

General Processing Safety Video

We didn't go to the Moon because it was easy. We didn't give America routine access to space because it had all been done before. We're not building an International Space Station because it's a piece of cake. No. We like challenges here at the Kennedy Space Center.

The real challenge, however, is to do all those things while protecting the public, the astronauts, ourselves, our equipment, and the environment.

This video covers:

- Employee / Supervisor responsibilities
- Top safety hazards at KSC
- Working in processing facilities
- Working around flight hardware
- Working outside.
- Emergencies.

Section 1. Employee / Supervisor Responsibilities

In 1999, 5.7 million people in the United States were injured on the job or suffered a job-related illness. That's roughly 6 people out of every 100 full-time workers. About half of those people lost at least one day of work due to their injury or illness. Maybe those numbers don't sound like much, but consider that we have approximately 12,000 people working here at the Kennedy Space Center. If we settled for the same accident rate, roughly 720 of us would be hurt on the job each year. That's far too many. One of us is far too many. That one could be you. Our goal is zero.

25 And, it's up to each and every one of us to make sure we're working safely—for own
26 sakes as well as those of the crews, visitors, equipment, and environmental resources
27 entrusted to our care.

28 Safety starts with you. You should be aware of the hazards in your area, follow the
29 appropriate safety procedures, obey all warning systems, never go into a safety control area
30 without proper authorization, and use the correct personal protective equipment.

31 You are also responsible for reporting anything that you see that's unsafe. It could
32 save your life as well as those of others. Open, honest communication is essential to safety.
33 No reprisals will be tolerated if you report an unsafe condition. You are the Center's eyes
34 and ears. Who else knows better about what's happening day-to-day than you, the worker?

35 You have several options for reporting an unsafe condition. First, try to resolve the
36 issue within your work unit or line organization. Report the condition to your supervisor,
37 and he or she is then responsible for initiating a corrective action.

38 If you feel your safety concerns have not been addressed within your organization
39 (or if you wish to remain anonymous), you can contact your company's safety office or the
40 KSC Safety Ombudsman. His or her job is to act as safety advocate for the Center.

41 Your other option is to report the matter through the NASA Safety Reporting
42 System, or NSRS. The NSRS is open to all employees—contractor and NASA. It's designed
43 to supplement standard safety reporting channels. (2 sentences deleted) The NSRS will
44 analyze your concern and forward it to the appropriate NASA office for action. This process
45 is entirely confidential.

46 Supervisors play a vital role in your safety. Supervisors have the added responsibility
47 for ensuring that their employees have safe working conditions. This means that supervisors
48 are responsible for:

- 49 • Identifying and evaluating hazards in the workplace
- 50 • Complying with safety requirements.
- 51 • Implementing necessary safety controls
- 52 • Making sure their employees are properly trained to do their jobs.
- 53 • Performing periodic walk downs of work areas to ensure that safety controls
- 54 are in place and being used.
- 55 • Resolving safety issues reported by workers.
- 56 • Reporting mishaps to their respective safety office

57

58 **Section Summary**

59 Our mission success depends on the safety of each and every person at KSC. Our
60 goal is zero mishaps in the workplace.

61 As an employee, you are responsible for doing your job safely and reporting any
62 unsafe conditions. You can report those to your supervisor, your company’s safety office,
63 the KSC Safety Ombudsman, and / or the NSRS.

64 Supervisors are responsible for ensuring that employees have safe working
65 conditions and the proper training and resources to perform their jobs safely. Supervisors
66 are also responsible for initiating corrective actions regarding safety issues reported to them.

67

68

69 **Section 2: Top Safety Hazards**

70 We’re in a risky business. We process and launch vehicles into space. We work with
71 hazardous rocket fuels, toxic vapors, confined spaces, cryogenics, and many other hazards.

72 The following are some of the safety hazards you should be aware of.

73

74 **Pressurized Systems**

75 “Contents under pressure.” We see this warning everyday on spray cans. “Danger.
76 Fire and explosion hazard.” If this little can could cause serious injury when punctured,
77 imagine what one of these could do.

