

Timecode	Notes/Pronunciations	Script
	PRE-TITLE TEASE	
10:00:00		<p>Coming up....On How do they do it?</p> <p><i>Sting</i></p> <p>Transforming humble horse hair into a bed fit for a king...</p> <p><i>Sting</i></p> <p>The \$200 million rocket-propelled takeaway service that keeps astronauts in coffee and pizza!</p> <p><i>Sting</i></p> <p>And growing salad in WW2 bomb shelters 33 metres under London's busy streets.</p> <p>How Do They Do It?</p>
10 SECS	TITLES	
		INTRO STORY 2

	TITLE CARD	
	INTRO STORY 2	<p>Since 1961, humans have blasted off into space.</p> <p>Once, they'd shoot for the moon.</p> <p>Today, they stay in orbit and savour the view.</p> <p>410 kilometres above terra firma is the international space station, ISS.</p> <p>A hotel in the heavens that welcomes astronauts for up to 6 months at a time.</p> <p>When they crave the comforts of home, they turn to Cygnus.</p> <p>A 200 million dollar capsule that's packed with the right stuff.</p> <p>But delivering a spacefarer's room service is no small step...</p> <p>How do they do it?</p>
	Title card	<i>HOW DO THEY DO IT?</i>
	COMM	<p>Turin, Northern Italy.</p> <p>Famous for cars, chocolate and cafes¹.</p> <p>Not so famous for its satellites².</p> <p>But for 40 years, Thales Alenia Space has been making out-of-this world technology.</p>

		<p>Crucially, its Cygnus re-supply module is a lifeline to the ISS.</p> <p>Franco Fenoglio, head of the human spaceflight and transportation unit, explains its mission.</p>
	NEW SYNC Franco	<p><i>They need water, they need gases, they need food, they need other resources like for instance spare parts for maintenance.</i></p>
	NEW COMM:	<p>The vessel carries living, breathing passengers too, so the atmosphere on board has to be ideal.</p> <p>Data from these white mice will provide insights into how microgravity affects bone, muscle and DNA³.</p> <p>Any flaw in the capsule's construction would imperil Cygnus and its roving rodents.</p> <p>It must be hardy enough to cope not only with intense heat and meteorite collisions, but with the merciless vacuum of space.</p>
	COMM	<p>To assess a ship's strength, first you need to look at its hull.</p> <p>At 27 cubic metres, Cygnus is the size of a removal truck. It's a giant, hollow cylinder, nearly 6.4 metres⁴ long, made from 3 concentric rings and two end plates.</p> <p>With a rotating bit, this heavy duty milling machine carves a ribbed pattern into the alloy rings.</p> <p>Enhanced with a few special ingredients, the aluminium/copper mix is lightweight, sturdy and crack-resistant.</p>

		<p>Once the milling process is finished, it’s lost a lot of weight but kept its strength.</p>
	COMM	<p>By now, the pieces are ready. But before assembly, every imperfection needs to be fixed.</p> <p>Using planes, technicians strip away the most microscopic bumps like the smooth operators they are.</p>
	COMM	<p>To avoid disaster, the team must slot together every section seamlessly.</p> <p>The grim truth is that the pressurised vessel couldn’t survive a crack or leak.</p> <p>Giant circular clamps hold the pieces snugly in place.</p> <p>They’re welded together with a revolutionary new technique, says engineer Francesca Mariaassunta.</p>
	FRANCESCA MARIAASSUNTA	<p><i>That’s called friction steel welding.</i></p> <p><i>We don’t arrive at the melting point of the material but we are only softening the material.</i></p>
	COMM	<p>On a rotating table, a robot arm with a spinning pin attachment applies pressure at the point where the two rings meet.</p>
	FRANCESCA MARIAASSUNTA	<p><i>When the temperature is hot enough the machine, the rotary table start to rotate and the welding starts.</i></p>
	COMM	<p>Friction and high pressure fuse the sections together without melting the alloy.</p> <p>What’s more, the rings’ shape and structural integrity remain intact.</p>

