API 620 Annex R

Public Reference Note for Refrigerated Products

A compact engineering summary focused on the public, reusable points behind Annex R of API Std 620. This note concentrates on the design boundary, component classes, material routes, inspection logic, and selected numeric checks that are useful in project screening and early document review.

Key boundary: Annex R addresses low-pressure storage tanks for refrigerated products with design metal temperatures from +40 F to -60 F. The current API catalog lists API Std 620 as the 12th edition (2013) with later addenda; the detailed Annex R notes in this PDF are distilled from the public 2002 Appendix R text and should be verified against the purchased current edition for contractual use.

Annex R at a Glance

Item	Public reference summary	Project meaning
Service range	Refrigerated products with design metal temperatures from +40 F to -60 F.	Useful for refrigerated liquid storage where the project stays within the Annex R low-temperature band.
Tank concept	Single-wall insulated tanks and double-wall refrigerated tanks are both covered.	The design route must define whether the project is an insulated single-wall tank or a composite double-wall arrangement.
Pressure basis	Annex R applies within the low-pressure scope of API 620.	The job remains a low-pressure tank project rather than a general pressure-vessel route.
Outer tank role	In a double-wall tank, the outer tank encloses the insulation space and is not required to contain the inner-tank product.	Inner and outer tanks can follow different material, design, and testing logic.

Annex R does not replace all of API 620. Where Annex R gives a specific requirement, it overrides the basic tank rules; otherwise the underlying API 620 requirements still apply. In practice, this is why refrigerated projects often need both the base standard and the annex logic checked together.

Component Classes and Material Logic

One of the most useful Annex R distinctions is the split between **primary**, **secondary**, and **basic** components. That split controls material selection, impact-testing expectations, and some of the fabrication and inspection route.

Class	How the public Appendix R describes it	Typical examples
Primary components	Failure could cause leakage of refrigerated liquid, exposure to refrigerated temperature, or thermal shock. Some roof and support items also become primary when combined tensile plus primary bending stress is greater than 6000 psi.	Inner-tank shell and bottom plates, knuckle plates, compression rings, shell manways/nozzles, shell anchors, piping, tubing, forgings, bolting, and roof nozzles in contact with refrigerated liquid.
Secondary components	Failure would not leak liquid; these parts may see refrigerated vapors but stay at a reduced combined tensile plus primary bending stress of 6000 psi or less.	Roof plates, roof manways/nozzles with reinforcement, roof-support members, and shell stiffeners designed within the reduced-stress limit.
Basic components	Components that contain vaporized liquefied gas but primarily operate near atmospheric temperature because of insulation design and ambient heating.	Outer wall and roof of a double-wall tank, plus roof components above an internally insulated suspended deck.

Material and impact-testing points worth screening early

Screening point	Publicly reusable guidance
Primary-component testing	All primary components are impact tested in Annex R. For many plate and weld combinations in the public 2002 tables, the baseline Charpy values are built around 25/20 ft-lb for plate average/minimum and 20/15 ft-lb for weld average/minimum, with higher values for some material routes and lower temperature conditions.
Primary material routes	The public Appendix R material tables reference plate routes tied to Table R-2 and list examples such as ASTM A333 seamless pipe, ASTM A350 forgings, and ASTM A320 Grade L7 bolting for primary-service use.
Secondary material routes	Secondary-component material selection is split by temperature band, including a -60 F to below -20 F band and a -20 F to +40 F band, with minimum permissible design metal temperature limits summarized in Table R-4.
Stainless and modified grades	The public Appendix notes allow certain stainless and modified carbon-steel routes under specific conditions, but the purchaser approval and impact route should be checked carefully before assuming interchangeability.

Selected Design and Test Controls

Annex R is useful because it converts refrigerated-tank design from a generic low-pressure idea into a set of specific controls for bottoms, shell joints, hydrotest, pneumatic test, and foundations. The summary below pulls out the most usable numeric notes.