78 At KSC, we have hundreds of pressurized systems, from propellant tanks to
79 cryogenic dewars to water deluge systems and common K-bottles. These systems include
80 pressure vessels and pressurized hardware—such as lines, pipes, fittings, flex hoses, valves,
81 and relief devices—that contain gas or fluid under pressure, some under extremely high
82 pressure. Many contain toxic or hazardous fluids, and all are inherently dangerous. A leak
83 could create potential health and safety hazards. A loose fitting or pipe could become a
84 projectile. A rupture could be devastating. An improperly restrained flex hose under
85 pressure can inflict severe equipment damage and personnel injury. Even cracking into a
86 pressure system mistakenly thought to be depressurized can be fatal.

87 When working with pressurized systems, bear in mind a few safety rules of thumb.

- 88
- 89 • Always follow procedures.
 - 90 • Be aware of the contents of the system.
 - 91 • Make sure all flex hoses pressurized to over 150 pounds per square inch are
92 properly restrained.
 - 93 • Always verify that the system has been completely depressurized before
94 disassembling any of its components.

94 Also, do not assume that a low pressure system is any less dangerous than a high
95 pressure one. If a high volume of gas or liquid is involved, the energy release could be just as
96 great.

97 **Explosives**

98 Most spacecraft, the Shuttle included, use explosives—ordnance as well as
99 propellants—as part of their operation. For instance, explosive bolts fire to separate the
100 Solid Rocket Boosters—which are filled with solid propellants—from the External Tank,
101 which, of course, is filled with liquid propellants.

102 Special training is required to work with explosives but you should bear in mind a
103 few safety restrictions when near operations involving explosives.

104 During ordnance operations, radio frequency transmissions are restricted within the
105 perimeter of the operation. This means no cell phones, or talkback pagers are allowed within
106 the control area and no radio transmissions are allowed within 20 feet of the ordnance task.
107 The ban also covers all sources of electrical ignitions. Specifically, do not start a vehicle,
108 whether it's a car or a forklift, within the control areas of flammable liquid operations and
109 oxygen-enriched environments.

110 Likewise, no flame producing devices are allowed near operations involving
111 propellants. This means no lighters or matches are allowed in many of the processing
112 facilities. In these areas, you are required to leave matches and lighters in the spaces provided
113 and may smoke only in designated areas approved by the fire department. Special lighters
114 are provided for these areas.

115 **Suspended loads**

116 We do lift a few heavy objects around here—from mating operations in the Vehicle
117 Assembly Building to testing at the Launch Equipment Test Facility. Do not walk or work
118 under a suspended load. Keep out of clear zones. These are marked and roped off for your
119 protection.

120 An Alternate OSHA Standard does allow for work under a suspended load but this
121 must be pre-approved by NASA safety

122

123 **Cryogenics**

124 Cryogenic liquids are refrigerated liquid gases with a boiling point below minus 130
125 degrees F. The shuttle uses liquid oxygen and liquid hydrogen as fuel. Liquid hydrogen is
126 especially cold. It has a boiling point of minus 423 degrees F and is explosive in air. KSC
127 also has a cryogenic testbed where a wide variety of cryogenic fluids are in use. They can also
128 be found in other labs and storage facilities.

129 The hazards of working with cryogenic fluids may include contact burns, frostbite,
130 and possibly even asphyxiation. A cold contact burn is similar to a heat burn, and its severity
131 will vary with temperature and exposure. When working with cryogenic liquids, always wear
132 protective clothing and gloves designed to prevent body tissue from freezing. If you should
133 touch an uninsulated pipe carrying liquefied gases with your bare hand, you may not only be
134 burned but the extremely cold metal may stick fast and tear your flesh when you try to
135 withdraw your hand. Face shields and splash-proof chemical safety goggles are required
136 when working with cryogenic fluids.

