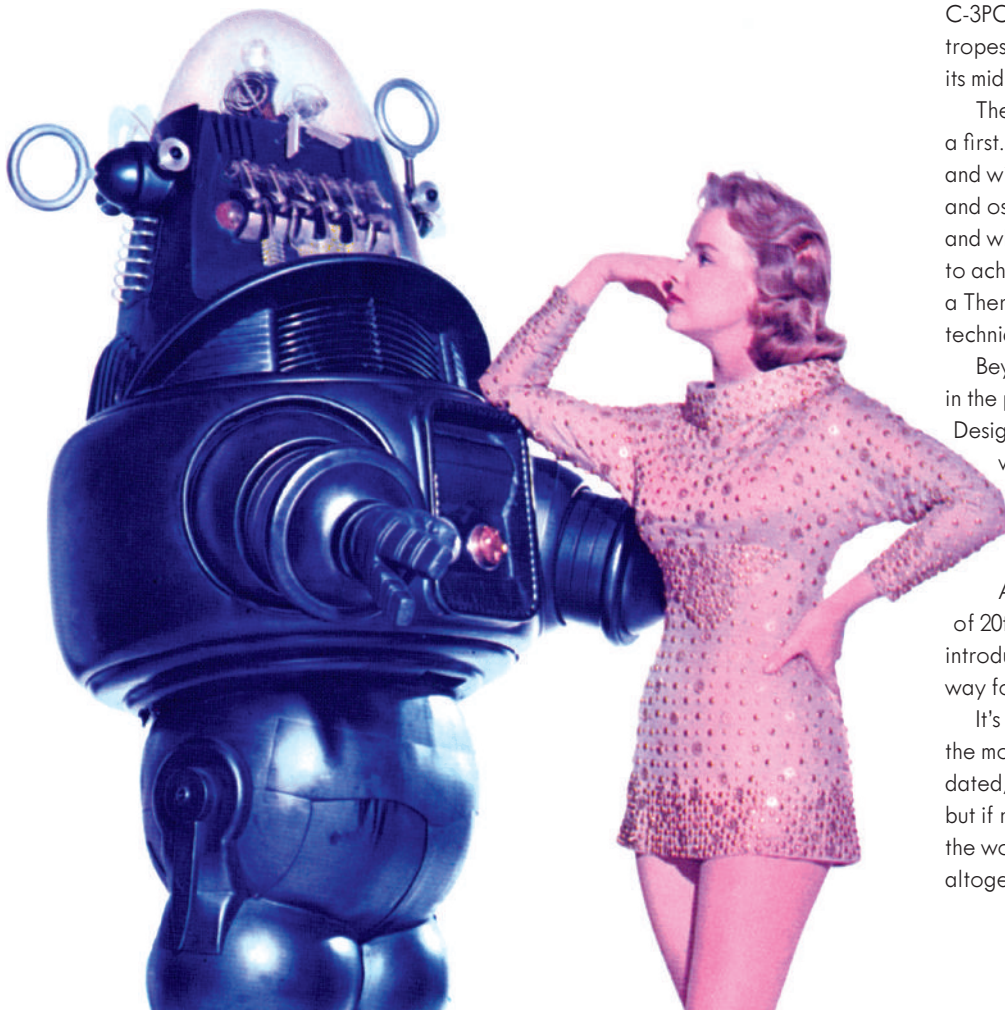
Beyond the realm of science fiction, the film's place in the pages of fashion history is also worth observing. Designed by double Oscar winner Helen Rose, wonderfully worn by its solo female star Anne Francis, and resulting in its banning in Spain, *Forbidden Planet* was one of Hollywood's first films to premiere the miniskirt — a controversial choice of attire at the time.

An instrumental part of cementing the cut as a staple of 20th century science fiction, the movie also helped introduce the clothing to a mainstream audience, paving the way for its breakthrough in the swinging sixties.

It's easy to write off *Forbidden Planet* as minor entry in the movie canon. The acting is wooden, the special effects dated, and the premise plundered a thousand times over, but if not for its audacious and groundbreaking approach, the world of science fiction cinema might be different altogether. ■

ABOVE: Robby the Robot: the perfect companion for any occasion. [Photo: TCD/Prod.DB / Alamy Stock Photo]

**"IF YOU DO NOT SPEAK ENGLISH, I AM AT YOUR DISPOSAL WITH 187 OTHER LANGUAGES ALONG WITH THEIR VARIOUS DIALECTS AND SUB-TONGUES."  
— ROBBY THE ROBOT**





# OBSERVING THE UNIVERSE: THE MOST ADVANCED TELESCOPES PART 1

With the aid of optical and radio telescopes on Earth and in space, we are currently peering further into the universe — and further back in time — than ever before. Here we get under the skin of how radio telescopes work, looking at the science and history of these incredible instruments.