Topic	Selected Annex R public note	Why it matters
Stored-liquid weight	The design weight of stored liquid is taken as the maximum weight per cubic foot within the operating-temperature range, but the assumed minimum may not be less than 36 lb/ft3.	This affects shell and foundation loading even when the product density varies with temperature.
Design metal temperature	For each component exposed to liquid or vapor, the design metal temperature is tied to the refrigerated product condition, including subcooling effects, and also to the possible effect of ambient temperature below the refrigerated condition.	The tank does not simply follow product temperature; insulation effectiveness and exposure path also matter.
Annular bottom plates	The liquid-containing shell is required to have butt-welded annular bottom plates. The public Appendix R text also gives a minimum radial-width relationship, with at least 24 in between the inside of shell and any lap-welded joint and at least 2 in projection outside the shell.	This is one of the places where refrigerated-tank bottom detailing becomes more specific than a generic tank sketch.
Opening connections	Openings in primary components are required to be complete-penetration, complete-fusion details.	Connection category and PWHT exceptions should be resolved before nozzle details are released.
Shell RT threshold	If the maximum actual operating membrane tensile stress in a butt-welded shell course is greater than 0.1 times the specified minimum tensile strength of the plate, the public Appendix R text calls for complete radiography; lower-stress courses follow a spot-RT pattern.	This directly changes weld quantity, NDE cost, and schedule.

Hydrotest, pneumatic test, and foundation checks

Check	Public Annex R reference point
Hydrostatic fill	The tank is vented to atmosphere during filling and emptying. During water filling, elevations at at least four equidistant points at the shell bottom and ringwall/slab are checked, and filling is stopped if settlement becomes unacceptable.
Hydrostatic level	The tank is filled to the design liquid level before the pneumatic phase.
Pneumatic pressure	Air pressure above the water level is raised to 1.25 times the vapor-space design pressure, held for 1 hour, and then reduced to design pressure for solution-film checks.
Relief devices	Pressure-relief and vacuum-relief valve opening checks are part of the test sequence.
Outer tank of a double-wall tank	The outer-tank tightness test is completed before insulation is installed.
Foundation design	Under water test, the total load on the foundation is limited to 125 percent of the allowable loading. Public Annex R uplift notes also distinguish the case below 1 psi internal design pressure from the case at 1 psi and above.

Buyer Review Checklist for Annex R Projects

For procurement and document review, the most common Annex R problems are not title-page issues. They are scope, classification, and test-route issues. The checklist below is designed for early review before fabrication moves too far.

What to verify	Why it is worth checking early
Tank concept is clearly defined	Confirm whether the project is a single-wall insulated tank or a double-wall refrigerated tank, because the inner and outer tanks can have different material, design, and test logic.
Component class is assigned correctly	Primary, secondary, and basic components do not share the same material and impact-testing route. Misclassification changes both cost and compliance.
Temperature basis is written	The design metal temperature and refrigerated product condition should be stated clearly, not left as a generic operating temperature note.
Material route is linked to impact testing	Do not review plate, pipe, forging, and bolting selections without checking the associated impact-testing expectation.
NDE scope matches stress level	The stress threshold for shell-joint RT in Annex R affects how much weld volume is fully radiographed and how much is inspected by spot RT.
Hydro/pneumatic test sequence is agreed	Settlement checks, pressure hold time, solution-film checks, and relief-device checks should be in the ITP before shop or field testing starts.
Foundation and uplift basis is documented	Refrigerated tanks impose added concerns such as thermal movement, foundation freezing/heaving, anchorage, and uplift checks under pressure plus wind.

Public-source note

This PDF is a public reference note prepared from the API public catalog description of API Std 620 and from the publicly accessible 2002 Appendix R text. It is intended for early screening, training, and content planning. Use the purchased current edition of API Std 620 for contractual, regulatory, or final engineering decisions.

Source basis used: API public catalog / webstore scope notes for current API Std 620; public 2002 API 620 text (Appendix R pages) made available via a U.S. incorporated-by-reference reading room source.