137 When released into the atmosphere, nitrogen depletes the oxygen in the air. This is
138 especially dangerous when working in a confined space, such as the Orbiter aft
139 compartment. You could be asphyxiated.

140

141 **Confined spaces**

142 We have many confined spaces around KSC. A confined space is any area with a
143 limited means of exit or entry that is large enough to enter bodily but not designed for

144 human occupancy. At KSC, this includes some of the orbiter compartments, portions of the
145 External Tank and Solid Rocket Booster, and storage vessels and tanks. Each of these
146 places have oxygen monitors that detect when the oxygen content falls below the minimum
147 acceptable level of 19.5%. Forced ventilation may be required to keep the oxygen level
148 above this limit. Working in any confined space requires working with a buddy.

149

150 **Hypergols**

151 Hypergolic propellants are fuels and oxidizers that ignite spontaneously on contact
152 with each other. For instance, the orbiter uses nitrogen tetroxide and monomethyl hydrazine
153 in its Orbital Maneuvering and Reaction Control Systems. By itself, each hypergol is
154 extremely toxic and reactive. In its gaseous state, nitrogen tetroxide is a red-brown and
155 smells like bleach. Monomethyl hydrazine is clear and smells like ammonia. Together they
156 are explosive enough to maneuver the Shuttle.

157 Hypergol operations require extensive training and specialized personal protective
158 equipment called Self-Contained Atmospheric Protective Ensemble, or SCAPE, suits.

159 Hypergol operations take place in a variety of facilities, including the Orbiter
160 Processing Facilities, Launch Pads 39 A and B, the Propellants South Fuel Farm, the
161 Hypergol Maintenance Facility, the Payload Hazardous Servicing Facility, the Vertical
162 Processing Facility, and the Spacecraft Assembly and Encapsulation Facility 2.

163 When entering an area where hypergolic propellants are stored or transferred, you
164 should always check the location of the windsocks around the facility and note the direction
165 of the wind. If there is a hypergol spill or leak, do not move down wind when you evacuate
166 the facility. Move upwind or crosswind from the vapor cloud. You cannot outrun it.

167

168

169 **Fire**

170 Fire needs three things: fuel, oxygen, and an ignition source. Almost everything at
171 the Center can provide that fuel to burn. High heat, electrostatic sparks, overloaded electrical
172 equipment, and even a stray cigarette can provide the ignition. And, oxygen? We have plenty
173 of that, even in the liquid state.

174 An accidental release of liquid oxygen would rapidly saturate the atmosphere with
175 oxygen, creating prime conditions for a fire. The release of liquid hydrogen can also create a
176 dangerous situation. Liquid hydrogen is flammable, and as vapor, it is explosive in the air.
177 Hydrogen fires are difficult to see because they burn with an almost invisible flame.

178 We also face the threat of fire from the outside, from wildfires exacerbated by
179 drought conditions and touched off by lightning strikes.

180 Most facilities are equipped with fire alarm and/or fire suppression systems. Use
181 them as necessary, especially the fire alarms. However, you are not expected to fight fires.
182 We don't want you becoming a statistic by doing so. Your first priority is to get out of the
183 facility. However, you may not be able to see exit signs because of smoke. So, know where
184 the exits are before you actually need them.

185

186 **Toxic Chemicals**

187 NASA has an inventory of approximately 17,000 chemicals that range from the
188 mundane to the extremely hazardous.

189 You can find out about each hazardous chemical we use at KSC by consulting its
190 Material Safety Data Sheet, or MSDS. The MSDS provides safety, health, and
191 environmental information on the substance. Manufacturers are required to supply this

192 information with every chemical. You can get this information online, at your job site, or by
193 contacting your supervisor.

194 You will also be required to take additional training on hazard communication,
195 which includes information on using Material Safety Data Sheets.

196

197 **Weather**

198 Lightning. Winds. Rain. Heat. Hurricanes. Our weather is to be respected.

199 Lightning strikes are the leading cause of weather-related deaths in Florida. And,
200 Central Florida (AKA, Lightning Alley) has one of the highest frequencies of lightning strikes
201 in the world. A bolt of lightning can carry over 200,000 amps of current at a temperature of
202 54,000 degrees F.