**R**adio light is emitted by many cosmological entities, from planets, to stars, to nebulae, and galaxies. While visible light waves are only a few hundred nanometres long, and perceptible by both the human eye and optical technologies, radio light waves can range from 1mm to over 10 meters long, and, coupled to the weakness of signals reaching us from space, only the largest and most sensitive forms of radio telescopes can receive them.

Cosmic radio waves travel to Earth through a noisy interstellar medium, which further degrades their quality. That's why most radio telescopes are able to move, physically, to follow the position of their target in the sky. This functions much like a long exposure on a camera, which

allows for detailed shots even in low-light conditions. Here, the longer the telescope can remain trained on its target, the better various algorithms can cut through and diminish the background noise and bring the true signal to 'light'.

Signals from space also risk obfuscation by Earthbound radio transmissions, which is why most radio telescopes are located in radio-minimal areas: areas that may even have a complete ban on civilian transmissions — such as the United States National Radio Quiet Zone, which spans the states of West Virginia, Virginia, and Maryland.

That 13,000 square mile area encompasses and includes the twin facilities of **Green Bank Telescope** and Sugar Grove, the former of which, built between 1991 and 2002, is the world's largest fully steerable radio

ABOVE: Nine of the twenty-seven 82 ft antennas in the Karl G. Jansky Very Large Array. [Shutterstock]



telescope, now in private hands — and the latter of which is an NSA communications intercept site, monitoring all communications entering the Eastern United States.

Giant parabolic dish-based radio telescopes, like Green Bank, like the Lovell telescope at Jodrell Bank, and like the Arecibo radio telescope, use huge reflectors to focus and condense distant and weak radio waves into a central receiving point.

The largest of these, the **Five hundred metre Aperture Spherical Telescope (FAST)** was completed in 2016, in China. As big as 30 football pitches, it is built into a natural depression in the landscape, and so cannot be moved. The Arecibo telescope is likewise fixed into its summit in Puerto Rico.

In the case of the FAST and Arecibo telescopes, the 'receiver' mechanism, or feed antenna, is suspended over the middle of the dish, though other models of parabolic telescopes reflect the signal back from the feed antenna and into a secondary receiver in the center of the dish. Spy fans may remember Arecibo as the location of the final showdown between James Bond and Sean Bean's 006 in the movie *Goldeneye*.

## NOT JUST THE DISH

Single, moveable dishes are only one form that radio telescopes can take — the other is as linked arrays of radio telescopes that build up a more accurate picture of their collective target by combining data from a wide spread of receivers, all placed a close but significant distance from one another. This process is called radio interferometry.

A key example is the **Long Wavelength Array** in New Mexico, which began regular operations in 2015. Currently comprised of a single station of 256 antennae, with each antenna standing 5 ft (1.5 m) high and 9 ft (2.7 m) wide, a second station is currently being built around 19 km (12 mi) away, which, when brought online, will increase the range and fidelity of the entire station. Like adding RAM to your computer, the bigger the capacity, the more the array can do — and the further it can see. The LWA has a fairly unique remit, even among such radio telescopes, because it scans relatively low frequencies — 10-88 Mhz — and has been used to trace cosmic background radiation to explore the evolution of the cosmos, track relativistic particles, zero in on extrasolar Jupiter-like planets, and monitor giant flares from magnetars — neutron stars with extremely powerful magnetic fields.

Its forerunner in the field is the **Karl G. Jansky Very Large Array**, built on the Plains of San Agustin in New Mexico between 1973 and 1980, and familiar to many from its pop culture appearances in such films as *2010: The Year We Make Contact*, *Contact*, *Terminator Salvation*, and many more.

It consists of twenty-seven 82 ft (25 meter) diameter radio telescopes arranged on moveable rails in a Y-shape, so that the distance between the dishes can be