	COMM	<p>At last, after months of intricate welding, the outer shell is ready.</p> <p>The completed module can carry twice its own weight. That's 3,500kg of cargo.</p>
	COMM	<p>Unlike most cargo ships, however, Cygnus must endure mind-boggling extremes of hot and cold.</p> <p>In sunlight, it can reach 250 degrees Celsius. In darkness, minus 120.</p> <p>Daniele Rolle runs the electrical and thermal workshop.</p>
	SYNC DANIELE	<p>Sono I veri e propri vestiti che proteggono chiaramente la struttura dal ambiente esterno</p> <p>TRANSLATION</p> <p><i>This material clothes the structure, protecting it from the external environment</i></p>
	COMM	<p>Italians know a nice fabric when they see one.</p> <p>But not many tailors use Beta cloth, a silica material similar to fibreglass.</p> <p>When astronauts take a space walk, they owe their lives to it.</p> <p>This amazing cloth doesn't burn. It will melt at 650 degrees Celsius – but that's like diving into molten lava⁵.</p> <p>For Cygnus, it's the practical choice. And where better than Italy to have a fitting⁶?</p>
	SYNC Daniele	<p>Vengono sagomate, vengono cucite, vengono applicate velcro,</p>

		<p>TRANSLATION</p> <p><i>They are shaped, they are sewn, they are fitted with Velcro.</i></p>
	COMM	<p>There’s one last problem, though. On its journey into space, Cygnus needs more than just a warm jacket.</p> <p>Over 500,000 pieces of space junk circle the planet at incredible speeds.</p> <p>Fortunately, a Meteoroid and Debris Protection System acts as the capsule’s bulletproof vest⁷.</p> <p>As fragments strike its outer shell at thousands of kilometres a second⁸, layers of aluminium sheets bear the brunt of their kinetic energy, rendering them harmless.</p>
	COMM	<p>Dressed for adventure, the module is checked and rechecked.</p>
	SYNC PAOLO PRATO	<p><i>We spend about 6 month to mount and test everything.</i></p>
	COMM	<p>As the countdown to launch looms, it’s loaded with mice and meals.</p> <p>In fact, Cygnus has been giving astronauts something to cheer about since 2014.</p> <p>Delivering pizza, an espresso machine and other goodies.</p> <p>Missions cost 200 million dollars, so an apple will set you back 10 grand. A bottle of water, 40,000 bucks.</p> <p>With overheads like that, you can see why the ISS recycles astronauts’ urine.</p>

	COMM	<p>Having emptied Cygnus, the space station crew restock it with up to 2.5 tonnes of rubbish and human waste.</p> <p>It's now the world's most expensive garbage can. Star dreck, if you want to call it that.</p> <p>Engineer Enrico Angelino is a production manager for the operation.</p>
	<i>SYNC Enrico Angelino</i>	<i>The module re-enters in the area in the pacific and it is completely burnt and destroyed ...due to the friction with the atmosphere</i>
		<p>After all their hard work, members of the ground team watch 20 million dollars' worth of technology burn up on re-entry. That, and a lot of poop.</p> <p>But it doesn't faze them.</p>
	SYNC PAULO PRATO	<i>It's always a pleasure to see one of your babies launch to the space station</i>
	COMM	<p>Thanks to their ingenuity, astronauts on the ISS can continue their ground-breaking research.</p> <p>Expanding humanity's knowledge of mice, the universe and everything.</p>
		END

2 <https://uk.reuters.com/article/uk-fiat-mirafiori-turin-idUKBRE91208U20130203>

3 https://www.nasa.gov/mission_pages/station/research/experiments/665.html

4 <http://spaceflight101.com/spacecraft/cygnus/>

5 <https://www.zmescience.com/science/geology/how-hot-is-lava/>

6 <https://www.esquire.com/uk/style/news/a8228/six-of-the-best-italian-tailors-worth-seeking-out/>

7 <https://www.sciencefocus.com/future-technology/how-do-bulletproof-vests-work/>

https://www.nasa.gov/missions/shuttle/f_debris.html

8 https://en.wikipedia.org/wiki/Whipple_shield