203 Spacecraft as well as people are vulnerable to lightning. In 1969, Apollo 12 was
204 struck by lightning seconds after launch. It was undamaged. However, in 1987, lightning
205 destroyed an Atlas / Centaur rocket.

206 KSC has a sophisticated lightning detection system designed to protect employees
207 and flight hardware. The Shuttle is protected by an 80-foot lightning mast atop the launch
208 pad. The Paging and Area Warning system issues lightning (and other weather-related)
209 advisories over the public announcement system. A Phase 1 lightning advisory is announced
210 when lightning is forecast to occur in the designated area within 30 minutes. A Phase 2
211 advisory is issued when lightning is imminent in that area.

212 Advisories are also issued for high winds, heavy rains, tornadoes, and hurricanes.
213 The Tornado Warning System is a three to five minute steady tone that warns individuals
214 working outside of a tornado threat.

215

216 **High voltage**

217 Approximately 200 electricians die on the job each year across the country. We have
218 many areas at KSC where high voltage is in use. Danger occurs when you make contact with
219 a conductor carrying electrical current and with the ground or something in contact with the
220 ground. Your body completes the circuit, allowing current to flow through you. How much
221 damage it does depends on the amperage and the duration of contact. It doesn't take much
222 current to cause a heart attack.

223 Common causes of electrical shock include:

- 224 • Coming into contact with bare wires
- 225 • Working on any electrical equipment that's supposed to be de-energized (but
226 isn't)
- 227 • Working with equipment that's not properly grounded
- 228 • Working with electricity while standing on a wet floor, metal ladder, or
229 something else that conducts electricity

230 You don't need to come into direct contact with an electrical current for it to hurt or
231 even kill you. An electrical arc, such as produced by a lightning strike or discharge from a
232 transformer, can kill you even if you're ten feet away.

233

234 **Manual Lifting**

235 Nationwide, approximately 46,000 people injure their backs in the workplace per
236 year. It's by far the most common and chronically debilitating injury on the job. Improper
237 lifting is probably one of the most common causes of back injuries. We bend at the waist to
238 pick something up. We reach a little too far. We overestimate our strength.

239 The proper way to lift something is with your legs rather than your back. Keep the
240 object close to you rather than reaching for it.

241 Regular exercise can strengthen your back and abdominal muscles, reducing the risk
242 of injury.

243

244

245 **Falls, slips, and trips**

246 KSC may enable you to rise to new heights—from work platforms in the Orbiter
247 Process Facilities to the top level of the pad. Unfortunately, in the U.S., hundreds of workers
248 a year die from falls.

249 OSHA and KSC regulations require safety lanyards and full-body harnesses for all
250 fall hazards over six feet. Safety ropes and barricades identify potential fall areas. These ropes
251 are not designed for support. Please don't lean on them.

252 Special training is required for those who work at heights.

253 Falling, however, is not restricted to heights. In fact, most falls are a little bit more
254 pedestrian. We trip over electrical cords, slip on freshly waxed or wet floors, and stumble
255 over an uneven bit of concrete. Good housekeeping and preventative maintenance are
256 essential to eliminating these kinds of hazards.

257

258 Before we recap the top hazards at KSC, we need to mention a key factor that
259 contributes to most accidents. The human factor. Wherever people work, there is the
260 potential for human error. We all make mistakes. The most common one is skipping a step
261 in a procedure. We get distracted. The phone rings or someone interrupts us, and then we
262 forget where we left off. Given the hazards we work with at KSC, imagine the accidents

263 that can happen when we leave out a key step or steps. You can reduce that risk by doing
264 something as simple as marking the steps in the procedure as you work.