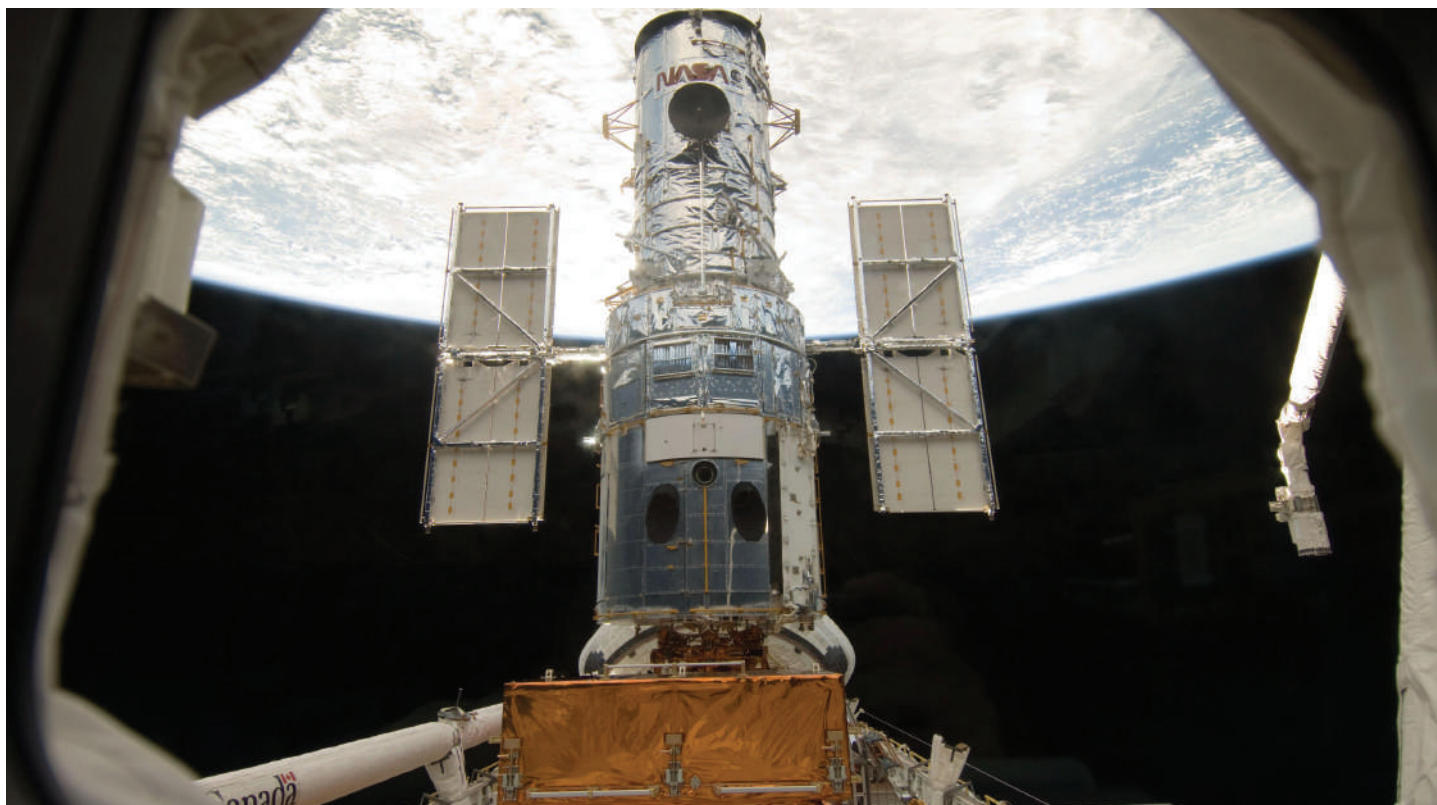
## THE VLA HAS EVEN SCANNED THE 'NEARBY' GALAXIES M31 AND M32 FOR EXTREMELY POWERFUL SIGNALS FROM ADVANCED CIVILIZATIONS.

increased or decreased depending on the object being targeted. The observatory normally cycles through four key configurations, with the dishes being moved every three to four months.

Much like the upgrades that have been performed in space on the Hubble telescope, the VLA was upgraded across the first decade of the new millennium, stripping out the 1970s-era electronic components in favour of state of the art computers. This new era was inaugurated in 2011, and the results have already been promising — but the site is not standing still. Plans are afoot to add eight more dishes, up to 299 km (186 mi) away from the current array, in order to increase its range and resolution yet further.

In its life to date, the VLA has uncovered the secrets of black holes and the boundaries of the cosmos, enlightened us on star formation, and even scanned the 'nearby' galaxies M31 and M32 for extremely powerful signals from advanced civilizations. Since September 2017, the VLA Sky Survey has been tracking 80% of the sky visible from Earth in search of 10 million new objects, four times more than are currently known to science. ■

ABOVE: The Lovell Radio Telescope at sunrise. [Shutterstock]



# OBSERVING THE UNIVERSE: THE MOST ADVANCED TELESCOPES PART 2

While radio telescopes and ever-more advanced telescopes continue to probe the cosmos from the ground, sometimes there's no substitute for measurements taken beyond the distorting properties of Earth's atmosphere.

**G**round-based observatories, however advanced, are always at the mercy of the triple terrors of Earth astronomy — a limited view of the sky, the distortive properties of electromagnetic radiation and atmosphere, and the weather. Many wavelengths that have proven essential to our ever-advancing understanding of the universe, such as infrared, ultraviolet, and X-rays, are largely blocked to Earthbound telescopes.

There are generally two kinds of space telescopes. Some are designed for surveys — constant catalogues of the universe in all spectra, building up an ever-changing map of the sky. Others are observatories with more focused missions, either with predefined stellar neighborhoods to track, or specific mission parameters designed to shed light on astronomical phenomena.