265

266 **Summary**

267 Here are our top hazards:

268 Pressurized Systems

269 Explosives

270 Suspended loads

271 Cryogenics

272 Confined spaces

273 Hypergols

274 Fire

275 Toxic Chemicals

276 Weather

277 High voltage

278 Lifting

279 Falls, slips, and trips

280

281 As you can see, KSC is not exactly a dull place to work. Being aware of its hazards is
282 the first step in being safe.

283

284 **Section 3: Working in Processing Facilities**

285 We have processing facilities where space station components, payloads, solid rocket
286 boosters, external tanks, orbiters are stored and processed and even launched. Each facility
287 has its own safety requirements.

288 Before working in or visiting a processing facility, you need to:

- 289 • Know its access requirements
- 290 • Be aware of its specific hazards
- 291 • Observe safety controlled areas and area warning signs
- 292 • Be familiar with its suppression and warning systems
- 293 • Be familiar with its emergency equipment
- 294 • Know how to get out and where to go in case of an emergency

295

296

297 **Access requirements**

298 Each facility has a specific area permit number that you must have to enter the
299 facility. For instance, to enter Orbiter Processing Facility Bay 3, you need to have number 24
300 on your area access permit. To get this number, you must take a safety familiarization course
301 on that area. Visitors can obtain a temporary area access permit.

302 When you enter a facility, security may check your badge and area permit to see if
303 you're authorized to enter. Some facilities have badge stations where you'll leave your picture
304 badge before you enter the processing area. In most facilities, you'll run your Personal
305 Access Control and Accountability System, or PACAS, badge through the access card
306 reader. Depending on the facility, you'll then probably need to check in with the control
307 desk. In the Industrial Area where payload processing is performed, you only need to

308 PACAS into the facility. Some processing areas may also require an Access Overlay. Check
309 in with the facility manager if you have questions.

310 Processing areas have dress restrictions. You must wear long pants, a short or long-
311 sleeve shirt, and closed-toed, flat shoes. Tank tops, shorts, skirts, sandals, and heels are not
312 allowed in processing facilities. This is for your own safety.

313 Facilities such as the Pad, the Vehicle Assembly Building, and the Shuttle Landing
314 Facility also have automobile restrictions. For instance, only government vehicles are allowed
315 within the pad perimeter fence. Check restrictions before you travel to the facility.

316 **Suppression and Warning Systems**

317 Each processing facility at KSC is equipped with fire protection and emergency
318 warning systems.

319 Warning beacons outside the facility tell you whether it's safe to enter. A flashing red
320 light means that an emergency situation exists. Clear the area immediately. A flashing amber
321 light means that hazardous operations are underway. Only essential personnel should enter.

322 The Paging and Area Warning System will alert you to any emergency and instruct
323 you to evacuate the facility. In high noise areas, beacons and strobes may be used as part of
324 the Area Warning System. Fire alarms are equipped with strobe lights for the hearing
325 impaired.

326 If the Area Warning System or fire alarms sound, you need to proceed to the
327 designated marshalling area outside the facility. Routes are typically marked with blue and
328 white evacuation signs. Use the stairs rather than the elevators and do not take the time to
329 badge out through the card readers. At the Marshaling Area, your supervisor or other
330 designated person will take a head count. Stay at the Marshaling Area until the all clear

331 sounds. If you have information that would assist the emergency responders, inform the
332 person in charge of the Marshaling Area and proceed to the Incident Command Post.

333

334 **Emergency equipment**

335 Emergency eyewashes, showers, and Emergency Life Support Apparatus, or ELSA,
336 breathing units are located throughout processing facilities where you might encounter
337 hazards. Know where these are located and how to use them.

338 Should you splash something in your eyes, rinse them thoroughly in the eyewash for
339 at least 15 minutes.

340 Should you spill a toxic liquid on yourself, remove the contaminated clothing and
341 flush yourself thoroughly in the emergency shower for 15 minutes or until help arrives.

342 ELSA's are stored in green and white boxes. These units are designed only for use in
343 emergencies. ELSA units only have 5 or 10 minutes of air, depending on your location. If
344 your work requires you to go into an area where ELSA's are staged, you will be required to
345 attend an ELSA training class.

346

347 **Know how to get out**

348 When the alarm sounds, you may have only a few minutes to get out of the facility
349 and to your marshalling area. Seconds count. Long before there's any emergency, review the
350 evacuation route for your facility and any operational restrictions that may exist. For
351 instance, in the VAB you may not be able to exit out of certain doors when the transfer aisle
352 doors are open.

353 **Summary:**

354 Before you work in or visit a particular facility, you'll be required to take a
355 familiarization course on the hazards and restrictions specific to that operational area.
356 However, you should be familiar with the following for any facility you are in:

- 357 • Access requirements
- 358 • Specific hazards
- 359 • Suppression and warning systems
- 360 • Emergency equipment
- 361 • Evacuation routes and marshalling areas.

362

363 **Section 4: Working around Flight Hardware**

364 We routinely subject the Shuttle and other spacecraft to extraordinary forces during a
365 mission; however, on the ground, these vehicles are delicate pieces of equipment.

366 When you are working around flight hardware, there are certain things you need to
367 do to insure that you don't accidentally damage the vehicle or cause an injury to someone
368 else working on the vehicle. You must:

- 369 • Remove items from your upper pockets.
- 370 • Move your badge to below your waist.
- 371 • Tape (or remove) jewelry and watches.
- 372 • Tether glasses and any tools.
- 373 • Pick up and properly dispose of Foreign Object Debris, or FOD.

374 FOD is anything that is left where it doesn't belong and has the potential to damage
375 flight hardware or injure personnel. FOD can range from contamination, like dirt and

376 debris, to tie wraps and tools. FOD can become deadly projectiles during launch or even
377 during high winds.

378

379 **Section 5: Working Outdoors**

380 Safing the orbiter after landing. Working on the pad. Or, just walking to the parking
381 lot. Your job may take you outdoors at some time.

382 When you're outside, you need to be aware of the potential hazards in your area.

383 They may include toxic chemicals, high voltage, weather, and even wildlife. (After all, we are
384 located in a national wildlife refuge.)

385 Weather will probably be your primary concern. This is Florida. Lightning, strong
386 sun, heat, and high winds can be hazardous to your health. Real-time weather advisories are
387 issued over the Paging and Area Warning system. You will also want to protect yourself
388 from the sun when working outdoors. The National Skin Cancer Foundation recommends
389 wearing sunscreen with a sun protection factor (SPF) of 15 or greater. The Foundation also
390 recommends wearing protective clothing, such as long pants, long sleeves, hat, and UV-
391 protective sunglasses. You should also drink plenty of liquids, especially water, when
392 working outdoors.

393

394 **Section 6: Emergencies**

395 No matter how well we prepare or how careful we are, accidents do happen. Do you
396 know what to do?

- 397 1. Evacuate the facility and proceed to your marshalling area. Do not use an
398 elevator take the stairs. Also, remain at the marshalling area until you are
399 released. This is the only means to account for missing personnel.

- 400 2. Call 911 (867-7911 from a cell phone) and give the KSC dispatcher your name,
401 organization, location, and type of emergency
- 402 3. Report to the incident Commander at the incident command post (flashing green
403 light) if you have information regarding the incident or operation.
- 404 4. Use emergency equipment (eyewash, showers, ELSA's) as necessary
- 405 5. If injured, report to the Occupational Health Facility.
- 406

407 **Overall Summary**

408 This is the challenge. KSC is a challenging and exciting place to work. Our goal is to
409 have no injuries. You have the right to a safe workplace, and you have the responsibility to
410 help make it so. You can do that by:

- 411 • Doing your job safely
- 412 • Reporting any unsafe conditions
- 413 • Knowing and respecting the hazards here at KSC
- 414 • Knowing what's expected when you work in a facility, near spacecraft, and
415 outdoors
- 416 • Knowing what to do in case of an emergency.

417

418 Their safety is in your hands. So is your own.