The first space observatory was launched by NASA in 1966 — though OAO-1, or **Orbiting Astronomical Observatory-1** was terminated after three days due to a power failure before it could activate its instruments. Subsequent launches in 1968 (OAO-2 **Stargazer**), and 1972 (OAO-3 **Copernicus**) proved more successful, and fed back innovative science on the make-up of cometary haloes and the discovery of long-period pulsars.

The Soviet space program relied on manned observatories over remotely-controlled ones, with their first forays coming in the form of **Orion 1** and **Orion 2**, telescopes installed aboard Salyut 1 and Soyuz 13, respectively, in 1971 and 1973. Cosmonauts Viktor Patsayev and Valentin Lebedev were responsible for their operation, with Viktor becoming the first man to use a

ABOVE: Hubble captured in the cargo bay of *Atlantis* on Wednesday, May 13, 2009. [Photo: NASA]



telescope outside of Earth's atmosphere. Spectrograms of stars, revealing stellar aluminium and titanium, were among their discoveries.

But perhaps the chief discovery was that scientists realised the true value of orbital telescopes through these pioneering missions, and began lobbying for bigger and more complex equipment, of which 1990's **Hubble Space Telescope** was the first realization of a decades-long dream.

Although one of the biggest and most adaptable space telescopes in history, it's important to note that the Hubble didn't launch alone, but is rather the longest-lasting of a fleet of complementary telescopes that launched in a particularly fertile two-year window between 1990 and 1992.

**ROSAT**, a collaboration between NASA, West Germany, and the UK, launched in June 1990, with a mission of X-ray telescope. As with many space-based technologies, it massively outperformed its intended operational parameters. Designed for an 18-month mission, five years at the outside, it was still going strong nearly nine years later, and only re-entered Earth's atmosphere in 2011, where it broke up over the Bay of Bengal.

The **Broad Band X-ray Telescope** flew on the Space Shuttle *Columbia* in 1990, from 2 December-11 December, as the 'ASTRO-1' payload. Mounted in the Shuttle's ever-adaptable cargo bay, it performed X-ray observations, with three ultraviolet telescopes running in parallel.

The **Compton Gamma Ray Observatory** launched in 1991 from the Space Shuttle *Atlantis*, and was de-orbited in June 2000. It was the heaviest payload ever put into space at the time, and comprised a platform of four linked telescopes designed to observe X-rays and gamma rays from all across the universe.

The **Solar Anomalous and Magnetospheric Particle Explorer** headed to low Earth orbit in July 1992, with a mission focused on cosmic rays and atmospheric particle interactions. Built to last for three years, it instead operated for twenty, its final re-entry occurring in 2012.

## KEEPING AN EYE ON THE STARS

Hubble is the born survivor of the Nineties crowd, though far from self-sufficient. To date, there have been five Hubble servicing missions performed in space. The first, in 1993, included planned maintenance, but also the adjusting of equipment to correct for a flaw in the primary mirror. In 1997, new instrumentation extended Hubble's range into new spectra. In 1999, a mission of preventative maintenance became one of rescue, as the fourth of six gyroscopes failed — and Hubble needs three in order to be useful. In fact, the telescope went dormant for a period while awaiting repairs, before being brought back on line.

2002 saw the replacement of the last instrument of the original Hubble, in an unintentional homage to the 'Ship of Theseus' problem, whereby every part of an original vessel



## AFTER ITS SERVICING IN 2009, IT'S POSSIBLE THAT HUBBLE WILL STILL BE OPERATIONAL IN THE 2040s.

is replaced, and yet it retains its essential nature. That repair mission saw the Advanced Camera for Surveys replace the Faint Object Camera. Finally, a twelve-day mission with five spacewalks in 2009 saw the first ever on-orbit repairs and refurbishment to the entire satellite — including new batteries, gyroscopes, guidance sensors, insulation, computers, and more, effectively granting Hubble another decade of operational life.

The Hubble's continued operation is very much welcome, as the next generation of space satellites is running a year or so behind schedule. Indeed, many scientists who log time on the existing fleet of space telescopes are concerned that there may be significant gaps in coverage in the coming decade, as current models are deorbited or reach the end of their useful life, without the budget for adequate replacements.

And, while the field for crewed spaceflight is more exciting now than it has been in decades, there's still no active replacement for the Space Shuttle that is able to reach and repair the current fleet of telescopes. One of the biggest drawbacks of space telescopes over Earthbound equivalents is the sheer expense of getting these large, heavy, and incredibly specialized chunks of technology into orbit, and the distinct lack of opportunities to fix anything that may go wrong while they're up there. ■

ABOVE: Hubble has brought us astounding visions of the universe around us, such as Messier 28, a globular cluster 18,000 light years away from Earth. [Photo: ESA/Hubble & NASA, J.E. Grindlay et al]

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